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TITLE: ENVISAT-1 PRODUCTS SPECIFICATIONS

VOLUME 12: MIPAS PRODUCTS SPECIFICATIONS

Abstract :

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AMENDMENT POLICY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

AMENDMENT RECORD SHEET

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
1	A	12/01/96	Issue 1	
1	B	16/02/96	SCR #16, CR #16 Issue 1, Revision B Reason for Change: Updated to reflect information in PO-TN-ESA-GS-0381 and to address RIDs of Feb. 2/96 pertaining to the Level 0 structure. MPH, SPH, DSD, and DSR structures modified. Table added showing generalized Level 0 product structure. RIDs Addressed ESA/0001: FEP header defined ESA/0002: PF-Host time stamp clarified ESA/0004: Processing PCD added ESA/0006: AF PCD ADS and DSD added ESA/0007: page A-3 updated ESA/0008: page B-3 updated ESA/0009: Table 8.1.1 modified ESA/0011: TBD changed to Range/ Doppler ESA/0013: FEP header defined ESA/0014: Table 8.4.7.4-2 corrected CSF/1: filename in MPH corrected CSF/2: page A-3 updated CSF/3: MPH PCD information updated CSF/5: DSD added to Level 0 SPH CSF/6: Section on AATSR updated and re-issued CSF/8: AATSR_O Summary Sheet updated	
1	C	04/04/96	SCR #38, CR #38 Issue 1, Revision C Reason for Change: Updated Sections 1-6, 17 and Annex A to reflect changes discussed at the Products Review Meeting #1, March 5-8, 1996, as per action item “AI MDA 6 April 96” from PO-MN-ESA-00416, Pg. 35.	Products Review Meeting #1
2	A	20/05/96	SCR #71, CR #71 Issue 2 Separate volume created. Updated with new product information from Document A-3.	
2	B	23/09/96	SCR #102, CR #102 Issue 2, Revision B Reason for Change: Data Structures added.	Products Review Meeting #2
3	A	10/02/97	SCR #133, CR #133 Issue 3 Reason for Change: Updated in response to ESA RIDs received 06/01/97, (FAX: DPD/JMJ/ ENV, 0021/97) and RIDs in fax.DPD/ JMJ/ENV, 0280/97 received 03/02/97.	ESA RIDs
3	B	14/04/97	SCR #145, CR #145 Issue 3, Revision B Reason for Change: Updated in response to comments from ESA/Thomson at MIPAS DDKP. See fax DPD/JMJ/ENV0812/97. ECMWF files consolidated as per fax DPD/JMJ/ENV0945/97. Further updates as per fax NW/4049/ HNE and NWP/4062/GL. Exceptions: RID 19: The product MIP_NL__1P retains 2 gain calibration ADSs because their DSR formats are	
			different, and to comply with the mechanism of stripline processing.	

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
			RID 10: correction to terminology made, but latitude is listed before longitude as per PDS standard.	
3	C	01/05/98	SCR #169, CR #169 Issue 3, Revision C Reason for Change: Updated to comply with the minutes of Products Review Meeting #4 (PO-MN-CSF-GS-1802) and the following SPRs: SPR-42000-0010-CSF to SPR-42000-0021-CSF, SPR-42000-0081-CSF, SPR-42000-0085-CSF to SPR-42000-0091-CSF, SPR-42000-0093-CSF to SPR-42000-0095-CSF, SPR-42000-0099-CSF, and SPR-42000-0158-CSF Updated to conform to latest ESA release of MIPAS Level 2 IODD: PO-RS-ESA-GS-0177, Issue 2, Rev. A, 15.12.97	Products Review Meeting #4
3	D	30/10/98	SCR #218, CR #218 Issue 3, Revision D Reason for Change: Updated for the following SPRs: SPR-42000-0193-CSF to SPR-42000-0195-CSF, SPR-42000-0207-CSF, SPR-42000-0210-CSF, SPR-42000-0211-CSF, SPR-42000-0223-CSF to SPR-42000-0228-CSF, SPR-42000-0230-CSF to SPR-42000-0236-CSF	
3	E	30/10/99	Reason for Change: Updates for the following SPRs: SPR-42000-0253-CSF to SPR-42000-0257-CSF, SPR-42000-0264-CSF to SPR-42000-0274-CSF, SPR-42000-0276-CSF Consecutive spares merged and fields re-numbered Discrepancy removed in dimension of field 'Number of deep space igm corrupted ...' in table 12.6.1.1.1-1.	
3	F	24/5/2000	Reason for Change: Updated to conform to: - MIPAS Level-1B IODD PO-TN-BOM_GS-0010, Issue 4.C, 17.01.2000 - MIPAS Level-2 IODD PO-RS-ESA-GS-0177, Issue 3.B, 09.11.99	PDS V3
3	G	20/9/2001	SPR-100OO-0927-ESA (2 DSDs names GAIN CORRECTION ...) SPR-100OO-0996-ESA table 12.5.2.6-1	
3	H	25/2/2002	Changes according to PO-SW-ESA-GS-1271 and IODD PO-RS-ESA-GS-0177 New Parameter in Level 2 SPH field n. 23 in Table 12.5.1.6-1 and modified spare field. Modified parameters in Table 12.5.1.7.3-1 fields 19-21 Modified title/description in 12.5.1.7.4 Modified table 12.5.1.7.4-1 cfr. change bars for modifications and addendums. Added field in table 12.5.1.7.8-1, modified field in same table. Added field in table 12.5.1.7.8-2, modified field in same table Changed field 53, 104,105,106 in table 12.6.8.1.2-1 Changed field 46,102,103,104 in table 12.6.8.1.3-1	

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
3	I	24/3/2003	Changes according to cross-check with ESA. Wrong aux files sph format definition corrected. MIP_CG1_AX: DSD #5 has been set as spare MIP_C01_AX: DSD #5 has been set as spare MIP_CL1_AX: DSDs #4 and #5 have been set as spare MIP_CS1_AX: DS#5 has been set as spare Changes according to new IODD for Level 2 V4.0 Table 12.6.1.1-1 DSD set to spare Table 12.6.2.1-1 DSDs set to spare Table 12.6.3.1-1 DSDs set to spare Table 12.6.4.1-1 DSD set to spare Chapter 12.6.8 Corrected size. Table 12.6.8.1.1-1 Fields 77,78,82,83 and footnotes. Table 12.6.8.1.2-1 Fields 22,23,24,80 and footnotes. Table 12.6.8.1.3-1 Added field 1a (DSR length), changed fields 79, 80 and footnotes. Chapter 12.6.9 Added comments. Chapter 12.6.9.1.1 Added description of ADS + footnote. Table 12.6.9.1.1-1 field #4 + footnote Table 12.6.9.1.3-1 fields #5, #6, #8, #15, #16, #18, #19, #20, #22 + footnotes. Chapter 12.6.9.1.4 Added description of ADS +comment + footnote. **Typos and added details:** Table 12.4.1.7.3-1 field #4 Table 12.4.1.7.4-1 field #13, #26 + ADSR size corrected. Chapter 12.4.1.8 Data set sizes corrected. Table 12.5.1.7.6-1 field #6	IODD PO-RS-ESA-GS-0177, Issue 4, Rev. 0, 11.10.02
4	A	18/07/2007	**Changes generated by the updated L1 IODD 5-A** - Table 12.4.1.7.1 1 MIPAS Level 1B MDSR fields, 30,31,32: Add MDS azimuth/elevation angles in topocentric coordinates and spare fields - Table 12.4.1.7.1 1 MIPAS Level 1B MDSR field 33: Add Auxiliary L0 data packet in MDS - Table 12.4.1.7.1 3 MIPAS Level 1B Scan information ADSR Field 23: Add Quadratic spectral correction factor in Scan ADS and CSI ADF - Table 12.4.1.7.1 4 ILS information structure for ILS & Spectral calibration MDS Field 7: Add ILS frequency shift in CS1 ADF - Table 12.4.1.7.1 5 MIPAS Level 1B Processing Parameters MDS, Field 97: Add flag for restituted attitude LOS correction option in PS1 ADF - Level 1B Product Size 313 992 249: Update product size - Table 12.4.1.7.1 3 MIPAS Level 1B Scan information ADSR Field 23 is do (uble): Modify field 12.5 in Scan Information ADS **Changes generated by the updated L2 IODD 5-D** - Table 12.4.1.7.1 7 Framework Parameters GADS Fields 16 , 17 , 18 - Table 12.4.1.7.1 14 p,T Retrieval GADS 92 , 93 , 94: Added coefficients A,B,C for tropopause correction in Framework, PT and VMR GADS: Removed tropopause polar and delta tropopause in Framework, PT and VMR GADS - Table 12.4.1.7.1 8 Framework Parameters GADS Field 44: Exchange of linear shear variation along Z with Retroreflector Linear Shear along Z in Framework GADS - Table 12.4.1.7.1 8 Framework Parameters GADS Field 65: Added flag to control, if interpolation coefficients shall be taken from L1B or PS2 (Framework GADS) - Table 12.4.1.7.1 10 Framework Parameters GADS fields 85 , 86: Added reference altitude and threshold for ECMWF altitude correction (Framework GADS) - Table 12.4.1.7.1 10 p,T Retrieval GADS Field 4: Added Switch to enable linear FOV convolution (PT and VMR GADS) - Table 12.4.1.7.1 10 p,T Retrieval GADS Field 5: Added number of elements for ESD vector corresponding to IG2 profiles (PT and VMR GADS) and IG2+ECMWF profiles - Table 12.4.1.7.1 10 p,T Retrieval GADS Field 6: Added Vectors for altitude and relative ESD for IG2 and ECMWF profiles VCM (PT and VMR GADS)	IODD L1 PO-TN-BOM-GS-0010, Issue 5, Rev. A, 30.01.07 IODD L2 PO-RS-ESA-GS-0177, Issue 5, Rev. D, 21.02.07

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
			- Table 12.4.1.7.1 14 p,T Retrieval GADS from field 85 to 90: Added Correlation Length for IG and IG+ECMWF VCM (PT and VMR GADS) - Level 2 Processing Parameters File: 13379 bytes * Updated figure of total size of PS2 file: Changed size of spare fields for GADS #4, field 4 and GAD #3...#7 field 4 - Table 12.5.1.4-1 MIPAS Level 2 Product Structure: Changed Scan Information ADS to MDS according to change in IODD 3C - Table 12.5.1.6-1 MIPAS Level 2 SPH field 28: Changed Scan Information ADS to MDS according to change in IODD 3C - Table 12.5.1.6-2 DSD names for MIPAS Level 2 SPH: Changed Scan Information ADS to MDS according to change in IODD 3C - Table 12.5.1.7.3-1 MIPAS Level 2 Structure ADS, field 26: Changed Scan Information ADS to MDS according to change in IODD 3C - Table 12.5.2.7.4-1 MIPAS Level 2 Scan Information MDS for MIP_NLE_2P: field 3 updated as “Quality indicator”; * fields #11..#29 added; - Table 12.5.2.7.8 1 MIPAS Level 2 Microwindows Occupation Matrices ADSR for MIP_NLE_2P: fields #4..#5 added; * fields #8..#9 added; * fields #12..#13 added; - Table 13.4.1.7.1 1 MIPAS Level 2 Scan Geolocation ADS fields 8, 9, 10, 11: Added further geolocation information into “Scan geolocation data ADS” (ADS #2) as copied from L1B file - Table 13.4.1.7.1 2 MIPAS Level 2 Structure ADS fields 22,23: Added the number of elements of base profiles for each retrieval in the structure ADS - Table 13.4.1.7.1 2 MIPAS Level 2 Structure ADS fields 24, 25: Added the number of MW labels used in occupation matrix (PT and VMR) in structure ADS - Table 13.4.1.7.1 4 MIPAS Level 2 Scan Information MDS field 18: Added ECMWF corrected Altitude into Scan Info MDS (MDS #1) - Table 13.4.1.7.1 4 MIPAS Level 2 Scan Information MDS fields 26, 27, 28, 29: Added Cloud Detection Information for first valid three Cloud detection meso window pairs into Scan Info MDS (MDS #1) - Table 13.4.1.7.1 6 MIPAS Level 2 p, T, and Height Correction Profiles MDSR fields from 14, 15, 16, 18, 19: Added base profiles, averaging kernel matrix and conditioning parameter into MDS # 2...# 8 - Table 13.4.1.7.1 6 MIPAS Level 2 p, T, and Height Correction Profiles MDSR field 17: Added ECMWF corrected altitudes to MDS 2 - Table 13.4.1.7.1 8 MIPAS Level 2 Microwindows Occupation Matrices ADSR fields 4,5 - Table 13.4.1.7.1 9 MIPAS Level 2 Microwindows Occupation Matrices ADSR fields 4,5: Added OM and MW labels for pT and VMR retrieval into ADS #5	
4	B	4/12/2007	Correction of one non-conformance of the Prod Spec with respect to the IODD: - Table 12.5.1.7.8 1 Added field “Number of valid PCD information strings” to “Additional PCD information”	
4	C	11/12/2008	Updated Table 12.5.1.7.5 1, field 18 and Table 12.5.1.7.6-1 field 17 following the L2 IODD update to v5-E Correction of few non conformances of the Prod spec with respect to the IODD: - Table 12.4.1.7.5 1, Field 13: correction of Data type - Table 12.5.2.7.8-1, Corrected dimension and size of Field 13 - Table 12.5.2.7.8 1, Field 16: corrected dimension - Pag 109: Corrected formula for ADSR calculation - Table 12.6.3.1.1 2: Corrected Total size formula	IODD l2 PO-RS-ESA-GS-0177, Issue 5, Rev. E, 01.10.08
4	D	20/11/2009	Clarification of the “PRODUCT ERR” field of the MPH in the MIPAS L1B products. Specification of the “MAX PATH DIFF” field of the SPH of MIPAS L1B product.	IODD L1 PO-TN-BOM-GS-0010, Issue 5, Rev. B, 20.11.09

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
5	A	15/07/2011	PS2-file: GADS#2. field 28,28.2,28.4,28.6,28.8,28.9 and GADS#3, field 19, 19.2, 19.4, 19.6,19.8,19.9: spare fields replaced by new (partially mode-dependent) threshold values for convergence check, number of modes and number of sweeps per mode ➔ C1, C2	IODD L2 PO-RS-ESA-GS-0177, Issue 6, Rev. A, 27.08.2010
			PS2-file: GADS#1, field9: spare field replaced by parameter "Number of modes". ➔ C3	
			PS2-file: GADS#1, fields 17.2, 17.5, 18, 19, 19.5: tropopause coefficients are now mode-dependent. ➔ C4	
			PS2-file: GADS#2, field 12.7: new parameter ivak ➔ C5	
			PS2-file: GADS#3, field 12.5 (ivcak), 13.5 (l1cont): new parameters ➔ C6	
			PS2-file: DSR structure in GADS#3 now repeated for four additional species ➔ C7	
			PS2-file: GADS#1, field 89: vector with 10 entries due to additional species ➔ C8	
			L2-and L2NRT-product: SPH, field 22: Changed length of "string describing sequence of species" ➔ C9	
			L2-and L2NRT-product: MDS#1, field 10, 10.2, 10.4, 10.6, 10.8: newly introduced flags describing the product quality ➔ C10	
			L2-product: SPH contains additional DSD for additional species ➔ C11, C12, C12a	
			L2-product: ADS#1, field 4, 6: vectors with 10 entries due to additional species ➔ C13	
			L2-product: ADS#3, field 5,6,8,10,12,14,16,18,20,21.4, 21.6: vector with 10 entries ➔ C14	
			L2-product: MDS#1, field 9: vector with 10 entries ➔ C15	
			L2-product: MDS#1, structure of fields 18-24 also repeated for additional species ➔ C16	
			L2-product: MDS#3 repeated for additional species, all following MDS-number are shifted by +4 ➔ C17	
			L2-product: ADS#5, structure of field 7.6-9 repeated for additional species ➔ C18	
			L2-product: ADS#6, structure of field 12-15 repeated for additional Species ➔ C19	
			L2-product: ADS#7, field 21.5, 22.5: vector with 10 entries ➔ C20	

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
			IG2-file: MDS #3. field 1.7, 2, 2.5: introduced for a day/night dependence in the initial guess of VMR ➔ C21	
			IG2-file: SPH contains additional DSD for additional species ➔ C22, C23	
			IG2-file: GADS#1, field 11: Now vector with 10 entries ➔ C24	
			IG2-file: GADS#1, field 12 repeated for additional species ➔ C25	
			SP2-file: SPH contains additional DSD for additional species ➔ C26, C27	
			SP2-file: ADS#2 also repeated for additional species ➔ C28	
			FM2-file: SPH: more DSD for additional species ➔ C29, C30	
			FM2-file: GADS#1, field 11: vector with 10 entries ➔ C31	
			FM2-file: GADS#1, field 12: repeated for additional species ➔ C32	
			FM2-file: MDS#3: field 1.7, 2, 2.5: introduced for a day/night dependence in the initial guess of VMR ➔ C33	
			FM2-file: MDS#5 repeated for additional species ➔ C34	
			OM2-file: SPH: additional DSD for additional species ➔ C35, C36	
			OM2-file: GADS#1, field 10: repeated for additional species ➔ C37	
			OM2-file: ADS#2 repeated for additional species, all following ADS-numbers are shifted by +4 ➔ C38	
			OM2-file: former ADS#9 repeated for additional species ➔ C39	
			OM2-file: MDS#2 repeated for additional species ➔ C40	
			MW2-file: SPH contains additional DSD for additional species ➔ C41, C42	
			MW2-file ADS#2 and MDS#2 also repeated for additional species ➔ C43, C44	
			CS2-file: SPH contains additional DSD for additional species ➔ C45, C46	
			CS2-file: GADS#1, field 3: vector with 10 entries ➔ C47	
			CS2-file: ADS#2 and MDS#2 also repeated for additional species ➔ C48, C49	

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
5	B	19/05/2015	L1B-product: SPH contains additional DSD for Restituted Attitude file used (field 48). SPH total size changed. ➔ C50, C50a, C50b	IODD L1b PO-TN-BOM-GS-0010, Issue 6A, 27.10.2014
			L1B-product: MDSR fields 34, day/night flag introduced; size of field 34.1 modified. ➔ C51	
			L1B-product: Scan Information ADS field 17.1, day/night flag introduced; size of field 18 modified. ➔ C52, C52a	
			L1B-product: Summary Quality ADS, modified description of fields 7 and 8. ➔ C53	
			CO1-file: MDS #1, fields 3.1 and 3.2, introduced offset validation parameters ➔ C54	
			CA1-file: Fields introduced in alignment matrix, mispointing commanding, and non-linearity scan mirror corrections sections ➔ C55	
			PS1-file: MDS, field 13 modified description. ➔ C56	
			PS2-file: GADS#1, 2 and 3 updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C57, C58, C59, C60, C61	IODD L2 PO-RS-ESA-GS-0177, Issue 7, 30.04.2013
			MW2-file: SPH, DSD, ADS and MDS fields updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C62, C63, C64, C65, C66	
			SP2-file: SPH, DSD fields updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C67, C68, C69	
			IG2-file: SPH, DSD, GADS fields updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C70, C71, C72, C73, C74	
			FM2-file: SPH, DSD, GADS fields updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C75, C76, C77, C78, C79	
			OM2-file: SPH, DSD, GADS fields updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C80, C81, C82, C83, C84, C85, C86	
			CS2-file: SPH, DSD, GADS fields updated to include additional VMRs. File size and VMR retrievals order updated. ➔ C87, C88, C89, C90, C91, C92	
			L2-product: SPH, DSD fields updated to include additional VMRs. SPH size and VMR retrievals order updated. ➔ C93, C94, C95, C96	
			L2-product: ADS#1, fields 4, 6 updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C97	

ISSUE	REV	DATE	CHANGE STATUS	ORIGIN
			L2-product: ADS#3, fields 5,6,8,10,12,14,16,18,20,23,25 updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C98	
			L2-product: MDS#1, fields 9, 10.2, 10.6 updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C99	
			L2-product: ADS#13 to ADS#32, added to include additional VMRs. Size and VMR retrievals order updated. ➔ C100	
			L2-product: MDS#33, field 9 updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C101	
			L2-product: ADS#4, field 10 updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C102	
			L2-product: ADS#5, fields 12 to 15 repeated to include additional VMRs. Size and VMR retrievals order updated. ➔ C103	
			L2-product: ADS#6, field updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C104	
			L2-product: ADS#7, fields 7, 9, 11, 13 updated to include additional VMRs. Size and VMR retrievals order updated. ➔ C105	
			L2-product: MDS#2, MDS#3 to MDS#32, field 4 updated to include additional flags for retrieval results. ➔ C106, C107	
			L2-product: Total Data size updated for MIP_NL__2P and MIP_NLE_2P products. ➔ C108, C109	
			L2-product: SPH, DSD, updated default order of retrieval sequence of species. ➔ C110, C111	IODD L2 PO-RS-ESA-GS-0177, Issue 7A, 11.04.2014
			PS2-file: GADS, updated default order of retrieval sequence of species. ➔ C112	

REGISTER OF CHANGES

SECTION	CHANGE	ID
Table 12.4.1.7.1-1	Changed field: 33 Added fields:, 33.2, 33.4, 33.6, 33.8, 33.9	C1
Table 12.4.1.7.1-2	Changed field: 23 Added fields: 23.2, 23.4, 23.6, 23.8, 23.9	C2
Table 12.4.1.7.1-3	Changed field: 9	C3
Table 12.4.1.7.1-4	Changed fields: 16, 17, 18 Added fields: 15.1, 15.2, 15.3	C4
Table 12.4.1.7.1-5	Changed field: 14	C5
Table 12.4.1.7.1-6	Changed fields: 15, 17	C6
Section 12.6.8.1.3	Added note II at the end of the section	C7
Table 12.4.1.7.1-7	Changed field: 76	C8
Table 12.5.1.6 1	Changed field: 22	C9
Table 12.5.1.7.4 1	Changed fields: 10 Added fields: 10.2, 10.4, 10.6, 10.8	C10
Table 12.5.1.6 1	Added fields: 35.1, 35.2, 35.3, 35.4	C11
Table 12.4.1.1-1	Added DSD	C12
Table 12.5.1.6 2	Added DSD	C12a
Table 12.4.1.7.1-8	Changed fields: 4, 6	C13
Table 12.4.1.7.1-9	Changed fields: 5, 6, 8, 10, 12, 14, 16, 18, 20, 23, 25	C14
Table 12.5.1.7.4 1	Changed fields: 9	C15
Table 12.5.1.7.4 1	Added annotation	C16
Table 12.4.1.7.1-10	Added annotation	C17
Table 12.4.1.7.1-11	Added annotation	C18
Table 12.4.1.7.1-12	Added annotation	C19
Table 12.5.1.7.11-1	Fields changed: 11, 13	C20
Table 12.6.11.1.4 1	Fields added: 3,4 Added table annotation Removed field 3	C21
Table 12.4.1.1-2	Added DSD	C22
Table 12.4.1.1-3	Added DSD	C23
Table 12.4.1.7.1-13	Changed field: 11	C24
Table 12.4.1.7.1-14	Added annotation	C25
Table 12.6.10.1 1	Added ADS	C26
Table 12.6.10.1 2	Added ADS	C27
Table 12.4.1.7.1-15	Added annotation	C28
Table 12.6.12.1 1	Added DSD	C29
Table 12.6.12.1 2	Added MDS	C30
Table 12.6.12.1.1 1	Changed field 11	C31
Table 12.6.12.1.1 1	Added fields 18, 19, 20, 21	C32
Table 12.4.1.7.1-16	Added fields: 3, 4, 5 Deleted field: 3	C33
Table 12.4.1.7.1-17	Added annotation	C34
Table 12.6.13.1 1	Added DSD	C35
Table 12.6.13.1 2	Added DSD	C36
Table 12.4.1.7.1-18	Added note Changed note	C37
Table 12.4.1.7.1-19	Added note	C38
Table 12.4.1.7.1-20	Added note	C39
Table 12.4.1.7.1-21	Added note	C40

SECTION	CHANGE	ID
Table 12.6.9.1 1	Added DSD	C41
Table 12.6.9.1 2	ADDS DSD	C42
Table 12.4.1.7.1-22	Added note	C43
Table 12.4.1.7.1-23	Added note	C44
Table 12.6.14.1 1	Added DSD	C45
Table 12.6.14.1 2	Added DSD	C46
Table 12.4.1.7.1-24	Changed field: 3	C47
Table 12.4.1.7.1-25	Added note	C48
Section 12.6.14.1.5	Added note	C49
Table 12.4.1.2-1	Added ADF	C50
Table 12.4.1.6-1	Added field: 47	C50a
Table 12.4.1.6-2	Added DSD	C50b
Table 12.4.1.7.4-1	Added field: 34 Changed field: 34.1	C51
Table 12.4.1.7.5-1	Added field: 17.1 Changed field: 18	C52
Section 12.4.1.8	Size updated	C52a
Table 12.4.1.7.1-1	Changed fields: 7, 8	C53
Table 12.6.4.1.1-1	Added fields: 3.1, 3.2 Changed field: 1	C54
Table 12.6.5.1.1-1	Deleted fields: 49, 50 Added fields: from 48.1 to 48.9	C55
Table 12.6.6.1.1-1	Changed field: 13	C56
Section 12.6.8	Size and note 7 updated	C57
Table 12.6.8.1.1-1	Changed field: 76 Deleted field: 19	C58
Table 12.6.8.1.2-1	Added fields: from 108 to 111 Size updated in note j	C59
Section 12.6.8.1.3	Text updated	C60
Table 12.6.8.1.3-1	Added fields: from 109 to 112 Size updated in note h Added note II	C61
Section 12.6.9	Size updated	C62
Table 12.6.9.1-1	Added DSD	C63
Table 12.6.9.1-2	Added DSD	C64
Section 12.6.9.1.2	Text updated	C65
Section 12.6.9.1.4	Text updated	C66
Section 12.6.10	Size updated	C67
Table 12.6.10.1-1	Added DSD	C68
Table 12.6.10.1-2	Added DSD	C69
Section 12.6.11	Size updated	C70
Table 12.6.11.1-1	Added DSD	C71
Table 12.6.11.1-2	Added DSD	C72
Table 12.6.11.1.1-1	Changed fields: 11, 13 Updated note b	C73
Section 12.6.11.1.6	Text updated	C74
Section 12.6.12	Size updated	C75
Table 12.6.12.1-1	Added DSD	C76
Table 12.6.12.1-2	Added DSD	C77
Table 12.6.12.1.1-1	Changed fields: 11, 13 Updated note b	C78
Section 12.6.12.1.6	Text updated	C79

SECTION	CHANGE	ID
Section 12.6.13	Size updated	C80
Table 12.6.13.1-1	Added DSD	C81
Table 12.6.13.1-2	Added DSD	C82
Table 12.6.13.1.1-1	Changed field: 11 Updated note a Deleted note b	C83
Section 12.6.13.1.3	Text updated	C84
Section 12.6.13.1.5	Text updated	C85
Section 12.6.13.1.7	Text updated	C86
Section 12.6.14	Size updated	C87
Table 12.6.14.1-1	Added DSD	C88
Table 12.6.14.1-2	Added DSD	C89
Table 12.6.14.1.1-1	Changed field: 3	C90
Section 12.6.14.1.3	Text updated	C91
Section 12.6.14.1.5	Text updated	C92
Section 12.5.1	Text updated	C93
Table 12.5.1.4-1	Added DSD	C94
Table 12.5.1.6-1	Changed fields: 22, 30 Updated total size	C95
Table 12.5.1.6-2	Added DSD	C96
Table 12.5.1.7.1-1	Changed fields: 4, 6 Updated total size	C97
Table 12.5.1.7.3-1	Changed fields: 5, 6, 8, 10, 12, 14, 16, 18, 20, 23, 25, 27 Updated total size	C98
Table 12.5.1.7.4-1	Changed fields: 9, 10.2, 10.6 Added MDS	C99
Section 12.5.1.7.6	Title updated Text updated	C100
Table 12.5.1.7.7-1	Changed field: 9 Updated total size	C101
Table 12.5.1.7.8-1	Changed field: 10 Updated total size	C102
Table 12.5.1.7.9-1	Changed fields: 12 to 15 Updated total size	C103
Table 12.5.1.7.10-1	Changed field: 9 Updated total size	C104
Table 12.5.1.7.11-1	Changed fields: 7, 9, 11, 13 Updated total size	C105
Table 12.5.1.7.5-1	Changed field: 4	C106
Table 12.5.1.7.6-1	Changed field: 4	C107
Section 12.5.1.8	Updated total size	C108
Section 12.5.2.8	Updated total size	C109
Table 12.5.1.6-1	Changed field: 22	C110
Table 12.5.1.6-2	Changed DSD order	C111
Section 12.6.8.1.3	Text updated Note II updated	C112

12. MIPAS PRODUCTS SPECIFICATIONS

12.1 INSTRUMENT OVERVIEW

The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) instrument measured atmospheric radiation emitted by trace gases in the infrared spectral range from 4.15 µm to 14.6 µm. Its primary mission was to perform global observations of atmospheric vertical pressure and temperature profiles, and the vertical Volume Mixing Ratios (VMR) of several primary trace gases in the Earth's atmosphere (e.g. O_3, H_2O, HNO_3, CH_4, N_2O). MIPAS information has application in ozone chemistry, monitoring of global distribution of major greenhouse gases, and atmospheric dynamics.

MIPAS measured emitted radiation while elevation scanning through the Earths' atmospheric limb within the Line Of Sight (LOS) which had an instantaneous field of view of 3 km vertically and 30 km horizontally. Two scan mirrors enabled viewing in both rearward (anti-flight) and sideways geometries (anti-sun), with scanning ranges of 35 and 30 degrees respectively. Sideways geometries were used during special events monitoring only.

To acquire vertical distribution information for the trace gases in the atmosphere, vertical pointing could cover a limb height from about 210 to 5 km. In general, the duration of an individual scan depended on both the number of height steps and the commanded spectral resolution. A maximum number of 75 acquisition heights (74 step increments) were commanded.

Table 12.1-1 MIPAS Characteristics

GEOMETRIC:	The MIPAS IFOV is 3 x 30 km^2 (.05157° x 0.5157°) with an elevation pointing range of 5 to 210 km. The azimuth pointing may be rearward (75° - 110°) or sideways (160° - 190° wide). The LOS pointing is calibrated monthly to reduce the uncertainty in the absolute elevation pointing knowledge to below 2 km at the LOS tangent point.
RADIOMETRIC:	Noise Equivalent Spectral Radiance ($NESR_0$) (nW/(cm^2*sr*cm^{-1})): 685 - 970 cm^{-1} : 50 1020 - 1170 cm^{-1} : 40 1215 - 1500 cm^{-1} : 20 1570 - 1750 cm^{-1} : 6 1820 - 2410 cm^{-1} : 4.2 Accuracy better than 2*$NESR_T$[a] + 5% of true radiance (685 - 1500 cm^{-1}) Accuracy between 2*$NESR_T$ + X% for 1570 cm^{-1} to 2410 cm^{-1}, where X is

<table>
<tr><td></td><td>linearly interpolated between 2 at 1570 cm^{-1} and 3 at 2410 cm^{-1} Variation in measured spectral radiance due to worst case orbit variations of instrument temperature = 2*$NESR_T$ + 1%</td></tr>
<tr><td rowspan="2">SPECTRAL:</td><td>MIPAS divides the incoming signal to eight detectors which cover the spectral region from 4.15 to 14.6 microns (685 to 2410 cm^{-1}) with 0.035 cm^{-1} resolution. The spectral range is split into five bands (A, AB, B, C, D), where each band is covered by one or two specific detector pairs.
The spectral ranges (cm^{-1}) for each of the detectors are:
A1 685-995
A2 685-1193
B1 995-1540
B2 1193-1540
C1 = C2 1540-1780
D1 = D2 1780-2410</td></tr>
<tr><td>After on-board processing, the following six channels are downlinked in nominal operation:
<table><tr><td>A</td><td>A1 & A2</td><td>685-970</td></tr><tr><td>AB</td><td>B1</td><td>1020-1170</td></tr><tr><td>B</td><td>B2</td><td>1215-1500</td></tr><tr><td>C</td><td>C1 & C2</td><td>1580-1750</td></tr><tr><td>D</td><td>D1 & D2</td><td>1820-2410</td></tr></table>Spectral calibration is typically performed once per elevation scan, using subsets of the limb measurement data. The instrument lineshape (ILS) is retrieved once per week from subsets of the scene data. A1 and A2 are combined on the ground during the calibration process.</td></tr>
</table>

a. Noise Equivalent Spectral Radiance when the instrument is viewing a blackbody source at temperature T.

12.2 PRODUCTS OVERVIEW

The MIPAS Product Tree is shown in Figure 1 and the products description is summarized in Table 12.2-1.

Table 12.2-1 MIPAS Products

Instrument	Product ID	Description
MIPAS	MIP_RW__0P	MIPAS Raw Data and SPE Self Test Mode Data
	MIP_LS__0P	MIPAS Line of Sight Level 0
	MIP_NL__0P	MIPAS Nominal Level 0
	MIP_NL__1P	Geolocated and Calibrated Spectra
	MIP_NL__2P	Temperature, Pressure and Atmospheric Constituents Profiles
	(*) MIP_NLE_2P	**(*)** Extracted Temperature, Pressure and Atmospheric Constituents Profiles for Meteo Users (NRT dissemination only)

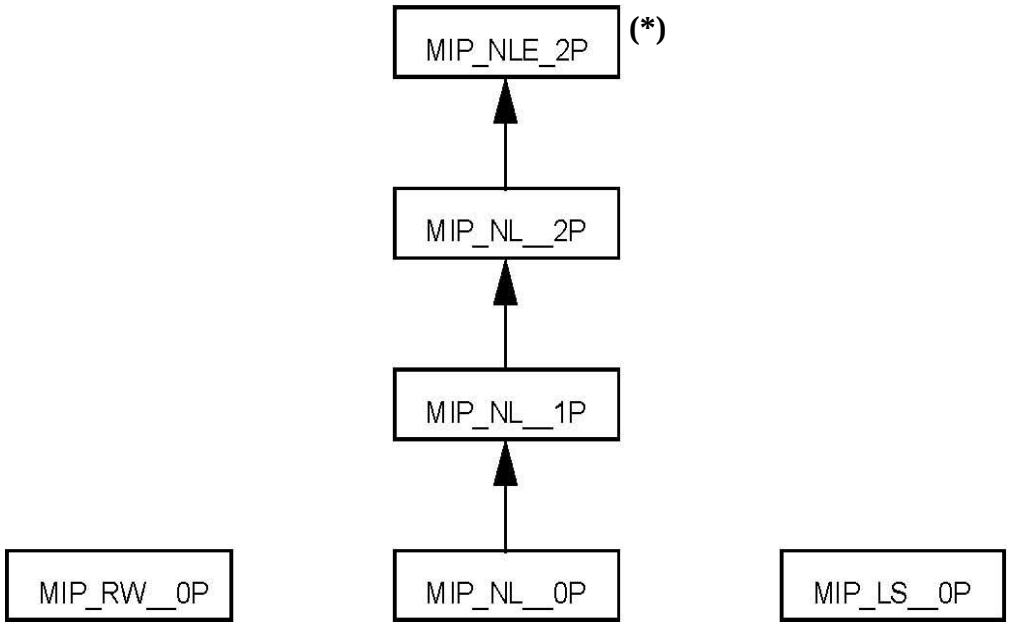

Figure 1 - MIPAS Product Tree

(*) NOTE: processing and dissemination of NRT Temperature, Pressure and Atmospheric Constituents products for meteo users was suspended at the end of the MIPAS mission (8 April 2012). Starting from Level 2 reprocessing with MIPAS

ML2PP processor Version 7 no MIP_NLE_2P products are provided anymore.

12.2.1 Product Specific Notation

r.u. = radiance units = nW/ (cm^2 sr cm^{-1})
scan = an elevation scan composed of several sweeps.
sweep = an interferometer sweep. The data recording for a single measurement resulting in a complete interferogram

12.3 LEVEL 0 PRODUCTS

There are three MIPAS Level 0 products: the Nominal Level 0 product which contains data acquired while the instrument was in Measurement Mode using the Nominal Output data format (MIP_NL__0P), the Line of Sight (LOS) Level 0 which contains data acquired while the instrument was in LOS Calibration Mode (MIP_LS__0P), and the Raw Data and Signal Processing Electronics (SPE) Self Test Mode Level 0 which contains data acquired while the instrument operated using the Raw Data output data format, or when an SPE Self Test had been requested (MIP_RW__0P).

12.3.1 MIPAS Nominal Level 0

The MIPAS Nominal Level 0 product contains time ordered AISPs which were acquired while the instrument was in Measurement Mode with the Nominal Output data format chosen. Measurement Mode was the normal operating mode of the instrument.

In the Measurement Mode the following activities could be commanded:

- Nominal Measurement,
- Special Event Measurement,
- Offset Calibration Measurement (routine deep space measurements used to correct for radiometric offset),
- Gain Calibration Measurement (sequence of deep space and blackbody measurements (commanded) needed to compute the radiometric gain of the instrument).

In the Nominal Measurement and Special Event activities the instrument sequentially observed the atmosphere and deep space. Deep space measurements provide the instrument self-emission data correction to be subtracted from the atmospheric data during on-ground processing. In the Blackbody Radiometric Calibration Measurement activity the instrument sequentially observed deep space and an internal calibration blackbody. The blackbody data together with deep space data provide the information to determine the MIPAS gain factors.

The Nominal Level 0 product was produced systematically during the MIPAS mission lifetime. The NRT version of the product was available from the PDHS three hours after data acquisition. The OFL (fully consolidated) version was available from the LRAC two weeks after acquisition. The Nominal Level 0 product was systematically stored into the archive, and it is the basis of further MIPAS data processing to create higher level products.

12.3.2 MIPAS Raw Data and SPE Self Test Mode

The MIPAS Raw Data output format was used periodically when the satellite

was within the direct line of sight of a receiving ground segment station. Whereas data acquired in Nominal Output format are processed to output approximately 533 kbps rates, the Raw Data Measurements are output at 8 Mbps, with little on-board processing applied. Raw Data output mode could be used for any of the data acquisition activities possible in Measurement Mode, since the only difference with the Nominal output is the level of signal processing applied to the data on-board the satellite.

The SPE Self Test is an instrument monitoring mode which was used to verify the performance of the signal processing electronics while in flight. During the SPE Self Test the instrument was actually in LOS Calibration Mode, thus SPE Self Test Mode was not a unique instrument mode but rather a special SPE mode. Note, however, that normal LOS Calibration functions were performed when an SPE Self Test had been requested. During an SPE Self Test the use of the Nominal Output data format was the baseline, although in special cases Raw Output could be selected by direct macrocommand from the ground station.

Raw Data and SPE Self Test mode have been used infrequently. Uses included specific calibration/characterization measurements (raw data mode) and instrument health checks. The product contains time ordered AISPs acquired when the instrument was in Raw Data output format or SPE Self-Test modes. During the missions, this product type was processed systematically and the NRT version was available from the PDHS 3 hours after data acquisition. The OFL (fully consolidated) version was available to internal ESA users two weeks after data acquisition from the LRAC. No other higher level PDS products are produced from this data type.

12.3.3 MIPAS Line of Sight Level 0

The LOS Calibration Mode was operated approximately once per week, pointing at pre-selected infrared targets to acquire reference data. The LOS pointing calibration is used to determine, during ground processing, the corrections needed to compensate for pointing errors. The LOS Level 0 product contains time-ordered AISPs acquired while the instrument was operated in LOS Mode. While in LOS Calibration Mode, only Nominal Output data format was possible.

The LOS Level 0 product was produced systematically during MIPAS lifetime. The NRT version of the product was available from the PDHS three hours after data acquisition. The OFL (fully consolidated) version was available from the LRAC two weeks after acquisition. No further higher level PDS products are created from this data type.

12.3.4 Input Data

Annotated ISPs were received from the Front End Processor (FEP) plus auxiliary data.

12.3.5 Auxiliary Data Used

The Level 0 product requires the following auxiliary information (refer to Volume 6):

- Phase, cycle and orbit number data,
- ID of the systems and subsystem that collect and process the data,
- ENVISAT orbital state vectors,
- Processor Configuration file, which includes PCD error codes and threshold values,
- SBT to UTC conversion data.

12.3.6 Processing Performed

Determination of the satellite position and conversion of Satellite Binary Time (SBT) to Universal Time Co-ordinates (UTC) is accomplished using ESA software.

12.3.7 Product Structure

As defined in Volume 6. A detailed description of the Instrument Source Packets is provided in Document A-1.

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12.4 LEVEL 1B PRODUCTS

There is one MIPAS Level 1B product type: the Geolocated and Calibrated Spectra product (MIP_NL__1P).

12.4.1 Geolocated and Calibrated Spectra

The MIPAS Geolocated and Calibrated Spectra Level 1B product contains geolocated, fully calibrated radiance spectra. Each MIPAS sweep generated five calibrated spectra (one for each band) and one set of auxiliary data, all with the same time of measurement. The output data file contains the calibrated spectra with reference to calibration data and to the auxiliary data used during calculations. Also included is Instrument Line Shape (ILS) data, data quality indicators, and identifiers for calibration validation files (offset, gain, LOS, non-linearity, spectrum, ILS, auxiliary data). The Level 1B product is the foundation product for further Level 2 processing. During the MIPAS mission, this product was processed systematically from the Nominal Level 0 product and the NRT version of the product was available from the PDHS three hours after data acquisition; the OFL (fully consolidated) product was available two weeks after acquisition from the D-PAC. Reprocessed data sets of Level 1B products are available at the official ESA dissemination center.

12.4.1.1 Input Data

Nominal Level 0 product plus auxiliary data.

12.4.1.2 Auxiliary Data Used

The following auxiliary files are needed for Level 1B processing.

Table 12.4.1.2-1 Auxiliary Data Files for MIPAS Level 1B Processing

Description	Auxiliary File ID	Mandatory
Instrument Characterization Data	MIP_CA1_AX	Yes
Gain calibration	MIP_CG1_AX	Yes
Line of sight (LOS) calibration	MIP_CL1_AX	Yes
Offset Validation	MIP_CO1_AX	Yes
ILS and spectral calibration data	MIP_CS1_AX	Yes
Microwindow Dictionary	MIP_MW1_AX	Yes
Level 1B Processing Parameters	MIP_PS1_AX	Yes

(*) Orbit state vector (one file among five)	AUX_FPO_AX AUX_FRO_AX DOR_NAV_0P DOR_POR_AX **(*)** DOR_VOR_AX	Yes
(*) Restituted attitude file	AUX_FRA_AX	**(*)** No

(*) NOTE: starting from Level 1b reprocessing with MIPAS IPF processor Version 7 the DORIS precise orbit file is used (DOR_VOR_AX) and the Restituted attitude file (AUX_FRA_AX) is mandatory for the processing.

12.4.1.3 Processing Performed

The document describing the sequence of the algorithms used for the MIPAS Level 1B processing is the Algorithm Theoretical Baseline Document (ATBD). The information here provided is intended only as a high level overview of the processing steps. The following comprise the major algorithm processing steps:

Geolocation:

- determine tangent point location using orbit data, satellite attitude data, and LOS pointing data (from LOS Calibration Mode).

Radiometric Calibration:

- correct for instrument offset and gain;
- convert to spectral radiance units (W/cm^{-1} sr cm^{2}).

Spectral Calibration:

- determination of the wavenumber axis.

ILS Calibration:

- correction for the instrument response function.

Data Validation:

- instrument validation and health monitoring;
- scene measurement and calibration measurement validation.

12.4.1.4 Product Structure

The overall product structure is shown below:

Table 12.4.1.4-1 MIPAS Level 1B Geolocated and Calibrated Spectra Product

MPH
SPH (includes DSDs)
Summary Quality ADS (SQ ADS)
Geolocation ADS (LADS)
Structure ADS
Calibrated Spectra MDS
Scan Information ADS
Offset Calibration ADS
Gain Calibration ADS#1
Gain Calibration ADS#2
ILS and Spectral Calibration GADS
LOS Calibration GADS
Processing Parameters GADS

12.4.1.5 Main Product Header

The MPH is the same as described in Section 5.2.

NOTE: for the MIPAS L1B products the error flag is defined as follows. The field PRODUCT_ERR is set to 1 by the IPF if the total number of corrupted sweeps is greater than 10% of the total number of sweeps in the product. This was a specific ESA request to industry (traced with SPR-42000-0091-CSF) and was meant to reduce the occurrence of products flagged as erroneous in the PDS.

12.4.1.6 Specific Product Header

The SPH is an ASCII structure which follows the ASCII formatting rules described in Volume 5.

Table 12.4.1.6-1 MIPAS Level 1B SPH

N	Description	Units	Byte Length	Data Type	Dim.
1	**SPH_DESCRIPTOR=**	keyword	15	uc	15
	quotation mark (“)	-	1	uc	1
	SPH descriptor ASCII string describing the product, set to “MIPAS_LEVEL_1B_PRODUCT ”	-	28	uc	28
	quotation mark (“)	-	1	uc	1
	newline character	terminator	1	uc	1

Table 12.4.1.6-1 MIPAS Level 1B SPH

N	Description	Units	Byte Length	Data Type	Dim.
2	**STRIPLINE_CONTINUITY_INDICATOR=**	keyword	31	uc	31
	Value +000 = No stripline continuity; the product is a complete segment. Other: Stripline Counter	-	4	Ac	1
	newline character	terminator	1	uc	1
3	**SLICE_POSITION=**	keyword	15	uc	15
	Value: +001 to NUM_SLICES. Default value if no stripline continuity = +001	-	4	Ac	1
	newline character	terminator	1	uc	1
4	**NUM_SLICES=**	keyword	11	uc	11
	Number of slices in this stripline. Default value if no continuity = +001	-	4	Ac	1
	newline character	terminator	1	uc	1
Product Location Information					
5	**START_TIME=**	keyword	11	uc	11
	quotation mark (“)	-	1	uc	1
	ZPD time of first MDSR of the first scan in the product. UTC time format	utc	27	uc	27
	quotation mark (“)	-	1	uc	1
	newline character	terminator	1	uc	1
6	**STOP_TIME=**	keyword	10	uc	10
	quotation mark (“)	-	1	uc	1
	ZPD time of last MDSR of the last scan in the Product. UTC time format	-	27	uc	27
	quotation mark (“)	-	1	uc	1
	newline character	terminator	1	uc	1
7	**FIRST_TANGENT_LAT=**	keyword	18	uc	18
	Latitude of LOS tangent point at center of scan (refraction corrected) of the first scan in the product. Positive North.	10^{-6} degrees	11	Al	1
	<10^{-6}degN>	units	10	uc	10
	newline character	terminator	1	uc	1
8	**FIRST_TANGENT_LONG=**	keyword	19	uc	19

Table 12.4.1.6-1 MIPAS Level 1B SPH

N	Description	Units	Byte Length	Data Type	Dim.
	Longitude of LOS tangent point at center of scan (refraction corrected) of the first scan in the product. Positive East.	10^{-6} degrees	11	Al	1
	<10^{-6}degE>	units	10	uc	10
	newline character	terminator	1	uc	1
9	**LAST_TANGENT_LAT=**	keyword	17	uc	17
	Latitude of LOS tangent point at center of scan (refraction corrected) of the last scan in the product. Positive North.	10^{-6} degrees	11	Al	1
	<10^{-6}degN>	units	10	uc	10
	newline character	terminator	1	uc	1
10	**LAST_TANGENT_LONG=**	keyword	18	uc	18
	Longitude of LOS tangent point at center of scan (refraction corrected) of the last scan in the product. Positive East.	10^{-6} degrees	11	Al	1
	<10^{-6}degE>	units	10	uc	10
	newline character	terminator	1	uc	1
11	**Spare (blank characters)**	-	50	uc	50
	newline character	terminator	1	uc	1
General Product Information					
12	**TOT_SWEEPS=**	keyword	11	uc	11
	Total number of sweeps in product	-	6	As	1
	newline character	terminator	1	uc	1
13	**TOT_SCANS=**	keyword	10	uc	10
	Total number of scans in product (*N*). The average number of scans in one orbit is $N = 80$.	-	6	As	1
	newline character	terminator	1	uc	1
14	**TOT_NOM_SCANS=**	keyword	14	uc	14
	Number of nominal elevation scans in product	-	6	As	1
	newline character	terminator	1	uc	1
15	**NUM_SWEEPS_PER_SCAN=**	keyword	20	uc	20
	Number of sweeps per nominal elevation scan	-	6	As	1
	newline character	terminator	1	uc	1

Table 12.4.1.6-1 MIPAS Level 1B SPH

N	Description	Units	Byte Length	Data Type	Dim.
16	**SCANS_PER_OFF_CAL=**	keyword	18	uc	18
	Number of nominal elevation scans per offset calibration	-	6	As	1
	newline character	terminator	1	uc	1
17	**TOT_SP_SCANS=**	keyword	13	uc	13
	Number of special event scans in product	-	6	As	1
	newline character	terminator	1	uc	1
18	**FRINGES_PER_SCENE=**	keyword	18	uc	18
	Number of fringe counts (samples at ADC) in scene (nominal mode)	-	11	A1	1
	newline character	terminator	1	uc	1
19	**NUM_POINTS_PER_BAND=**	keyword	20	uc	20
	Number of points in bands. Field for common spectral axis definition. (listed in order of band A, AB, B, C, D)	-	55	Al	5
	newline character	terminator	1	uc	1
20	**FIRST_WAVENUM=**	keyword	14	uc	14
	Wavenumber of first point in bands Field for common spectral axis definition. (listed in order of band A, AB, B, C, D)	cm^{-1}	125	Ado	5
	<cm^{-1}>	units	6	uc	6
	newline character	terminator	1	uc	1
21	**LAST_WAVENUM=**	keyword	13	uc	13
	Wavenumber of last point in bands Field for common spectral axis definition. (listed in order of band A, AB, B, C, D)	cm^{-1}	125	Ado	5
	<cm^{-1}>	units	6	uc	6
	newline character	terminator	1	uc	1
22	**NUM_NESR_PNTS=**	keyword	14	uc	14
	Number of points in NESR reported	-	11	Al	1
	newline character	terminator	1	uc	1
23	**NESR_FIRST_WAVENUM=**	keyword	19	uc	19
	Wavenumber of first point in NESR reported	cm^{-1}	25	Ado	1
	<cm^{-1}>	units	6	uc	6
	newline character	terminator	1	uc	1

Table 12.4.1.6-1 MIPAS Level 1B SPH

N	Description	Units	Byte Length	Data Type	Dim.
24	**NESR_LAST_WAVENUM=**	keyword	18	uc	18
	Wavenumber of last point in NESR reported	cm^{-1}	25	Ado	1
	<cm^{-1}>	units	6	uc	6
	newline character	terminator	1	uc	1
25	**SWEEP_ID=**	keyword	9	uc	9
	Sweep ID counter of first sweep in current product (as in source packet)	-	6	As	1
	newline character	terminator	1	uc	1
26	**MAX_PATH_DIFF=**	keyword	14	uc	14
	Maximum path difference in nominal scene measurements (set to the same value as the field 57 of MIP_PS1_AX auxiliary file that was used to generate the Level 1b product)	cm	15	Afl	1
	<cm>	units	4	uc	4
	newline character	terminator	1	uc	1
27	**Spare (blank characters)**	-	47	uc	47
	newline character	terminator	1	uc	1
Data Set Descriptors for attached Data Sets					
28	**DSD (A) for the SQ ADS**	-	280	dsd	1
29	**DSD (A) for the Geolocation ADS (LADS)**	-	280	dsd	1
29.5	**DSD (A) for Structure ADS**	-	280	dsd	1
30	**DSD (M) for MDS**	-	280	dsd	1
31	**DSD (A) for Scan Information ADS**	-	280	dsd	1
32	**DSD (A) for Offset Calibration ADS**	-	280	dsd	1
33	**DSD (A) for Gain Calibration ADS #1 (set to NOT USED if data not included in this product)**	-	280	dsd	1
34	**DSD (A) for Gain Calibration ADS #2 (set to NOT USED if data not included in this product)**	-	280	dsd	1
35	**DSD (G) for ILS and Spectral Calibration GADS (set to NOT USED if data not included in this product)**[a]	-	280	dsd	1
36	**DSD (G) for LOS Calibration Data**	-	280	dsd	1
37	**DSD (G) for Processing Parameters Data**	-	280	dsd	1
Data Set Descriptors for Referenced Files					

Table 12.4.1.6-1 MIPAS Level 1B SPH

N	Description	Units	Byte Length	Data Type	Dim.
38	**DSD (R) for ILS and Spectral Calibration File used during processing**	-	280	dsd	1
39	**DSD (R) for Gain Calibration File used during processing**	-	280	dsd	1
40	**DSD (R) for Line of Sight Calibration File used during processing**	-	280	dsd	1
41	**DSD (R) for Instrument Characterization Data used during processing**	-	280	dsd	1
42	**DSD (R) for Offset Validation Auxiliary Data used during processing**	-	280	dsd	1
43	**DSD (R) for Micro Window Dictionary File used during processing**	-	280	dsd	1
44	**DSD (R) for Level 1B Processing Parameters used during processing**	-	280	dsd	1
45	**DSD (R) for Level 0 product file**	-	280	dsd	1
46	**DSD (R) for Orbit Data file used**	-	280	dsd	1
47	**DSD (R) for Restituted Attitude file used**	-	280	dsd	1
TOTAL			**7040**		

a. The ILS and Spectral Calibration GADS is NOT USED if:
1) the processing has not been requested, or
2) the processing has been requested but the ILS retrieval has failed or cannot be performed.

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. If reported in the DS_NAME fields, entries are left justified with unused characters set to blank space characters.

Table 12.4.1.6-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (A) for the SQ ADS	SUMMARY QUALITY ADS
DSD (A) for the Geolocation ADS (LADS)	GEOLOCATION ADS
DSD (A) for Structure ADS	STRUCTURE ADS
DSD (M) for MDS	MIPAS LEVEL-1B MDS
DSD (A) for Scan Information ADS	SCAN INFORMATION ADS
DSD (A) for Offset Calibration ADS	OFFSET CALIBRATION ADS
DSD (A) for Gain Calibration ADS #1	GAIN CALIBRATION ADS #1

DSD (A) for Gain Calibration ADS #2	GAIN CALIBRATION ADS #2
DSD (G) for ILS and Spectral Calibration GADS	ILS/SPECTRAL CAL GADS
DSD (G) for LOS Calibration Data	LOS CALIBRATION GADS
DSD (G) for Processing Parameters Data	PROCESS PARAMETERS GADS
Data Set Descriptors for Referenced Files	
DSD (R) for ILS and Spectral Calibration File used during processing	ILS&SPECTRAL CAL FILE
DSD (R) for Gain Calibration File used during processing	GAIN CALIBRATION FILE
DSD (R) Line of Sight Calibration File used during processing	LINE OF SIGHT FILE
DSD (R) for Instrument Characterization Data used during processing	INSTRUMENT CHAR FILE
DSD (R) for Offset Validation Auxiliary Data used during processing	OFFSET VALIDATION FILE
DSD (R) for Micro Window Dictionary File used during processing	MICROWINDOWS FILE
DSD (R) for Level 1B Processing Parameters used during processing	PROCESS PARAMETERS FILE
DSD (R) for Level 0 product file	LEVEL-0 PRODUCT FILE
DSD (R) for Orbit Data file used	ORBIT DATA FILE
DSD (R) for Restituted Attitude file used	RESTITUTED ATTITUDE FILE

12.4.1.7 Data Sets

The following sub-sections describe the Data Sets of the Level 1B product. The Data Sets are in mixed-binary format. They may contain ASCII strings, but the ASCII strings are not contained within quotes as in the case of the MPH and SPH.

12.4.1.7.1 Summary Quality (SQ) ADS

The SQ ADS provides a quality summary for each scan in the product. One time stamped ADSR is provided for each scan. The time stamp corresponds to the start time of the scan to which the SQ information applies. The format of each SQ ADSR is described below:

Table 12.4.1.7.1-1 MIPAS Level 1B SQ ADSR

N	Description	Units	Byte Length	Data Type	Dim
1	**ZPD time of the first sweep in the scan**	-	12	mjd	1

N	Description	Units	Byte Length	Data Type	Dim
2	**Attachment flag** (Set to 1 if all MDSRs associated with this ADSR are blank or missing. Set to zero otherwise).	-	1	uc	1
	Scan Quality Information				
3	**Number of corrupted sweeps**[a] (Sum of MDSRs having a PCD quality indicator showing one or more bands corrupted) .	-	2	us	1
4	**Number of corrupted sweeps with instrument errors** (sum of sweeps where either: 1) auxiliary data was not found or not usable in the ISP, or 2) band C had a missing ISP, or 3) all bands, as indicated by the band validity PCD in the MDSR, were corrupted due to transmission errors)	-	2	us	1
5	**Spare (always set to zero)**	-	2	uc	2
6	**Number of corrupted sweeps with observational errors** (Number of sweeps where at least one band, as indicated by the band validity PCD, is corrupted due to transmission errors) .	-	2	us	1
7	**Number of sweeps for which the phase parameter exceeds 0.1.** Sequence is: forward band B, forward band C, reverse band B, reverse band C.	-	8	us	4
8	**Number of sweeps for which the OPD shift in band C differs from band B** Sequence is: forward direction, reverse direction.	-	4	us	2
9	**Number of sweeps for which the flux is out of range for one or all detectors** (Range checking is recorded in the field #27 of the MDSR of the product)	-	2	us	1
10	**Spare**	-	22	uc	22
TOTAL			**57**		

a. Field #3 equals the sum of field #4 plus field #6.

12.4.1.7.2 Geolocation ADS

The Geolocation ADS (or LADS) provides geolocation information for each scan in the product and thus allows one to separate scans in the MDS. It is composed of one ADSR for each scan in the product. The format of each ADSR is described below:

Table 12.4.1.7.2-1 MIPAS Level 1B Geolocation ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**ZPD time of the first sweep in the scan**	-	12	mjd	1
2	**Attachment Flag** (Set to 1 if all MDSRs associated with this ADSR are blank or missing. Set to zero otherwise.)	-	1	uc	1
3	**ZPD time of the sweep closest in time to the center of the scan**	-	12	mjd	1
4	**ZPD time of the last sweep in the scan**	-	12	mjd	1
5	**WGS84 latitude and longitude of first sweep in the scan**	10^{-6} degees	8	sl	2
6	**WGS84 latitude and longitude of the sweep closest in time to the center of the scan**	10^{-6} degees	8	sl	2
7	**WGS84 latitude and longitude of last sweep in the scan**	10^{-6} degees	8	sl	2
8	**Spare**	-	8	uc	8
TOTAL			**69**		

12.4.1.7.3 Structure ADS

The Structure ADS provides information about internal structure of the Scan information ADS, for each scan. It is composed of up to one ADSR for each scan in the product. The format of each ADSR is described below:

Table 12.4.1.7.3-1 MIPAS Level 1B Structure ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of the first Scan Information ADSR this record refers to**	-	12	mjd	1
2	**Attachment Flag** (Always set to zero for this ADSR)	-	1	uc	1
3	**Application process ID** (set to value of field #4 of the Scan Information ADSR)	-	2	us	1
4	**DSR length of the Scan Information ADSR to which this record refers to** (set to value of field #2 of the Scan Information ADSR)	-	4	ul	1
5	**Number of sweeps in current scan (M)** (set to value of field #8 of the Scan Information ADSR)	-	2	us	1

6	**Number of points in NESR (N)** (set to value of field #22 of the SPH)	-	4	ul	1
7	**Number of peaks fitted (S)** (set to value of field #24 of the Scan Information ADSR)	-	2	us	1
8	**Size of blocks reporting of peaks fitted** Blocks corresponds to peak #1 to peak #S, in field #27 of the Scan Information ADSR (set to value 34*S+2* $\Sigma_{(i=1..S)}K(i)$, in bytes)	-	2	us	1
9	**Index of first Scan Information ADSR to which Structure ADS pertains**	-	4	ul	1
10	**Number of Scan Information ADSR to which Structure ADS applies**	-	4	ul	1
11	**Index of first MDSR to which Structure ADS pertains**	-	4	ul	1
12	**Spare**	-	9	uc	9
TOTAL			**50**		

12.4.1.7.4 Measurement Data Set

MDS is composed of one time-stamped MDSR per sweep. It contains sweep data, i.e. sweep information and calibrated spectra. The spectra are calibrated radiometrically, spectrally and localized. Each MDSR is of the format described below:

Table 12.4.1.7.4-1 MIPAS Level 1B MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**ZPD crossing time (MJD)** MJD time format is described in Annex A.	-	12	mjd	1
2	**Quality indicator (PCD)** Summary PCD information per band (field #26) “0” = not corrupted, "1" = one or more bands corrupted	-	1	sc	1
Sweep Header					
3	**Sequential ID counter** The sweep ID counter is a sequential counter that starts at 0 for each output file. It identifies each sweep contained within an output file (Level 1B product).	-	2	us	1
4	**S/C position vector in earth-fixed reference**	km	24	do	3
5	**LOS pointing angles (azimuth and elevation)**	degrees	16	do	2
6	**Geodetic tangent point geolocation (limb and error)**	km	16	do	2

Table 12.4.1.7.4-1 MIPAS Level 1B MDSR

N	Description	Units	Byte Length	Data Type	Dim.
7	**Geodetic latitude and geographic longitude of the tangent point (lat. then long.)**	10^{-6} degrees	8	sl	2
8	**Radius of earth surface curvature in looking direction at nadir of LOS tangent point**	km	8	do	1
9	**Earth fixed target to satellite range rate**	km/s	8	do	1
10	**Geodetic altitude rate of the target**	km/s	8	do	1
11	**Interferogram min/max at ADC for each detector.** Order: min for detectors A1, A2, ..., D2 followed by max for A1, A2, ..., D2.	-	32	ss	16
12	**Sweep ID counter (as in source packet)**	-	2	us	1
13	**Instrument mode/activity** This field holds the code for "instrument mode" and 'sub-activity' within that mode. The corresponding bit pattern is copied from the instrument source packets and converted into decimal.	-	2	us	1
14	**Last commanded number of sweeps**	-	2	us	1
15	**Relative position of current sweep in scan**	-	2	us	1
16	**Doppler correction factor calculated**	-	8	do	1
17	**Number of detected/corrected spikes** Result of spike detection/correction for the current sweep and for each of the 6 channels/ bands (A1, A2, B1, B2, C, and D). Are stored the number of spikes detected/corrected, the location of the bad pixel and the amplitude of the spikes (for the 10 highest) and the number and average of the remaining spikes. It is assumed that all detected spikes are corrected.	-	12	us	6
18	**Spike positions in the interferogram** Position of spike given in sampling number for each band (A1, A2, B1, B2, C, and D).	-	240	ul	6 × 10
19	**Spike amplitudes** Amplitude (complex) of spike for each band (A1, A2, B1, B2, C, and D) is given in arbitrary or normalized units as given at the output of the instrument.	-	960	do	6×10×2
20	**Number of remaining detected/corrected spikes** for each band (A1, A2, B1, B2, C, and D)	-	12	us	6
21	**Average amplitudes of remaining detected spikes (absolute values)** for each band (A1, A2, B1, B2, C, and D)	-	96	do	6 × 2
22	**Commanded left and right fringe count**	-	8	ul	2
23	**APS position at last scan gate start and stop**	-	8	ul	2
24	**Number of detected/corrected fringe counter errors** (relative fringe count error wrt the gain; i.e., the number of fringe counts (to left (-) or right(+)) the IGM is shifted to match the gain)	-	2	ss	1

Table 12.4.1.7.4-1 MIPAS Level 1B MDSR

N	Description	Units	Byte Length	Data Type	Dim.
25	**Sweep Direction** F = forward, R = reverse	ascii	1	uc	1
26	**Band Validity PCD:** One value per band (A, AB, B, C, D) where "0" = not corrupted, "2" = corrupted due to transmission errors, "4" = corrupted due to observational validation,"8" = corrupted due to ADC saturation	-	5	uc	5
27	**Detector non-linearity flux validity** (4 values for detectors A1, A2, AB and B) where "0" = flux value is valid, "1" = flux > upper threshold or flux < lower threshold	-	4	uc	4
28	**Warning flag in ISP**	-	2	us	1
29	**Error flag in ISP**	-	2	us	1
30	**LOS elevation angle in topocentric coordinates**	degrees	8	do	1
31	**LOS azimuth angle in topocentric coordinates**	degrees	8	do	1
32	**Spare**	-	2	uc	2
33	**Auxiliary L0 data packet** This field is a copy of the ICU/SPE auxiliary packet contained in the L0 Product for each measurement.	-	1400	uc	1400
34	**Day/Night flag** -1 Sun eclipsed by earth at tangent point +1 Sun direct sight at tangent point	-	2	ss	1
34.1	**Spare**	-	510	uc	510
Processed Data					
35	**Spectral data points band A** Single precision floating point data is assumed for the calculated spectra. Amplitude of points is given in radiance units [W/(cm^2 sr cm^{-1})]. The given data points are real. The imaginary part (i.e., noise) is summarized and reported in the scan header information ADS. The number of points for each band is given is the SPH.	r.u.	$N_A \times 4$	fl	N_A
36	**Spectral data points band AB** Single precision floating point data is assumed for the calculated spectra. Amplitude of points is given in radiance units [W/(cm^2 sr cm^{-1})]. The given data points are real. The imaginary part (i.e., noise) is summarized and reported in the scan header information ADS. The number of points for each band is given is the SPH.	r.u.	$N_{AB} \times 4$	fl	N_{AB}

Table 12.4.1.7.4-1 MIPAS Level 1B MDSR

N	Description	Units	Byte Length	Data Type	Dim.
37	**Spectral data points band B** Single precision floating point data is assumed for the calculated spectra. Amplitude of points is given in radiance units [W/(cm^2 sr cm^{-1})]. The given data points are real. The imaginary part (i.e., noise) is summarized and reported in the scan header information ADS. The number of points for each band is given is the SPH.	r.u.	$N_B \times 4$	fl	N_B
38	**Spectral data points band C** Single precision floating point data is assumed for the calculated spectra. Amplitude of points is given in radiance units [W/(cm^2 sr cm^{-1})]. The given data points are real. The imaginary part (i.e., noise) is summarized and reported in the scan header information ADS. The number of points for each band is given is the SPH.	r.u.	$N_C \times 4$	fl	N_C
39	**Spectral data points band D** Single precision floating point data is assumed for the calculated spectra. Amplitude of points is given in radiance units [W/(cm^2 sr cm^{-1})]. The given data points are real. The imaginary part (i.e., noise) is summarized and reported in the scan header information ADS. The number of points for each band is given is the SPH.	r.u.	$N_D \times 4$	fl	N_D
TOTAL			**3433 + 4 ×** $\sum N$		

Size Note: The following table computes the total number of points according to the measurement resolution, number of points in each band depending on the resolution:

Table 12.4.1.7.4-2 Data Points per Band

Band	Range	Band-width	Number of points depending on output requested resolution		
	[cm^{-1}]	[cm^{-1}]	0.025 cm^{-1}	0.05 cm^{-1}	0.25 cm^{-1}
A	685 - 970	285	11 401	5 701	1 141
AB	1020 -1170	150	6 001	3 001	601
B	1215 -1500	285	11 401	5 701	1 141
C	1570 -1750	180	7 201	3 601	721
D	1820 -2410	590	23 601	11 801	2 361
TOTAL		**1 490**	**59 605**	**29 805**	**5 965**

Assuming a nominal value of 1280 sweeps per orbit at the maximal output

requested resolution (59605 data points for the 5 bands), the size is: MDSR total size = (3433 + (59605 × 4)) bytes = 241 853 bytes MDS total size = 1280 * MDSR total size = 309 571 840 bytes.

12.4.1.7.5 Scan Information ADS

This ADS contains auxiliary information provided for each scan. Each ADS contains several time stamped ADSRs. One ADSR is included for each scan. The ADSR structure and contents are described below:

Table 12.4.1.7.5-1 MIPAS Level 1B Scan information ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of last start elevation scan sequence (MJD)** (this time corresponds to the ZPD crossing time of the first sweep of the scan for which the data is valid or used)	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Attachment flag** (always set to zero for this ADSR)	-	1	uc	1
4	**Application process ID**	-	2	us	1
5	**Filter set ID**	-	2	us	1
6	**Decimation factors** (Order: detectors A1,A2,B1,B2,C1,C2,D1,D2)	-	8	uc	8
7	**Band mapping configuration**	-	6	uc	6
8	**Number of sweeps in current scan (*M*)**	sweeps	2	us	1
9	**Number of fringe counts (samples at ADC)**	-	4	ul	1
10	**Commanded elevation and azimuth SAIT ID of current scan**	-	2	uc	2
11	**Commanded start elevation and azimuth angles of current scan**	-	8	ul	2
12	**Elevation scan counter (reset to zero after a new valid offset calibration)**	-	4	ul	1
13	**Accumulated FCE corrected in gain calibration data, at the end of current scan.** (Reset to zero at the start of the processing window and incremented by the actual detected and corrected FCE after processing of each sweep. Set to the sum of all the MDSR field #24 of the whole scan)	-	4	sl	1
CFI information					

14	**True local solar time at target** (CFI information of sweep closest in time to center of scan)	$1e^{-6}$ hours	4	sl	1
15	**Satellite to target azimuth** (CFI information of sweep closest in time to center of scan)	$1e^{-6}$ degrees	4	sl	1
16	**Target to Sun azimuth** (CFI information of sweep closest in time to center of scan)	$1e^{-6}$ degrees	4	sl	1
17	**Target to Sun elevation** (CFI information of sweep closest in time to center of scan)	$1e^{-6}$ degrees	4	sl	1
17.1	**Day/Night flag** -1 Sun eclipsed by earth for all tangent points in scan 0 Transition from day to night or vice versa in scan +1 Sun direct sight for all tangent points in scan	-	2	ss	1
Spare					
18	Spare	-	68	uc	68
Spectral calibration data					
19	**MJD start time of first elevation scan (ZPD) from which scene data were extracted for actual spectral calibration.** (In the case where the spectral calibration parameters are extracted from MIP_CS1_AX, this value is to agree with that in field #15 of Table 12.6.3.1.1-1.)	-	12	mjd	1
20	**Quality indicator (PCD)** "0" non-corrupted, "-1" = default values filled in (In the case where the spectral calibration parameters are extracted from MIP_CS1_AX, this value is to agree with that of field #16 of Table 12.6.3.1.1-1.)	-	1	sc	1
21	**Linear spectral correction factor (K_{sc})** Linear correction factor (same for all the bands). Doppler effect is treated separately and removed from scene spectra before spectral calibration	-	8	do	1
22	**Standard deviation of correction factor**	-	8	do	1
23	**Quadratic spectral correction factor (Asc, Bsc, Csc)**	-	24	do	3
24	**Number of peaks fitted (*S*)**	-	2	us	1
25	**PAW gain scaling constant**	-	32	fl	8
26	**Spare**	-	14	uc	14
Peak #1 to #S					
27	**Each peak i (i=1..S) has the format described in table attached hereafter**	-	$S\times34+2\times\sum K_{(i)}$	peak information	S

NESR data (total MIPAS bandwidth)					
28	The number of points (*N*) in NESR reported is given in the SPH. *M* = number of sweeps in the scan. **Data points first sweep of scan … Data points last sweep of scan**	W/ (cm^2×sr ×cm^{-1})	*N* × 4 … *N* × 4	*N*×fl … *N*×fl	*M*×*N*
TOTAL			**variable**		

Size Note: Assuming the number of sweeps in the scan (M) = 16, number of points in NESR (N) = 173, number of peaks (S) = 5 and number of co-added scenes (K) = 1, then ADSR size = 246 + S * (34 + K * 2) + M * N * 4 = 11498 bytes.

The format of the peak information structure recorded for each peak in the scan information ADSR is described below:

Table 12.4.1.7.5-2 Peak information structure for scan information ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Microwindow ID**	-	8	uc	8
2	**Exact wavenumber of spectral line**	cm^{-1}	8	do	1
3	**Detected frequency shift**	cm^{-1}	8	do	1
4	**Correlation coefficient**	-	8	do	1
5	**Number of coadded scene measurements (*K*)**	-	2	us	1
6	**Sequential ID of scene measurements coadded**	-	*K*×2	us	*K*
TOTAL			**34+*K*×2**		

12.4.1.7.6 Offset Calibration ADS

The offset calibration is used for the radiometric calibration of the scene interferograms. It allows the removal of the instrument intrinsic contribution to detected radiance. The offset calibration is the result of a dedicated processing at the ground segment of special measurements, the deep space measurements for offset calibration. Each ADSR contains the offset data for 5 bands (A, AB, B, C, and D). One offset is produced and required for each sweep direction (forward and reverse). Each ADS contains several time stamped ADSRs. Two ADSRs (1 forward sweep offset, 1 reverse sweep offset) are included for approximately every 4 scans in the MDS. The ADSR structure and contents are described in the table below.

Only valid (non-corrupted) offsets are stored, and a new ADSR is written only if the selection of offset data for a given scan changes with respect to the previous scan. The selection may change due to the closest in time strategy, which is applied for each band separately. For an offset repeat cycle of four scans the number of records per offset measurement will vary between four (this is the worst case where selections of bands changes each scan) and one (the case where all bands in the previous and new offset measurement are valid).

Table 12.4.1.7.6-1 MIPAS Level 1B Offset Calibration ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time (MJD) of the elevation scan to which this data pertains.** (ZPD crossing time of first sweep in scan for which offset cal. data are valid)	-	12	mjd	1
2	**Attachment flag** (always set to zero for this ADSR)	-	1	uc	1
3	**Band Validity PCD for latest offset measurement (five values for bands A, AB, B, C, and D)** 0 = non-corrupted 1 = corrupted due to instrument errors 2 = corrupted due to transmission errors 4 = corrupted due to observational validation	-	5	uc	5
Offset Calibration header					
4	**Accumulated FCE correction in gain calibration data, at end of offset measurement sequence** (five values for bands A, AB, B, C, and D)	-	10	ss	5
5	**Sweep direction, "F" forward and "R" reverse**	ascii	1	uc	1
6	**Detectors non-linearity flux validity** (four values for detectors A1, A2, AB, B) 0 = flux value is valid; 1 = flux > upper threshold of flux < lower threshold for at least 1 offset	-	4	uc	4
7	**Spare**	-	46	uc	46
	Bands A to D				
8	**Each band has the format described in table attached hereafter** (Order of the 5 bands: A, AB, B, C, D. N(i) is the number of data points per band i)	-	$5\times260+8\times\sum N(i)$	Band informa-tion	5
TOTAL			**1379 +** $\mathbf{8}\times\sum N$		

The format of the band information structure recorded for each band in the offset calibration ADSR is described below:

Table 12.4.1.7.6-2 Band information structure for offset calibration ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**ZPD crossing time of first sweep in currently valid offset sequence for this band** (ZPD time is that for the first sweep co-added in offset for the given direction. In the case the offset comes from MIP_CO1_AX, this value will agree with field #1 of Table 12.6.4.1.1-1)	mjd	12	mjd	1
2	**Decimation factor**	-	2	us	1
3	**Number of detected spikes**	-	4	ul	1
4	**Sweep IDs of IGM containing spike**	-	20	us	10
5	**Sample position of spikes in IGM**	-	40	ul	10
6	**Amplitude of spikes**	-	160	do	10×2
7	**Number of remaining detected spikes**	-	2	us	1
8	**Average amplitude of remaining detected spikes**	-	16	do	2
9	**Number of data points (*N*)** Before decimation, low resolution sweep produces approximately 30682 data points while high resolution sweep produces approximately 304 520 data points. The decimation factor depends on the band and varies from 11 to 36	-	4	ul	1
10	**Complex data points** IGM data points are complex data output from FIR filter at the SPE.	-	*N*×8	fl	*N*×2
TOTAL			260 +*N*×8		

Size Note: A sweep generates the same number of points in each channel; this number of points varies with the resolution:

Table 12.4.1.7.6-3 Data Points per Resolution

Resolution [cm^{-1}]	Number of points
0.025	304 520
0.05	152 388
0.25	30 682

These data points are then filtered with complex coefficients and decimated. This results in vectors with real and imaginary parts for each band. The

decimation factor used in each band depends on its bandwidth. In the following table, the decimation factor that can be used in each channel and the resulting number of points (assuming low resolution offset calibration) is listed below.

Table 12.4.1.7.6-4 Data Points per Decimation Factor

Band	Decimation factor	Number of points
A	21	1 449
AB	36	846
B	22	1 384
C	30	1 015
D	11	2 767
TOTAL		**7 461**

Assuming the total number of points $\Sigma N = 7461$, the ADSR length is:
ADSR total = $1379 + \Sigma N \times 8 = 61067$ bytes

12.4.1.7.7 Gain Calibration ADS #1

This ADS contains information describing the gain calibration data produced from the Level 0 product. This ADS is only produced if the Level 0 product contains full, uncorrupted gain data, and the processor has been commanded to produce the ADS. Otherwise this ADS will not be included in the product, and the DSD pointing to it will be set to NOT USED, as described in Volume 5. There are two ADSRs, one for the forward sweep direction and one for the reverse. Each ADSR is time-stamped with the time corresponding to the first sweep of the scan in the MDSR to which the data pertains. The ADSR format is described below:

Table 12.4.1.7.7-1 MIPAS Level 1B Gain Calibration ADS #1 ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time (MJD)** (this time corresponds to the ZPD crossing time of the first sweep of the scan for which the data is valid or used)	-	12	mjd	1
2	**Attachment flag** (always set to zero for this ADSR)	-	1	uc	1
Gain Calibration Data					
3	*Copy of the MDSR of the Gain Calibration file MDS #1* Refer to Table 12.6.1.1.1-1	-	variable		

12.4.1.7.8 Gain Calibration ADS #2

This ADS contains information describing the gain calibration spectra data. This ADS is only produced if complete and uncorrupted gain information is available in the Level 0 product, and the processor is commanded to produce the ADS. Otherwise, this ADS will not be included in the product, and the DSD pointing to the ADS will be set to NOT USED, as described in Volume 5. There are two ADSRs, one for the forward sweep direction and one for the reverse. Each ADSR is time-stamped with the time corresponding to the first sweep of the scan in the MDSR to which the data pertains. The ADSR format is described below:

Table 12.4.1.7.8-1 MIPAS Level 1B Gain Calibration ADS #2 ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time (MJD)** (this time corresponds to the ZPD crossing time of the first sweep of the scan for which the data is valid or used)	-	12	mjd	1
2	**Attachment flag** (always set to zero for this ADSR)	-	1	uc	1
Gain Calibration Data					
3	*Copy of the MDSR of the Gain Calibration file MDS #2* Refer to Table 12.6.1.1.2-1	-	variable		

12.4.1.7.9 ILS and Spectral Calibration GADS

This GADS contains information describing the ILS and Spectral calibration data generated by the processor. This GADS is only produced if the processor is commanded to produce it. Otherwise, this GADS may not be included in the product, and the DSD pointing to this Data Set is set to NOT USED, as described in Volume 5. The information in the GADS corresponds to the entire product. The GADS format is described below:

Table 12.4.1.7.9-1 MIPAS Level 1B ILS and Spectral Calibration GADS

N	Description	Units	Byte Length	Data Type	Dim.
ILS and Spectral Calibration Data					
1	*Copy of the MDS of the ILS and spectral calibration file* Refer to Section 12.6.3	-	variable		

12.4.1.7.10 LOS Calibration GADS

The LOS Calibration GADS provides a copy of the LOS Calibration Auxiliary data file used to process the data in the product.

Table 12.4.1.7.10-1 MIPAS Level 1B LOS Calibration GADS

N	Description	Units	Byte Length	Data Type	Dim.
LOS Calibration Data					
1	*Copy of the MDS of the LOS calibration data file* Refer to Section 12.6.2	-	175		

12.4.1.7.11 Processing Parameters GADS

This GADS is included in the product to provide a record of the processing parameters used to create the product. It consists of a copy of the Level 1B processing parameters:

Table 12.4.1.7.11-1 MIPAS Level 1B Processing Parameters GADS

N	Description	Units	Byte Length	Data Type	Dim.
Processing Parameters Data					
1	*Copy of the MDS of the Level 1B Processing Parameters data file* Refer to Section 12.6.6	-	67982		

12.4.1.8 12.4.1.8 Level 1B Product Size

The following calculations provide an estimate of the size of the MIPAS Level 1B product:

Assumptions:

One product per orbit in nominal mode

Output resolution to 0.025 cm^{-1}

80 scans per product, 16 sweeps per scan = 1280 sweeps per product

Gain and ILS information included in the product

Data Set sizes:

MPH = 1 247 bytes

SPH = 7 040 bytes

Summary Quality ADS (SQADS) = 80 scans * 57 bytes = 4 560 bytes

Geolocation ADS (LADS) = 80 scans * 69 bytes = 5 520 bytes

Structure ADS = 80 scans * 50 bytes = 4 000 bytes

MDS = 1280 sweeps * 241853 bytes = 309 571 840 bytes

Scan Information ADS = 80 scans * 11498 bytes = 919 840 bytes

Offset Calibration ADS = 80 scans / 4 x 2 dir. x 61067 bytes = 2 442 680 bytes

Gain ADS #1 = 2 directions * (13 + 478322 bytes) = 956 670 bytes

Gain ADS #2 = 2 directions * (13 + 4976 bytes) = 9 978 bytes

ILS and Spectral Calibration GADS = 997 bytes

LOS Calibration GADS = 175 bytes

Processing Parameters GADS = 67 982 bytes

TOTAL SIZE: 313 992 529 bytes

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12.5 LEVEL 2 PRODUCTS

There are two Level 2 MIPAS products:

- the Temperature, Pressure, and Atmospheric Constituents Profiles product (MIP_NL__2P);
- the Extracted Temperature, Pressure, and Atmospheric Constituents Profiles product for Meteo users (MIP_NLE_2P). (*)

(*) NOTE: processing and dissemination of NRT Temperature, Pressure and Atmospheric Constituents products for meteo users was suspended at the end of the MIPAS mission (8 April 2012). Starting from Level 2 reprocessing with MIPAS ML2PP processor Version 7 no MIP_NLE_2P products are provided anymore.

12.5.1 MIPAS Temperature, Pressure, and Atmospheric Constituents Profiles (MIP_NL__2P)

This Level 2 product consists of a number of geophysical parameters which have been derived from the MIPAS measurement data using instrument pointing information and other auxiliary data. This includes:

- geolocation of LOS tangent points (corrected for atmospheric refraction),
- atmospheric pressure at the LOS tangent altitudes,
- kinetic temperature, represented on a standard vertical pressure grid,
- LOS tangent altitude correction data for the acquired LOS tangent heights,
- concentration profile data of the 15 MIPAS target species: H_2O, N_2O, HNO_3, CH_4, O_3, NO_2, CFC-11, $ClONO_2$, N_2O_5, CFC-12, CCl_4, COF_2, CFC-14, CFC-22, HCN. Such profile data will be represented either on a grid defined by the acquisition of scene data or on a standard pressure grid.
- Integrated vertical column density profile data of the 15 MIPAS target species,
- volume mixing ratio (VMR) profile data of the 15 MIPAS target species;
- other auxiliary information.

12.5.1.1 Input Data

Level 1B product plus auxiliary data.

12.5.1.2 Auxiliary Data Used

The following auxiliary data files are needed for Level 2 processing:

Table 12.5.1.2-1 Auxiliary Data Files for MIPAS Level 2 Processing

Description	Auxiliary File ID

Cross section lookup tables file	MIP_CS2_AX
Forward calculation results file	MIP_FM2_AX
Initial Guess profile	MIP_IG2_AX
Level 2 Microwindows data	MIP_MW2_AX
Microwindows occupation matrices file	MIP_OM2_AX
A priori pointing information file	MIP_PI2_AX
Level 2 processing parameters	MIP_PS2_AX
Spectroscopic data file	MIP_SP2_AX
(*) ECMWF Forecast or ECMWF Analysis data file	(*) AUX_ECF_AX AUX_ECA_AX

(*) NOTE: starting from Level 2 reprocessing with MIPAS ML2PP prototype processor Version 7, only the ECMWF Analysis data file is used (AUX_ECA_AX) for the processing.

12.5.1.3 Processing Performed

The MIPAS Level 2 processing is essentially a two step procedure. The first step is a retrieval of temperature and pressure profiles from the Level 1B data. These profiles are then used in conjunction with the Level 1B data to retrieve the primary species profiles.

12.5.1.4 Product Structure

The high level product structure is shown below:

Table 12.5.1.4-1 MIPAS Level 2 Product Structure

MPH
SPH
Summary Quality ADS (SQ ADS)
Scan Geolocation ADS (LADS)
Structure ADS
Scan Information MDS
p,T, and height correction profiles MDS
Target Species # 1 MDS
MDS repeated for all retrieved target species
Continuum Contribution and Radiance Offset MDS
PCD Information of Individual Scans ADS
Microwindows occupation matrices ADS

Residual Spectra ADS
Instrument and Processing Parameters ADS

12.5.1.5 Main Product Header

The MPH is the same as described in Volume 5.

12.5.1.6 Specific Product Header

The MIPAS Level 2 SPH is an ASCII format header. The structure and contents are described below.

Table 12.5.1.6-1 MIPAS Level 2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
1	**SPH_DESCRIPTOR=**	keyword	15	uc	15
	quotation mark (“)	-	1	uc	1
	SPH descriptor ASCII string describing the product	-	28	uc	28
	quotation mark (“)	-	1	uc	1
	newline character	terminator	1	uc	1
2	**STRIPLINE_CONTINUITY_INDICATOR=**	keyword	31	uc	31
	Value: +000 = No stripline continuity, the product is a complete segment Other: Stripline Counter	-	4	Ac	1
	newline character	terminator	1	uc	1
3	**SLICE_POSITION=**	keyword	15	uc	15
	Value: +001 to NUM_SLICES Default value if no stripline continuity = +001	-	4	Ac	1
	newline character	terminator	1	uc	1
4	**NUM_SLICES=**	keyword	11	uc	11
	Number of slices in this stripline Default value if no continuity = +001	-	4	Ac	1
	newline character	terminator	1	uc	1
Product location information					
5	**START_TIME=**	keyword	11	uc	11
	quotation mark (“)	-	1	uc	1
	Start time of first retrieval in this product (UTC format)	-	27	uc	27

Table 12.5.1.6-1 MIPAS Level 2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	quotation mark (“)	-	1	uc	1
	newline character	terminator	1	uc	1
6	**STOP_TIME=**	keyword	10	uc	10
	quotation mark (“)	-	1	uc	1
	Stop time of last retrieval in this product (UTC format)	-	27	uc	27
	quotation mark (“)	-	1	uc	1
	newline character	terminator	1	uc	1
7	**FIRST_TANGENT_LAT=**	keyword	18	uc	18
	Latitude of LOS tangent point at center of scan (refraction corrected) of the first scan in the product. Positive north.	10^{-6} degrees	11	Al	1
	<10-6degN>	units	10	uc	10
	newline character	terminator	1	uc	1
8	**FIRST_TANGENT_LONG=**	keyword	19	uc	19
	Longitude of LOS tangent point at center of scan (refraction corrected) of the first scan in the product. Positive east.	10^{-6} degrees	11	Al	1
	<10-6degE>	units	10	uc	10
	newline character	terminator	1	uc	1
9	**LAST_TANGENT_LAT=**	keyword	17	uc	17
	Latitude of LOS tangent point at center of scan (refraction corrected) of the last scan in the product. Positive north.	10^{-6} degrees	11	Al	1
	<10-6degN>	units	10	uc	10
	newline character	terminator	1	uc	1
10	**LAST_TANGENT_LONG=**	keyword	18	uc	18
	Longitude of LOS tangent point at center of scan (refraction corrected) of the last scan in the product. Positive east.	10^{-6} degrees	11	Al	1
	<10-6degE>	units	10	uc	10
	newline character	terminator	1	uc	1
11	**Spare (blank characters)**	-	48	uc	48

Table 12.5.1.6-1 MIPAS Level 2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	newline character	terminator	1	uc	1
Other product information					
12	**NUM_SCANS=**	keyword	10	uc	10
	No. of acquired elevation scans in Level 1 B input file	-	6	As	1
	newline character	terminator	1	uc	1
13	**NUM_LOS_GEOMS=**	keyword	14	uc	14
	Number of LOS geometries per elev. scan in nominal mode [Nacq]	-	6	As	1
	newline character	terminator	1	uc	1
14	**NUM_SCANS_PER_DS=**	keyword	17	uc	17
	Number of elevation scans per D.S. calibration cycle in nominal mode	-	6	As	1
	newline character	terminator	1	uc	1
15	**NUM_SCANS_PROC=**	keyword	15	uc	15
	No. of elevation scans in nominal mode processed	-	6	As	1
	newline character	terminator	1	uc	1
16	**NUM_SP_NOT_PROC=**	keyword	16	uc	16
	No. of elevation scans in special events mode not processed	-	6	As	1
	newline character	terminator	1	uc	1
17	**NUM_SPECTRA=**	keyword	12	uc	12
	No. of scene spectra in measurement interval	-	6	As	1
	newline character	terminator	1	uc	1
18	**NUM_SPECTR_PROC=**	keyword	16	uc	16
	Number of scene spectra processed	-	6	As	1
	newline character	terminator	1	uc	1
19	**NUM_GAIN_CAL=**	keyword	13	uc	13
	No. of gain calibration cycles in measurement time interval This value will be 0 if no Gain Calibration ADSRs appeared in the input Level-1B product and 1 otherwise.	-	6	As	1
	newline character	terminator	1	uc	1

Table 12.5.1.6-1 MIPAS Level 2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
20	**TOT_GRANULES=**	keyword	13	uc	13
	Total number of elevation scans ('granules') processed [Nscan]		6	As	1
	newline character	terminator	1	uc	1
21	**MAX_PATH_DIFF=**	keyword	14	uc	14
	Maximum path difference in nominal scene measurements	cm	15	Afl	1
	<cm>	units	4	uc	4
	newline character	terminator	1	uc	1
22	**ORDER_OF_SPECIES=**	keyword	17	uc	17
	quotation mark (")	-	1	uc	1
	String describing the sequence of species within this product Sequence of species inside this product; the default sequence is: "H2O, O3, HNO3, CH4, N2O, NO2, F11, CLNO, N2O5, F12, COF2, CCL4, HCN, F14, F22, 15 spare species". Unused characters are set to blank. String is left justified.	character string	149	uc	149
	quotation mark (")	-	1	uc	1
	newline character	terminator	1	uc	1
23	**NUM_SWEEPS_PER_SCAN=**	-	20	keyword	1
	Number of sweeps per nominal elevation scan		6	As	1
	newline character		1	uc	1
24	**Spare (blank characters)**	-	20	uc	1
	newline character	terminator	1	uc	1
Data Set Descriptors for attached data sets					
25	**DSD (A) for the SQ ADS**	-	280	dsd	1
26	**DSD (A) for Scan Geolocation ADS (LADS)**	-	280	dsd	1
27	**DSD (A) for Structure ADS**	-	280	dsd	1
28	**DSD (A) for Scan Information MDS**	-	280	dsd	1
29	**DSD (M) p,T, and height correction profiles MDS**	-	280	dsd	1
30	**DSD (M) for Target Species MDSs**	-	8400	dsd	30

Table 12.5.1.6-1 MIPAS Level 2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
36	**DSD (M) for Continuum Contribution and Radiance Offset MDS**	-	280	dsd	1
37	**DSD (A) for PCD Information for Individual Scans ADS**	-	280	dsd	1
38	**DSD (A) for Microwindows occupation matrices ADS**	-	280	dsd	1
39	**DSD (A) for Residual Spectra ADS**	-	280	dsd	1
40	**DSD (A) for Instrument and Processing Parameters ADS**	-	280	dsd	1
Data Set Descriptors for referenced files					
41	**DSD (R) referencing Level 1B input product**	-	280	dsd	1
42	**DSD (R) referencing the Level 2 processing parameters data file**	-	280	dsd	1
43	**DSD (R) referencing the Level 2 microwindows data file**	-	280	dsd	1
44	**DSD (R) referencing the Spectroscopic data file**	-	280	dsd	1
45	**DSD (R) referencing the Initial guess data file**	-	280	dsd	1
46	**DSD (R) referencing the Forward calculation results file**	-	280	dsd	1
47	**DSD (R) referencing the Microwindows occupation matrices file**	-	280	dsd	1
48	**DSD (R) referencing the Cross section look-up tables file**	-	280	dsd	1
49	**DSD (R) referencing the A priori pointing information file**	-	280	dsd	1
50	**DSD (R) referencing the ECMWF file**	-	280	dsd	1
51	**DSD Spare (279 blank space characters followed by one newline character)**	-	280	dsd_sp	1
TOTAL			**15 128**		

The following table provides the DSD names used for each DSD in the SPH.

Table 12.5.1.6-2 DSD Names for MIPAS Level 2 SPH

Description	DS_NAME

DSD (G) for the SQ ADS	SUMMARY QUALITY ADS
DSD (A) for Scan Geolocation ADS (LADS)	SCAN GEOLOCATION ADS
DSD (A) for Structure ADS	DATASET STRUCTURE ADS
DSD (A) for Scan Information MDS	SCAN INFORMATION MDS
DSD (M) p,T, and height correction profiles MDS	PT RETRIEVAL MDS
DSD(M) for Target Species # 1 MDS	H2O RETRIEVAL MDS
DSD (M) for Target Species #2 MDS	O3 RETRIEVAL MDS
DSD (M) for Target Species #3 MDS	HNO3 RETRIEVAL MDS
DSD (M) for Target Species #4 MDS	CH4 RETRIEVAL MDS
DSD (M) for Target Species #5 MDS	N2O RETRIEVAL MDS
DSD (M) for Target Species #6 MDS	NO2 RETRIEVAL MDS
DSD (M) for Target Species #7 MDS	F11 RETRIEVAL MDS
DSD (M) for Target Species #8 MDS	CLNO RETRIEVAL MDS
DSD (M) for Target Species #9 MDS	N2O5 RETRIEVAL MDS
DSD (M) for Target Species #10 MDS	F12 RETRIEVAL MDS
DSD (M) for Target Species #11 MDS	COF2 RETRIEVAL MDS
DSD (M) for Target Species #12 MDS	CCL4 RETRIEVAL MDS
DSD (M) for Target Species #13 MDS	HCN RETRIEVAL MDS
DSD (M) for Target Species #14 MDS	F14 RETRIEVAL MDS
DSD (M) for Target Species #15 MDS	F22 RETRIEVAL MDS
DSD (M) for Target Species #16, ... to Target Species #30 MDS	SPARE RETRIEVAL MDS
DSD (M) for Continuum Contribution and Radiance Offset MDS	CONTINUUM AND OFFSET MDS
DSD (A) for PCD Information for Individual Scans ADS	PCD INFORMATION ADS
DSD (A) for Microwindows occupation matrices ADS	MICROWINDOW OCCUPATION ADS
DSD (A) for Residual Spectra ADS	RESIDUAL SPECTRA ADS
DSD (A) for Instrument and Processing Parameters ADS	PROCESSING PARAMETERS ADS
Data Set Descriptors for referenced files	
DSD (R) referencing Level 1B input product	REFERENCE TO USED LEVEL_1B
DSD (R) referencing the Level 2 processing parameters data file	REFERENCE TO USED MIP_PS2_AX
DSD (R) referencing the Level 2 microwindows data file	REFERENCE TO USED MIP_MW2_AX
DSD (R) referencing the Spectroscopic data file	REFERENCE TO USED MIP_SP2_AX
DSD (R) referencing the Initial guess data file	REFERENCE TO USED MIP_IG2_AX

DSD (R) referencing the Forward calculation results file	REFERENCE TO USED MIP_FM2_AX
DSD (R) referencing the Microwindows occupation matrices file	REFERENCE TO USED MIP_OM2_AX
DSD (R) referencing the Cross section look-up tables file	REFERENCE TO USED MIP_CS2_AX
DSD (R) referencing the A priori pointing information file	REFERENCE TO USED MIP_PI2_AX
DSD (R) referencing the ECMWF file	ECMWF_FILE

12.5.1.7 Data Sets

The following subsections describe the Data Sets contained in the product. The data is in mixed-binary format. It may contain ASCII strings, but the strings are not placed in quotation marks as in the case of the MPH and SPH.

12.5.1.7.1 Summary Quality ADS

The SQ ADS provides quality information pertaining to the entire product. The information represents information collected from each scan in the product. The layout of the ADS is described below:

Table 12.5.1.7.1-1 MIPAS Level 2 SQ ADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1
2	**Attachment Flag** (set to 1 if all MDSRs associated with this ADSR are blank or missing. Set to zero otherwise.)	-	1	uc	1
General Level 2 product quality information					
3	**Total no. of p, T retrievals terminated due to excess number of macro / micro iterations**	-	4	us	2
4	**Total number of VMR retrievals terminated due to due to excess number of macro / micro iterations (**two values for each species, ordered according to field #22 of the SPH)	-	120	us	30×2×us
5	**Total number of p,T retrievals terminated due to run time limitation**	-	2	us	1
6	**Total no. of VMR retrievals terminated due to run time limitation** (one value for each species, ordered according to field #22 of the SPH)	-	60	us	30×us
7	**Spare**	-	65	uc	65
TOTAL			**264**		

12.5.1.7.2 Scan Geolocation ADS

The Geolocation ADS (or LADS) provides geolocation information for each scan in the MDS. There is one ADSR per scan.

Table 12.5.1.7.2-1 MIPAS Level 2 Scan Geolocation ADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1
2	**Attachment Flag** (set to 1 if all MDSRs associated with this ADSR are zero or missing. Set to zero otherwise.)	-	1	uc	1
Information on sensing time and geolocation of elevation scan scene					
3	**Geolocation (lat. / long.) of first scene LOS tangent point** WGS84 reference, refraction corrected	10^{-6} degrees	8	sl	2
4	**Tangent altitude of first scene LOS tangent point**	km	8	do	1
5	**Geolocation (lat. / long.) of last scene LOS tangent point** WGS84 reference, refraction corrected	10^{-6} degrees	8	sl	2
6	**Tangent altitude of last scene LOS tangent point**	km	8	do	1
7	**Geolocation (lat. / long.) of LOS tangent point closest to scans mean time.** WGS84reference, refraction corrected	10^{-6} degrees	8	sl	2
8	**True local solar time at target**	10^{-6} hours	4	sl	1
9	**Satellite to target azimuth**	10^{-6} degrees	4	sl	1
10	**Target to Sun azimuth**	10^{-6} degrees	4	sl	1
11	**Target to Sun elevation**		4	sl	1
12	**Spare**	-	31	uc	31
TOTAL			**100**		

12.5.1.7.3 Structures ADS

The Structure ADS provides structure information for MDSs and ADSs.

There is one ADSR per scan or group of consecutive scans:

Table 12.5.1.7.3-1 MIPAS Level 2 Structure ADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time of first scan this ADSR refers to	-	12	mjd	1
2	**Attachment Flag** (Always set to zero)	-	1	uc	1
	General Structure Information				
3	**Number of sweeps per scan [Nsw]**	-	2	us	1
4	**Number of retrieved pressure/temperature profile points [NpT]**	-	2	us	1
5	**Number of retrieved VMR profile points [NV (j)]** (j=1..30)	-	60	us	30×us
6	**Flags indicating existence of p,T error propagation data [Flerr (j)]** (j=1..30)	-	60	us	30×us
7	**Number of fitted continuum parameters in p,T retrieval [Ncont (pT)]**	-	2	us	1
8	**Number of fitted continuum parameters in VMR retrieval [Ncont (V(j))]** (j=1..30)	-	60	us	30×us
9	**Number of fitted instrument offset values in p,T retrieval [Noffset (pT)]**	-	2	us	1
10	**Number of fitted instrument offset values in VMR retrieval [Noffset (V(j))]** (j=1..30)	-	60	us	30×us
11	**Max. number of microwindows per acquisition tangent height used for p,T retrieval [NMWpT]**	-	2	us	1
12	**Max. number of microwindows per acquisition tangent height used for VMR retrieval [NMWV(j)]** (j=1..30)	-	60	us	30×us
13	**Total number of p,T microwindows (all altitudes) processed in current scan [Ntot (pT)]**	-	2	us	1
14	**Total number of VMR retrieval microwindows (all altitudes) processed in current scan [Ntot (V(j))]** (j=1..30)	-	60	us	30×us
15	**Total number of spectral grid points contained in selected p,T microwindows [Ntot_grid (pT)]**	-	2	us	1

Table 12.5.1.7.3-1 MIPAS Level 2 Structure ADS

N	Description	Units	Byte Length	Data Type	Dim.
16	**Total number of spectral grid points contained in selected VMR retrieval microwindows [Ntot_grid (V(j))]** (j=1..30)	-	60	us	30×us
17	**Number of profile grid points to represent continuum profile data for p,T retrieval [Ncgrid (pT)]**	-	2	us	1
18	**Number of profile grid points to represent continuum profile data for VMR retrieval [Ncgrid (V(j))]** (j=1..30)	-	60	us	30×us
19	**Max Number of evolution steps reported for p,T retrievals within ADS 4 DSRs this DSR refers to [$n_{evo,pT}$]**	-	2	us	1
20	**Max Number of evolution steps reported for VMR retrievals within ADS 4 DSRs this DSR refers to [$n_{evo,V(j)}$, j=1,…,30]**	-	60	us	30×us
21	**Max. Number of PCD information strings witin ADS 4 DSRs this DRS refers to [N_{pcd}^{max}]**	-	2	us	1
22	**Number of points in base profiles for p,T retrieval [$N_{b(p,T)}$]**	-	2	us	1
23	**Number of points in base profiles for VMR retrievals [$N_{b(V(j))}$, j =1,…,30]**	-	60	us	30×us
24	**Number of MW labels within p,T occupation matrix [Nmw(p,T)]**	-	2	us	1
25	**Number of MW labels within VMR occupation matrices [Nmw(V(j)), j=1,...,30]**	-	60	us	30×us
Scan Information MDS[1] structure information					
26	**DSR information for Scan Information MDS**	-	8	DSR info	1
MDSs structure information					
27	**DSR information for MIPAS Level 2 MDSs** (order of MDSs: p,T and height correction profile MDS, Target species profiles MDSs with 30 species ordered according to field #22 in SPH, Offset and continuum data MDS)	-	32×8	DSR info	8

[1] Changed Scan Information ADS to MDS (new MDS#1) since IODD L2 3/C 22/06/2001

Table 12.5.1.7.3-1 MIPAS Level 2 Structure ADS

N	Description	Units	Byte Length	Data Type	Dim.
Last ADSs structure information					
28	**DSR information for last MIPAS Level 2 ADSs** (order of ADSs: PCD information for individual scans ADS, MW occupation matrices ADS, Mean values and st.dev. of residual spectra ADS, Instrument and processing parameters ADS)	-	4×8	DSR info	4
29	**Spare**	-	27	uc	27
TOTAL			**1020**		

The DSR information provides offset and size to refer to DSRs inside a Data Set of the MIPAS Level 2 product:

Table 12.5.1.7.3-2 Information for MIPAS Level 2 Structure ADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Offset of first DSR within Data Set this DSR information refers to** (set to -1 if no DSR is referred)	bytes	4	sl	1
2	**Size of DSRs within Data Set this DSR information refers to**	bytes	4	ul	1
TOTAL			**8**		

12.5.1.7.4 Scan Information MDS

The Scan information MDS provides information for each scan in the MDS. There is one ADSR per scan.

Table 12.5.1.7.4-1 MIPAS Level 2 Scan Information MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Quality indicator (PCD)** set to -1 if all information in DSR is blank or zero, else set to 0	-	1	sc	1

Table 12.5.1.7.4-1 MIPAS Level 2 Scan Information MDS

N	Description	Units	Byte Length	Data Type	Dim.
Information on sensing time and geolocation of elevation scan scene					
4	**ZPD crossing time of the ith scene spectrum in elevation scan [$t_{zpd}(N_{sw})$]** (i = 1 ... N^{sw} , ordered from the highest to the lowest altitude)	-	N^{sw} ×12	mjd	N^{sw}
5	**Geolocation (lat. / long.) of the ith scene LOS tangent point** WGS84 reference, refraction corrected (i = 1 ... N^{sw} , ordered from the highest to the lowest altitude)	(1e-6) deg	N^{sw} ×8	sl	N^{sw}×2
6	**Tangent altitude of the ith scene LOS tangent point** (i = 1 ... N^{sw} , ordered from the highest to the lowest altitude)	km	N^{sw} ×8	do	N^{sw}
7	**Application process ID**	-	2	us	1
8	**Flag indication successful p,T retrieval**	-	1	uc	1
9	**Flag indication successful VMR retrieval** (one flag for each of the 30 species, ordered according to field #22 of the SPH)	-	30	uc	30×uc
10	**Flag indicating if Marquardt limit is exceeded for pT retrieval**	-	1	uc	1
10.2	**Flag indicating if Marquardt limit is exceeded for VMR retrieval**	-	30	uc	30×uc
10.4	**Flag indicating if chisquare limit is exceeded for pT retrieval**	-	1	uc	1
10.6	**Flag indicating if chisquare limit is exceeded for VMR retrieval**	-	30	uc	30×uc
10.8	**Spare**	-	40	uc	40×uc
p,T retrieval results					
11	**Logical retrieval vector for p,T retrieval**		N^{sw}	uc	N^{sw}
12	**Retrieved pressure for each sweep**	hPa	N^{sw} ×4	float	N^{sw}
13	**Pressure variance data**	hPa^2	N^{sw} ×4	float	N^{sw}
14	**Corrected Tangent Altitudes of sweeps**	km	N^{sw} ×4	float	N^{sw}
15	**Height correction variance data**	m^2	N^{sw} ×4	float	N^{sw}
16	**Retrieved temperatures for each sweep**	K	N^{sw} ×4	float	N^{sw}

Table 12.5.1.7.4-1 MIPAS Level 2 Scan Information MDS

N	Description	Units	Byte Length	Data Type	Dim.
17	**Temperature variance data**	K^2	N^{sw} ×4	float	N^{sw}
18	**ECMWF corrected altitudes**	km	N^{sw} ×4	float	N^{sw}
VMR retrieval results					
19	**Logical retrieval vector for species 1 VMR retrieval**		N^{sw}	uc	N^{sw}
20	**Retrieved VMR for each sweep**	ppm	N^{sw} ×4	Float	N^{sw}
21	**VMR variance data**	ppm^2	N^{sw}×4	float	N^{sw}
22	**Concentration for each sweep**	cm^{-3}	N^{sw}×4	float	N^{sw}
23	**Concentration variance data**	$(cm^{-3})^2$	N^{sw}×8	double	N^{sw}
24	**Vertical column density for each sweep**	cm^{-2}	N^{sw} ×4	float	N_{sw}
25	**Vertical column density variance data**	$(cm^{-2})^2$	N^{sw} ×8	double	N_{sw}
Structure of fields from #19 up to #25 is repeated for species from #2 up to #30 applying the corresponding MDS					
26	**Labels of first 3 cloud detection meso windows per sweep**	-	N^{sw}×24	uc	N^{sw}×3×8
27	**Cloud indexes for sweeps, 3 per sweep**	-	Nsw×12	float	N^{sw}×3
28	**Cloud index thresholds for sweeps, 3 per sweep**	-	Nsw×12	float	N^{sw} × 3
29	**Flags indicating detection of clouds, 3 per sweep**	-	Nsw×3	uc	N^{sw}×3
TOTAL			**135+variable**		

12.5.1.7.5 p,T, and Height Correction Profiles MDS

This MDS contains information describing the Pressure, Temperature and height correction profiles. There is one MDSR per scan.

Table 12.5.1.7.5-1 MIPAS Level 2 p,T, and Height Correction Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator** (set to -1 if retrieval failed and them all information in DSR is blank or zero. Set to 0 otherwise.)	-	1	sc	1
4	**ID of convergence condition terminating the iteration** 0 = convergence reached 1 = maximum number of macro iterations exceeded 2 = maximum number of micro iterations exceeded 3 = maximum run time exceeded 4 = retrieval failed 5 = convergence reached, and final matrix was singular 6 = maximum number of macro iterations exceeded, and final matrix was singular 7 = maximum number of micro iterations exceeded, and final matrix was singular 8 = maximum run time exceeded, and final matrix was singular 9 = retrieval failed, and final matrix was singular	-	2	us	1
5	**Last $\chi 2$ test value**	-	4	fl	1
6	**Flag indicating source of used initial guess data** bitvector: 0x01: MIP_IG2_AX data file used; 0x02: ECMWF data file used; 0x04: optimum estimate used; 0x08: retrieved p,T data used; 0x10: MIP_FM2_AX data file used. 0x20: Recursive loop for p,T retrieval and first VMR retrieval (usually H2O) entered. This bit is reported only for the p,T retrieval.	-	1	uc	1
Tangent pressure profile and covariance data					
7	**Tangent pressure of ith LOS tangent altitude [p_{tan} (N_{pT})].** Relating elements of vector of retrieved parameters. (i = 1, ..., N_{pT} , ordered from highest to lowest altitude)	hPa	N_{pT}×4	fl	N_{pT}
8	**Tangent pressure variance / covariance data** Elements of diagonal and off-diagonal elements of var./cov. matrix. Contains for each matrix row #i the first i elements	hPa^2	2×N_{pT}× (N_{pT} +1)	fl	N_{pT}× (N_{pT}+ 1) / 2
Height correction profile and covariance data					
9	**Height increment correction for the ith LOS tangent altitude [δz (N_{pT} -1)].** (i = 1, ..., N_{pT} - 1 , ordered from highest to lowest altitude)	m	(N_{pT}- 1) ×4	fl	N_{pT} -1

Table 12.5.1.7.5-1 MIPAS Level 2 p,T, and Height Correction Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.
10	**Height correction variance / covariance data** Elements of diagonal and off-diagonal elements of var./cov. matrix. Contains for each matrix row #i the first i elements	m^2	$2 \times N_{pT} \times (N_{pT} - 1)$	fl	$N_{pT} \times (N_{pT} 1) / 2$
	Temperature profile and covariance data (NT0 element output grid)				
11	**Temperature of ith grid point** Relating elements of vector of retrieved parameters. (i = 1, ..., N_{pT} , ordered from highest to lowest altitude) ($N_{pT} = N_{V(1)} = ... = N_{V(6)} = N_{SW}$ if Sg is set to 'T')	K	$N_{pT} \times 4$	fl	N_{pT}
12	**Temperature profile variance /covariance data** Elements of diagonal and off-diagonal elements of var./cov. matrix. Contains for each matrix row #i the first i elements	K^2	2×NpT× (NpT + 1)	fl	NpT * (NpT + 1) / 2
13	**Tangent pressure / temperature profile covariance data** The value will be set to -1030 for sweeps where pressure is not fitted.	hPa*K	NpT×NpT× 4	fl	NpT *NpT
14	**Altitude grid for base profiles**	km	Nb(pT) ×4	fl	Nb(pT)
15	**Pressure profile consisting of retrieved pressure and assumed values above and below (= base profile)**	hPa	Nb(pT) ×4	fl	Nb(pT)
16	**Temperature profile consisting of retrieved temperature and assumed values above and below (= base profile)**	K	Nb(pT) ×4	fl	Nb(pT)
17	**ECMWF corrected altitudes**	km	NpT×4	fl	NpT
18	**Averaging kernel matrix**	-	16×NpT×NpT	fl	(2*NpT) *(2*NpT)
19	**Conditioning parameter**		4	fl	1
TOTAL			**80+variable**		

12.5.1.7.6 Target Species#1 to #30 Retrievals MDSs

Each Target Species Retrieval MDS contain the profile and covariance data for a specific target species. There is one MDS for each target species. Each MDSR in the MDS corresponds to one scan.

Table 12.5.1.7.6-1 MIPAS Level 2 Target Species Retrieval MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time.	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator** (set to -1 if retrieval failed and them all information in DSR is blank or zero. Set to 0 otherwise.)	-	1	sc	1
4	**ID of convergence condition terminating the iteration** 0 = convergence reached 1 = maximum number of macro iterations exceeded 2 = maximum number of micro iterations exceeded 3 = maximum run time exceeded 4 = retrieval failed 5 = convergence reached, and final matrix was singular 6 = maximum number of macro iterations exceeded, and final matrix was singular 7 = maximum number of micro iterations exceeded, and final matrix was singular 8 = maximum run time exceeded, and final matrix was singular 9 = retrieval failed, and final matrix was singular	-	2	us	1
5	**Last $\chi 2$ test value**	-	4	fl	1
6	**Flag indicating source of used initial guess data** bitvector: 0x01: MIP_IG2_AX data file used; 0x02: ECMWF data file used; 0x04: optimum estimate used; 0x08: retrieved p,T data used; 0x10: MIP_FM2_AX data file used. 0x20: Recursive loop for p,T retrieval and first VMR retrieval (usually H2O) entered. This bit is reported only for the p,T retrieval.	-	1	uc	1
Species #1 profile and covariance data *(N_{VMR1} element output grid) * species 1 shown as an example*					
7	**VMR of ith LOS tangent altitude [$VMR_1(i)$]** (i = 1, ..., $N_{V(1)}$)	ppm	$N_{V(1)} * 4$	fl	$N_{V(1)}$
8	**VMR profile variance / covariance data** Elements of diagonal and off-diagonal elements of var./cov. matrix. Contains for each matrix row #i the first i elements	ppm^2	$N_{V(1)} * (N_{V(1)} + 1)*2$	fl	$N_{V(1)}*(N_{V(1)} + 1) / 2$
9	**Concentration of ith LOS tangent altitude [ρ_1 (i)]** (i = 1, ..., $N_{V(1)}$)	cm^{-3}	$N_{V(1)} * 4$	fl	$N_{V(1)}$
10	**Concentration profile variance / covariance data** Elements of diagonal and off-diagonal elements of var./cov. matrix. Contains for each matrix row #i the first i elements	$(cm^{-3})^2$	$N_{V(1)} * (N_{V(1)}+ 1)*4$	do	$N_{V(1)}*(N_{V(1)} + 1) / 2$
11	**Vertical column density of ith LOS tangent altitude [η_1 (i)]** (i = 1, ..., $N_{V(1)}$)	cm^{-2}	$N_{V(1)} \times 4$	fl	$N_{V(1)}$
12	**Vertical column density profile variance / covariance data** Elements of diagonal and off-diagonal elements of var./cov. matrix. Contains for each matrix row #i the first i elements	$(cm^{-2})^2$	$N_{V(1)} * (N_{V(1)}+ 1)*4$	do	$N_{V(1)}*(N_{V(1)} + 1) / 2$

Table 12.5.1.7.6-1 MIPAS Level 2 Target Species Retrieval MDS

N	Description	Units	Byte Length	Data Type	Dim.
13	**Flag indicating used approach for p,T error propagation** 'E': No use of matrix S, only matrix E0 has been used (simplified approach), 'S': Matrix S and reference profiles have been used, 'N': No p,T error propagation has been performed	-	1	uc	1
14	**p,T error on VCM** (i = 1, ..., $N_{V(1)}$)	-	$N_{V(1)}$ ×$N_{V(1)}$ ×4	fl	$N_{V(1)}$×$N_{V(1)}$
15	**Altitude grid for VMR base profile**	Km	Nb(V(1)) ×4	fl	Nb(V(1))
16	**VMR profile consisting of retrieved VMR and assumed values above and below (= base profile)**	ppm	Nb(V(1))×4	fl	Nb(V(1))
17	**Averaging kernel matrix**		4×NV(1) ×NV(1)	fl	NV(1)*NV(1)
18	**Conditioning parameter**	-	4	fl	1
TOTAL			**64+variable**		

The above MDSR structure corresponds to the Target Species #1 Retrieval MDS. The Target Species #2 to #30 Retrieval MDSs follow the same format, but they correspond to species #2, #3, … and #30 respectively, and therefore $N_{V(1)}$ has to be replaced by $N_{V(2)}$, ..., $N_{V(30)}$, respectively in above table.

12.5.1.7.7 Continuum Contributions and Radiance Offset MDS

This MDS contains the fitted instrumental radiance offset and continuum contribution (emissions and absorption) in different microwindows. There is one MDSR per scan, and each MDSR contains information pertaining to all target species.

Table 12.5.1.7.7-1 MIPAS Level 2 Continuum Contribution and Radiance Offset MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator** (set to -1 if retrieval failed and them all information in DSR is blank or zero. Set to 0 otherwise.)	-	1	sc	1

p, T retrievals: Radiometric offset values fitted in different spectral intervals					
4	**Fitted instrument offset in p , T retrieval microwindows** (offset (i), i = 1, …, $N_{offset(pT)}$)	r.u.	4 * $N_{offset(pT)}$	fl	$N_{offset(pT)}$
5	**Instrument offset variance data** Elements of diagonal of variance/covariance matrix (field is omitted for $Fl_{err(j)}$=0)	$(r.u.)^2$	4 * $N_{offset(pT)}$	fl	$N_{offset(pT)}$
6	**Definition of p, T retrieval microwindows in which offset values are fitted:** Each entry is an 8 character string (i = 1, …, $N_{offset(pT)}$)	ascii	8 * $N_{offset(pT)}$	uc	$N_{offset(pT)}$ *8
p, T retrievals: continuum values fitted in different spectral intervals					
7	**Indices of tangent height for which continuum absorption coefficients are fitted [$index_{Con\ (pT)}$ (i)]** (i = 1, …, $N_{cgrid(pT)}$) If no continuum is fitted, values are set to -1.	-	2×$N_{cgrid(pT)}$	us	$N_{cgrid(pT)}$
8	**Each structure #$index_{Con\ (pT)}$ (i) of continuum values (fitted in different spectral intervals) for p,T retrieval corresponds to one altitude. It follows the format described in table attached below** : "Continuum values Structure for p, T retrievals" (i = 1, …, $N_{cgrid(pT)}$)	-	26×N_{MWPT}×$N_{cgrid(pT)}$	p,T continuum structure	$N_{cgrid(pT)}$
VMR #1 to VMR #30 retrievals: Radiometric offset values and Continuum values fitted in different spectral intervals (species #1 to #30)					
9	**Each structure of Radiometric offset and Continuum values (fitted in different spectral intervals) for VMR #j retrieval corresponds to one species # j. It follows the format described in table attached below** : "Radiometric offset and Continuum values Structure for VMR retrievals" (order of the 30 species follows SPH field #22 for VMR #1, … , VMR #30)	-	$16\times\sum_j N_{offset(V(j))} + 2\times\sum_j N_{cgrid(V(j))} + 22 \times \sum_j (N_{cgrid(V(j))} * N_{MWV(j)})$	VMR radiom. Offset and continuum structure	30
10	**Spare**	-	47	uc	47
TOTAL			**variable ***		

* MDSR size : 64 + 16 * Noffset(pT) + Ncgrid(pT) * (2 + 26*NMWPT)

+ 16*∑j=1..30 Noffset(V(j))+ 2*∑j=1..30 Ncgrid(V(j))

+ 22 * ∑j=1..30 (Ncgrid(V(j))*NMWV(j))

The following structure is used to define the continuum values fitted in different spectral intervals for the p, T retrievals, for one altitude:

Table 12.5.1.7.7-2 Continuum values Structure for p, T retrievals

N	Description	Units	Byte Length	Data Type	Dim.
1	**Definition of p, T retrieval microwindows used at altitude #index$_{Con\ (pT)}$ (i)** 8 character ascii string for each entry. Row relating to this altitude of matrix for p,T retrieval in corresponding MDSR of Scan Information MDS.	-	8×N_{MWPT}	uc	8×N_{MWPT}
2	**Types of grouping for above MWs used at altitude #index$_{Con\ (pT)}$ (i)** 0: not used 1: isolated 2: edge of a loose group 3: leftmost edge of a tight group 4: leftmost edge of a tight group and edge of a loose group 5: member of a tight group but not at the corner of the group 6: member of a loose group but not at the corner of the group not used fields are set to -1.	-	2×N_{MWPT}	ss	N_{MWPT}
3	**Fitted continuum values used at altitude #index$_{Con\ (pT)}$ (i)** Not used values set to 0	10^{-30} × (cm^2/ molec)	4×N_{MWPT}	fl	N_{MWPT}
4	**Variance data of continuums fitted used at altitude #index$_{Con\ (pT)}$ (i)** Not used values set to 0	10^{-60} × (cm^4/ $molec^2$)	4×N_{MWPT}	fl	N_{MWPT}
5	**Covariance data of fitted continuums and retrieved pressure used at altitude #index$_{Con\ (pT)}$ (i)** Not used values set to 0	10^{-30} × (hPa×cm^2/ molec)	4×N_{MWPT}	fl	N_{MWPT}
6	**Covariance data of fitted continuums and retrieved temperature used at altitude #index$_{Con\ (pT)}$ (i)** Not used values set to 0	10^{-30} × (K×cm^2/ molec)	4×N_{MWPT}	fl	N_{MWPT}
TOTAL			**26 * N_{MWPT}**		

The following structure is used to define the radiometric offset and the continuum values fitted in different spectral intervals for the VMR #j retrievals (one species #j).

Table 12.5.1.7.7-3 Radiometric offset and Continuum values Structure for VMR retrievals

N	Description	Units	Byte Length	Data Type	Dim.
VMR # j retrievals: Radiometric offset values fitted in different spectral intervals (one species # j)					
1	**Fitted instrument offset in species #j VMR retrieval microwindows**	r.u.	4 * $N_{offset(V(j))}$	fl	$N_{offset(V(j))}$

2	**Instrument offset variance data** Elements of diagonal of variance/covariance matrix	$(r.u.)^2$	4 * $N_{offset(V(j))}$	fl	$N_{offset(V(j))}$
3	**Definition of species #j VMR retrieval microwindows in which offset values are fitted**	ascii	8 * $N_{offset(V(j))}$	uc	$N_{off-set(V(j))}$ *8
VMR # j retrievals: continuum values fitted in different spectral intervals (one species # j)					
4	**Indices of tangent height for which continuum absorption coefficients are fitted [index$_{Con\ (V(j))}$ (i)]** (i = 1, ..., $N_{cgrid(V(j))}$) If no continuum is fitted, values are set to -1.	-	$N_{cgrid(V(j))}$ ×2	us	$N_{cgrid(V(j))}$
5	**Each structure #index$_{Con\ (V(j))}$ (i) of continuum values (fitted in different spectral intervals) for VMR #j retrieval corresponds to one altitude. It follows the format described in table attached below** : "Continuum values Structure for VMR retrievals" (i = 1, ..., $N_{cgrid(V(j))}$)	-	22 × $N_{MWV(j)}$ × $N_{cgrid(V(j))}$	VMR conti-nuum structure	$N_{cgrid(V(j))}$
TOTAL			**16 × $N_{offset(V(j))}$ + $N_{cgrid(V(j))}$ × (2 + 22 × $N_{MWV(j)}$)**		

The following structure is used to define the continuum values fitted in different spectral intervals for the VMR #j retrievals (one species #j), for one altitude:

Table 12.5.1.7.7-4 Continuum values Structure for VMR retrievals

N	Description	Units	Byte Length	Data Type	Dim.
1	**Definition of species #j VMR retrieval microwindows used at altitude #index$_{Con\ (V(j))}$ (i)** row relating to this altitude of matrix for species #j VMR retrieval in corresponding in corresponding MDSR of Scan Information MDS.	ascii	8×$N_{MWV(j)}$	uc	$N_{MWV(1j}$ * 8
2	**Types of grouping for above MWs used at altitude #index$_{Con\ (V(j))}$ (i)** 0: not used 1: isolated 2: edge of a loose group 3: leftmost edge of a tight group 4: leftmost edge of a tight group and edge of a loose group 5: member of a tight group but not at the corner of the group 6: member of a loose group but not at the corner of the group not used fields are set to -1.	-	$N_{MWV(j)}$×2	ss	$N_{MWV(j)}$

N	Description	Units	Byte Length	Data Type	Dim.
3	**Fitted continuum values at altitude #index$_{Con(V(j))}$ (i)** not used fields set to zero Relating elements of vector of retrieved parameters	10^{-30} * (cm^2/ molec)	4 * $N_{MWV(j)}$	fl	$N_{MWV(j)}$
4	**Variance data of continuums fitted at altitude #index$_{Con(V(j))}$ (i)** not used fields set to zero Elements of diagonal of variance/covariance matrix relating to this altitude	10^{-60} * (cm^4/ molec^2)	4 * $N_{MWV(j)}$	fl	$N_{MWV(j)}$
5	**Covariance data of fitted continuums and retrieved VMR profile point at altitude #index$_{Con(V(j))}$ (i)** not used fields set to zero Elements of covariance matrix relating to VMR and continuums fitted at this altitude	10^{-30} * (ppm* cm2/ molec)	4 * $N_{MWV(j)}$	fl	$N_{MWV(j)}$
TOTAL			**22 * $N_{MWV(j)}$**		

12.5.1.7.8 PCD Information of Individual Scans ADS

The following ADS contains auxiliary information which may be used to assess the quality of the retrieval. The ADS is formed of several ADSRs. There is one ADSR per scan. The ADSR format is described below:

Table 12.5.1.7.8-1 PCD Information of Individual Scans ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of granule** ZPD time of sweep closest to mean time of corresponding scan	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Attachment flag** Always set to zero for this ADS	-	1	uc	1
PCD information in p,T retrieval					
4	**Number of macro iterations**	-	2	ss	
5	**Number of micro iterations [$n_{mic,pT)}$]**	-	2	us	1
6	**Partial $\chi^2$for microwindows #j at altitude #i, i = 1, ..., N_{sw} , j = 1, ..., N_{MWPT}** not used fields are set to -1	-	4* N_{sw} *N_{MWPT}	fl	N_{sw} * N_{MWPT}
7	**Evolution of χ^2during iteration procedure**	-	4*($n_{mac,pT}$+1)	fl	$n_{mac,pT}$ +1
8	**Evolution of λ (Marquardt damping factor) during iteration procedure**	-	4*($n_{mac,pT}$+1)	fl	$n_{mac,pT}$ +1

9	**Values of retrieved parameters for each macro iteration**	-	$4*(n_{mac,pT}+1) * (2 * N_{pT} + N_{cont(pT)} + N_{offset(pT)})$	fl	$(n_{mac,pT}+1)* (2 * N_{pT} + N_{cont(pT)} + N_{offset(pT)})$
PCD information in target species #1, ..., #30 retrievals					
10	**Each structure of PCD information for target species retrieval corresponds to one species # j. It follows the format described in table attached below** : "PCD information for target species retrievals" (order of the 6 species follows SPH field #22 for VMR #1, ... , VMR #30)	-	$4*\Sigma_{j=1..30} ((n_{mac,V(j)}+1) *(N_{V(j)} + N_{cont(V(j))} + N_{offset(V(j))}))$	PCD Info for target species retrieval	30
Additional PCD information					
11	**Number of valid PCD information strings**		2	us	1
12	**PCD information strings**	-	$N_{pcd}^{max} \times 80$	uc	$80 \times N_{pcd}^{max}$ [2]
13	**Spare**	-	47	uc	47
TOTAL			**variable ***		

* ADSR size : $80 + 4* N^{sw} *N_{MWPT}$
$+ 4*(n_{mac,pT}+1) (2 + 2 * N_{pT} + N_{cont(pT)} + N_{offset(pT)})$
$+ 4*\Sigma_{j=1..30} ((n_{mac,V(j)}+1) *(N_{V(j)} + N_{cont(V(j))} + N_{offset(V(j))}))$
$+ N_{pcd} * 80$

The following structure contains the PCD information for one target species #j, used for each of the 6 species in the PCD information of individual scans ADSR:

Table 12.5.1.7.8-2 PCD Information for target species retrieval

N	Description	Units	Byte Length	Data Type	Dim.
1	**Number of macro iterations**	-	2	us	
1.5	**Number of micro iterations [$n_{mic,V(j)}$]**	-	2	us	1
2	**Partial χ^2 for microwindows #m at altitude #i, i = 1, ..., N_{sw} , m = 1, ..., $N_{MWV(j)}$** not used fields set to -1	-	$4 \times N_{sw} \times N_{MWV(j)}$	fl	$N_{sw} *N_{MWV(j)}$
3	**Evolution of χ^2during iteration procedure**	-	$4 * (n_{mac,V(j)}+1)$	fl	$(n_{mac,V(j)}+1)$
4	**Evolution of λ during iteration procedure**	-	$4 * (n_{mac,V(j)}+1)$	fl	$(n_{mac,V(j)}+1)$

[2] N_{pcd}^{max} *is equal to field 21 of* ***Table 12.5.1.7.3-1 MIPAS Level 2 Structure ADS****.*

Table 12.5.1.7.8-2 PCD Information for target species retrieval

N	Description	Units	Byte Length	Data Type	Dim.
5	**Values of retrieved parameters for each macro iteration**	-	4* ($n_{mac,V(j)}$+1) *($N_{V(j)}$ + $N_{cont(V(j))}$ + $N_{offset(V(j))}$)	fl	($n_{mac,V(j)}$+1) *($N_{V(j)}$ + $N_{cont(V(j))}$ + $N_{offset(V(j))}$)
TOTAL			**variable**		

12.5.1.7.9 Microwindows Occupation Matrices ADS

This ADS contains identifiers of the microwindows used for p, T, and target species retrievals. There is at least one ADSR in the ADS, one new ADSR per update of occupation matrices. A time stamp is used to indicate the portion of the product to which each ADSR corresponds.

Table 12.5.1.7.9-1 MIPAS Level 2 Microwindows Occupation Matrices ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time of validity of DSR** ZPD time of sweep closest to mean time of the corresponding scan	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag** (always set to 0 for this ADSR)	-	1	uc	1
Identifiers of microwindows used in p, T retrievals					
4	**p,T OM label**	ascii	10	uc	10
5	p,T retrieval MW labels	ascii	Nmw(p,T) *8	uc	Nmw(p,T) *8
6	**Labels of p,T retrieval microwindows selected for sweep #i** (i = 1,..., N_{sw}) Each is an 8 character string. Not used fields are blanked.	ascii	N^{sw} * N_{MWPT} *8	uc	8*N^{sw} *N_{MWPT}
7	**Logical retrieval vector for p,T retrieval**		N^{sw}	uc	N^{sw}
Identifiers of microwindows used in target species #1, ..., #30 profile retrievals The order of the species is as described in the SPH					
8	**Species #1 VMR OM label**	ascii	10	uc	10
9	**Species #1 VMR retrieval MW labels**	ascii	8 * Nmw(V(1))	uc	Nmw(V(1))*8
10	**Labels of species #1 VMR retrieval microwindows selected for sweep #i** (i = 1,...,	ascii	8 * Nsw * MWV(1)	uc	8*Nsw* NMWV(1)

Table 12.5.1.7.9-1 MIPAS Level 2 Microwindows Occupation Matrices ADSR

N	Description	Units	Byte Length	Data Type	Dim.
	Nsw) not used fields are blanked each is an 8 character string				
11	**Logical retrieval vector for species #1 VMR retrieval**		Nsw	uc	Nsw
Structure of fields #8, ..., #11 is repeated for species #2,..., #30 VMR retrievals, using NmwV(j) (j = 2,..., 30), respectively					
12	**species #j VMR OM label**	ascii	10	uc	10
13	**species #j VMR retrieval MW labels**	ascii	8 * Nmw(V(j))	uc	Nmw(V(j))×8
14	**Labels of species #j VMR retrieval microwindows selected for sweep #i** (i = 1,..., Nsw) not used fields are blanked each is an 8 character string	ascii	8*Nsw* NMWV(j)	uc	8*Nsw* NMWV(j)
15	**Logical retrieval vector for species #j VMR retrieval**		N^{sw}	uc	N^{sw}
16	**Spare**		47	uc	47
	TOTAL		**variable ***		

$$\text{ADSR size : } 134 + 8 * Nmw(p,T) + 8 * N^{sw} * N_{MWPT} + 7 * N^{sw} + \Sigma_{j=1..30} \left(8 * N_{mw(V(j))} + 8 * N^{sw} * N_{MWV(j)} \right)$$

12.5.1.7.10 Residual Spectra ADS

This ADS contains residual spectra, mean values and standard deviation data, for the set of microwindows used in p, T and trace gas profile retrievals. The ADSR format is shown below.

Table 12.5.1.7.10-1 MIPAS Level 2 Residual Spectra ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Star time of DSR** ZPD time of sweep closest to the mean time of the corresponding scan	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag** (always set to 0 for this ADSR)	-	1	uc	1
Residual spectra in p,T microwindows					
4	**Vector defining number of spectral grid points for each microwindow used in p, T retrievals [nspec_pT (i)]** (i = 1, ..., Ntot(pT))	-	2* Ntot(pT)	us	Ntot(pT)

Table 12.5.1.7.10-1 MIPAS Level 2 Residual Spectra ADSR

N	Description	Units	Byte Length	Data Type	Dim.
5	**Spectral mask**	-	ceil ($N_{tot\_grid(pT)}$) / 8	uc	ceil ($N_{tot\_grid(pT)}$) / 8
6	**Number of p,T retrievals for which mean values and standard deviations are computed**	-	2	us	1
7	**Mean value of residual spectra for spectral grid points in p,T retrieval microwindows** $N_{tot\_grid(pT)} = \Sigma_i$ nspec_pT (i)	r.u.	4 * $N_{tot\_grid(pT)}$	fl	$N_{tot\_grid(pT)}$
8	**Standard deviation of residual spectra for spectral grid points in p,T retrieval microwindows** $N_{tot\_grid(pT)} = \Sigma_i$ nspec_pT (i)	r.u.	4 * $N_{tot\_grid(pT)}$	fl	$N_{tot\_grid(pT)}$
Residual spectra in target species #1 to #30 retrieval microwindows (order of species given in SPH)					
9	**Each structure of Residual spectra for target species retrieval microwindows corresponds to one species # j. It follows the format described in table attached below** : "Residual spectra for target species retrievals" (order of the 30 species follows SPH field #22 for VMR #1, ... , VMR #30)	-	variable	Residual spectra for target species structure	30
10	**Spare**	-	49	uc	49
TOTAL			**variable ***		

* ADSR size : $80 + 2 * N_{tot(pT)} + \text{ceil}(N_{tot\_grid(pT)}) / 8 + 8 * N_{tot\_grid(pT)} + \Sigma_{j=1..30} (N_{tot(V(j))}) + \Sigma_{j=1..30} (\text{ceil} (N_{tot\_grid(V(j))}) / 8) + 8 * \Sigma_{j=1..30} (N_{tot\_grid(V(j))})$

The following structure contains the Residual spectra for one target species #j retrieval microwindows, used for each of the 30 species in the Residual Spectra ADSR:

Table 12.5.1.7.10-2 Residual spectra for target species retrieval

N	Description	Units	Byte Length	Data Type	Dim.
1	**Vector defining number of spectral grid points for each microwindow used in species #j VMR retrievals [nspec_v(j,i)]** (i = 1, ..., $N_{tot(V(j))}$)	-	2×$N_{tot(V(j))}$	us	$N_{tot(V(j))}$
2	**Spectral mask**	-	ceil ($N_{tot\_grid(V(j))}$) / 8	uc	ceil ($N_{tot\_grid(V(j))}$) / 8
3	**Number of species #j VMR retrievals for which mean values and standard deviations are computed**	-	2	us	1

N	Description	Units	Byte Length	Data Type	Dim.
4	**Mean value of residual spectra for spectral grid points in species #j VMR retrieval microwindows** $N_{tot\_grid(V(j))} = \Sigma_i$ nspec_V(j,i)	r.u.	$4 \times N_{tot\_grid(V(j))}$	fl	$N_{tot\_grid(V(j))}$
5	**Standard deviation of residual spectra for spectral grid points in species #1 VMR retrieval microwindows** $N_{tot\_grid(V(j))} = \Sigma_i$ nspec_V(j,i)	r.u.	$4 \times N_{tot\_grid(V(j))}$	fl	$N_{tot\_grid(V(j))}$
TOTAL			**variable ***		

* Size : $2 + 2 * N_{tot(V(j))} + \text{ceil}(N_{tot\_grid(V(j))}) / 8 + 8 * N_{tot\_grid(V(j))}$

Note: structure of fields #1,...,#5 repeated for species #2,..., #30 VMR retrievals, using Ntot(V(j)), Ntot_grid(V(j)),nspec_v(j,i) (j = 2,..,30), respectively.

12.5.1.7.11 Instrument and Processing Parameters ADS

This ADS contains the instrument parameters and processing parameters used when performing the Level 2 processing. There is at least one ADSR in the ADS, and one new ADSR per update of instrument / processing parameters. A time stamp is used to indicate the portion of the product to which each ADSR corresponds.

Table 12.5.1.7.11-1 MIPAS Level 2 Instrument and Processing Parameters ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of granule** ZPD time of sweep closest to mean time of corresponding scan	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Attachment flag** (always set to 0 for this ADSR)	-	1	uc	1
Information related to Level 2 data processing / representation					
4	**Vector of actual elevation scan angles**	degrees	$4 * N_{sw}$	fl	N_{sw}
5	**Switch indicating whether standard pressure grids (P_T , $P_{VMR(j)}$, $P_{cont(pT)}$, $P_{cont(V(j))}$ see below) are used to represent retrieved profile data [S_g]** 'T': standard output grid 'S': tangent pressure grid	-	1	uc	1

Table 12.5.1.7.11-1 MIPAS Level 2 Instrument and Processing Parameters ADSR

N	Description	Units	Byte Length	Data Type	Dim.
6	**Vector defining pressure levels at which temperature profile data are represented P_T (i)**, (i = 1, ..., N_{pT}) if Sg set to 'T', $P_T(i) = p_{tan}(i)$	hPa	4 * N_{pT}	fl	N_{pT}
7	**Vector defining pressure levels at which target species # j (j = 1, ..., 30) profile data are represented $P_{V(j)}$ (i)**, (i = 1, ..., $N_{V(j)}$) (Ordering of species according to SPH) if Sg set to 'T', $P_{V(j)}(i) = p_{tan}(i)$	hPa	4 * $\Sigma_j N_{V(j)}$	fl	$\Sigma_j N_{V(j)}$
8	**Vector defining pressure levels at which continuum data for p,T retrieval are represented $P_{cont(pT)}$ (i)**, (i = 1, ..., $N_{cgrid(pT)}$) if Sg set to 'T', $P_{cont(pT)}(i) = p_{tan}(indexCon_{(pT)}(i))$	hPa	4 * $N_{cgrid(pT)}$	fl	$N_{cgrid(pT)}$
9	**Vectors defining pressure levels at which continuum data for species #j (j = 1, ..., 30) VMR retrievals are represented $P_{cont(V(j))}$ (i)**, (i = 1, ..., $N_{cgrid(V(j))}$) (Ordering of species according to SPH) if Sg set to 'T', $P_{cont(V(j))}(i) = p_{tan}(indexCon_{(V(j))}(i))$	hPa	4 * Σ_j ($N_{cgrid(V(j))}$)	fl	Σ_j ($N_{cgrid(V(j))}$)
10	**Max. number of macro iterations of Newton / Marquardt algorithm for p,T retrieval [$N_{mac(pT)\ max}$]**	-	2	us	1
11	**Max. number of macro iterations of Newton / Marquardt algorithm for species #j (j =1, ..., 30) VMR retrievals [$N_{mac(V(j))\ max}$]** (Ordering of species according to SPH)	-	60	us	30*us
12	**Max. number of micro iterations of Newton / Marquardt algorithm for p,T retrieval [$N_{mic(pT)\ max}$]**	-	2	us	1
13	**Max. number of micro iterations of Newton / Marquardt algorithm for species #j (j =1, ..., 30) VMR retrievals [$N_{mic(V(j))\ max}$]** (Ordering of species according to SPH)	-	60	us	30*us
14	**Spare**	-	80	uc	80
15	**Spare**	-	82	uc	82
TOTAL			**variable ***		

* ADSR size : $208 + 4 * N^{SW} + 4 * N_{pT} + 4 * \Sigma_{j=1..30} (N_{V(j)}) + 4 * N_{cgrid(pT)} + 4 * \Sigma_{j=1..30} (N_{cgrid(V(j))})$

12.5.1.8 Level 2 Product Size Estimate

Assumptions for MDSs and ADSs:

$N^{sc} = 75$
$N^{sw} = N_{pT} = N_{V(j)} = 16$
$N_{offset(pT)} = N_{offset(V(j))} = 20$
$N_{MWPT} = N_{MWV(j)} = 15$
$N_{cgrid(pT)} = N_{cgrid(V(j))} = 10$

Additional assumptions for ADSs:

$n_{mac,pT} = n_{mac,V(i)} = 2$
nevo,pT = 3
$N_{cont(pT)} = N_{cont(V(j))} = 50$
$N_{tot(pT)} = N_{tot(V(i))} = 160$
$N_{tot\_grid(pT)} = N_{tot\_grid(V(i))} = 4000$
$N_{pcd} = 1$
$N_{pcd}^{max} = 5$
15 SRs in each of the following ADSs :

- Data Set Structure ADS,
- Microwindows Occupation matrices for p,T and trace gas retrievals,
- Residual spectra, mean value and standard deviation data.

MPH: 1 247 bytes
SPH: 15 128 bytes
MDSs: 4 647 300 bytes
ADSs: 4 848 350 bytes
Total size of Level 2 product: approx. 9.5 MBytes.

12.5.2 MIPAS Extracted Temperature, Pressure, and Atmospheric Constituents Profiles for Meteo Users (MIP_NLE_2P) *(*)*

This Level 2 product consists of a number of geophysical parameters which have been extracted from the Temperature, Pressure, and Atmospheric Constituents Profiles product. Applications include global monitoring, atmospheric modelling, and meteorology. During MIPAS operational mission the product was disseminated in NRT only and it was available from the PDHS 3 hours after data acquisition. It could be converted to BUFR format outside the PDS for GTS communications.

(*) NOTE: processing and dissemination of NRT Temperature, Pressure and Atmospheric Constituents products for meteo users was suspended at the end of the MIPAS mission (8 April 2012). Starting from Level 2 reprocessing with MIPAS ML2PP processor Version 7 no MIP_NLE_2P products are provided anymore.

12.5.2.1 Input Data

Level 2 Temperature, Pressure, and Atmospheric Constituents Profiles product.

12.5.2.2 Auxiliary Data Used

No additional auxiliary data is needed to produce this product.

12.5.2.3 Processing Performed

Extraction only.

12.5.2.4 Product Structure

The high level product structure is shown below:

Table 12.5.2.4-1 MIPAS Level 2 Extracted Product for Meteo Users

MPH
SPH
Summary Quality GADS (SQUADS)
Scan Geolocation ADS (LADS)
Structure ADS
Scan Information MDS
p, T and height correction profiles MDS
O3 profile and covariance data MDS
H2O profile and covariance data MDS
Microwindows occupation matrices ADS
Instrument and Processing Parameters ADS

12.5.2.5 Main Product Header

The MPH is described in Volume 5.

12.5.2.6 Specific Product Header

The MIPAS Level 2 SPH is an ASCII format header. The structure and contents are described below.

Table 12.5.2.6-1 MIPAS Level 2 SPH for MIP_NLE_2P

N	Description	Units	Byte Length	Data Type	Dim.

1 to 23	**Same structure as fields 1 to 23 of the Level 2 SPH described in Section 12.5.1.6. Except for field 22 to be set to "O3,H2O"**	-	729		
Data Set Descriptors for attached data sets					
24	**DSD (A) for the SQ ADS**	-	280	dsd	1
25	**DSD (A) for Scan Geolocation ADS (LADS)**	-	280	dsd	1
26	**DSD (A) for the Structure ADS**	-	280	dsd	1
27	**DSD (A) for Scan Information MDS**	-	280	dsd	1
28	**DSD (M) p,T, and height correction profiles MDS**	-	280	dsd	1
29	**DSD (M) for Target Species # 1 MDS**	-	280	dsd	1
30	**DSD (M) for Target Species #2 MDS**	-	280	dsd	1
31	**DSD (A) for Microwindows occupation matrices ADS**	-	280	dsd	1
32	**DSD (A) for Instrument and Processing Parameters ADS**	-	280	dsd	1
Data Set Descriptors for referenced files					
33	**DSD (R) referencing Level 1B input product**	-	280	dsd	1
34	**DSD (R) referencing the Level 2 processing parameters data file**	-	280	dsd	1
35	**DSD (R) referencing the Level 2 microwindows data file**	-	280	dsd	1
36	**DSD (R) referencing the Spectroscopic data file**	-	280	dsd	1
37	**DSD (R) referencing the Initial guess data file**	-	280	dsd	1
38	**DSD (R) referencing the Forward calculation results file**	-	280	dsd	1
39	**DSD (R) referencing the Microwindows occupation matrices file**	-	280	dsd	1
40	**DSD (R) referencing the Cross section look-up tables file**	-	280	dsd	1
41	**DSD (R) referencing the A priori pointing information file**	-	280	dsd	1
42	**DSD (R) referencing the ECMWF file**	-	280	dsd	1
43	**DSD Spare (279 blank space characters followed by one newline character)**	-	280	dsd_sp	1
44	**DSD (R) referencing the corresponding MIP_NL__2P product from which this product was extracted.**	-	280	dsd	1

TOTAL		**6609**		

The following table provides the DSD Names used in the SPH.

Table 12.5.2.6-2 DSD Names for MIP_NLE_2P

Description	DS_NAME
DSD (A) for the SQ ADS	SUMMARY QUALITY ADS
DSD (A) for Scan Geolocation ADS (LADS)	SCAN GEOLOCATION ADS
DSD (A) for Data Sets Structure ADS	DATASET STRUCTURE ADS
DSD (A) for Scan Information MDS	SCAN INFORMATION MDS
DSD (M) p,T, and height correction profiles MDS	PT RETRIEVAL MDS
DSD(M) for Target Species # 1 MDS	O3 RETRIEVAL MDS
DSD (M) for Target Species #2 MDS	H2O RETRIEVAL MDS
DSD (A) for Microwindows Occupation Matrices ADS	MICROWINDOW OCCUPATION ADS
DSD (A) for Instrument and Processing Parameters ADS	INSTR_PROC_PARAMETERS_ADS
Data Set Descriptors for referenced files	
DSD(R) for MIP_NL__2P product	REFERENCE TO LEVEL 2 PRODUCT
For all others see Table 12.5.1.6-2	

12.5.2.7 Data Sets

The following subsections describe the Data Sets contained in the product. The data is in mixed-binary format. It may contain ASCII strings, but the strings are not placed in quotation marks as in the case of the MPH and SPH.

12.5.2.7.1 Summary Quality ADS (SQ ADS)

The SQ ADS provides quality information pertaining to the entire product. The information represents information collected from each scan in the product. The layout of the ADS is described below:

Table 12.5.2.7.1-1 MIPAS Level 2 SQ ADS for MIP_NLE_2P

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1

2	**Attachment Flag** (set to 1 if all MDSRs associated with this ADSR are blank or missing. Set to zero otherwise.)	-	1	uc	1
General Level 2 product quality information					
3	**Total no. of p, T retrievals terminated due to excess number of macro / micro iterations**	-	4	us	2
4	**Total no. of VMR retrievals terminated due to due to excess number of macro / micro iterations** 2 values for each species, ordered according to field #22 of the SPH	-	8	us	2*2
5	**Total no. of p,T retrievals terminated due to run time limitation**	-	2	us	1
6	**Total no. of VMR retrievals terminated due to run time limitation** 1 value for each species, ordered according to field #22 of the SPH	-	4	us	2
7	**Spare**	-	65	uc	65
TOTAL			**96**		

12.5.2.7.2 Scan Geolocation ADS (LADS) for MIP_NLE_2P

Format as described in Section 12.5.1.7.2.

12.5.2.7.3 Structures ADS for MIP_NLE_2P

Format as described in Section 12.5.1.7.2.

The content of Structure ADS for the fields: 5, 6, 8, 10, 12, 14, 16, 18, 20, 23 follows the number and ordering of species provided into SPH field 22. The sequence of species is left justified into the referenced fields. Information into the fields regarding species not included into these products is set to 0 or -1.

That is: the same record format is used but all its elements are not filled: The first is used for O_3, the second for H_2O, the others are unused and set to a default value (compounding 0 and -1).

12.5.2.7.4 Scan Information MDS for MIP_NLE_2P

The Scan information MDS provides information for each scan in the MDS. There is one MDSR per scan.

Table 12.5.2.7.4-1 MIPAS Level 2 Scan Information MDS for MIP_NLE_2P

N	Description	Units	Byte Length	Data Type	Dim.

1	**Time of DSR** ZPD time of sweep closest to scans mean time	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Quality indicator** (set to -1 if all information in DSR is blank or zero, else set to 0)	-	1	sc	1
Information on sensing time and geolocation of elevation scan scene					
4	**ZPD crossing time of the ith scene spectrum in elevation scan [$t_{zpd}(N_{sw})$]** (i = 1 ... N_{sw} , ordered from the highest to the lowest altitude)	-	N^{sw} *12	mjd	N^{sw}
5	**Geolocation (lat. / long.) of the ith scene LOS tangent point** WGS84 reference, refraction corrected (i = 1 ... N_{sw} , ordered from the highest to the lowest altitude)	(1e-6) deg	N^{sw} *8	sl	N^{sw}*2
6	**Tangent altitude of the ith scene LOS tangent point** (i = 1 ... N_{sw} , ordered from the highest to the lowest altitude)	km	N^{sw} *8	do	N^{sw}
7	**Application process ID**	-	2	us	1
8	**Flag indication successful p,T retrieval**	-	1	uc	1
9	**Flag indication successful VMR retrieval** (one flag for each of the 2species, ordered according to field #22 of the SPH)	-	2	uc	2
10	**Spare**	-	58	uc	58
11	**Logical retrieval vector for p,T retrieval** [3]	-	N^{sw}	uc	N^{sw}
12	**Retrieved pressure for each sweep**	hPa	N^{sw} *4	float	N^{sw}
13	**Pressure variance data**	hPa^2	N^{sw} *4	float	N^{sw}
14	**Corrected tangent altitudes of sweeps**	km	N^{sw} *4	float	N^{sw}
15	**Height correction variance data**	m^2	N^{sw} *4	float	N^{sw}
16	**Retrieved temperatures for each sweep**	K	N^{sw} *4	float	N^{sw}
17	**Temperature variance data**	K^2	N^{sw} *4	float	N^{sw}
18	**ECMWF corrected altitudes**[4]	km	N^{sw} *4	float	N^{sw}
VMR retrieval results					
19	**Logical retrieval vector for O3 retrieval** [5]	-	N^{sw}	uc	N^{sw}

[3] **Fields from 11 to 17 have been added to fix old discrepancies with older L2 IODD**

[4] **This field 18 has been added as requested by IODD L2 5/D**

[5] **Fields from 19 to 25 have been added to fix old discrepancies with older L2 IODD; structure of fields #19,...,#25 is repeated for H2O MDS**

20	**Retrieved O3 VMR for each sweep**	ppm	N^{sw} *4	float	N^{sw}
21	**O3 VMR variance data**	ppm^2	N^{sw} *4	float	N^{sw}
22	**O3 concentration for each sweeps**	cm^{-3}	N^{sw} *4	float	N^{sw}
23	**O3 concentration variance data**	$(cm^{-3})^2$	N^{sw} *8	double	N^{sw}
24	**O3 vertical column density for each sweep**	cm^{-2}	N^{sw} *4	float	N^{sw}
25	**O3 vertical column density variance data**	$(cm^{-2})^2$	N^{sw} *8	double	N^{sw}
26	**Labels of first 3 cloud detection meso windows per sweep**	ascii	N^{sw} *24	uc	N^{sw} *24
27	**Cloud indexes for sweeps, 3 per sweep**	-	N^{sw} *12	float	N^{sw} *3
28	**Cloud index thresholds for sweeps, 3 per sweep**	-	N^{sw} *12	float	N^{sw} *3
29	**Flags indicating detection of clouds, 3 per sweep**	-	N^{sw} *3	uc	N^{sw} *3
TOTAL			**variable**		

12.5.2.7.5 p,T, and height correction profiles MDS for MIP_NLE_2P

Format as described in Section 12.5.1.7.5.

12.5.2.7.6 O3 profile and covariance data MDS for MIP_NLE_2P

Format as described in Section 12.5.1.7.6.

12.5.2.7.7 H2O profile and covariance data MDS for MIP_NLE_2P

Format as described in Section 12.5.1.7.6.

12.5.2.7.8 Microwindows Occupation Matrices ADS for MIP_NLE_2P

This ADS contains identifiers of the microwindows used for p, T, and target species retrievals. There is at least one ADSR in the ADS, one new ADSR per update of occupation matrices. A time stamp is used to indicate the portion of the product to which each ADSR corresponds.

Table 12.5.2.7.8-1 MIPAS Level 2 Microwindows Occupation Matrices ADSR for MIP_NLE_2P

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time of validity of DSR** ZPD time of sweep closest to mean time of the corresponding scan	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1

3	**Attachment flag** (always set to 0 for this ADSR)	-	1	uc	1
Identifiers of microwindows used in p, T retrievals					
4	**p,T OM label**	ascii	10	uc	10
5	**p,T retrieval MW labels**	ascii	Nmw(p,T) ×8	uc	Nmw(p,T) ×8
6	**Labels of p,T retrieval microwindows selected for sweep #i** (i = 1,..., N_{sw}) Each is an 8 character string. Not used fields are blanked.	ascii	$8*N^{sw}*N_{MWPT}$	uc	$8*N^{sw}*N_{MWPT}$
7	**Logical retrieval vector for p,T retrieval**		N^{sw}	uc	N^{sw}
Identifiers of microwindows used in target species #1 and #2 profile retrievals The order of the species is as described in the SPH					
8	**species #1 VMR OM label**	ascii	10	uc	10
9	**species #1 VMR retrieval MW labels**	ascii	Nmw(V(1))*8	uc	Nmw(V(1))*8
10	**Labels of species #1 VMR retrieval microwindows selected for sweep #i** (i = 1,..., N^{sw}) not used fields are blanked each is an 8 character string	ascii	$8*N^{sw}*N_{MWV(1)}$	uc	$8*N^{sw}*N_{MWV(1)}$
11	**Logical retrieval vector for species #1 VMR retrieval**		N^{sw}	uc	N^{sw}
12	**species #2 VMR OM label**	ascii	10	uc	10
13	**species #2 VMR retrieval MW labels**	ascii	Nmw(V(2))*8	uc	Nmw(V(2))*8
14	**Labels of species #2 VMR retrieval microwindows selected for sweep #i** (i = 1,..., N^{sw}) not used fields are blanked each is an 8 character string	ascii	$8*N^{sw}*N_{MWV(2)}$	uc	$8*N^{sw}*N_{MWV(2)}$
15	**Logical retrieval vector for species #2 VMR retrieval**		N^{sw}	uc	N^{sw}
16	**Spare**		113	uc	113
TOTAL			**variable ***		

* ADSR size : $160 + 8*(N_{MWPT} + N_{MWV(1)} + N_{MWV(2)}) + N^{SW} * (3 + 8*(N_{MWPT} + N_{MWV(1)} + N_{MWV(2)}))$

12.5.2.7.9 Instrument and Processing Parameters ADS for MIP_NLE_2P

This ADS contains the instrument parameters and processing parameters used when performing the Level 2 processing. There is at least one ADSR in the ADS, and one new ADSR per update of instrument / processing parameters. A time stamp is used to indicate the portion of the product to which each ADSR corresponds.

Table 12.5.2.7.9-1 MIPAS Level 2 Instrument and Processing Parameters ADSR for MIP_NLE_2P

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of granule** ZPD time of sweep closest to mean time of corresponding scan	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Attachment flag** (always set to 0 for this ADSR)	-	1	uc	1
Information related to Level 2 data processing / representation					
4	**Vector of actual elevation scan angles**	degrees	$4\times N_{sw}$	fl	N_{sw}
5	**Switch indicating whether standard pressure grids (P_T , $P_{VMR(j)}$, $P_{cont(pT)}$, $P_{cont(V(j))}$ see below) are used to represent retrieved profile data [S_g]** 'T': standard output grid 'S': tangent pressure grid	-	1	uc	1
6	**Vector defining pressure levels at which temperature profile data are represented P_T (i)**, (i = 1, ..., N_{pT}) if S_g set to 'T', $P_T(i) = p_{tan}(i)$	hPa	$4\times N_{pT}$	fl	N_{pT}
7	**Vector defining pressure levels at which target species # j (j = 1, ..., 2) profile data are represented $P_{V(j)}$ (i)**, (i = 1, ..., $N_{V(j)}$) (Ordering of species according to SPH) if S_g set to 'T', $P_{V(j)}(i) = p_{tan}(i)$	hPa	$4\times\Sigma_j N_{V(j)}$	fl	$\Sigma_j N_{V(j)}$
8	**Vector defining pressure levels at which continuum data for p,T retrieval are represented $P_{cont(pT)}$ (i)**, (i = 1, ..., $N_{cgrid(pT)}$) if S_g set to 'T', $P_{cont(pT)}(i) = p_{tan}(index_{Con(pT)}(i))$	hPa	4 * $N_{cgrid(pT)}$	fl	$N_{cgrid(pT)}$
9	**Vectors defining pressure levels at which continuum data for species #j (j = 1, ..., 2) VMR retrievals are represented $P_{cont(V(j))}$ (i)**, (i = 1, ..., $N_{cgrid(V(j))}$) (Ordering of species according to SPH) if S_g set to 'T', $P_{cont(V(j))}(i) = p_{tan}(index_{Con(V(j))}(i))$	hPa	$4\times\Sigma_j$ ($N_{cgrid(V(j))}$)	fl	Σ_j ($N_{cgrid(V(j))}$)
10	**Max. number of macro iterations of Newton / Marquardt algorithm for p,T retrieval [$N_{mac(pT)\ max}$]**	-	2	us	1
11	**Max. number of macro iterations of Newton / Marquardt algorithm for species #j (j =1, ..., 2) VMR retrievals [$N_{mac(V(j))\ max}$]** (Ordering of species according to SPH)	-	4	us	2
12	**Max. number of micro iterations of Newton / Marquardt algorithm for p,T retrieval [$N_{mic(pT)\ max}$]**	-	2	us	1
13	**Max. number of micro iterations of Newton / Marquardt algorithm for species #j (j =1, ..., 2) VMR retrievals [$N_{mic(V(j))\ max}$]** (Ordering of species according to SPH)	-	4	us	2
14	**Spare**	-	80	uc	80
15	**Spare**	-	82	uc	82

Table 12.5.2.7.9-1 MIPAS Level 2 Instrument and Processing Parameters ADSR for MIP_NLE_2P

N	Description	Units	Byte Length	Data Type	Dim.
TOTAL			**variable ***		

* ADSR size : 192 + 4 * NSW + 4 * NpT + 4 * Σj=1..2 (NV(j))

+ 4 * Ncgrid(pT) + 4 * Σj=1..2 (Ncgrid(V(j)))

12.5.2.8 Product Size Estimate (MIP_NLE_2P)

Assumptions for MDSs and ADSs:

$N^{sc} = 75$
$N^{sw} = N_{pT} = N_{V(j)} = 16$

Additional assumptions for the ADS:

$N_{cgrid(pT)} = N_{cgrid(V(i))} = 10$
$N_{MWPT} = N_{MWV(j)} = 15$
15 DSRs in each of the following ADSs:

- Data Set Structure ADS,
- Microwindows Occupation matrices for p,T and trace gas retrievals.

MPH: 1 247 bytes

SPH: 6 717 bytes

MDSs: 1 184 100 bytes

ADSs: 143 766bytes

Total size of product: approx. 1.3 MBytes.

12.5.3 Variations in Level 2 Product Size

The Level 2 product size estimate corresponds to a nominal measurement scenario, with 16 sweep measurements per elevation scan at high spectral resolution, and duration of ca. 71 s per scan. Furthermore, it has been assumed that ca. 10% of the available measurement time is used for offset calibration measurements and that no other dedicated calibration measurements are performed. The corresponding measurement time available for scene measurements will allow to complete ca. 75 elevation scans per

orbit.

It should be noted that the number of retrieved quantities typically varies linearly with the number of scene measurements in an individual elevation scan whereas the number of elevation scans per orbit is roughly inversely proportional to the number of height steps. As a consequence, no significant variations are expected in the size of the p, T and trace gas VMR or concentration profile data per orbit volume. However, the overall size of the data products may vary significantly for scenarios with different height step numbers as the sizes of the covariance matrices typically vary with the square of the number of vertical grid points. In addition, some variations in product size will occur for different numbers of elevation scans per orbit, each contributing with a number of data set records in the MDS fields and with various annotation data. Moreover, some (minor) differences in product size may be expected between Level 2 NRT and Level 2 off-line data sets, depending on the specific algorithms used in the two processing chains. These algorithms may, for instance, use different gridding schemes to represent the p, T and VMR profile and covariance data.

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12.6 AUXILIARY DATA FILES

12.6.1 Gain Calibration

The gain calibration is a file used for the radiometric calibration of the scene interferograms. It allows to convert the scene (uncalibrated) spectra into physical units of spectral radiance. The gain calibration is the result of a dedicated processing at the ground segment of special measurements, the blackbody measurements and deep space measurements for gain calibration.

This file contains also a template for the validation of radiometric spectra generated using the gain measurements. The radiometric accuracy estimation is based on readings from the internal blackbody of the instrument and also on readings from the deep space. This estimation is done by a comparison of the computed magnitude against the accumulated mean and standard deviation kept in the present calibration file.

FILE ID: **MIP_CG1_AX**

TYPE: Calibration

USE: Level 1B processing

UPDATED:

A gain calibration measurement sequence is expected to occur once a week.

SIZE:

MPH	1247 bytes
SPH	1778 bytes
MDSs	2 MDSRs * 478322 bytes/ MDSR + 2 MDSRs * 4796 bytes/MDSR
TOTAL	969 261 bytes

MPH(1247 bytes) + SPH(1778 bytes) + MDSs (2 MDSRs * 478322 bytes/ MDSR + 2 MDSRs * 4796 bytes/MDSR) = 969 261 bytes

The size is calculated assuming that nominally low resolution spectra are taken to calculate the gain. The number of points per band is the same as the ones calculated in the table of section Table 12.4.1.7.4-2 for resolution of 0.25 cm^{-1}. In band A, since the detector combination has been performed within the processing of the gain calibration, the number of points corresponds to the final bandwidth (685 cm^{-1} to 970 cm^{-1}).

12.6.1.1 Format

The high level format of the file is shown below:

Table 12.6.1.1-1 MIPAS Gain Calibration structure

MPH
Auxiliary Data SPH (see Volume 16) with 6 DSDs: SPH_DESCRIPTOR shall be set to "MIPAS_GAIN_CALIBRATION " *DSD for the MDS #1* *DSD for the MDS #2* *DSD pointing to Instrument characterization data file* *DSD pointing to Processing parameters file* *DSD spare* *DSD pointing to ILS and spectral calibration file*
MDS #1
MDS #2

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.1.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (M) for the MDS #1	MIPAS_GAIN_VECTORS
DSD (M) for the MDS #2	MIPAS_GAIN_STATISTICS
Data Set Descriptors for referenced files	
DSD (R) for Instrument Characterization data File	MIPAS_INST_CHARACTERIZATION
DSD (R) for Level 1B Processing Parameters file	MIPAS_PROCESSING_PARAMETER
DSD (R) spare	
DSD (R) for ILS and Spectral Calibration File	MIPAS_ILS_SPEC_CALIBRATION

12.6.1.1.1 MDS #1

The following describes the format of the MDSR for MDS #1. There are 2 MDSRs per MDS, one for the forward sweep direction and one for the reverse.

Table 12.6.1.1.1-1 MIPAS Gain Calibration MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time of cal. data acquisition** This time corresponds to the ZPD crossing time of the first sweep coadded in gain for the given direction.	-	12	mjd	1
2	**Quality indicator (PCD)** Summary PCD information per band (field #13): "0" = not corrupted, "4" = at least one band is invalid due to radiometric accuracy	-	1	sc	1

N	Description	Units	Byte Length	Data Type	Dim.
	verification				
	Gain Header				
3	**IGM average min/max at ADC for each detector** (IGM min at ADC for detectors A1, A2, ..., D2 followed by IGM max at ADC for detectors A1, A2, ..., D2)	-	32	ss	16
4	**PRT average temperatures**	K	40	do	5
5	**Spare**	-	8	uc	8
6	**Number of blackbody igms coadded**	-	2	us	1
7	**Number of blackbody igms corrupted and not coadded**	-	2	us	1
8	**Number of deep space igms coadded**	-	2	us	1
9	**Number of deep space igms corrupted and not coadded**	-	2	us	2
10	**Fringe count error after current gain measurement wrt previous gain**	-	2	ss	1
11	**FEO Element temperature**	K	24	do	3
12	**Sweep direction, "F" forward and "R" reverse**	-	1	uc	1
13	**Band Validity PCD for latest gain measurement** (5 values for bands A, AB, B, C, and D), 0 = not corrupted 4 = invalid due to radiometric accuracy verification	-	5	uc	5
14	**Detector non-linearity flux validity for Dark Source** (4 values for detectors A1, A2, AB and B), 0 = flux value is valid 1= flux > upper threshold or flux < lower threshold for at least 1 Dark Source	-	4	uc	4
15	**Detector non-linearity flux validity for Black Body** (4 values for detectors A1, A2, AB and B), 0 = flux value is valid 1= flux > upper threshold or flux < lower threshold for at least 1 Black Body	-	4	uc	4
16	**Spare**	-	11	uc	11
	Bands A to D				
17	**Each band has the format described in table attached hereafter** (Order of the 5 bands: A, AB, B, C, D. N(i) is the number of data points per band i)	-	5*266 +8×$\sum N(i)$	band informa-tion	5
TOTAL			$1482 + 8 \times \sum N$		

The format of the band information structure recorded for each band in the gain

calibration MDS #1 is described below:

Table 12.6.1.1.1-2 Band information structure for gain calibration MDS #1

N	Description	Units	Byte Length	Data Type	Dim.
1	**Decimation factor for current band**	-	2	us	1
2	**Number of detected/corrected spikes**	-	4	ul	1
3	**Sweep ID of igms containing spikes** (Room for 10 values. Unused values set to zero.)	-	20	us	10
4	**Spike positions in the interferogram (**Room for 10 values. Unused values set to zero.)	-	40	ul	10
5	**Spike amplitudes.** (Room for 10 complex values, each i followed by q. Unused entries set to zero). Spike occurred at positions described by the corresponding entry in previous fields.	-	160	do	10 * 2
6	**Number of remaining detected/corrected spikes**	-	4	ul	1
7	**Average amplitudes of remaining detected/ corrected spikes**	-	16	do	2
8	**Number of points in band (*N*)**	-	4	ul	1
9	**Wavenumber of first point in band**	cm^{-1}	8	do	1
10	**Wavenumber of last point in band**	cm^{-1}	8	do	1
11	**Complex data points (i,q)**	-	$N \times 8$	fl	N*2
TOTAL			$266 + N \times 8$		

Size Note:
The total number of complex points for each band of the MDSR is provided in the table below.

Table 12.6.1.1.1-3 Total number of complex data points in Gain Calibration file MDSR for MDS #1

Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	Requested resolution [cm^{-1}]	Number of points
A	685 -970	285	0.025	11 401
AB	1020 -1170	150	0.025	6 001
B	1215 -1500	285	0.025	11 401
C	1570 - 1750	180	0.025	7 201
D	1820 -2410	590	0.025	23 601
TOTAL		1 490		59 605

Assuming the total number of points ΣN = 59605, the MDSR length is MDSR total = 1482 + ΣN∗8 = 478322 bytes

12.6.1.1.2 Gain Calibration MDS #2

The following describes the format of the MDSR for MDS #2. There are 2 MDSRs per MDS, one for the forward sweep direction and one for the reverse.

Table 12.6.1.1.2-1 MIPAS Gain Calibration MDS #2

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted, "1" corrupted due to the instrument, "2" corrupted due to the transmission and "4" corrupted due to the observational validation, -1 = empty	-	1	sc	1
	Radiometric accuracy statistic information				
3	**Number cumulated in statistics** One value per band (A, AB, B, C, D)	-	20	ul	5
4	**Sweep direction, "F" forward and "R" reverse**	-	1	uc	1
5	**Spare**	-	34	uc	34
	Bands A to D				
6	**Each band has the format described in table attached hereafter** (Order of the 5 bands: A, AB, B, C, D. M(i) is the number of data points per band i)	-	5*20+ 8×∑*M(i)*	band informa-tion	5
TOTAL			168 + $8 \times \sum M$		

The format of the band information structure recorded for each band in the gain calibration MDS #2 is described below:

Table 12.6.1.1.2-2 Band information structure for gain calibration MDS #2

N	Description	Units	Byte Length	Data Type	Dim.
1	**Number of points in band (*M*)**	-	4	ul	1
2	**Wavenumber of first point in band**	cm^{-1}	8	do	1
3	**Wavenumber of last point in band**	cm^{-1}	8	do	1
4	**Mean data points**	W/ (cm^2×sr ×cm^{-1})	*M*×4	fl	*M*
5	**Standard deviation data points**	W/ (cm^2×sr ×cm^{-1})	*M*×4	fl	*M*

TOTAL		20+*M*×8		

Size Note:

The total number of template points for the MDSR is provided in the table below.

Table 12.6.1.1.2-3 Total number of template points in Gain Calibration file MDSR for MDS #2

Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	100 × Requested resolution [cm^{-1}]	Number of points
A	685 -970	285	2.5	115
AB	1020 -1170	150	2.5	61
B	1215 -1500	285	2.5	115
C	1570 -1750	180	2.5	73
D	1820 -2410	590	2.5	237
TOTAL		1 490		601

Assuming the total number of template points $\Sigma M = 601$, the MDRS length is MDSR total = $168 + \Sigma M \times 8 = 4976$ bytes.

12.6.2 LOS Calibration

The LOS calibration is a file used for the calibration of LOS pointing of the scene spectra. It allows correcting for instrument and platform pointing errors. The LOS calibration is the result of a dedicated processing at the ground segment of special measurements, the LOS measurements.

FILE ID: MIP_CL1_AX

TYPE: Calibration

USE: Level 1B processing

UPDATED: once per month

SIZE:

MPH(1247 bytes) + SPH(1498 bytes) + MDS(175 bytes) = 2920 bytes

12.6.2.1 Format

The high level format of the file is shown below:

Table 12.6.2.1-1 MIPAS LOS Calibration structure

MPH

Auxiliary Data SPH (see Volume 16) with 5 DSDs: SPH_DESCRIPTOR shall be set to "MIPAS_LOS_CALIBRATION " *DSD for the MDS* *DSD pointing to LOS inputs data file* *DSD pointing to Processing parameters file* *DSD spare DSD spare*
MDS #1

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.2.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (M) for the MDS	MIPAS_LOS_CALIBRATION
Data Set Descriptors for referenced files	
DSD (R) for LOS inputs data File	MIPAS_LOS_INPUTS
DSD (R) for Level 1B Processing Parameters file	MIPAS_LOS_PROCESSING_PARAM
DSD (R) spare	
DSD (R) spare	

12.6.2.1.1 LOS Calibration MDS

The following describes the format of the MDSR. There is one MDSR per MDS. The exact content is TBD.

Table 12.6.2.1.1-1 MIPAS LOS Calibration MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted," - 1" = default values filled in	-	1	sc	1
	LOS Calibration				
3	**Angular frequency of first order harmonic pointing error related to x-axis (pitch)**	degrees/ second	8	do	1
4	**Angular frequency of first order harmonic pointing error related to y-axis (roll)**	degrees/ second	8	do	1

N	Description	Units	Byte Length	Data Type	Dim.
5	**Estimated bias of pointing related to x-axis (pitch)**	degrees	8	do	1
6	**Estimated amplitude of first order harmonic pointing error related to x-axis (pitch)**	degrees	8	do	1
7	**Estimated phase of first order harmonic pointing error related to x-axis (pitch)**	degrees	8	do	1
8	**Estimated bias of pointing related to y-axis (roll)**	degrees	8	do	1
9	**Estimated amplitude of first order harmonic pointing error related to y-axis (roll)**	degrees	8	do	1
10	**Estimated phase of first order harmonic pointing error related to y-axis (roll)**	degrees	8	do	1
11	**Variance of estimated bias of pointing related to x-axis (pitch)**	$degrees^2$	8	do	1
12	**Variance of estimated amplitude of first order harmonic pointing error related to x-axis (pitch)**	$degrees^2$	8	do	1
13	**Variance of estimated phase of first order harmonic pointing error related to x-axis (pitch)**	$degrees^2$	8	do	1
14	**Variance of estimated bias of pointing related to y-axis (roll)**	$degrees^2$	8	do	1
15	**Variance of estimated amplitude of first order harmonic pointing error related to y-axis (roll)**	$degrees^2$	8	do	1
16	**Variance of estimated phase of first order harmonic pointing error related to y-axis (roll)**	$degrees^2$	8	do	1
17	**Minimum function value for fit**	-	8	do	1
18	**Number of orbits averaged**	-	4	ul	1
19	**Spare**	-	38	uc	38
TOTAL			**175**		

Notes:

1. The overall approach of LOS calibration processing still needs to be confirmed with instrument contractor.
2. It is anticipated that the LOS calibration measurements will allow only the calibration of elevation pointing angle and not for the azimuth pointing angle.

12.6.3 ILS and Spectral Calibration

This file contains the ILS calibration representing the characteristic response of the instrument for different wavenumbers. This file is used in Level 1B

processing as it provides the default/initial linear stretching factor for spectral calibration. As for the spectral calibration, the ILS calibration does not require special measurements. In fact, it is the result of a dedicated processing at the ground segment of normal scene measurements.
This file also contains spectral calibration used for setting the wavenumber axis; i.e., the spectral calibration, of scene spectra. Unlike the previous calibrations, the spectral calibration does not require special measurements. In fact, it is also the result of a dedicated processing at the ground segment of normal scene measurements.

FILE ID: **MIP_CS1_AX**

TYPE: Calibration

USE: Level 1B processing

UPDATED:

An ILS calibration is expected to be performed at least once every week, when the instrument is acquiring scene measurements. A spectral calibration is expected to be performed at least once every two scans, i.e., approximately 150 seconds, when the instrument is acquiring scene measurements.

SIZE: MPH(1247 bytes) + SPH(1498 bytes) + MDS(997 bytes) = 3742 bytes *

* File size estimation is based on assumptions detailed in this chapter.

12.6.3.1 Format

The high level format of the file is shown below:

Table 12.6.3.1-1 MIPAS ILS and Spectral Calibration structure

MPH
Auxiliary Data SPH (see Volume 16) with 5 DSDs: • SPH_DESCRIPTOR shall be set to "MIPAS_ILS_SPEC_CALIBRATION " • *DSD for the MDS* • *DSD pointing to MIPAS Instrument Characterization file* • *DSD pointing to Processing parameters file* • *DSD pointing to Microwindow Dictionary file* • *DSD spare*

MDS #1

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.3.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (M) for the MDS	MIPAS_ILS_SPEC_CALIBRATION
Data Set Descriptors for referenced files	
DSD (R) for MIPAS Instrument Characterisation file	MIPAS_INST_CHARACTERISATION
DSD (R) for Level 1B Processing Parameters file	MIPAS_PROCESSING_PARAMETER
DSD (R) for Microwindow Dictionary file	MIPAS_MICROWINDOW_DICTIONARY
DSD (R) spare	

12.6.3.1.1 ILS and Spectral Calibration MDS

The MDSR format is described below. There is one MDSR per MDS.

Table 12.6.3.1.1-1 MIPAS ILS and Spectral Calibration MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)** 0 = non-corrupted, -1 = default values filled in	-	1	sc	1
ILS calibration data					
3	**ILS time** ZPD time of first scene sweep used for ILS retrieval	-	12	mjd	1
4	**Quality indicator (PCD)** "0" non-corrupted, " -1" = default values filled in	-	1	sc	1

Table 12.6.3.1.1-1 MIPAS ILS and Spectral Calibration MDSR

N	Description	Units	Byte Length	Data Type	Dim.
5	**Level 1B product filename containing the scene measurements used** With the reference to the Level 1B product file and sweep ID, it is possible to identify unambiguously the scene measurement that has been used for the actual spectral calibration. The reference to all underlying files can also be identified, including the offset calibration file, the gain calibration file, the LOS calibration file, the instrument characterization data file, the processing parameter file and the validation file.	-	62	uc	62
6	**Number of ILS retrieved (*R*)**	-	2	us	1
7	**Spare**	-	50	uc	50
	ILS #1 to #R				
8	**Each ILS data has the format described in table attached hereafter** (N(i) is the number of coadded scene measurements per ILS i)	-	R*84 +2×$\sum N(i)$	ILS informa-tion	*R*
Spectral calibration data					
9	**Spectral time** ZPD time of first scene sweep used for spectral calibration	-	12	mjd	1
10	**Quality indicator (PCD)** "0" non-corrupted, "-1" = default values filled in	-	1	sc	1
11	**Level 1B product filename containing the scene measurements used** With the reference to the Level 1B product file and sweep ID, it is possible to identify unambiguously the scene measurement that has been used for the actual spectral calibration. The reference to all underlying files can also be identified, including the offset calibration file, the gain calibration file, the LOS calibration file, the instrument characterization data file, the processing parameter file and the validation file.	-	62	uc	62
12	**Linear spectral correction factor (K_{sc})** Linear correction factor (same for all the bands). Doppler effect is treated separately and removed from scene spectra before spectral calibration	-	8	do	1
13	**Standard deviation of correction factor**	-	8	do	1
14	**Quadratic spectral correction factor (Asc, Bsc Csc)**	-	24	do	3
15	**Number of peak fitted (*S*)**	-	2	us	1
16	**Spare**	-	50	uc	50
	Peak #1 to #S				

Table 12.6.3.1.1-1 MIPAS ILS and Spectral Calibration MDSR

N	Description	Units	Byte Length	Data Type	Dim.
17	**Each Peak data has the format described in table attached hereafter** (M(i) is the number of coadded scene measurements per Peak i)	-	S*34+ $2\times\sum M(i)$	Peak informa-tion	S
TOTAL			**307+ variable**		

Table 12.6.3.1.1-2 ILS information structure for ILS & Spectral calibration MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Microwindow ID**	-	8	uc	8
2	**Exact wavenumber of spectral line** The wavenumber at which the ILS or peak has been computed in a given microwindow is also given, corresponding to the reference line position used in auxiliary data.	cm^{-1}	8	do	1
3	**Number of coadded scene measurements (*N*)**	-	2	us	1
4	**Sequential ID of scene measurements coadded**	-	$N \times 2$	us	N
5	**ILS modelling parameter: linear shear variation along Z** The computed ILS itself is not stored, but instead are stored the two generating parameters that can be used to generate the corresponding ILS at a given wavenumber	cm	4	fl	1
6	**ILS modelling parameter: systematic IR misalignment along Y** The computed ILS itself is not stored, but instead are stored the two generating parameters that can be used to generate the corresponding ILS at a given wavenumber	rad	4	fl	1
7	**ILS frequency shift**	cm^{-1}	8	do	1
8	**Spare**		50	uc	50
TOTAL			84+N×2		

The format of the Peak information structure recorded for each Peak in the ILS & Spectral calibration MDS is described below:

Table 12.6.3.1.1-3 Peak information structure for ILS & Spectral calibration MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Microwindow ID**	-	8	uc	8

2	**Exact wavenumber of spectral line**	cm^{-1}	8	do	1
3	**Detected frequency shift**	cm^{-1}	8	do	1
4	**Correlation coefficient**	-	8	do	1
5	**Number of coadded scene measurements (*M*)**	-	2	us	1
6	**Sequential ID of scene measurements coadded**	-	$M \times 2$	us	M
TOTAL			$34+M\times2$		

Size Note

If we assume M = 1, i.e., no scene coadded for spectral calibration and N = 5 coadded scenes for ILS retrieval, R and S = 5, i.e., one ILS retrieval and one peak fitted per band then the size of the MDSR is

MDSR total = 307 + (R *(84 + N *2)) + (S *(34 + M *2)) = 997 bytes

Remarks:

1. The file format defined above allows for more than one ILS curve in each spectral band. Each set of retrieved ILS parameters corresponds to a particular set of scene measurements, indicated by the use of the Level 1B product file name and sweep ID number. Thus, different ILS can refer to different scene measurements.
2. The ILS curves are assumed to be obtained from selected spectral lines taken in normal scene measurements (at full resolution). The selected spectral lines come from an appropriate choice and are listed in auxiliary data.
3. The ILS calibration must be repeated at least every week because of the requirement on ILS stability.

4. The spectral calibration is repeated at least every 150 seconds because of the requirement on spectral stability. It may be possible to perform a spectral calibration for every scan measurement.
5. Even if the spectral calibration is done for every scene measurement, it will be necessary to generate a spectral calibration file because the spectral calibration is needed for the computation of the radiometric gain.

12.6.4 Offset Validation

The offset validation is a file used for validation of calibrated offsets. It is used also for estimation of the NESR of the instrument. It consists of a valid offset, an accumulated mean and standard deviation of the calibrated difference of offset interferograms.

FILE ID: MIP_CO1_AX

TYPE: Calibration

USE: Level 1B processing

UPDATED: A new offset calibration file is expected to be computed at the end of an orbit.

SIZE: MPH(1247 bytes) + SPH(1778 bytes) + MDS(2 MDSRs*59998 bytes/ MDSR + 2 MDSRs*4976 bytes/MDSR) = 132 973 bytes. *

* File size estimation is based on assumptions detailed in this chapter.

12.6.4.1 12.6.4.1 Format

The high level format of the file is shown below:

Table 12.6.4.1-1 MIPAS Offset Calibration structure

MPH
Auxiliary Data SPH (see Volume 16) with 6 DSDs: SPH_DESCRIPTOR shall be set to "MIPAS_OFFSET_VALIDATION " *DSD for the MDS #1* *DSD for the MDS #2* *DSD pointing to Instrument characterization data file* *DSD pointing to Processing parameters file* *DSD spare* *DSD pointing to ILS and spectral calibration file*
MDS #1
MDS #2

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.4.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (M) for the MDS #1	MIPAS_OFFSET_VECTORS
DSD (M) for the MDS #2	MIPAS_OFFSET_STATISTICS
Data Set Descriptors for referenced files	
DSD (R) for Instrument Characterization data File	MIPAS_INST_CHARACTERIZATION
DSD (R) for Level 1B Processing Parameters file	MIPAS_PROCESSING_PARAMETER
DSD (R) spare	

DSD (R) for ILS and Spectral Calibration File	MIPAS_ILS_SPEC_CALIBRATION

12.6.4.1.1 Offset Validation MDS #1

The following describes the format of the MDSR for MDS #1. There are 2 MDSRs per MDS: one for the forward sweep and one for the reverse.

Table 12.6.4.1.1-1 MIPAS Offset Validation MDSR for MDS #1

N	Description	Units	Byte Length	Data Type	Dim.
1	**ZPD time of first deep space sweep used to generate average offset data over one orbit**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted," - 1" = default values filled in	-	1	sc	1
	Average offset				
3	**Sweep direction, "F" forward and "R" reverse**	-	1	uc	1
3.1	**Least square mean of uncalibrated power spectrum average offset for band A, AB, B, C and D**	-	20	fl	5
3.2	**Least square standard deviation of uncalibrated power spectrum average offset for band A, AB, B, C and D**	-	20	fl	5
4	**Spare**	-	10	uc	10
	Bands A to D				
5	**Each Band data has the format described in table attached hereafter** (Ordered: A, AB, B, C, D; N(i) is the number of points per band i)	-	*5** (22+ 8×∑*N(i)*)	Band informa-tion	*5*
TOTAL			**174 + 8 × ∑*N***		

The format of the Band information structure recorded for each band in the Offset calibration MDS #1 is described below:

Table 12.6.4.1.1-2 Band information structure for Offset calibration MDS #1

N	Description	Units	Byte Length	Data Type	Dim.
1	**Decimation factor for current band**	-	2	us	1
2	**Number of points in band (*N*)**	-	4	ul	1
3	**Wavenumber of first point in band**	cm^{-1}	8	do	1
4	**Wavenumber of last point in band**	cm^{-1}	8	do	1
5	**Complex data points**	-	*N* × 8	fl	*N* × 2

TOTAL		22+*N*×8		

Size Note:
A sweep generates the same number of points in each channel; this number of points varies with the resolution:

Table 12.6.4.1.1-3 Number of Points per Resolution

Resolution [cm^{-1}]	Number of points
0.025	304 520
0.05	152 388
0.25	30 682

These data points are then filtered with complex coefficients and decimated. It results in vectors with real and imaginary parts for each band. The decimation factor used in each band depends on its bandwidth. In the following table, we list the decimation factor that can be used in each channel and the resulting number of points assuming low resolution offset calibration.

Table 12.6.4.1.1-4 Number of Complex Points after Decimation

Band	Decimation factor	Number of points
A	21	1 449
AB	36	846
B	22	1 384
C	30	1 015
D	11	2 767
TOTAL		7 461

Assuming the total number of points $\Sigma N = 7461$, the MDSR length is MDSR total = $174 + \Sigma N \times 8 = 59998$ bytes

12.6.4.1.2 Offset Validation MDS #2

MDS #2 contains NESR information. The format of the MDSR for MDS #2 is shown below. There are two MDSRs per MDS, one for the forward sweep and one for the reverse.

Table 12.6.4.1.2-1 MIPAS Offset Validation MDSR for MDS #2

N	Description	Units	Byte Length	Data Type	Dim.
1	**ZPD time of first deep space sweep used to generate current offset validation data**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted," - 1" = default values filled in	-	1	sc	1
	NESR statistic information				
3	**Number cumulated in statistics** One value per band (A, AB, B, C, D)	-	20	ul	5
4	**Sweep direction "F" forward and "R" reverse**	-	1	uc	1
5	**Spare**	-	34	uc	34
	Band A				
6	**Each Band data has the format described in table attached hereafter** (Ordered: A, AB, B, C, D M(i) is the number of points per band i)	-	*5** (20+ 8×∑*M(i)*)	Band information	*5*
TOTAL			**168 + 8 × ∑*M***		

The format of the Band information structure recorded for each band in the Offset calibration MDS #2 is described below:

Table 12.6.4.1.2-2 Band information structure for Offset calibration MDS #2.

The total number of template points for MDS #2 is provided in the table below.

N	Description	Units	Byte Length	Data Type	Dim.
1	**Number of points in band (*M*)**	-	4	ul	1
2	**Wavenumber of first point in band**	cm^{-1}	8	do	1
3	**Wavenumber of last point in band**	cm^{-1}	8	do	1
4	**Mean data points**	W/ (cm^2×sr ×cm^{-1})	*M* × 4	fl	*M*
5	**Standard deviation data points**	W/ (cm^2×sr ×cm^{-1})	*M* × 4	fl	*M*
TOTAL			20+M×8		

Table 12.6.4.1.2-3 Number of Template Points in Each Band

Band	Range [cm^{-1}]	Bandwidth [cm^{-1}]	100 × Requested resolution [cm^{-1}]	Number of points
A	685 -970	285	2.5	115
AB	1020 -1170	150	2.5	61
B	1215 -1500	285	2.5	115
C	1570 -1750	180	2.5	73
D	1820 -2410	590	2.5	237
TOTAL		1 490		601

Assuming the total number of template points ΣM = 601, the MDSR length is MDSR total = 168 + ΣM × 8 = 4976 bytes

12.6.5 Instrument Characterization Data

This file contains all instrument characterization data needed at ground by processing algorithms. It includes thermistor characterizations, non-linearity characterization, equalization characterization, blackbody characterization, DTU characterization, LOS characterization, SPE characterization, PAW characterization.

FILE ID: **MIP_CA1_AX**

TYPE: Auxiliary

USE: Level 1B processing

UPDATED: This file is expected to change at every re-calibration of digital to resistance coefficients. The maximal frequency of re-calibration is every 2 weeks but it is expected to be every 3 months.

SIZE: MPH(1247 bytes) + SPH(378 bytes) + MDS(13267 bytes) = 14892 bytes *

* File size estimation is based on assumptions detailed in this chapter.

12.6.5.1 Format

The high level format of the file is shown below:

Table 12.6.5.1-1 MIPAS Instrument Characterization structure

MPH

Auxiliary Data SPH (see Volume 16) with 1 DSD: SPH_DESCRIPTOR shall be set to “MIPAS_INST_CHARACTERIZATION ” *DSD for the MDS*
MDS

The following table defines the DS_NAME field in the DSD of the SPH. When written to the DS_NAME field, characters string is left justified with unused characters set to blank space characters:

Table 12.6.5.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Set	
DSD (M) for the MDS	MIPAS_INST_CHARACTERIZATION

12.6.5.1.1 Instrument Characterization MDS

The MDSR of the file is described below. There is one MDSR per MDS.

Table 12.6.5.1.1-1 MIPAS Instrument Characterization Data MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Creation Time**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted, ” -1” = default values filled in	-	1	sc	1
Thermistors					
3	**Thermistor time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
4	**FEO** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6
5	**Instrument** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6

Table 12.6.5.1.1-1 MIPAS Instrument Characterization Data MDSR

N	Description	Units	Byte Length	Data Type	Dim.
6	**CBE** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6
7	**DPU/DTU range 1** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6
8	**DPU/DTU range 2** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6
9	**SPE** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6
10	**PAW** A fifth order polynomial relates each thermistor (or a set of) reading (ADC count) to the actual temperature (Kelvin) which leads to a set of 6 coefficients. The units of coefficients are K, K/ ADC count, K/(ADC count)2, K/(ADC count)3 , K/(ADC count)4, K/(ADC count)5	-	48	do	6
11	**Spare**	-	50	uc	50
	Non-linearity				
12	**Non-linearity time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
13	**Detector responsivity coefficients with ASCM approach (relates responsivity to a "digitized" incident flux).** A fourth order polynomial relates detectors (A1, A2, B1 and B2 respectively) responsivity to a "digitized" incident flux which leads to a set of 4 coefficients. There is a different set of coefficients for the Forward and the Reverse direction for each detector A1, A2, B1 and B2.	-	256	do	4 * 4 * 2
14	**Photon flux min associated with the fit coefficients**	-	32	do	4
15	**Photon flux max associated with the fit coefficients**	-	32	do	4

Table 12.6.5.1.1-1 MIPAS Instrument Characterization Data MDSR

N	Description	Units	Byte Length	Data Type	Dim.
16	**Spare**	-	32	uc	32
17	**Spare**	-	50	uc	50
	Equalization				
18	**Equalization time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
19	**Output port to equalize channel A** '0' means no equalization, '1' means channel A1 and '2' means channel A2	-	1	uc	1
20	**Number of coefficients (*N*=32** TBD**)** The number of coefficients is expected to be between 2 and 32, may be set to zero if field #16 is zero.	-	2	us	1
21	**Complex coefficients**	-	$N \times 16$	do	$N \times 2$
22	**Spare**	-	50	uc	50
	Blackbody				
23	**Blackbody time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
24	**Correction factors** (size TBD)	-	8	do	1
25	**Base area element locations**	m	64	do	8
26	**Base area PRT locations**	m	24	do	3
27	**View factors**	-	24	do	3
28	**Start wavenumber of grid on which surface emissivity data are represented**	cm^{-1}	4	fl	1
29	**Wavenumber increment of grid on which surface emissivity data are represented**	cm^{-1}	4	fl	1
30	**Number of data points in grid for surface emissivity (G)**	-	2	us	1
31	**Surface emissivity vs wavenumber**	-	G × 8	do	G
32	**Start wavenumber of grid on which effective emissivity data are represented**	cm^{-1}	4	fl	1
33	**Wavenumber increment of grid on which effective emissivity data are represented**	cm^{-1}	4	fl	1
34	**Number of data points in grid for effective emissivity (H)**	-	2	us	1
35	**Effective emissivity vs wavenumber**	-	H × 8	do	H
36	**PRT resistance values (high & low)**	-	80	do	10

Table 12.6.5.1.1-1 MIPAS Instrument Characterization Data MDSR

N	Description	Units	Byte Length	Data Type	Dim.
37	**Digital to PRT resistance** A second order polynomial relates digital reading (from the 5 CBB PRT) to resistance values which leads to a set of 3 coefficients. The units of the coefficients are ohm, ohm/ADC count, ohm/ (ADC count)2 .	-	120	do	5*3
38	**PRT resistance to temperature** A second order polynomial relates PRT resistance values to actual temperature (Kelvin) which leads to a set of 3 coefficients. The units of coefficients are K, K/ohm, K/ohm^2	-	120	do	5*3
39	**Spare**	-	30	uc	30
	DTU				
40	**DTU time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
41	**Detector responsivity vs temperature** A third order polynomial relates detector (for all 8) responsivity to DTU temperature which leads to a set of 4 coefficients. The units of coefficients are no units, K-1, K-2, K-3	-	256	do	8*4
42	**Responsivity scaling factor (kR)**	-	8	do	1
43	**Spare**	-	42	uc	42
	SPE				
44	**SPE time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
45	**Gain vs temperature and frequency** (size TBD, supposed to be 12 (TBD) * 5 (TBD) *8)	-	3840	do	12*5*8
46	**Phase vs temperature and frequency** (size TBD, supposed to be 12 (TBD) * 5 (TBD) *8)	-	3840	do	12*5*8
47	**Spare**	-	50	uc	50
	PAW				
48	**PAW time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
	Alignment matrix				
48.1	**Alignment matrix [3,3]**	-	72	do	9
48.2	**Spare**	-	50	uc	50
	Mispointing commanding				
48.3	**Pitch, roll and yaw biases**	-	24	do	3
48.4	**Pitch, roll and yaw harmonics** (sine, cosine, frequency)	-	216	do	27

Table 12.6.5.1.1-1 MIPAS Instrument Characterization Data MDSR

N	Description	Units	Byte Length	Data Type	Dim.
48.4	**Derivative type**	-	1	uc	1
48.5	**Number of harmonics**	-	1	uc	1
48.6	**Spare**	-	48	uc	48
Non-linearity scan mirror corrections					
48.7	**Elevation angles**	degrees	16	do	2
48.8	**Elevation angles corrections**	degrees	16	do	2
48.9	**Spare**	-	148	uc	148
Azimuth					
51	**Azimuth offset**	degrees	8	do	1
52	**Spare**	-	42	uc	42
TOTAL			**13267***		

* Assuming N=16 and G=H=175, size = 10211 + N*16 + (G+H)*8 =13267.

12.6.6 Level 1B Processing Parameters

This file contains all other parameters needed at ground by the Level 1B processing algorithms. It includes requested spectral axis definition, sinc interpolation table, standard deviation and rejection thresholds, conversion matrix between frame, etc.

FILE ID: **MIP_PS1_AX**

TYPE: Auxiliary

USE: Level 1B processing

UPDATED: updated infrequently following in-flight instrument testing

SIZE: MPH (1247 bytes) + SPH (378 bytes) + MDS (67982 bytes) = 69607 bytes *

* File size estimation is based on assumptions detailed in this chapter.

12.6.6.1 Format

The high level format of the file is shown below:

Table 12.6.6.1-1 MIPAS Processing Parameters structure

MPH
Auxiliary Data SPH (see Volume 16) with 1 DSD: SPH_DESCRIPTOR shall be set to “MIPAS_PROCESSING_PARAMETER ” *DSD for the MDS*
MDS

The following table defines the DS_NAME field in the DSD of the SPH. When written to the DS_NAME field, characters string is left justified with unused characters set to blank space characters:

Table 12.6.6.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Set	
DSD (M) for the MDS	MIPAS_PROCESSING_PARAMETER

12.6.6.1.1 Level 1B Processing Parameters MDS

The MDSR of the file is described below. There is one MDSR per MDS:

Table 12.6.6.1.1-1 MIPAS Level 1B Processing Parameters MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Start time of calibration data acquisition (ZPD time of first sweep used for gain calibration)**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted, “-1” = default values filled in	-	1	sc	1
Sampling					
3	**Sampling time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
4	**Nominal laser frequency** Nominal set of modelling ILS parameters.	cm^{-1}	8	do	1
5	**Spare**	-	50	uc	50

Table 12.6.6.1.1-1 MIPAS Level 1B Processing Parameters MDS

N	Description	Units	Byte Length	Data Type	Dim.
	Requested spectral axis				
6	**Axis time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
7	**Number of points per band** Band sequence is A, AB, B, C, D	-	20	ul	5
8	**Wavenumber of first point in band** Band sequence is A, AB, B, C, D	cm^{-1}	40	do	5
9	**Wavenumber of last point in band** Band sequence is A, AB, B, C, D	cm^{-1}	40	do	5
10	**Spare**	-	50	uc	50
	Fringe counting error (FCE)				
11	**FCE time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
12	**Spare**	-	4	uc	4
13	**Number of points around ZPD band B and C**	-	8	ul	2
14	**Spare**	-	50	uc	50
	NESR assessment				
15	**NESR time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
16	**Standard deviation threshold**	-	8	do	1
17	**Threshold of rejection** (given as ratio, e.g. 0.05 means 5%)	%	8	do	1
18	**Template reduction factor**	-	2	us	1
19	**Spare**	-	50	uc	50
	Radiometric validation				
20	**Radiometric time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
21	**Standard deviation threshold**	-	8	do	1
22	**Threshold of rejection** (given as ratio, e.g. 0.05 means 5%)	%	8	do	1
23	**Template reduction factor**	-	2	us	1
24	**Spare**	-	50	uc	50
	Scene measurement quality				

Table 12.6.6.1.1-1 MIPAS Level 1B Processing Parameters MDS

N	Description	Units	Byte Length	Data Type	Dim.
25	**Quality time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
26	**Standard deviation threshold**	-	8	do	1
27	**Threshold of rejection** (given as ratio, e.g. 0.05 means 5 %)	%	8	do	1
28	**Template reduction factor**	-	2	us	1
29	**Spare**	-	50	uc	50
	Spike detection				
30	**Spike time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
31	**Number of points per block**	-	4	ul	1
32	**Standard deviation threshold**	-	8	do	1
33	**Spare**	-	50	uc	50
	Sinc interpolation table				
34	**Sinc time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
35	**Number of rows (*N*)**	-	4	ul	1
36	**Number of columns (*J*)**	-	4	ul	1
37	**Interpolation coefficients**	-	$N \times J \times 8$	do	$N \times J$
38	**Spare**	-	50	uc	50
	Spectral calibration				
39	**Spectral time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
40	**Time since ascending node crossing from which the search for the first valid scene data shall start**	s	8	do	1
41	**Update period** (expressed in nominal scans, i.e. ignore scans in special event mode)	-	2	us	1
42	**Tangent height interval within which scene data shall be extracted**	km	8	fl	2
43	**Number of scenes to be co-added**	-	2	us	1
44	**Simplex convergence tolerance**	-	8	do	1
45	**Maximum number of iterations**	-	4	ul	1
46	**Validity threshold for standard deviation**	-	8	do	1
47	**Calibration method** (0= peak find method, 1= cross correlation method)	-	1	uc	1

Table 12.6.6.1.1-1 MIPAS Level 1B Processing Parameters MDS

N	Description	Units	Byte Length	Data Type	Dim.
48	**Spare**	-	29	uc	29
	ILS retrieval				
49	**ILS time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
50	**Time since ascending node crossing from which the search for the valid scene data shall start**	s	8	do	1
51	**Tangent height interval within which scene data shall be extracted**	km	8	fl	2
52	**Max. number of scenes to be co-added**	-	2	us	1
53	**Max. number of subsequent scans from which scenes are to be extracted** (expressed in nominal scans, i.e. ignore scans in special event mode)	-	2	us	1
54	**Simplex convergence tolerance**	-	8	do	1
55	**Maximum number of iterations**	-	4	ul	1
56	**Initial guess parameters for height and offset** (Initial search value for ILS retrieval by simplex method)	km	8	fl	2
	Nominal set of modelling ILS parameters.				
57	**Maximum optical path difference**	cm	4	fl	1
58	**Shear at ZPD along Y**	cm	4	fl	1
59	**Shear at ZPD along Z**	cm	4	fl	1
60	**Systematic IR misalignment angle along Y** (Initial search value for ILS retrieval by simplex method)	rad	4	fl	1
61	**Systematic IR misalignment angle along Z**	rad	4	fl	1
62	**Interferometer divergence (total angle) along Y**	rad	4	fl	1
63	**Interferometer divergence (total angle) along Z**	rad	4	fl	1
64	**Systematic laser misalignment angle along Y**	rad	4	fl	1
65	**Systematic laser misalignment angle along Z**	rad	4	fl	1
66	**Number of field of view subdivisions along Y**	-	4	ul	1
67	**Number of field of view subdivisions along Z**	-	4	ul	1
68	**Spare**	-	4	uc	4
69	**Blur angular width along Y**	rad	4	fl	1
70	**Blur angular width along Z**	rad	4	fl	1

Table 12.6.6.1.1-1 MIPAS Level 1B Processing Parameters MDS

N	Description	Units	Byte Length	Data Type	Dim.
71	**Nominal optical speed**	cm/sec	4	fl	1
72	**Sampling perturbation of first sample**	cm	4	fl	1
73	**Time constant for attenuation of sampling perturbation**	sec	4	fl	1
74	**Relative speed fluctuation on the first sample**	-	4	fl	1
75	**Time constant for attenuation of speed fluctuation**	sec	4	fl	1
76	**Slope of relative gain vs relative frequency**	-	4	fl	1
77	**Delay mismatch between IR electrical response and ADC trigger signal**	sec	4	fl	1
78	**Relative drift rate of laser wavenumber per second**	sec^{-1}	4	fl	1
79	**Laser bandwidth due to white frequency noise**	Hz	4	fl	1
80	**Linear shear variation along Y**	-	4	fl	1
81	**Linear shear variation along Z** (Initial search value for ILS retrieval by simplex method)	-	4	fl	1
82	**Spare**	-	42	uc	42
	LOS				
83	**LOS time (UTC)** Last modification time of file section using UTC time format	UTC	27	uc	27
84	**Minimum azimuth angle in side observation geometry**	-	8	do	1
85	**Maximum azimuth angle in side observation geometry**	-	8	do	1
86	**Spare**	-	56	uc	56
87	**Minimum azimuth angle in rearward observation geometry**	-	8	do	1
88	**Maximum azimuth angle in rearward observation geometry**	-	8	do	1
89	**Threshold used to compute the value to fill MPH field #35**	%	4	fl	1
90	**Spare**	-	46	uc	46
	Geolocation				
91	**Altitude and orbit control system (AOCS) defaults - pitch, roll, and yaw**	degrees	24	do	3

Table 12.6.6.1.1-1 MIPAS Level 1B Processing Parameters MDS

N	Description	Units	Byte Length	Data Type	Dim.
92	**Altitude and orbit control system mispointing angle - pitch, roll, and yaw**	degrees	24	do	3
93	**Altitude and orbit control system mispointing rate - pitch, roll, and yaw**	degrees/s	24	do	3
94	**TARGET mode**	-	2	ss	1
95	**TARGET ray tracing mode switch**	-	2	us	1
96	**TARGET extended results vector switch**	-	2	us	1
97	**Restituted attitude flag option** When it is =0 the processor uses the LOS CL1 ADF method, when it is =1 the processor uses the Restituted attitude AUX_FRA ADF (offline processing only)	-	2	us	2
98	**Spare**	-	48	uc	48
TOTAL			**67982 ***		

* Assuming N=65 and J=128, size = 1422 + N * J *8 = 67982 bytes.

12.6.7 Level 1B Microwindow Dictionary

This file contains the reference microwindows that are used for spectral calibration and ILS retrieval. One or more reference spectral lines will be used for each channel/band. Each spectral line is defined unambiguously by a set of selected parameters. The description includes the precise wavenumber value and its uncertainty, the limits of the microwindow in which the spectral line can be found, and also additional information on the peak shape and on the circumstances like the tangent height for which the line is expected to be used.

The maximum number of stored reference lines is not limited, but the number of active reference lines could be much less, with a minimum of about 5 (one per spectral band).

FILE ID: **MIP_MW1_AX**

TYPE: Auxiliary

USE: Level 1B processing

UPDATED: infrequently

SIZE: MPH(1247 bytes) + SPH(378 bytes) + MDS(9105 bytes) = 10730 bytes *

* File size estimation is based on assumptions detailed in this chapter.

12.6.7.1 Format

The high level format of the file is shown below:

Table 12.6.7.1-1 MIPAS Microwindows Dictionary structure

MPH
Auxiliary Data SPH (see Volume 16) with 1 DSD: SPH_DESCRIPTOR shall be set to "MIPAS_MICROWINDOW_DICTIONARY " *DSD for the MDS*
MDS

The following table defines the DS_NAME field in the DSD of the SPH. When written to the DS_NAME field, characters string is left justified with unused characters set to blank space characters:

Table 12.6.7.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Set	
DSD (M) for the MDS	MIPAS_MICROWINDOW_DICTIONARY

12.6.7.1.1 Level 1B Microwindows Dictionary MDS

The MDSR of the file is described below. There is one MDSR per MDS:

Table 12.6.7.1.1-1 MIPAS Level 1B Microwindow Dictionary MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)** "0" non-corrupted," - 1" = default values filled in	-	1	sc	1
3	**Total number of microwindows in file (*N*)**	-	4	ul	1
	Microwindows #1 to #N				
4	**Each Microwindow data has the format described in table attached hereafter**	-	$N \times 71$	Micro-window information	*N*

TOTAL		17 + $N \times 71$ *		

* Assuming a total of N = 128 reference microwindows, size = 17 + N*71 = 9105 bytes

Table 12.6.7.1.1-2 MIPAS Level 1B Microwindow information structure

N	Description	Units	Byte Length	Data Type	Dim.
1	**ID** The spectral line is referenced by its 8 character id	-	8	uc	8
2	**Active** Set to 'A' if the microwindow is active or set to 'N' if it is not active.	ascii	1	uc	1
3	**Utility** Set to 'S' if the microwindow is used for spectral calibration or set to 'I' if it is used for ILS retrieval, or set to 'B' if it is used for both.	ascii	1	uc	1
4	**Peak position**	cm^{-1}	8	do	1
5	**Microwindow left limit**	cm^{-1}	8	do	1
6	**Microwindow right limit**	cm^{-1}	8	do	1
7	**Altitude**	km	8	do	1
8	**Peak height**	$W/(cm^2 \times sr \times cm^{-1})$	8	do	1
9	**Peak width (HWHM)**	cm^{-1}	8	do	1
10	**Mathematical model**	-	1	uc	1
11	**Number of necessary coadditions**	-	4	ul	1
12	**Validity threshold**	-	8	do	1
TOTAL			**71**		

12.6.8 Level 2 Processing Parameters File

This file contains a complete list of input parameters, settings and switches that control the execution of the Level 2 processor.

FILE ID: **MIP_PS2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: once per month

SIZE: MPH (1247 bytes) + SPH (1218 bytes) + DSRs (44 252 bytes[6]) = 46 717 bytes

12.6.8.1 Format

The high level format of the file is shown below:

Table 12.6.8.1-1 MIPAS Level-2 Processing Parameters structure

MPH
Auxiliary Data SPH (see Volume 16) with 4 DSDs: • DSD for the Framework Parameters GADS • DSD for the p,T Retrieval Parameters GADS • DSD for the VMR Retrieval Parameters GADS • DSD referencing MIP_CS1_AX
Framework Parameters GADS
p, T Retrieval Parameters GADS
VMR Retrieval Parameters GADS

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.8.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (G) for the Framework Parameters GADS	SETTINGS FOR FRAMEWORK
DSD (G) for the p,T Retrieval Parameters GADS	SETTINGS FOR PT RETRIEVAL
DSD (G) for the VMR Retrieval Parameters GADS	SETTINGS FOR VMR RETRIEVALS
Data Set Descriptors for referenced files	
DSD (R) for ILS and Spectral Calibration data File	REFERENCE TO USED MIP_CS1_AX

12.6.8.1.1 Framework Parameters GADS

The format of the GADS is shown in the table below.

[6] Assumption: N_{NESRth} = 174, N_{Cn} = 5, N_c^{ILS} = 5, $N_{FOV}(i)$ = 4, $nEsd_{IG2}$=8, $nEsd_{ECMWF}$=8, N_{mod}=4, NumbMod=4

Table 12.6.8.1.1-1 Framework Parameters GADS

N	Description	Units	Byte Length	Data Type	Dimension
1	**Time of creation**	-	12	mjd	1
	Health check				
2	**Switch for processing of special events**[a]	-	1	uc	1
3	**Spare**	-	2	uc	2
4	**Maximum optical path difference**	cm	8	do	1
5	**Reference character to be compared with PCD**	-	1	sc	1
6	**Threshold of spike location wrt ZPD**	-	4	ul	1
7	**Threshold for maximum rms amplitude of spikes**	-	8	do	1
8	**Wavenumber of laser**	cm^{-1}	8	do	1
	Selection of microwindows				
9	**Spare**	-	4	uc	4
10	**Number of fringe counts valid for nominal measurement at MPD**	-	4	ul	1
11	**Number of NESR thresholds [N_{NESRth}]**	-	2	us	1
12	**Wavenumber related to the first NESR threshold**	cm^{-1}	8	do	1
13	**Wavenumber related to the last NESR threshold**	cm^{-1}	8	do	1
14	**Vector containing NESR thresholds**	r.u.	N_{NESRth} ×8	do	N_{NESRth}
15	**Maximum number of MW's used in retrieval**	-	2	us	1
15.1	**Spare**	-	24	uc	24
15.2	**Number of modes (N_{mod})**	-	2	us	1
15.3	**Number of sweeps characterizing each mode**	-	N_{mod}×2	us	N_{mod}×us
16	**Mode dependent Coefficient A for Tropopause Altitude Correction**	km	N_{mod}×8	double	N_{mod}×double
17	**Mode dependent Coefficient B for Tropopause Altitude Correction**	km	N_{mod}×8	double	N_{mod}×double
18	**Mode dependent Coefficient C for Tropopause Altitude Correction**	km	N_{mod}×8	double	N_{mod} *double
	Extraction of spectral input data				
20	**Spectral resolution of the general coarse wavenumber grid**	cm^{-1}	8	do	1
21	**Maximum allowed deviation between input grid and general coarse wavenumber grid**	cm^{-1}	8	do	1
22	**Number of sinc interpolation coefficients**	-	2	us	1

Table 12.6.8.1.1-1 Framework Parameters GADS

N	Description	Units	Byte Length	Data Type	Dimension
23	**Number of offsets used for interpolation**	-	2	ss	1
	Apodisation of microwindows				
24	**Number of coefficients defining analytical Norton-Beer apodisation function [N_{Cn}]**	-	2	us	1
25	**Coefficients of analytical Norton-Beer apodisation function**	-	N_{Cn}×8	do	N_{Cn}
	Computation of complex modulation and apodised ILS				
26	**Number of wavenumbers at which the ILS has been characterised [Nc^{ILS}]**	-	2	us	1
27	**Vector containing wavenumbers at which the ILS has been characterised**	cm^{-1}	Nc^{ILS}×8	do	Nc^{ILS}
28	**Vector containing for each wavenumber the linear shear variation along Z vs. OPD**	cm	Nc^{ILS} × 8	do	Nc^{ILS}
29	**Vector containing for each wavenumber the systematic IR misalignment along Y**	rad	Nc^{ILS}×8	do	Nc^{ILS}
30	**Spectral resolution of the general fine wavenumber grid**	cm^{-1}	8	do	1
31	**Requested spectral width of the AILS in each spectral band**	cm^{-1}	8	do	1
32	**Required minimum resolution of computed AILS**	cm^{-1}	8	do	1
33	**Minimum resolution of sampling grid in OPD domain**	cm	2	us	1
34	**Maximum number of FFT samples to be used**	-	2	us	1
35	**Minimum divergence for which the modulation MIR is computed**	deg	8	do	1
36	**Spare**	-	8	uc	8
37	**Systematic IR misalignment along Z**	rad	8	do	1
38	**Retroreflector linear shear along Y vs. OPD**	cm	8	do	1
39	**Interferometer divergence along Y**	rad	8	do	1
40	**Interferometer divergence along Z**	rad	8	do	1
41	**Systematic OPD measuring laser misalignment along Y**	rad	8	do	1
42	**Systematic OPD measuring laser misalignment along Z**	rad	8	do	1

Table 12.6.8.1.1-1 Framework Parameters GADS

N	Description	Units	Byte Length	Data Type	Dimension
43	**Linear shear variation along Y**	-	8	do	1
44	**Retroflector Linear shear along Z**	-	8	do	1
45	**Blur angular width along Y**	rad	8	do	1
46	**Blur angular width along Z**	rad	8	do	1
47	**Optical speed of interferometer**	cm/s	8	do	1
48	**Initial perturbation on sampling of first sample**	cm	8	do	1
49	**Time constant of exponential attenuation of initial sampling perturbation**	s	8	do	1
50	**Initial relative speed fluctuation at the beginning of scan**	-	8	do	1
51	**Time constant of exponential attenuation of the initial speed fluctuation**	s	8	do	1
52	**Gain slope of electrical response of IR detector and preamplifer**	-	8	do	1
53	**Mismatch delay between IR electronics response and ADC trigger**	s	8	do	1
54	**Relative drift rate of laser wavenumber**	cm^{-1}	8	do	1
55	**Bandwidth of laser white noise**	Hz	8	do	1
56	**Bandwidth of laser 1/f noise**	Hz	8	do	1
57	**Number of discrete samples of integral approximation along Y**	-	2	us	1
58	**Number of discrete samples of integral approximation along Z**	-	2	us	1
59	**Coefficient C used for ILS/AILS interpolation**	-	8	do	1
60	**Coefficient B used for ILS/AILS interpolation**	cm	8	do	1
61	**Coefficient A used for ILS/AILS interpolation**	cm^2	8	do	1
62	**Constant spectral correction coefficient of AILS**	cm^{-1}	8	do	1
63	**Linear spectral correction coefficient of AILS**	-	8	do	1
64	**Quadratic spectral correction coefficient of AILS**	cm	8	do	1
65	**Flag to control, if AILS interpolation coefficients shall be taken from L1B (1) or PS2 (0)**		2	us	1
Additional Quantities					
66	**Spare**	-	2	uc	2

Table 12.6.8.1.1-1 Framework Parameters GADS

N	Description	Units	Byte Length	Data Type	Dimension
67	**Number of samples of apodisation vector in spectral domain**	-	2	us	1
68	**Number of elements of apodisation vector in OPD domain**	-	2	us	1
69	**Spare**	-	10	uc	10
70	**Threshold for spectral grid error on which the ILS is computed**	cm^{-1}	8	do	1
71	**Lowest value of apodisation vector**	-	8	do	1
72	**Threshold of ratio for which inversed squared apodisation function is computed**	-	8	do	1
73	**Spare**	-	2	uc	2
74	**Threshold defining minimum value of eigenvalue**	-	8	do	1
75	**Maximum number of spectral lines per MW**	-	2	us	1
76	**Sequence of processing of VMR retrievals** [b] (each is a 4 character string)	-	120	char.string[4]	30
77	**Switch for skipping p,T retrieval** [c]	-	2	us	1
78	**Maximum HITRAN code to be considered**	-	2	us	1
79	**Maximum number of p,T - 1st VMR preloop iterations**		2	us	1
80	**Spare**	-	6	uc	6
81	**Upper altitude threshold for use of spectral lines**	km	8	do	1
82	**Lower altitude threshold for use of spectral lines**	km	8	do	1
83	**Maximum altitude step for hydrostatic equilibrium**	km	8	do	1
84	**Switch for activation of correction of lowest level for continuum derivatives**[d]		2	us	1
85	**Vector containing three reference altitudes to be used for ECMWF based altitude correction**	km	24	do	3
86	**Threshold to use lowest three altitudes for ECMWF based altitude correction**		8	do	1
87	**Spare**	-	6	uc	6
TOTAL			**GADS size** [e]		

a. **'B': both, nominal and special event scans**
'N': only nominal scans
'S': only special event scans

b. **Labels of 4 bytes for each species (with trailing blanks).**
A blank label indicates that no further species shall be retrieved.

c. **0: Perform p,T retrieval**
1: Skip p,T retrieval.

d. **0: Deactivate correction,**
1: Activate Correction

e. **GADS size = $592 + 8*N_{NESRth} + 8*N_{Cn} + 24*N_c^{ILS}$.**

12.6.8.1.2 p,T Retrieval GADS

The format of the GADS is shown in the table below.

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Minimum value used to check non-singularity of matrix**	-	8	do	1
3	**Switch for usage of a priori pointing information** [a]	-	2	us	1
4	**Switch to enable linear FOV convolution**		2	us	1
5	**Number of elements of the estimated standard deviation (ESD) vector for IG2 temperature profiles: [$nEsd_{IG2}$]**		2	us	1
6	**Number of elements of the estimated standard deviation (ESD) vector for "ECMWF merged with IG2" temperature profiles: [$nEsd_{ECMWF}$]**		2	us	1
7	**Spare**	-	6	uc	6
8	**Maximum number of elements in profiles**	-	2	us	1
9	**Number of allowed unsuccessful previous retrievals**	-	2	us	1
10	**Enhanced spectral range of MW's used to decide whether a line inside the MW shall be considered as line or as nearby continuum**	cm^{-1}	8	do	1

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
11	**Maximum number of spectral samples on fine grid**	-	2	us	1
12	**Threshold to check convergence of chi-square**	-	8	do	1
13	**Threshold to check convergence of fitted pressure**	-	8	do	1
	Threshold to check convergence of fitted temperature	-	8	do	1
14	**Switch for choosing between different ways to calculate VCM and AKM**	-	2	us	1
16	**Maximum number of Gauss-Newton macro-iterations**	-	2	us	1
17	**Spare**	-	2	uc	2
18	**Maximum number of Marquardt micro-iterations**	-	2	us	1
19	**Lower threshold of estimated pressure**	hPa	8	do	1
20	**Upper threshold of estimated pressure**	hPa	8	do	1
21	**Lower threshold of estimated temperature**	K	8	do	1
22	**Upper threshold of estimated temperature**	K	8	do	1
23	**Lower threshold of estimated continuum parameter**	cm^2	8	do	1
24	**Upper threshold of estimated continuum parameter**	cm^2	8	do	1
25	**Switch for activation of constraining of altitude correction**[b]	-	2	uc	2
26	**Constraining of maximum relative pressure correction**	%	8	do	1
27	**Spare**	-	14	uc	14
28	**Difference between spectral resolution of general fine wavenumber grid and spectral grid of cross section look-up tables**	cm^{-1}	8	do	1
29	**Switch for using pre-stored spectra and jacobian matrix** [c]	-	2	us	1

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
30	**Control parameter for fitting of continuum and instrumental offset** [d]	-	2	us	1
31	**Upper altitude limit where continuum shall be fitted**	km	8	do	1
32	**Altitude above which the continuum shall be set to zero**	km	8	do	1
33	**Number of modes for thresholds (NumbMod)**	-	2	us	1
33.2	**Number of sweeps characterizing each mode**	-	NumbMod×2	NumbMod×us	1
33.4	**Vector of thresholds to check the size of chisquare**	-	NumbMod×8	NumbMod×double	1
33.6	**Vectot of thresholds to check Marquardt parameter**	-	NumbMod×8	NumbMod×double	1
33.8	**Threshold to check the chi-square variation between previous and current iteration**	-	8	double	1
33.9	**Threshold to check the variation of weighted L2-norm of parameters**	-	8	double	1
34	**Maximum number of fitted parameters**	-	2	us	1
35	**Overlap of spectral range between two adjacent MW's**	%	8	do	1
36	**Temperature increment used to compute per-turbed temperature profile**	K	8	do	1
37	**Central wavenumber of the line used as reference**	cm^{-1}	8	do	1
38	**Coefficient of temperature dependence of Lorentz half-width of the line used as reference**	-	8	do	1
39	**Guess of altitude increment above highest level**	km	8	do	1
40	**Reduction factor applied to guess of altitude increment**	-	8	do	1
41	**Upper limit of atmosphere**	km	8	do	1
42	**Half-width of the line used as reference**	cm^{-1}	8	do	1

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
43	**Maximum allowed temperature variation between atmospheric levels for lower altitudes**	K	8	do	1
44	**Maximum allowed temperature variation between atmospheric levels for higher altitudes**	K	8	do	1
45	**Altitude threshold where temperature thresholds are changed**	km	8	do	1
46	**Maximum allowed variation of half-width of the line between adjacent atmospheric levels**	cm^{-1}	8	do	1
47	**Number of maximum levels for modelling of the atmosphere**	-	2	us	1
48	**Maximum number of different gases**	-	2	us	1
49	**Maximum number of simulated geometries**	-	2	us	1
50	**Maximum number of parameters to be retrieved for p, T and continuum**	-	2	us	1
51	**Coefficients for latitude dependent correction of gravity acceleration**	-	16	do	2
52	**Equivalent reference temperature**	K	8	do	1
53	**Reference equivalent pressure at equivalent reference temperature used for line computa-tion**	hPa	8	do	1
54	**Approximation error of integrals (Curtis-Godson)**	-	8	do	1
55	**Initial temperature of perturbed equivalent temperature**	K	8	do	1
56	**Maximum number of layers**	-	2	us	1
57	**Minimum number of samples at which the integrand of each integral shall be computed**	-	2	us	1
58	**Maximum number of elements in base profile**	-	2	us	1
59	**Minimum value of**	-	8	do	1

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
	integration variable				
60	**Number of additional IAPT numbers for each geometry above the lowest geometry**	-	2	us	1
61	**Multiplier for Lorentz and Doppler half width used for Lorentz lineshape computations on the local coarse wavenumber grid**	-	8	do	1
62	**Multiplier for Doppler half width used for Voigt lineshape computations on the local fine wavenumber grid**	-	8	do	1
63	**Switch for interpolation of absorption cross sections for geometries above the lowest geometry** [e]	-	2	ss	1
64	**Switch for usage of cross section lookup tables** [f]	-	2	us	1
65	**Spare**	-	8	uc	8
66	**Switch for computation of CO_2 chi factor** [g]	-	2	us	1
67	**Multiplication factor applied to approximate Voigt half width to determine the local fine grid**	-	8	do	1
68	**Multiplier for definition of local coarse wave-number grid**	-	2	us	1
69	**Spare**	-	8	uc	8
70	**Number of samples along x coordinate**	-	2	us	1
71	**Number of samples along y coordinate**	-	2	us	1
72	**Greater base of trapezium defining the vertical FOV**	km	8	do	1
73	**Smaller base of trapezium defining the vertical FOV**	km	8	do	1
74	**Spare**	-	8	uc	8
75	**Lambda damping factor**	-	8	do	1
76	**Scaling of lambda damping factor related to continuum parameters**	-	8	do	1

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
77	**Scaling factor used to decrease λ at each macro iteration**	-	8	do	1
78	**Scaling factor used to increase λ at each micro iteration**	-	8	do	1
79	**Threshold for maximum relative error of retrieved pressure**	-	8	do	1
80	**Temperature threshold used to check the max-imum error of retrieved temperature**	K	8	do	1
81	**Switch for usage of previous retrieved profiles** [h]	-	2	us	1
82	**Constants for computation of half-width**	-	24	do	3
83	**Switch for multiplication of VCM of retrieved profile with factor chi^2 for optimum estimate** [i]	-	2	us	1
84	**Sampling interval of x coordinate of Voigt LUT**	-	8	do	1
85	**Sampling interval of y coordinate of Voigt LUT**	-	8	do	1
86	**Reference half width exponent of lineshape to be computed**	-	8	do	1
84	**Reference half-width of lineshape to be computed**	cm^{-1}	8	do	1
85	**Vector of relative estimated standard deviation (ESD) for IG2 temperature profiles**	%	8 × nEsdIG2	do	nEsdIG2
86	**Altitude vector for ESD of IG2 temperature profiles**	km	8 × nEsdIG2	do	nEsdIG2
87	**Correlation length of estimated IG2 VCM**	km	8	do	1
88	**Vector of relative estimated standard deviation (ESD) for IG2 merged with ECMWF temperature profiles**	%	8 × nEsdECMWF	do	nEsdECMWF
89	**Altitude vector for ESD of IG2 merged with ECMWF temperature profiles**	km	8 × nEsdECMWF	do	nEsdECMWF

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
90	**Correlation length of Estimated IG2+ECMWF VCM**	km	8	do	1
91	**Time constant aging VCM of retrieved profiles**	s	8	do	1
92	**Coefficient A for Tropopause Altitude Correction**	km	8	do	1
93	**Coefficient B for Tropopause Altitude Correction**	km	8	do	1
94	**Coefficient C for Tropopause Altitude Correction**	km	8	do	1
95	**Maximum distance of simulated geometries below tropopause**	km	8	do	1
96	**Maximum distance of simulated geometries above tropopause**	km	8	do	1
97	**Switch for enabling profile regulation**	-	2	us	1
98	**Parameter for tuning profile regulation**	-	8	do	1
99	**Diagonal and first off-diagonal element of regularisation matrix referring to pressure**	-	16	do	2
100	**Diagonal and first off-diagonal element of regularisation matrix referring to temperature**	-	16	do	2
101	**Diagonal and first off-diagonal element of regularisation matrix referring to continuum**	-	16	do	2
102	**Diagonal and first off-diagonal element of regularisation matrix referring to offset**	-	16	do	2
103	**Switch for usage of FOV tabulated function**	-	2	us	1
104	**Maximum number of simulated geometries for FOV**	-	2	us	1
105	**Number of points for FOV tabulation for spectral band 1 (band A)** $[N_{FOV}]^k$	-	2	us	1
106	**Heights of FOV function for band 1**	-	$8 \times N_{FOV}$	do	N_{FOV}
107	**Grid for FOV function**	-	$8 \times N_{FOV}$	do	N_{FOV}

Table 12.6.8.1.2-1 p,T Retrieval GADS

N	Description	Units	Byte Length	Data Type	Dim.
	for band 1				
Structure of fields #105 and #107 is repeated for spectral bands #2... #5 (bands AB, B, C, D), using NFOV (i), (j = 2,..., 5), respectively					
108	**Allowed fraction of error bar variation**	-	8	do	1
109	**Allowed factor of vertical resolution worsening**	-	8	do	1
110	**Maximal value for the lambda profile**	-	8	do	1
111	**Constants ensuring positive exponents < 1**	-	8	do	1
TOTAL			**GADS size** [j]		

a. **0: don't use a priori pointing information**
1: use during retrieval
2: use after retrieval

b. **0: disable constraining**
1: enable constraining

c. **0: don't use prestored spectra and jacobian matrix**
1: use prestored spectra and jacobian matrix if available

d. **0: exclude continuum and offset**
1: include continuum, exclude offset
2: include continuum and offset

e. **-1: no interpolation, all cross sections**
0: all above the lowest geometry are interpolated
1: new calculation only for tangent layer
2: new calculation for tangent layer and one layer above

f. **0: don't use cross sections lookup tables**
1: use available cross sections lookup tables

g. **0: no factor**
1: N_2/O_2 broadening
2: N_2 broadening only

h. **0: don't use previous retrieved profiles**
1: use previous retrieved profiles if available

i. **0: deactivate multiplication**
1: activate multiplication

j. **GADS size = 736 + 18 * NumbMod + 16 * $nEsd_{IG2}$ + 16 * $nEsd_{ECMWF}$ + 16x5 * N_{FOV}**

k. **structure of fields #105 and #107 is repeated for spectral bands #2... #5 (bands AB, B, C, D), using N_{FOV} (i), (i = 2,..., 5), respectively**

12.6.8.1.3 VMR Retrieval Parameters GADS

There are 30 GADSRs in this GADS. Each GADSR contains the information for one species. The order of GADSRs is: H2O, O3, HNO3, CH4, N2O, NO2, F11, CLNO, N2O5, F12, COF2, CCL4, HCN, F14, F22, 15 spare species.

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Minimum value used to check non-singularity of matrix**	-	8	do	1
4	**Switch for usage of matrix S in p,T error propagation**[a]	-	2	uc	2
5	**Switch to enable linear FOV convolution**	-	2	us	1
6	**Number of elements of the estimated standard deviation (ESD) vector for IG2 VMR profile:[nEsdIG2]**	-	2	us	1
7	**Number of elements of the estimated standard deviation (ESD) vector for "ECMWF merged with IG2"VMR profile: nEsdECMWF**	-	2	us	1
8	**Spare**	-	6	uc	6
9	**Maximum number of elements in profiles**	-	2	us	1
10	**Number of allowed unsuccessful previous retrievals**	-	2	us	1
11	**Enhanced spectral range of MW's used to decide whether a line inside the MW shall be considered as line or as nearby continuum**	cm^{-1}	8	do	1
12	**Maximum number of spectral samples on fine grid**	-	2	us	1
13	**Threshold to check convergence of chi-square**	-	8	do	1
14	**Threshold to check convergence of fitted VMR**	-	8	do	1
15	**Switch for choosing between different ways to calculate VCM and AKM**	-	2	us	2

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
16	**Maximum number of Gauss-Newton macro-iterations**	-	2	us	1
17	**Switch for handling the fitting of the continuum profile**	-	2	us	2
18	**Maximum number of Marquardt micro-iterations**	-	2	us	1
19	**Lower threshold of estimated VMR**	ppm	8	do	1
20	**Upper threshold of estimated VMR**	ppm	8	do	1
21	**Lower threshold of estimated continuum parameter**	cm^2	8	do	1
22	**Upper threshold of estimated continuum parameter**	cm^2	8	do	1
23	**Number of modes for thresholds (NumbMod)**	-	2	us	1
23.2	**Number of sweeps characterizing each mode**	-	NumbMod×2	NumbMod×us	1
23.4	**Vector of thresholds to check the size of chisquare**	-	NumbMod×8	NumbMod×double	1
23.6	**Vectot of thresholds to check Marquardt parameter**	-	NumbMod×8	NumbMod×double	1
23.8	**Threshold to check the chi-square variation between previous and current iteration**	-	8	double	1
23.9	**Threshold to check the variation of weighted L2-norm of parameters**	-	8	double	1
24	**Difference between spectral resolution of general fine wavenumber grid and spectral grid of cross section look-up tables**	cm^{-1}	8	do	1
25	**Control parameter for fitting of continuum and instrumental offset**[b]	-	2	us	1
26	**Upper altitude limit where continuum shall be fitted**	km	8	do	1

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
27	**Tangent height above which offsets are to be fitted**	km	8	do	1
28	**Maximum number of fitted parameters**	-	2	us	1
29	**Overlap of spectral range between two adjacent MW's**	%	8	do	1
30	**Altitude above which the continuum shall be set to zero**	km	8	do	1
31	**Central wavenumber of the line used as reference**	cm^{-1}	8	do	1
32	**Coefficient of temperature dependence of Lorentz half-width of the line used as reference**	-	8	do	1
33	**Guess of altitude increment above highest level**	km	8	do	1
34	**Reduction factor applied to guess of altitude increment**	-	8	do	1
35	**Upper limit of atmosphere**	km	8	do	1
36	**Half-width of the line used as reference**	cm^{-1}	8	do	1
37	**Maximum allowed temperature variation between atmospheric levels for lower altitudes**	K	8	do	1
38	**Maximum allowed temperature variation between atmospheric levels for higher altitudes**	K	8	do	1
39	**Altitude threshold where temperature thresholds are changed**	km	8	do	1
40	**Maximum allowed variation of half-width of the line between adjacent atmospheric levels**	cm^{-1}	8	do	1
41	**Number of maximum levels for modelling of the atmosphere**	-	2	us	1
42	**Maximum number of different gases**	-	2	us	1
43	**Maximum number of simulated geometries**	-	2	us	1
44	**Maximum number of parameters to be retrieved for VMR and continuum**	-	2	us	1

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
45	**Coefficients for latitude dependent correction of gravity acceleration**	-	16	do	2
46	**Approximation error of integrals (Curtis-Godson)**	-	8	do	1
47	**Initial temperature of perturbed equivalent temperature**	K	8	do	1
48	**Maximum number of layers**	-	2	us	1
49	**Minimum number of samples at which the integrand of each integral shall be computed**	-	2	us	1
50	**Maximum number of elements in base profiles**	-	2	us	1
51	**Minimum value of integration variable**	-	8	do	1
52	**Number of additional IAPT numbers for each geometry above the lowest geometry**	-	2	us	1
53	**Reference equivalent pressure at equivalent reference temperature used for line computation**	hPa	8	do	1
54	**Equivalent reference temperature**	K	8	do	1
55	**Multiplier for Lorentz and Doppler half width used for Lorentz lineshape computations on the local coarse wavenumber grid**	-	8	do	1
56	**Multiplier for Doppler half width used for Voigt lineshape computations on the local fine wavenumber grid**	-	8	do	1
57	**Switch for interpolation of absorption cross sections for geometries above the lowest geometry**[c]	-	2	ss	1
58	**Switch for usage of cross section lookup tables**[d]	-	2	us	1
59	**Spare**	-	6	uc	6
60	**HITRAN code of the lineshape to be precom-puted**	-	2	us	1
61	**Isotope number of lineshape to be precom-puted**	-	2	us	1

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
62	**Switch for computation of CO2 chi factor[e]**	-	2	us	1
63	**Reference half width exponent of lineshape to be computed**	-	8	do	1
64	**Reference half-width of lineshape to be computed**	cm^{-1}	8	do	1
65	**Multiplication factor applied to approximate Voigt half width to determine the local fine grid**	-	8	do	1
66	**Multiplier for definition of local coarse wave-number grid**	-	2	us	1
67	**Spare**	-	8	uc	8
68	**Number of samples along x coordinate**	-	2	us	1
69	**Number of samples along y coordinate**	-	2	us	1
70	**Greater base of trapezium defining the vertical FOV**	km	8	do	1
71	**Smaller base of trapezium defining the vertical FOV**	km	8	do	1
72	**Spare**	-	16	uc	16
73	**Scaling factor used to scale base VMR profile**	-	8	do	1
74	**Threshold of temperature difference between two model layers**	K	8	do	1
75	**Lambda damping factor**	-	8	do	1
76	**Scaling of lambda damping factor related to continuum parameters**	-	8	do	1
77	**Scaling factor used to decrease λ at each macro iteration**	-	8	do	1
78	**Scaling factor used to increase λ at each micro iteration**	-	8	do	1
79	**Switch for usage of previous retrieved profiles[f]**	-	2	us	1
80	**Spare**	-	2	uc	2
81	**VCM threshold used to check the maximum error of retrieved VMR**	ppm	8	do	1
82	**Constants for computation of half-width**	-	24	do	3

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
83	**Switch for multiplication of VCM of retrieved profile with factor chi²for optimum estimateg**		2	us	1
84	**Spare**	-	6	uc	6
85	**Sampling interval of x coordinate of Voigt LUT**	-	8	do	1
86	**Sampling interval of y coordinate of Voigt LUT**	-	8	do	1
87	**Vector of relative estimated standard deviation (ESD) for IG2 VMR profiles**	%	8 × nEsdIG2	do	nEsdIG2
88	**Altitude vector for ESD of IG2 VMR profiles**	km	8 × nEsdIG2	do	nEsdIG2
89	**Correlation length of estimated IG2 VCM**	km	8	do	1
90	**Vector of relative estimated standard deviation (ESD) for IG2 merged with ECMWF VMR profiles**	%	8 × nEsdECMWF	do	nEsdECMWF
91	**Altitude vector for ESD of IG2 merged with ECMWF VMR profiles**	km	8 × nEsdECMWF	do	nEsdECMWF
92	**Correlation length of Estimated IG2+ECMWF VCM**	km	8	do	1
93	**Time constant aging VCM of retrieved profiles**	s	8	do	1
94	**Coefficient A for Tropopause Altitude Correction**	km	8	do	1
95	**Coefficient B for Tropopause Altitude Correction**	km	8	do	1
96	**Coefficient C for Tropopause Altitude Correction**	km	8	do	1
97	**Maximum distance of simulated geometries below tropopause**	km	8	do	1
98	**Maximum distance of simulated geometries above tropopause**	km	8	do	1
99	**Switch for enabling profile regulation**	-	2	us	1
100	**Parameter for tuning profile regulation**	-	8	do	1

Table 12.6.8.1.3-1 VMR Retrieval Parameters GADSR

N	Description	Units	Byte Length	Data Type	Dim.
101	**Diagonal and first off-diagonal element of regularisation matrix referring toVMR**	-	16	do	2
102	**Diagonal and first off-diagonal element of regularisation matrix referring to continuum**	-	16	do	2
103	**Diagonal and first off-diagonal element of regularisation matrix referring to offset**	-	16	do	2
104	**Switch for usage of FOV tabulated function**	-	2	us	1
105	**Maximum number of simulated geometries for FOV**	-	2	us	1
106	**Number of points for FOV tabulation for spectral band 1(band A) [N_{FOV}] [I]**	-	2	us	1
107	**Heights of FOV function for band 1**	-	$8 \times N_{FOV}$	do	N_{FOV}
108	**Grid for FOV function for band 1**	-	$8 \times N_{FOV}$	do	N_{FOV}
Structure of fields #106 and #108 is repeated for spectral bands #2... #5 (bands AB, B, C, D), using NFOV (i), (j = 2,..., 5), respectively					
109	**Allowed fraction of error bar variation**	-	8	do	1
110	**Allowed factor of vertical resolution worsening**	-	8	do	1
111	**Allowed factor of vertical resolution worsening**	-	8	do	1
112	**Constants ensuring positive exponents < 1**	-	8	do	1
TOTAL			**DSR size[h]**		

a. **0:** **don't use matrix S, always simplified approach**
1: **use matrix S, if available**

b. **0:** **exclude continuum and offset**
1: **include continuum, exclude offset**
2: **include continuum and offset**

c. **-1:** **no interpolation, all cross sections**
0: **all above the lowest geometry are interpolated**
1: **new calculation only for tangent layer**
2: **new calculation for tangent layer and one layer above**

d. **0:** **don't use cross sections lookup tables**
1: **use available cross sections lookup tables**

e. **0:** **no factor**
1: **N_2/O_2 broadening**

2: N_2 **broadening only**

f. 0: **don't use previous retrieved profiles**
1: **use previous retrieved profiles if available**

g. 0: **deactivate multiplication**
1: **activate multiplication**

h. **DSR size = 700 + 18 * NumbMod + 16 * $nEsd_{IG2}$ + 16* $nEsd_{ECMWF}$ + 5x16 * N_{FOV}**

I **Structure of fields #106 and #108 is repeated for spectral bands #2... #5 (bands AB, B, C, D), using N_{FOV} (i), (i = 2,..., 5), respectively**

II **Above DSR structure repeated for species #2, ..., #30.**
Data for VMR retrievals is ordered H2O, O3, HNO3, CH4, N2O, NO2, F11, CLNO, N2O5, F12, COF2, CCL4, HCN, F14, F22, 15 spare species.

12.6.9 Level 2 Microwindows Data File

This file describes a set of spectral intervals to be extracted from the Level 1B data for the subsequent retrieval steps. For each spectral interval (microwindow) the valid altitude range, information on spectral range of continuum, sensitivity and correlation parameters, NLTE quantifiers, NESR, and contributions to the systematic/random retrieval error is given. Cloud detection microwindow pairs are contained within the p,T retrieval microwindows with some of the fields having different meanings or set to default values.

FILE ID: **MIP_MW2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: every several months

SIZE: MPH (1247 bytes) + SPH (17 458 bytes) + DSRs (6 986 SP2873 bytes[7]) = ca. 7.0 MBytes

12.6.9.1 Format

The high level format of the file is shown below:

Table 12.6.9.1-1 Level-2 Microwindows data structure

MPH

[7] *Assumption: N_{Alt} = 20, N_{pT} = $N_{V(i)}$ = 180, N_{WN} = 25, N_p = 1970, N_g = 5, N_M = 10*

Auxiliary Data SPH (see Volume 16) with 62 DSDs: • DSD for the p,T Retrieval MicroWindows ADS • 30 DSD for the VMR Retrieval MicroWindows ADSs • DSD for the p,T Retrieval MicroWindows MDS • 30 DSD for the VMR Retrieval MicroWindows MDSs
p,T Retrieval Microwindows ADS
Species #1 VMR Retrieval Microwindows ADS This structure is repeated for species #2 to species #30
p,T Retrieval Microwindows MDS
Species #1 VMR Retrieval Microwindows MDS This structure is repeated for species #2 to species #30

MDS#1 p,T Retrieval MicroWindows

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.9.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (A) for p, T Retrieval MicroWindows ADS	PT MICROWINDOWS ADS
DSD (A) for VMR #1 Retrieval MicroWindows ADS	H2O MICROWINDOWS ADS
DSD (A) for VMR #2 Retrieval MicroWindows ADS	N2O MICROWINDOWS ADS
DSD (A) for VMR #3 Retrieval MicroWindows ADS	HNO3 MICROWINDOWS ADS
DSD (A) for VMR #4 Retrieval MicroWindows ADS	CH4 MICROWINDOWS ADS
DSD (A) for VMR #5 Retrieval MicroWindows ADS	O3 MICROWINDOWS ADS
DSD (A) for VMR #6 Retrieval MicroWindows ADS	NO2 MICROWINDOWS ADS
DSD (A) for VMR #7 Retrieval MicroWindows ADS	F11 MICROWINDOWS
DSD (A) for VMR #8 Retrieval MicroWindows ADS	CLNO MICROWINDOWS ADS
DSD (A) for VMR #9 Retrieval MicroWindows ADS	N2O5 MICROWINDOWS ADS
DSD (A) for VMR #10 Retrieval MicroWindows ADS	F12 MICROWINDOWS ADS
DSD (A) for VMR #11 Retrieval MicroWindows ADS	CCL4 MICROWINDOWS ADS
DSD (A) for VMR #12 Retrieval MicroWindows ADS	COF2 MICROWINDOWS ADS

DSD (A) for VMR #13 Retrieval MicroWindows ADS	F14 MICROWINDOWS ADS
DSD (A) for VMR #14 Retrieval MicroWindows ADS	F22 MICROWINDOWS ADS
DSD (A) for VMR #15 Retrieval MicroWindows ADS	HCN MICROWINDOWS ADS
DSD (A) for VMR #16, ... to VMR #30 Retrieval MicroWindows ADS	SPARE GAS MICROWINDOWS ADS
DSD (M) for p, T Retrieval MicroWindows MDS	PT MICROWINDOWS MDS
DSD (M) for VMR #1 Retrieval MicroWindows MDS	H2O MICROWINDOWS MDS
DSD (M) for VMR #2 Retrieval MicroWindows MDS	N2O MICROWINDOWS MDS
DSD (M) for VMR #3 Retrieval MicroWindows MDS	HNO3 MICROWINDOWS MDS
DSD (M) for VMR #4 Retrieval MicroWindows MDS	CH4 MICROWINDOWS MDS
DSD (M) for VMR #5 Retrieval MicroWindows MDS	O3 MICROWINDOWS MDS
DSD (M) for VMR #6 Retrieval MicroWindows MDS	NO2 MICROWINDOWS MDS
DSD (M) for VMR #7 Retrieval MicroWindows MDS	F11 MICROWINDOWS MDS
DSD (M) for VMR #8 Retrieval MicroWindows MDS	CLNO MICROWINDOWS MDS
DSD (M) for VMR #9 Retrieval MicroWindows MDS	N2O5 MICROWINDOWS MDS
DSD (M) for VMR #10 Retrieval MicroWindows MDS	F12 MICROWINDOWS MDS
DSD (A) for VMR #11 Retrieval MicroWindows MDS	CCL4 MICROWINDOWS MDS
DSD (A) for VMR #12 Retrieval MicroWindows MDS	COF2 MICROWINDOWS MDS
DSD (A) for VMR #13 Retrieval MicroWindows MDS	F14 MICROWINDOWS MDS
DSD (A) for VMR #14 Retrieval MicroWindows MDS	F22 MICROWINDOWS MDS
DSD (A) for VMR #15 Retrieval MicroWindows MDS	HCN MICROWINDOWS MDS
DSD (A) for VMR #16, ... to VMR #30 Retrieval MicroWindows MDS	SPARE GAS MICROWINDOWS MDS

12.6.9.1.1 p,T Retrieval MicroWindows ADS + CD Microwindows Pairs [8]

There is one ADSR in this ADS for all p,T retrieval microwindows. The structure of the ADSR is shown below.

Table 12.6.9.1.1-1 p, T Retrieval MicroWindows ADSR

[8] Sequence of DSRs referring to CD MW pairs according priority (1st pair has highest priority)

N	Description	Units	Byte Length	Data Type	Dimension
1	**Time of creation**	-	12	mjd	1
2	**Attachment flag**[a]	-	1	uc	1
3	**Height of tropopause for p,T retrieval microwindows**	km	8	do	1
4	**Number of p,T retrieval microwindows (including CD microwindow pairs) [N_{pT}]**[b]	-	2	us	1
5	**Label of p,T microwindow #i (i = 1, ... , N_{pT})**	-	8 × N_{pT}	uc	8 × N_{pT}
6	**Offset of DSR within the MDS (for p,T retrieval microwindows) containing data for p,T microwindow #i** (i = 1, ... , N_{pT})	-	4 × N_{pT}	ul	N_{pT}
TOTAL			**23 + 12×N_{pT}**		

a. **0: at least one DSR is contained in the MDS associated with this ADSR**
1: no DSR contained in the MDS associated with this ADSR.

b. **Each cloud detection microwindow pair counts 1.**

12.6.9.1.2 Species VMR Retrieval MicroWindows ADSs

There is one ADS per species #j : species #1 VMR retrieval microwindow ADS to species #30 VMR retrieval microwindow ADS.
There is one ADSR in each of these ADSs for all VMR retrieval microwindows. The structure of the ADSR is shown below.

Table 12.6.9.1.2-1 Species VMR Retrieval MicroWindows ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Attachment flag** [a]	-	1	uc	1
3	**Height of tropopause for species #j VMR retrieval microwindows**	km	8	do	1
4	**Number of species #j VMR retrieval micro-windows [$N_{V(j)}$]**	-	2	us	1
5	**Label of species #j VMR microwindow #i** (i = 1, ... , $N_{V(j)}$)	-	8 × $N_{V(j)}$	uc	8 × $N_{V(j)}$
6	**Offset of DSR within the MDS (for species #j VMR retrieval microwindows) containing data for species #j VMR microwindow #i** (i = 1, ... , $N_{V(j)}$)	-	4 × $N_{V(j)}$	ul	$N_{V(j)}$
TOTAL			**23 + 12×$N_{V(j)}$**		

a. **0: at least one DSR is contained in the MDS associated with this ADSR**
1: no DSR contained in the MDS associated with this ADSR.

12.6.9.1.3 p, T Retrieval MicroWindows MDS

There is one MDSR in this MDS for each p,T retrieval microwindows. The structure of the MDSR is shown below.

Table 12.6.9.1.3-1 p,T Retrieval MicroWindows MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator** (always set to zero for this MDS)	-	1	sc	1
4	**Microwindow identifier** [a]	-	8	uc	8
5	**Lowest wavenumber CD microwindow pairs: Lowest wavenumber of 1st MW.**	cm^{-1}	8	do	1
6	**Highest wavenumber CD microwindow pairs: Highest wavenumber of 1st MW**	cm^{-1}	8	do	1
7	**Spacing of wavenumber grid**	cm^{-1}	8	do	1
8	**Number of wavenumber grid points [NWN] CD microwindow pairs: Number of wavenumber grid points within 1st MW**	-	2	us	1
9	**Lowest latitude where MW is valid**	deg	8	do	1
10	**Highest latitude where MW is valid**	deg	8	do	1
11	**Number of altitudes [N_{Alt}]**	-	2	us	1
12	**Tangent altitude #i (i = 1, ... , N_{Alt})**	km	$8 \times N_{Alt}$	do	N_{Alt}
13	**Lower and upper border of region of linear continnum for altitudes #i** (i = 1, ... , NAlt) **CD microwindow pairs: 1st element: cloud index threshold for altitude #i. 2nd element zero.**	km	$16 \times N_{Alt}$	do	$2 \times N_{Alt}$
14	**Spacing of fine grid CD microwindow pairs: same value as field #7**	cm^{-1}	8	do	1
15	**Number of fine grid points for irregular grid [Np] CD microwindow pairs: Number of wavenumber grid points within 2nd MW**	-	2	us	1
16	**Wavenumber of first fine grid point CD microwindow pairs: Lowest wavenumber of 2nd MW**	cm^{-1}	8	do	1
17	**Bitvector indicating fine grid points to be used for compressed grid** [b]	-	ceil(Np/8)	uc	ceil (Np/8)
18	**Number of compressed grid points** [c d]	-	2	us	1
19	**Flag indicating interpolation method** [e f]	-	2	us	1
20	**Number of gases [Ng]** [g]	-	2	us	1

N	Description	Units	Byte Length	Data Type	Dim.
21	**HITRAN codes of gases**	-	2 × Ng	us	Ng
22	**Number of spectral masks [N_M]**[h]	-	2	us	1
23	**Lower altitude border for mask #i** (i = 1, ..., N_M)	km	8 × N_M	do	N_M
24	**Upper altitude border for mask #i** (i = 1, ..., N_M)	km	8 × N_M	do	N_M
25	**Spectral Masks #i** [i] (i = 1, ..., N_M ; N_{WN} bytes per spectral mask)	-	N_M × N_{WN}	uc	N_M × N_{WN}
TOTAL			**DSR Size** [j]		

a. **Format GGGGNNNN;**
GGGG: main gas (trailing blanks filled with '_'), for p,T, MWs = 'PT__', for CD MW pairs='CD__'; NNNN: number of microwindow (with leading '0').

b. **The leftmost bit refers to the first wavenumber point of the fine grid. All bytes set to zero for cloud detection MW pairs.**

c. **Number of '1' bits in bitvector.**

d. **Set to 0 for cloud detection MW pairs**

e. **0:** **No irregular grid available,**
1: **Linear interpolation; the first and last valid bit must be set to 1,**
3: **Cubic interpolation; the leftmost 2 bits and the rightmost 2 bits must be set to 1.**

f. **Set to 0 for cloud detection MW pairs**

g. **Set to 0 for cloud detection MW pairs**

h. **Set to 0 for cloud detection MW pairs**

i. **Masks are ordered according to ascending altitudes.**

j. **DSR size = $95 + 24*N_{Alt} + 2*N_g + ceil(N_p/8) + (16+N_{WN})*N_M$**

12.6.9.1.4 Species VMR Retrieval MicroWindows (+ CD Microwindows pairs[9])

There is one MDS per species #j : species #1 VMR retrieval microwindow MDS to species #30 VMR retrieval microwindow MDS, ordered H2O, N2O, HNO3, CH4, O3, NO2, F11, ClONO2, N2O5, F12, CCl4, COF2, F14, F22, HCN, and 15 spare species. In each MDS, there is one MDSR each species #j VMR retrieval microwindows. The structure of the MDSR is shown below.

[9] *Sequence of DSRs referring to CD MW pairs according priority (1st pair has highest priority)*

Table 12.6.9.1.4-1 VMR Retrieval MicroWindows MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator** (always set to zero for this MDS)	-	1	sc	1
4	**Microwindow identifier** [a]	-	8	uc	8
5	**Lowest wavenumber**	cm^{-1}	8	do	1
6	**Highest wavenumber**	cm^{-1}	8	do	1
7	**Spacing of wavenumber grid**	cm^{-1}	8	do	1
8	**Number of wavenumber grid points [N_{WN}]**	-	2	us	1
9	**Lowest latitude where MW is valid**	deg	8	do	1
10	**Highest latitude where MW is valid**	deg	8	do	1
11	**Number of altitudes [NAlt]**	-	2	us	1
12	**Tangent altitude #i** (i = 1, ... , NAlt)	km	8 × NAlt	do	NAlt
13	**Lower and upper border of region of linear continnum for altitudes #i** (i = 1, ... , NAlt)	km	16 × NAlt	do	2 × NAlt
14	**Spacing of fine grid**	cm^{-1}	8	do	1
15	**Number of fine grid points for irregular grid [Np]**	-	2	us	1
16	**Wavenumber of fine grid point**	cm^{-1}	8	do	1
17	**Bitvector indicating fine grid points to be used for compressed grid** [b]	-	ceil(Np/8)	uc	ceil (Np/8)
18	**Number of compressed grid points** [c]	-	2	us	1
19	**Flag indicating interpolation method** [d]	-	2	us	1
20	**Number of gases [Ng]**	-	2	us	1
21	**HITRAN codes of gases**	-	2 × Ng	us	Ng
22	**Number of spectral masks [N_M]**	-	2	us	1
23	**Lower altitude border for mask #i** (i = 1, ..., N_M)	km	8 × N_M	do	N_M
24	**Upper altitude border for mask #i** (i = 1, ..., N_M)	km	8 × N_M	do	N_M
25	**Spectral Masks #i** [e] (i = 1, ..., N_M ; N_{WN} bytes per spectral mask)	-	N_M × N_{WN}	uc	N_M × N_{WN}
TOTAL			**DSR Size** [f]		

a. **Format GGGGNNNN; GGGG: main gas (trailing blanks filled with '_'); NNNN: number of microwindow (with leading '0').**
b. **The leftmost bit referres to the first wavenumber point of the fine grid.**
c. **Number of '1' bits in bitvector.**
d. **0: No irregular grid available,**
1: Linear interpolation; the first and last valid bit must be set to 1,
3: Cubic interpolation; the leftmost 2 bits and the rightmost 2 bits must be set to 1.
e. Masks are ordered according to ascending altitudes.
f. DSR size = 95 + 24*NAlt + 2*Ng + ceil(Np/8) + (16+NWN)*NM

12.6.10 Spectroscopic Data file

This input data is used in forward calculation for the simulation of atmospheric spectra. Spectroscopic data are provided for each microwindow as defined in the microwindows data file.

FILE ID: **MIP_SP2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: every several months

SIZE: MPH (1247 bytes) + SPH (9058 bytes) + DSRs (874 944 899 bytes [10]) = ca. 875 MBytes

12.6.10.1 Format

The high level format of the file is shown below:

Table 12.6.10.1-1 Spectroscopic data structure

MPH
Auxiliary Data SPH (see volume 16) with 32 DSDs: • DSD for the p,T Retrieval Micro Windows ADS • 30 DSD for the VMR Retrieval Micro Windows ADSs • DSD for the Spectral Lines MDS
p,T Retrieval Microwindows ADS
Species#1 VMR Retrieval Microwindows ADS This structure is repeated for species #2 to species #30
Spectral Lines MDS

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters

[10] *Assumption: $N_{p,T} = N_{V(1)} = ... = N_{V(6)} = 180$; 3200 lines per microwindow*

set to blank space characters:

Table 12.6.10.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (A) for p, T Retrieval MicroWindows ADS	PT MICROWINDOWS ADS
DSD (A) for VMR #1 Retrieval MicroWindows ADS	H2O MICROWINDOWS ADS
DSD (A) for VMR #2 Retrieval MicroWindows ADS	N2O MICROWINDOWS ADS
DSD (A) for VMR #3 Retrieval MicroWindows ADS	HNO3 MICROWINDOWS ADS
DSD (A) for VMR #4 Retrieval MicroWindows ADS	CH4 MICROWINDOWS ADS
DSD (A) for VMR #5 Retrieval MicroWindows ADS	O3 MICROWINDOWS ADS
DSD (A) for VMR #6 Retrieval MicroWindows ADS	NO2 MICROWINDOWS ADS
DSD (A) for VMR #7 Retrieval MicroWindows ADS	F11 MICROWINDOWS ADS
DSD (A) for VMR #8 Retrieval MicroWindows ADS	CLNO MICROWINDOWS ADS
DSD (A) for VMR #9 Retrieval MicroWindows ADS	N2O5 MICROWINDOWS ADS
DSD (A) for VMR #10 Retrieval MicroWindows ADS	F12 MICROWINDOWS ADS
DSD (A) for VMR #11 Retrieval MicroWindows ADS	CCL4 MICROWINDOWS ADS
DSD (A) for VMR #12 Retrieval MicroWindows ADS	COF2 MICROWINDOWS ADS
DSD (A) for VMR #13 Retrieval MicroWindows ADS	F14 MICROWINDOWS ADS
DSD (A) for VMR #14 Retrieval MicroWindows ADS	F22 MICROWINDOWS ADS
DSD (A) for VMR #15 Retrieval MicroWindows ADS	HCN MICROWINDOWS ADS
DSD (A) for VMR #16, ... to VMR #30 Retrieval MicroWindows ADS	SPARE GAS MICROWINDOWS ADS
DSD (M) for Spectral Lines MDS	SPECTROSCOPIC LINES MDS

12.6.10.1.1 p, T Retrieval MicroWindows ADS

This ADS contains $N_{p,T}$ ADSRs (one ADSR per p,T Retrieval Microwindow). The format of each ADSR is shown in the table below.

Table 12.6.10.1.1-1 p,T Retrieval MicroWindows ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1

2	**Attachment flag** (always set to zero for this ADS)	-	1	uc	1
3	**Microwindow identifier** [a] (8 character string)	ascii	8	uc	8
4	**Number of spectral lines**	-	4	ul	1
5	**DSR in Spectral Lines MDS containing data of first line** [b]	-	4	ul	1
TOTAL			**29**		

a. Same identifier as in MIP_MW2_AX

b. 0 refers to first DSR of MDS, spectral lines belonging to the same microwindow are contained in consecutive DSR

12.6.10.1.2 VMR Retrieval MicroWindows ADSs

There is one ADS per species, ordered H2O, N2O, HNO3, CH4, O3, NO2, F11, ClONO2, N2O5, F12, CCl4, COF2, F14, F22, HCN, and 15 spare species. Each ADS for Species #j VMR Retrieval Microwindows contains $N_{V(j)}$ ADSRs (one ADSR per microwindow). The format of each ADSR is shown in the table below.

Table 12.6.10.1.2-1 VMR Retrieval MWs ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Attachment flag** (Always set to zero for this ADS)	-	1	uc	1
3	**Microwindow identifier** [a] (8 character string)	ascii	8	uc	8
4	**Number of spectral lines**	-	4	ul	1
5	**DSR in Spectral Lines MDS containing data of first line** [b]	-	4	ul	1
TOTAL			**29**		

a. Same identifier as in MIP_MW2_AX

b. 0 refers to first DSR of MDS, spectral lines belonging to the same microwindow are contained in consecutive DSR

12.6.10.1.3 Spectral Lines MDS

This MDS contains several MDSRs. There is one MDSR for each line of each MW.

Table 12.6.10.1.3-1 Spectral Lines MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)** [a]	-	1	sc	1
3	**Wavenumber**	cm^{-1}	8	do	1
4	**Intensity**	cm^{-1}/ molec×cm^{-2}	4	fl	1
5	**Air broadened half-width at 296K**	cm^{-1}	4	fl	1
6	**Coefficient of temperature dependence of air broadened half-width**	-	4	fl	1
7	**Lower state energy**	cm^{-1}	4	fl	1
8	**Flag for line wing treatment** [b]	-	2	us	1
9	**Isotope number**	-	2	us	1
10	**HITRAN molecular code**	-	2	us	1
11	**Upper limit where line has to be considered**	km	4	fl	1
12	**Lower limit where line has to be considered**	km	4	fl	1
TOTAL			**51**		

a. Always set to zero for this MDS
b. 0: interpolation possible
1: full treatment (calculation at each grid point in the MW)

12.6.11 Initial Guess Profile Data

This file includes initial guess profiles of pressure, temperature, VMR and continuum for different latitudes.

FILE ID: **MIP_IG2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: every several months

SIZE: MPH (1247 bytes) + SPH (9 898 bytes) + DSRs (13 803 574 bytes 11) = ca. 14.0 Mbytes.

12.6.11.1 12.6.11.1 Format

The high level format of the file is shown below:

Table 12.6.11.1-1 Initial Guess Profile data structure

[11] *Assumption: N_{alt} = 121, N_{lat} = 5, N_{gas} = 48, N_{pT} = $N_{V(i)}$ = 180*

MPH
Auxiliary Data SPH (see Volume 16) with 35 DSDs: • *DSD for the General GADS* • *DSD for the Pressure Profiles MDS* • *DSD for the Temperature Profiles MDS* • *DSD for the VMR Profiles MDS* • *DSD for the Continuum Profiles for p,T Retrieval MW MDS* • *30 DSD for the Continuum Profiles for VMR Retrieval MWs MDS*
General GADS
Pressure Profiles MDS
Temperature Profiles MDS
VMR Profiles MDS
Continuum Profiles for p,T Retrieval MW MDS
Species #1 Continuum Profiles MDS This structure is repeated for species #2 to species #30

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.11.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (G) for General GADS	INITIAL GUESS GENERAL DATA
DSD (M) for Pressure profiles MDS	PRESSURE PROFILES MDS
DSD (M) for Temperature profiles MDS	TEMPERATURE PROFILES MDS
DSD (M) for VMR profiles MDS	VMR PROFILES MDS
DSD (M) for Continuum profiles for p,T Retrieval MW MDS	PT MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #1 Retrieval MW MDS	H2O MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #2 Retrieval MW MDS	N2O MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #3 Retrieval MW MDS	HNO3 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #4 Retrieval MW MDS	CH4 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #5 Retrieval MW MDS	O3 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #6 Retrieval MW MDS	NO2 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #7 Retrieval MW MDS	F11 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #8 Retrieval MW MDS	CLNO MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #9 Retrieval MW MDS	N2O5 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #10 Retrieval MW MDS	F12 MW CONTINUUM PROF MDS

DSD (M) for Continuum profiles for VMR #11 Retrieval MW MDS	CCL4 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #12 Retrieval MW MDS	COF2 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #13 Retrieval MW MDS	F14 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #14 Retrieval MW MDS	F22 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #15 Retrieval MW MDS	HCN MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #16, ... to VMR #30 Retrieval MW MDS	SPARE MW CONTINUUM PROF MDS

12.6.11.1.1 General GADS

The format of the General GADS is defined below.

Table 12.6.11.1.1-1 General GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Number of latitude bands for which data is contained [N_{lat}]**	-	2	us	1
3	**Vector of latitude bands**	deg	Nlat×8	fl	Nlat×2
4	**Number of elements in altitude grid [N_{alt}]**	-	2	us	1
5	**Altitude grid**	km	Nalt×4	fl	Nalt
6	**Number of gases contained [N_{gas}]**	-	2	us	1
7	**HITRAN codes of gases**	-	Ngas×4	ul	Ngas
8	**Names of gases** (Each is a 16 character string)	ascii	Ngas×16	uc	Ngas×16
9	**Number of p,T microwindows [NpT]**	-	2	us	1
10	**p,T retrieval microwindow labels** [a] (each is an 8 character string)	ascii	NpT×8	uc	NpT× 8
11	**Number of species #i VMR microwindows, i = 1,...,30 [NV(i)]** [b]	-	60	us	30*us
12	**Species #1 VMR retrieval microwindow labels** (each is an 8 character string)[c]	ascii	NV(1) ×8	uc	NV(1)×8
Structure of field #12 is repeated for species #2,..., #30 VMR retrievals, using NV(j), (j = 2,..., 30), respectively					
TOTAL			**variable**		

a. Same label as in MIP_MW2_AX
b. Data concerning VMR retrieval species are ordered H2O, N2O, HNO3, CH4, O3, NO2, F11, ClONO2, N2O5, F12, CCl4, COF2, F14, F22, HCN, 15 spare species.

12.6.11.1.2 Pressure Profiles MDS

This MDS contains N_{lat} MDSRs (one MDSR per latitude). The format of each MDSR is described in the table below.

Table 12.6.11.1.2-1 Pressure Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Pressure profile**[b]	hPa	Nalt×4	fl	Nalt
TOTAL			**variable**		

a. Always set to zero for this MDS
b. Profiles are referred to altitude grid given in the General GADS

12.6.11.1.3 Temperature Profiles MDS

This MDS contains N_{lat} MDSRs (one MDSR per latitude). The format of each MDSR is described in the table below.

Table 12.6.11.1.3-1 Temperature Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Temperature profile**[b]	K	Nalt×4	fl	Nalt
TOTAL			**variable**		

a. Always set to zero for this MDS
b. Profiles are referred to altitude grid given in the General GADS

12.6.11.1.4 VMR Profiles MDS

This MDS contains N_{lat} MDSRs (one MDSR per latitude). The format of each MDSR is described in the table below.

Table 12.6.11.1.4-1 VMR Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dimension
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Day/Night flag**	-	Ngas*2	us	Ngas
4	**VMR profile for gas #1, day**[b]	ppm	Nalt*4	float	Nalt
5	**VMR profile for gas #1, night**[b]	ppm	Nalt*4	float	Nalt
TOTAL			**variable**		

a. Set to -1 if no VMR profiles contained, i.e. NV(j)=0, else set to zero
b. Structure repeated for gas #2,..., #Ngas

12.6.11.1.5 Continuum Profiles for p,T Retrieval MW's MDS

This MDS contains N_{lat} MDSRs (one MDSR per latitude). The format of each MDSR is described in the table below.

Table 12.6.11.1.5-1 Continuum Profiles for p,T Retrieval MWs MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Continuum profiles for p,T retrieval micro-window #i (i = 1, ..., NpT)** [b] (one continuum profile per p,T retrieval microwindow, each profile containing Nalt values)	cm^2	NpT×Nalt ×4	fl	NpT ×Nalt
TOTAL			**variable**		

a. Set to -1 if no continuum profiles for p,T MWs are contained, i.e. N_{pT}=0, else set to zero
b. Profiles are referred to altitude grid given in the General GADS

12.6.11.1.6 Continuum Profiles for VMR Retrieval MW's MDSs

There is one VMR continuum profile MDS per species #j (j = 1, ..., 30). Each MDS contains N_{lat} MDSRs. The format of each MDSR is described in the table below.

Table 12.6.11.1.6-1 Continuum Profiles for VMR Retrieval MWs MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Continuum profiles for species #j VMR retrieval microwindow #i (i = 1, ..., NV(j))** [b] (one continuum profile per species #j VMR retrieval microwindow, each profile containing Nalt values)	cm^2	NV(j) ×Nalt×4	fl	NV(j) ×Nalt
TOTAL			**variable**		

a. Set to -1 if no continuum profiles for species #j MWs are contained, i.e. $N_{V(j)}$=0, else set to zero
b. Profiles are referred to altitude grid given in the General GADS

12.6.12 Forward Calculation Results File

This file contains initial guess data copied from an initial guess data file and

the results of forward calculations based on this data.

FILE ID: **MIP_FM2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: every several months

SIZE: MPH (1247 bytes) + SPH (11 858 bytes) + DSRs (195 863 185 bytes [12]) = ca. 196 MBytes.

12.6.12.1 Format

The high level format of the file is shown below:

Table 12.6.12.1-1 Forward Calculation Results data structure

MPH
Auxiliary Data SPH (see Volume 16) with 42 DSDs: • *DSD for General GADS* • *DSD for Pressure Profiles MDS* • *DSD for Temperature Profiles MDS* • *DSD for VMR Profiles MDS* • *DSD for Continuum Profiles for p,T Retrieval MWs MDS* • *30 DSDs for Continuum Profiles for VMR Retrieval MWs MDSs* • *DSD for General Data for Forward Calculation GADS* • *DSD for Data Depending on Occupation Matrix Location of Results ADS* • *DSD for Microwindow grouping ADS* • *DSD for Spectra MDS* • *DSD for Values of Unknown Parameters MDS* • *DSD for Jacobian Matrices MDS* • *DSD containing reference to MIP_PS2_AX*
General GADS
Pressure Profiles MDS
Temperature Profiles MDS
VMR Profiles MDS
Continuum Profiles for p,T Retrieval MWs MDS

[12] Assumption: $N_{alt} = 121$, $N_{gas} = 48$, $N_{pT} = N_{V(i)} = 180$, $N_{lat} = 5$ $N_{geo} = 16$, $N_{sim}(i) = 11$, $N_{mw}(i) = 20$, $N_{sp}(i, j) = 25$, $N_{par}(i) = 16$, $N_{offset}(i) = 20$, $N_{cont}(i) = 50$ $N_{geo,cont} = 10$, $N_{MW,cont}(i) = 5$, $N_{MW,geo}(i) = 10$, $N_{holedMW} = 2$, $N_{holes}(i) = 1$, $N_{CC} = 2$, $N_{CC,geo}(i) = 2$ Each microwindow is selected at 8 altitudes

Species #1 Continuum Profiles Retrieval MWs MDS This structure is repeated for species #2 to species #30
General Data for Forward Calculation GADS
Data Depending on Occupation Matrix Location of Results ADS
Data for Microwindow Grouping ADS
Computed Spectra MDS
Values of Unknown Parameters MDS
Jacobian Matrices MDS

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.12.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (G) for General GADS	INITIAL GUESS GENERAL DATA
DSD (M) for Pressure profiles MDS	PRESSURE PROFILES MDS
DSD (M) for Temperature profiles MDS	TEMPERATURE PROFILES MDS
DSD (M) for VMR profiles MDS	VMR PROFILES MDS
DSD (M) for Continuum profiles for p,T Retrieval MW MDS	PT MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #1 Retrieval MW MDS	H2O MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #2 Retrieval MW MDS	N2O MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #3 Retrieval MW MDS	HNO3 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #4 Retrieval MW MDS	CH4 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #5 Retrieval MW MDS	O3 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #6 Retrieval MW MDS	NO2 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #7 Retrieval MW MDS	F11 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #8 Retrieval MW MDS	CLNO MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #9 Retrieval MW MDS	N2O5 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #10 Retrieval MW MDS	F12 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #11 Retrieval MW MDS	CCL4 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #12 Retrieval MW MDS	COF2 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #13 Retrieval MW MDS	F14 MW CONTINUUM PROF MDS

DSD (M) for Continuum profiles for VMR #14 Retrieval MW MDS	F22 MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #15 Retrieval MW MDS	HCN MW CONTINUUM PROF MDS
DSD (M) for Continuum profiles for VMR #16, ... to VMR #30 Retrieval MW MDS	SPARE MW CONTINUUM PROF MDS
DSD (G) for General Data for Forward Calculation GADS	FORWARD MODEL GENERAL DATA
DSD (A) for Data Depending on Occupation Matrix Location of Results ADS	MW OCCUPATION MATRIX ADS
DSD (A) for Data for Microwindow Grouping ADS	MW GROUPING ADS
DSD (M) for Spectra MDS	SIMULATED SPECTRA MDS
DSD (M) for Values of Unknown Parameters MDS	FITTED PARAMETERS MDS
DSD (M) for Jacobian Matrices MDS	JACOBI MATRICES MDS
DSD (R) for reference to MIP_PS2_AX	REFERENCE TO USED MIP_PS2_AX

12.6.12.1.1 General GADS

The format of the General GADS is defined below.

Table 12.6.12.1.1-1 General GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Number of latitude bands for which data is contained [Nlat]**	-	2	us	1
3	**Vector of latitude bands**	deg	Nlat×8	fl	Nlat×2
4	**Number of elements in altitude grid [Nalt]**	-	2	us	1
5	**Altitude grid**	km	Nalt*4	fl	Nalt
6	**Number of gases contained [Ngas]**	-	2	us	1
7	**HITRAN codes of gases**	-	Ngas×4	ul	Ngas
8	**Names of gases** (each is a 16 character string)	ascii	Ngas×16	uc	Ngas×16
9	**Number of p,T microwindows [NpT]**	-	2	us	1
10	**p,T retrieval microwindow labels** [a] (each is a 8character string)	ascii	NpT×8	uc	NpT×8
11	**Number of species #i VMR microwindows, i = 1,...,30 [NV(i)]** [b]	-	60	us	30×us
12	**Species #1 VMR retrieval microwindow labels** [a,b] (each is a 8character string)	ascii	NV(1) ×8	uc	NV(1) ×8
Structure of field #12 repeated for species #2,..., #30 VMR retrievals, using NV(j), (j = 2,..., 30), respectively					
TOTAL			**variable**		

a. Same label as in MIP_MW2_AX
b. Data concerning VMR retrieval species are ordered H2O, N2O, HNO3, CH4, O3, NO2, F11, ClONO2, N2O5, F12, CCL4, COF2, F14, F22, HCN, 15 spare species

12.6.12.1.2 Pressure Profiles MDS

This MDS contains N_{lat} MDSRs. The format of each MDSR is defined below.

Table 12.6.12.1.2-1 Pressure Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Pressure profile**[b]	hPa	Nalt×4	fl	Nalt
TOTAL			**variable**		

a. Always set to zero for this MDS
b. Profiles are referred to altitude grid given in the General GADS

12.6.12.1.3 Temperature Profiles MDS

This MDS contains N_{lat} MDSRs. The format of each MDSR is defined below.

Table 12.6.12.1.3-1 Temperature Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Temperature profile**[b]	K	Nalt×4	fl	Nalt
TOTAL			**variable**		

a. Always set to zero for this MDS
b. Profiles are referred to altitude grid given in the General GADS

12.6.12.1.4 VMR Profiles MDS

This MDS contains N_{lat} MDSRs. The format of each MDSR is defined below.

Table 12.6.12.1.4-1 VMR Profiles MDSR

N	Description	Units	Byte Length	Data Type	Dim.

1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Day/Night flag**	-	Ngas×2	us	Ngas×us
4	**VMR profile for gas #1, day**[b]	ppm	Nalt×4	float	Nalt×float
5	**VMR profile for gas #1, night**[b]	ppm	Nalt×4	float	Nalt×float
TOTAL			**variable**		

a. Set to -1 if no VMR profiles contained, i.e. N_{gas}=0, else set to zero
b. Profiles are referred to altitude grid given in the General GADS, one VMR profile per gas, each profile containing N_{alt} values.

12.6.12.1.5 Continuum Profiles for p,T Retrieval MWs MDS

This MDS contains N_{lat} MDSRs. The format of each MDSR is defined below.

Table 12.6.12.1.5-1 Continuum Profiles for p,T Retrieval MWs MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1
3	**Continuum profiles for p,T retrieval microwindow #i (i = 1, ... , NpT)** [b] (one continuum profile per p,T retrieval microwindow, each profile containing Nalt values)	cm^2	NpT×Nalt×4	fl	NpT×Nalt
TOTAL			**variable**		

a. Set to -1 if no continuum profiles for p,T MWs are contained, i.e. N_{pT}=0, else set to zero
b. Profiles are referred to altitude grid given in the General GADS

12.6.12.1.6 Continuum Profiles for VMR Retrieval MWs MDSs

There is one VMR continuum profile MDS per species #j (j = 1, ..., 30).

Each MDS contains N_{lat} MDSRs. The format of each MDSR is defined below.

Table 12.6.12.1.6-1 Continuum Profiles for VMR Retrieval MWs MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Quality indicator (PCD)**[a]	-	1	sc	1

3	**Continuum profiles for species #j VMR retrieval microwindow #i (i = 1, ... , NV(j))** [b] (one continuum profile per species #j VMR retrieval microwindow, each profile containing Nalt values)	cm^2	NV(j) ×Nalt×4	fl	NV(j)×Nalt
TOTAL			**variable**		

a. Set to -1 if no continuum profiles for species #j MWs are contained, i.e. $N_{V(j)}$=0, else set to zero
b. Profiles are referred to altitude grid given in the General GADS

12.6.12.1.7 General Data for Forward Calculation GADS

The format of this GADS is defined below.

Table 12.6.12.1.7-1 General Data for Forward Calculation GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Number of simulated LOS geometries [Ngeo]**	-	2	us	1
3	**Flag indicating fitting of continuum and off-sets at contained forward calculations**[a]	-	2	us	1
TOTAL			**16**		

a. 0: no continuum and offset fit
1: only continuum fit
2: continuum and offset fit

12.6.12.1.8 Data Depending on Occupation Matrix Location of Results ADS

This ADS contains N_{lat} ADSRs. The format of the ADSR #lat (lat = 1, ..., N_{lat}) is shown below.

Table 12.6.12.1.8-1 Data Depending on Occupation Matrix Location of Results ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag**[a]	-	1	uc	1

N	Description	Units	Byte Length	Data Type	Dim.
4	**Label of occupation matrix used for latitude #lat** [b] (10 character string)	ascii	10	uc	10
5	**Number of p,T retrieval MWs used at latitude #lat [Nmw(lat)]**	-	2	us	1
6	**p,T retrieval microwindows used for forward calculations** [c] (each is an 8 character string)	ascii	Nmw (lat) ×8	uc	Nmw (lat) ×8
7	**Microwindow occupation matrix**	-	Ngeo×Nmw(lat)×2	us	Ngeo×Nmw(lat)
8	**Number of spectral data points in p,T MW #i, (i = 1 ,... , Nmw(lat)) [Nsp(lat, i)]**	-	Nmw(lat) ×2	us	Nmw(lat)
9	**Number of parameter levels for latitude #lat [Npar(lat)]**	-	2	us	1
10	**Number of fitted continuum values for latitude #lat [Ncont(lat)]**	-	2	us	1
11	**Number of fitted offset values for latitude #lat [Noffset(lat)]**	-	2	us	1
12	**Number of simulations for latitude #lat [Nsim(lat)]**	-	2	us	1
13	**Altitude grid for simulation #i, (i = 1, ... , Nsim(lat))**	-	Nsim(lat) ×Ngeo×4	fl	Nsim(lat)×Ngeo
14	**Offset of DSR within Microwindow Grouping Data ADS containing data relevant for continuum fit** [d]	-	4	sl	1
15	**Offset of DSR within Values for Unknown Parameters MDS containing data relevant for simulation #i, (i = 1, ... , Nsim(lat))** [d]	-	Nsim(lat)×4	sl	Nsim(lat)
16	**Offset of DSR within Spectra MDS containing spectrum for microwindow #k at geometry #j for simulation #i, (i = 1, ..., Nsim(lat)) , (j = 1, ... , Ngeo) , (k = 1, ..., Nmw(lat))** [d,e]	-	Nsim(lat) ×Ngeo×Nmw(lat) ×4	sl	Nsim(lat)×Ngeo×Nmw(lat)

N	Description	Units	Byte Length	Data Type	Dim.
17	**Offset of DSR within Jacobian Matrices MDS containing rows of jacobian matrix for microwindow #k at geometry #j for simulation #i, (i = 1, ..., Nsim(lat)) , (j = 1, ... , Ngeo) , (k = 1, ..., Nmw(lat)) [d,e]**	-	Nsim(lat) ×Ngeo×Nmw(lat)×4	sl	Nsim(lat) ×Ngeo×Nmw(lat)
TOTAL			**variable**		

a. Always set to zero for this ADS

b. Same label as in MIP_OM2_AX

c. Same label as in MIP_MW2_AX

d. Offset of first byte of referenced DSR w.r.t. first byte of referenced DS

e. -1: microwindow is not used at this geometry/latitude

12.6.12.1.9 Microwindow Grouping Data ADS

This ADS contains N_{lat} ADSRs. The format of the ADSR #lat (lat = 1, ... , N_{lat}) is shown below.

Table 12.6.12.1.9-1 Microwindow Grouping Data ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag [a]**	-	1	uc	1
4	**Index of highest considered geometry for continuum fit [b]**	-	2	us	1
5	**Number of geometries used for continuum fit [Ngeo,cont]**	-	2	us	1
6	**Continuum occupation matrix**	-	Ngeo,cont * Nmw(lat)*2	us	Ngeo,cont * Nmw(lat)
7	**Occupation matrix of close to close microwin-dows**	-	Ngeo,cont * Nmw(lat)*2	us	Ngeo,cont * Nmw(lat)
8	**Types of grouping for continuum fit [c]**	-	$N_{geo,cont}$ * Nmw(lat)*2	us	$N_{geo,cont}$ * Nmw(lat)
9	**Number of microwindows considered for continuum fit at geometries used for**	-	$N_{geo,cont}$ * 2	us	$N_{geo,cont}$

N	Description	Units	Byte Length	Data Type	Dim.
	continuum fit [$N_{MW,cont}(i)$], (i = 1, ... , $N_{geo,cont}$)				
10	**Total number of microwindows selected at geometries used for continuum fit [$N_{MW,geo}(i)$] ,** (i = 1, ... , $N_{geo,cont}$)	-	$N_{geo,cont}$ * 2	us	$N_{geo,cont}$
11	**Relative index of microwindows considered for continuum fit at each geometry #i used for continuum fit (i = 1, ... , $N_{geo,cont}$)** ($N_{MW,cont}(i)$ consecutive values per geometry #i)	-	2 * $\sum_i$ $N_{MW,cont}(i)$	us	$\sum_i$ $N_{MW,cont}(i)$
12	**Progressive enumeration of microwindows considered for continuum fit at each geometry #i used for continuum fit (i = 1, ... , $N_{geo,cont}$)** ($N_{MW,cont}(i)$ consecutive values per geometry #i)	-	2 * $\sum_i$ $N_{MW,cont}(i)$	us	$\sum_i$ $N_{MW,cont}(i)$
13	**Absolute index of all microwindows selected at each geometry #i used for continuum fit (i = 1, ... , $N_{geo,cont}$)** ($N_{MW,geo}(i)$ consecutive values per geometry #i)	-	2 * $\sum_i$ $N_{MW,geo}(i)$	us	$\sum_i$ $N_{MW,geo}(i)$
14	**Number of continuum values to be interpolated at each geometry #i used for continuum fit (i = 1, ... , $N_{geo,cont}$)** ($N_{MW,cont}(i)$ consecutive values per geometry #i)	-	2 * $\sum_i$ ($N_{MW,cont}(i)$ -1)	us	$\sum_i$ ($N_{MW,cont}(i)$ 1)
15	**Total number of 'holed' microwindows [$N_{holedMW}$]**	-	2	us	1
16	**Total number of holes in occupation matrix**	-	2	us	1
17	**Number of holes in each holed microwindow [N_{holes} (i)]** (i = 1, ... , $N_{holedMW}$)	-	$N_{holedMW}$×2	us	$N_{holedMW}$
18	**Indices of holed microwindows**	-	$N_{holedMW}$×2	us	$N_{holedMW}$
19	**Indices of geometries containing holes for each holed microwindow #i (i = 1 , ... , $N_{holedMW}$)** ($N_{holes}(i)$ consecutive values per holed microwindow #i)	-	2×$\sum_i$ N_{holes} (i)	us	$\sum_i$ N_{holes} (i)
20	**Number of geometries containing at least one close to close microwindow pair [N_{CC}]**	-	2	us	1
21	**Number of close to close microwindows for each geometry containing close to close microwindow pairs [$N_{CC,geo}$ (i)] , (i = 1, ... , N_{CC})**	-	N_{CC}×2	us	N_{CC}
22	**Indices of geometries containing close to close microwindow-pairs**	-	N_{CC}×2	us	N_{CC}
23	**Indices of parent windows for each close to close microwindow pair contained for each geometry #i containing close to close microwindow pairs. (i = 1 , ... , N_{CC})** ($N_{CC,geo}(i)$ consecutive values per geometry #i)	-	2×$\sum_i$$N_{CC,geo}$ (i)		$\sum_i$ $N_{CC,geo}$ (i)
24	**Indices of highest and lowest geometry where microwindow #i is selected, (i = 1, ... , N_{mw}(lat))**	-	N_{mw}(lat) ×4	us	N_{mw}(lat) ×2

N	Description	Units	Byte Length	Data Type	Dim.
TOTAL			**variable**		

a. Always set to zero for this ADS
b. 0 refers to highest altitude
c. 0: not used
1: isolated
2: edge of a loose group
3: leftmost edge of a tight group
4: leftmost edge of a tight group and edge of a loose group
5: member of a tight group but not at the corner of the group
6: member of a loose group but not at the corner of the group

12.6.12.1.10 Computed Spectra MDS

This MDS contains several MDSRs. The format of the MDSR is shown below.

Table 12.6.12.1.10-1 Computed Spectra MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator (PCD)**[a]	-	1	sc	1
4	**Spectrum for MicroWindow #mw, at geometry #geo of simulation #sim at latitude #lat** [b]	-	Nsp(lat, mw) ×4	fl	Nsp(lat, mw)
TOTAL			**variable**		

a. -1: blank DSR, i.e. microwindow is not used at this geometry/latitude
b. Field is missing for blank DSRs

A structure of $N_{mw}(lat)$ consecutive MDSRs corresponds to microwindows mw = 1 , ..., $N_{mw}(lat)$, with $N_{sp}(lat,mw)$ corresponding to $N_{sp}(lat, 1)$, ... , $N_{sp}(lat, N_{mw}(lat))$, respectively.

Upper structure of N_{geo} * $N_{mw}(lat)$ MDSRs corresponds to consecutive geometries geo = 1, ..., N_{geo}.

Upper structure of $N_{sim}(lat)$ * N_{geo} * $N_{mw}(lat)$ MDSRs corresponds to consecutive simulations sim = 1, ..., $N_{sim}(lat)$.

MDS structure of Σ_{lat} ($N_{sim}(lat)$ * N_{geo} * $N_{mw}(lat)$) MDSRs corresponds to

consecutive latitudes lat = 1, ... , N_{lat}.

12.6.12.1.11 Values of Unknown Parameters MDS

This MDS contains several MDSRs.

The format of the MDSR is shown below.

Table 12.6.12.1.11-1 Values of Unknown Parameters MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator (PCD)**[a]	-	1	sc	1
4	**Pressure profile for simulation #sim at latitude #lat**	-	N_{par}(lat) ×4	fl	N_{par}(lat)
5	**Temperature profile for simulation #sim at latitude #lat**	-	N_{par}(lat) ×4	fl	N_{par}(lat)
6	**Continuum values for simulation #sim at latitude #lat**	-	N_{cont}(lat) ×4	fl	N_{cont}(lat)
7	**Offset values for simulation #sim at latitude #lat**	-	N_{offset} (lat) ×4	fl	$N_{off-set}$(lat)
TOTAL			**variable**		

a. Always set to zero for this MDS

A structure of N_{sim}(lat) consecutive MDSRs corresponds to simulations sim = 1 , ..., N_{sim}(lat).

MDS structure of Σ_{lat} (N_{sim}(lat)) MDSRs corresponds to consecutive latitudes lat = 1, ... , N_{lat}.

12.6.12.1.12 Jacobian Matrices MDS

This MDS contains several MDSRs. The format of the MDSR is shown below.

Table 12.6.12.1.12-1 Jacobian Matrices MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator (PCD)** [a]	-	1	sc	1
4	**Derivatives w.r.t. pressure, temperature, continuum and offset samples of microwindow #mw used for geometry #geo of simulation #sim at latitude #lat** (Nsp(lat,mw) samples ; each sample follows the format defined in the table attached hereafter)	-	variable	Samples for Jacobian Matrices MDSR	Nsp(lat, mw)
TOTAL			**variable**		

a. -1: blank DSR, i.e. microwindow is not used at this geometry/latitude

A structure of N_{mw}(lat) consecutive MDSRs corresponds to microwindows mw = 1 , ..., N_{mw}(lat), with N_{sp}(lat,mw) corresponding to N_{sp}(lat, 1) , ... , N_{sp}(lat, N_{mw}(lat)), respectively.

Upper structure of N_{geo} * N_{mw}(lat) MDSRs corresponds to consecutive geometries geo = 1, ..., N_{geo}.

Upper structure of N_{sim}(lat) * N_{geo} * N_{mw}(lat) MDSRs corresponds to consecutive simulations sim = 1, ..., N_{sim}(lat).

MDS structure of Σ_{lat} (N_{sim}(lat) * N_{geo} * N_{mw}(lat)) MDSRs corresponds to consecutive latitudes lat = 1, ... , N_{lat}.

The following structure is used to define sample for the Jacobian Matrices MDSRs:

Table 12.6.12.1.12-2 Sample for Jacobian Matrices MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Derivatives w.r.t. pressure of sample of microwindow #mw used for geometry #geo of simulation #sim at latitude #lat**	-	N_{geo}×4	fl	N_{geo}
2	**Derivatives w.r.t. temperature of sample of microwindow #mw used for geometry #geo of simulation #sim at latitude #lat**	-	N_{geo}×4	fl	N_{geo}

N	Description	Units	Byte Length	Data Type	Dim.
3	**Derivatives w.r.t. continuum of sample of microwindow #mw used for geometry #geo of simulation #sim at latitude #lat**	-	$N_{cont}(lat)$ ×4	fl	$N_{cont}(lat)$
4	**Derivatives w.r.t. offset of sample of microwindow #mw used for geometry #geo of simulation #sim at latitude #lat**	-	$N_{offset}(lat)$ ×4	fl	$N_{offset}(lat)$
TOTAL			**variable**		

12.6.13 Microwindow Occupation Matrices File

This files contains pre-computed occupation matrices for p,T and VMR retrievals for different latitude bands and a fixed altitude grid. Also occupation matrices to be used in cases of missing or corrupted spectral bands are contained.

FILE ID: **MIP_OM2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: every several months

SIZE: MPH (1247 bytes) + SPH (26 418 bytes) + DSRs (126 508 899 bytes[13)] = ca. 126 MBytes

12.6.13.1 Format

The high level format of the file is shown below:

Table 12.6.13.1-1 Microwindows occupation matrices data structure

MPH
Auxiliary Data SPH (see Volume 16) with 94 DSDs: • *DSD for General GADS* • *DSD for priority of p,T Retrieval Occupation Matrices ADS* • *30 DSDs for priority of VMR Retrieval Occupation Matrices ADSs* • *DSD for p,T Retrieval Occupation Matrices ADS*

[13] Assumption: N_{lat} = 5, N_{band} = 5, N_{Nsw} = 1, N_{OM} = 80, N_{row} = 16, N_{col} = 20, N_{par} = 16, 200 different occupation matrices per retrieval, matrix S available for 40 occupation matrices per retrieval.

• *30 DSDs for VMR Retrieval Occupation Matrices ADSs* • *DSD for p,T Retrieval Occupation Matrices MDS* • *30 DSDs for VMR Retrieval Occupation Matrices MDSs*
General GADS
Priority of p,T Retrieval Occupation Matrices ADS
Species #1 Priority of VMR Retrieval Occupation Matrices ADS This structure is repeated for species #2 to species #30
p,T Retrieval Occupation Matrices ADS
Species #1 VMR Retrieval Occupation Matrices ADS This structure is repeated for species #2 to species #30
p,T Retrieval Occupation Matrices MDS
Species #1 VMR Retrieval Occupation Matrices MDS This structure is repeated for species #2 to species #30

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.13.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (G) for General GADS	OCC MATRIX GENERAL DATA
DSD (A) for Priority of p,T Retrieval Occupation Matrices ADS	PT OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #1 Retrieval Occup. Matrices ADS	H2O OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #2 Retrieval Occup. Matrices ADS	N2O OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #3 Retrieval Occup. Matrices ADS	HNO3 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #4 Retrieval Occup. Matrices ADS	CH4 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #5 Retrieval Occup. Matrices ADS	O3 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #6 Retrieval Occup. Matrices ADS	NO2 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #7 Retrieval Occup. Matrices ADS	F11 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #8 Retrieval Occup. Matrices ADS	CLNO OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #9 Retrieval Occup. Matrices ADS	N2O5 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #10 Retrieval Occup. Matrices ADS	F12 OCC MATRIX PRIORITY ADS

DSD (A) for Priority of VMR #11 Retrieval Occup. Matrices ADS	CCL4 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #12 Retrieval Occup. Matrices ADS	COF2 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #13 Retrieval Occup. Matrices ADS	F14 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #14 Retrieval Occup. Matrices ADS	F22 OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #15 Retrieval Occup. Matrices ADS	HCN OCC MATRIX PRIORITY ADS
DSD (A) for Priority of VMR #16, ... to VMR #30 Retrieval Occup. Matrices ADS	SPARE OCC MATRIX PRIORITY ADS
DSD (A) for p,T Retrieval Occupation Matrices ADS	PT OCCUPATION MATRICES ADS
DSD (A) for VMR #1 Retrieval Occup. Matrices ADS	H2O OCCUPATION MATRICES ADS
DSD (A) for VMR #2 Retrieval Occup. Matrices ADS	N2O OCCUPATION MATRICES ADS
DSD (A) for VMR #3 Retrieval Occup. Matrices ADS	HNO3 OCCUPATION MATRICES ADS
DSD (A) for VMR #4 Retrieval Occup. Matrices ADS	CH4 OCCUPATION MATRICES ADS
DSD (A) for VMR #5 Retrieval Occup. Matrices ADS	O3 OCCUPATION MATRICES ADS
DSD (A) for VMR #6 Retrieval Occup. Matrices ADS	NO2 OCCUPATION MATRICES ADS
DSD (A) for VMR #7 Retrieval Occup. Matrices ADS	F11 OCCUPATION MATRICES ADS
DSD (A) for VMR #8 Retrieval Occup. Matrices ADS	CLNO OCCUPATION MATRICES ADS
DSD (A) for VMR #9 Retrieval Occup. Matrices ADS	N2O5 OCCUPATION MATRICES ADS
DSD (A) for VMR #10 Retrieval Occup. Matrices ADS	F12 OCCUPATION MATRICES ADS
DSD (A) for VMR #11 Retrieval Occup. Matrices ADS	CCL4 OCCUPATION MATRICES ADS
DSD (A) for VMR #12 Retrieval Occup. Matrices ADS	COF2 OCCUPATION MATRICES ADS
DSD (A) for VMR #13 Retrieval Occup. Matrices ADS	F14 OCCUPATION MATRICES ADS
DSD (A) for VMR #14 Retrieval Occup. Matrices ADS	F22 OCCUPATION MATRICES ADS
DSD (A) for VMR #15 Retrieval Occup. Matrices ADS	HCN OCCUPATION MATRICES ADS
DSD (A) for VMR #16, ... to VMR #30 Retrieval Occup. Matrices ADS	SPARE OCCUPATION MATRICES ADS
DSD (M) for p,T Retrieval Occupation Matrices MDS	PT OCCUPATION MATRICES MDS
DSD (M) for VMR #1 Retrieval Occup. Matrices MDS	H2O OCCUPATION MATRICES MDS
DSD (M) for VMR #2 Retrieval Occup. Matrices MDS	N2O OCCUPATION MATRICES MDS
DSD (M) for VMR #3 Retrieval Occup. Matrices MDS	HNO3 OCCUPATION MATRICES MDS
DSD (M) for VMR #4 Retrieval Occup. Matrices MDS	CH4 OCCUPATION MATRICES MDS
DSD (M) for VMR #5 Retrieval Occup. Matrices MDS	O3 OCCUPATION MATRICES MDS
DSD (M) for VMR #6 Retrieval Occup. Matrices MDS	NO2 OCCUPATION MATRICES MDS
DSD (M) for VMR #7 Retrieval Occup. Matrices MDS	F11 OCCUPATION MATRICES MDS

DSD (M) for VMR #8 Retrieval Occup. Matrices MDS	CLNO OCCUPATION MATRICES MDS
DSD (M) for VMR #9 Retrieval Occup. Matrices MDS	N2O5 OCCUPATION MATRICES MDS
DSD (M) for VMR #10 Retrieval Occup. Matrices MDS	F12 OCCUPATION MATRICES MDS
DSD (M) for VMR #11 Retrieval Occup. Matrices MDS	CCL4 OCCUPATION MATRICES MDS
DSD (M) for VMR #12 Retrieval Occup. Matrices MDS	COF2 OCCUPATION MATRICES MDS
DSD (M) for VMR #13 Retrieval Occup. Matrices MDS	F14 OCCUPATION MATRICES MDS
DSD (M) for VMR #14 Retrieval Occup. Matrices MDS	F22 OCCUPATION MATRICES MDS
DSD (M) for VMR #15 Retrieval Occup. Matrices MDS	HCN OCCUPATION MATRICES MDS
DSD (M) for VMR #16, ... to VMR #30 Retrieval Occup. Matrices MDS	SPARE OCCUPATION MATRICES MDS

12.6.13.1.1 General GADS

The format of the General GADS is defined below.

Table 12.6.13.1.1-1 General GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	Mjd	1
2	**Number of latitude bands for which data is contained [Nlat]**	-	2	us	1
3	**Vector of latitude bands**	deg	Nlat×8	fl	Nlat×2
4	**Number of spectral bands [Nband]**	-	2	us	1
5	**Spectral bands in which used microwindows are located**	cm^{-1}	Nband×8	fl	Nband×2
6	**Reference tropopause height for contained altitude data**	km	4	fl	1
7	**Number of different numbers of sweeps for which occupation matrices are contained [NNsw]**	-	2	us	1
8	**Number of sweeps for which occupation matrices are contained [NSw (i)] (i=1, ... , NNsw)**	-	NNsw×2	us	NNsw
9	**Offsets of DSRs within "Priority of p,T Retrieval Occupation Matrices ADS" with NSw (k) rows valid for latitude band #i.** (each set of Nlat consecutive offsets with i=1, ..., Nlat , is repeated for k = 1, ... , NNsw)	-	NNsw×Nlat×4	ul	NNsw×Nlat

N	Description	Units	Byte Length	Data Type	Dim.
10	**Offsets of DSRs within "Priority of species #1 VMR Retrieval Occupation Matrices ADS" with NSw (k) rows valid for latitude band #i a** (each set of Nlat consecutive offsets with i=1, ..., Nlat , is repeated for k = 1, ... , NNsw)	-	NNsw×Nlat×4	ul	NNsw×Nlat
Structure of field #10 is repeated NNsw times for species #2,..., #30 VMR retrievals					
TOTAL			**variable**		

a. VMR retrieval species are ordered H2O, N2O, HNO3, CH4, O3, NO2, F11, CLNO, N2O5, F12, CCL4, COF2, F14, F22, HCN, 15 spare species

12.6.13.1.2 Priority of p,T Retrieval Occupation Matrices ADS

This ADS contains several ADSRs. The format of the each ADSR is defined below.

Table 12.6.13.1.2-1 Priority of p,T Retrieval Occupation Matrices ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag** [a]	-	1	uc	1
4	**Number of occupation matrices with NSw (k) rows valid for latitude #lat**	-	N_{OM}×2	us	N_{OM}
5	**Labels of occupation matrices with NSw (k) rows valid for latitude #lat** [bc]	-	N_{OM}×10	uc	N_{OM}×10
6	**Offset of DSRs within "p,T Retrieval Occupation Matrices ADS" containing annotation data for above occupation matrix**	-	N_{OM}×4	ul	N_{OM}
TOTAL			**variable**		

a. 0: At least 1 occupation matrix is valid for current number of sweeps at current latitude band
1: No occupation matrix for current number of sweeps and current latitude band is contained
b. Ordered according to priority
c. Format OM_ggggnnn;
gggg: main gas (trailing blanks filled with '_'), for p,T, MWs = 'PT__';
nnn: number of occupation matrix (with leading zeros)

A structure of N_{lat} consecutive ADSRs corresponds to latitude bands #lat = 1, ..., N_{lat}, respectively.

ADS structure of (N_{Nsw} * N_{lat}) ADSRs corresponds to consecutive occupation matrices with $N_{Sw}(k)$ rows, k = 1, ..., N_{Nsw} respectively.

12.6.13.1.3 Priority of VMR Retrieval Occupation Matrices ADSs

There is one "Priority of Species #j VMR Retrieval Occupation Matrices ADS" for each of the 30 species (#j = 1, ..., 30). Each ADS concerning species #j contains several ADSRs. The format of the each ADSR is defined below.

Table 12.6.13.1.3-1 Priority of VMR Retrieval Occupation Matrices ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag** [a]	-	1	uc	1
4	**Number of occupation matrices with NSw (k) rows valid for latitude #lat**	-	N_{OM}×2	us	N_{OM}
5	**Labels of occupation matrices with NSw (k) rows valid for latitude #lat** [bc]	-	N_{OM}×10	uc	N_{OM}×10
6	**Offset of DSRs within "Species #j VMR Retrieval Occupation Matrices ADS" containing annotation data for above occupation matrix, concerning species #j**	-	N_{OM}×4	ul	N_{OM}
TOTAL			**variable**		

a. **0: At least 1 occupation matrix is valid for current number of sweeps at current latitude band**
1: No occupation matrix for current number of sweeps and current latitude band is contained
b. **Ordered according to priority**
c. **Format OM_ggggnnn;**
gggg: main gas (trailing blanks filled with '_'), for p,T, MWs = 'PT__';
nnn: number of occupation matrix (with leading zeros)

A structure of N_{lat} consecutive ADSRs corresponds to latitude bands #lat = 1, ..., N_{lat}, respectively.

ADS structure of (N_{Nsw} * N_{lat}) ADSRs corresponds to consecutive occupation matrices with $N_{Sw}(k)$ rows, k = 1, ..., N_{Nsw} respectively.

12.6.13.1.4 p,T Retrieval Occupation Matrices ADS

This ADS contains several ADSRs. The format of the ADSR for each p,T retrieval occupation matrix is defined below.

Table 12.6.13.1.4-1 p,T Retrieval Occupation Matrices ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Attachment flag** [a]	-	1	uc	1
4	**Label for occupation matrix** [b]	-	10	uc	10
5	**Number of rows of current occupation matrix [Nrow]**	-	2	us	1
6	**Band occupation matrix for current occupation matrix** [c]	-	Nrow×Nband×2	us	Nrow×Nband
7	**Vector containing valid ranges for each row of occupation matrix**[d]	km	Nrow×8	fl	Nrow×2
8	**Logical retrieval vector indicating sweeps where parameters shall be fitte**[d]	-	Nrow×2	us	Nrow
9	**Offset of DSR within "p,T Retrieval Occupation Matrices MDS" containing occupation matrix data**	-	4	ul	1
TOTAL			**variable**		

a. **Always set to zero for this ADS**
b. **Format OM_ggggnnn;**
gggg: main gas (trailing blanks filled with '_'), for p,T, MWs = 'PT__';
nnn: number of occupation matrix (with leading zeros)
c. **0: No microwindow inside this band is used**
1: Microwindows inside this band are used
d. **Lowest and highest valid altitude for each row of the occupation matrix**

12.6.13.1.5 VMR Retrieval Occupation Matrices ADSs

There is one "Species #j VMR Retrieval Occupation Matrices ADS" for each of the 30 species (#j = 1, ..., 30). Each ADS concerning species #j contains several ADSRs. The format of the ADSR for each VMR retrieval occupation matrix is defined below.

Table 12.6.13.1.5-1 VMR Retrieval Occupation Matrices ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1

N	Description	Units	Byte Length	Data Type	Dim.
3	**Attachment flag** [a]	-	1	uc	1
4	**Label for occupation matrix** [b]	-	10	uc	10
5	**Number of rows of current occupation matrix [Nrow]**	-	2	us	1
6	**Band occupation matrix for current occupation matrix** [c]	-	Nrow×Nband×2	us	Nrow×Nband
7	**Vector containing valid ranges for each row of occupation matrix**[d]	km	Nrow×8	fl	Nrow×2
8	**Logical retrieval vector indicating sweeps where parameters shall be fitted**	-	Nrow×2	us	Nrow
9	**Offset of DSR within "Species #j VMR Retrieval Occupation Matrices MDS" containing occupation matrix data, concerning species #j**	-	4	ul	1
TOTAL			**variable**		

a. **Always set to zero for this ADS**
b. **Format OM_ggggnnn;**
gggg: main gas (trailing blanks filled with '_'),
nnn: number of occupation matrix (with leading zeros)
c. **0: No microwindow inside this band is used**
1: Microwindows inside this band are used
d. **Lowest and highest valid altitude for each row of the occupation matrix**

12.6.13.1.6 p,T Retrieval Occupation Matrices MDS

This MDS contains several MDSRs (one MDSR for each p,T retrieval occupation matrix). The format of each MDSR is defined below.

Table 12.6.13.1.6-1 p,T Retrieval Occupation Matrices MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator (PCD)** [a]	-	1	sc	1
4	**Label for occupation matrix** [b]	-	10	uc	10

N	Description	Units	Byte Length	Data Type	Dim.
5	**Number of sweeps (rows of occupation matrix) [Nrow]**	-	2	us	1
6	**Number of microwindows (columns of occupation matrix) [Ncol]**	-	2	us	1
7	**Label of microwindows** [c]	-	Ncol×8	uc	Ncol×8
8	**Occupation matrix**	-	Nrow× (Ncol×2)	us	Nrow×Ncol
TOTAL			**variable**		

a. **Always set to zero for this MDS**
b. **Format OM_ggggnnn:**
gggg: main gas (trailing blanks filled with '_'), for p,T, MWs = 'PT__';
nnn: number of occupation matrix (with leading zeros)
c. **Same labels as in MIP_MW2_AX**

12.6.13.1.7 VMR Retrieval Occupation Matrices MDSs

There is one "Species #j VMR Retrieval Occupation Matrices MDS" for each of the 30 species (#j = 1, ..., 30). Each MDS concerning species #j contains several MDSRs

Table 12.6.13.1.7-1 VMR Retrieval Occupation Matrices MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator (PCD)** [a]	-	1	sc	1
4	**Label for occupation matrix** [b]	-	10	uc	10
5	**Number of sweeps (rows of occupation matrix) [Nrow]**	-	2	us	1
6	**Number of microwindows (columns of occupation matrix) [Ncol]**	-	2	us	1
7	**Label of microwindows** [c]	-	Ncol×8	uc	Ncol×8
8	**Occupation matrix**	-	Nrow×(Ncol×2)	us	Nrow×Ncol
9	**Number of fitted parameters [Npar]**	-	2	us	1
10	**Reference VMR profile**	ppm	Npar×4	fl	Npar

N	Description	Units	Byte Length	Data Type	Dim.
11	**Matrix E0**	-	Npar×(2×Nrow×4)	fl	Npar×2×Nrow
12	**Flag for use of matrix S [lAvailS]** [d]	-	2	us	1
13	**Reference pressure profile** [e]	hPa	Nrow×4	fl	Nrow
14	**Reference temperature profile** [e]	K	Nrow×4	fl	Nrow
15	**Matrix S** [e]	-	(Npar+ 2×Nrow) × (Npar× (2×Nrow)) ×4	fl	(Npar+ 2×Nrow) × (Npar× (2×Nrow))
TOTAL			**variable**		

a. **Always set to zero for this MDS**
b. **Format OM_ggggnnn:**
gggg: main gas (trailing blanks filled with '_'), for p,T, MWs = 'PT__';
nnn: number of occupation matrix (with leading zeros)
c. **Same labels as in MIP_MW2_AX**
d. **0: No use of matrix S, following fields are not contained in DSR**
1: Use of matrix S, following fields are contained
e. **Field is only contained in DSR for l_{AvailS}=1**

12.6.14 Cross Sections Lookup Table File

This file contains absorption cross section lookup tables for a set of microwindows.

FILE ID: **MIP_CS2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: every several months

SIZE: MPH (1247 bytes) + SPH (17738 bytes) + DSRs (1177865586 bytes[14]) = ca. 1.2GBytes

12.6.14.1 Format

The high level format of the file is shown below:

Table 12.6.14.1-1 Cross sections lookup tables data structure

[14] *Assumption: $N_{p,T} = N_{V(i)} = 180$, $N_{gas} = 25$, $N_{LUT} = 4$, $N_p = 25$, $N_T = 9$, $N_{bv} = 6$, $N_{wn} = 1970$*

MPH
Auxiliary Data SPH (see Volume 16) with 63 DSDs: • *DSD for General GADS* • *DSD for p,T Retrieval Microwindows ADS* • *30 DSDs for VMR Retrieval Microwindows ADSs* • *DSD for Lookup Tables for p,T Retrieval Microwindows MDS* • *30 DSDs for Lookup tables for VMR Retrieval Microwindows MDSs*
General GADS
p,T Retrieval Microwindows ADS
VMR #1 Retrieval Microwindows ADS
Above structure repeated for species #2 to #30
Lookup Tables for p,T Retrieval Microwindows MDS
Lookup Tables for VMR #1 Retrieval Microwindows MDS
Above structure repeated for species #2 to #30

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.14.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (G) for General GADS	LOOKUP TABLES GENERAL DATA
DSD (A) for p,T Retrieval Microwindows ADS	PT MICROWINDOWS LUT ADS
DSD (A) for VMR #1 Retrieval Microwindows ADS	H2O MICROWINDOWS LUT ADS
DSD (A) for VMR #2 Retrieval Microwindows ADS	N2O MICROWINDOWS LUT ADS
DSD (A) for VMR #3 Retrieval Microwindows ADS	HNO3 MICROWINDOWS LUT ADS
DSD (A) for VMR #4 Retrieval Microwindows ADS	CH4 MICROWINDOWS LUT ADS
DSD (A) for VMR #5 Retrieval Microwindows ADS	O3 MICROWINDOWS LUT ADS
DSD (A) for VMR #6 Retrieval Microwindows ADS	NO2 MICROWINDOWS LUT ADS
DSD (A) for VMR #7 Retrieval Microwindows ADS	F11 MICROWINDOWS LUT ADS
DSD (A) for VMR #8 Retrieval Microwindows ADS	CLNO MICROWINDOWS LUT ADS
DSD (A) for VMR #9 Retrieval Microwindows ADS	N2O5 MICROWINDOWS LUT ADS
DSD (A) for VMR #10 Retrieval Microwindows ADS	F12 MICROWINDOWS LUT ADS
DSD (A) for VMR #11 Retrieval Microwindows ADS	CCL4 MICROWINDOWS LUT ADS
DSD (A) for VMR #12 Retrieval Microwindows ADS	COF2 MICROWINDOWS LUT ADS

DSD (A) for VMR #13 Retrieval Microwindows ADS	F14 MICROWINDOWS LUT ADS
DSD (A) for VMR #14 Retrieval Microwindows ADS	F22 MICROWINDOWS LUT ADS
DSD (A) for VMR #15 Retrieval Microwindows ADS	HCN MICROWINDOWS LUT ADS
DSD (A) for VMR #16, ... to VMR #30 Retrieval Microwindows ADS	SPARE MICROWINDOWS LUT ADS
DSD (M) for LUT for p,T Retrieval Microwindows MDS	PT MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #1 Retrieval Microwindows MDS	H2O MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #2 Retrieval Microwindows MDS	N2O MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #3 Retrieval Microwindows MDS	HNO3 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #4 Retrieval Microwindows MDS	CH4 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #5 Retrieval Microwindows MDS	O3 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #6 Retrieval Microwindows MDS	NO2 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #7 Retrieval Microwindows MDS	F11 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #8 Retrieval Microwindows MDS	CLNO MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #9 Retrieval Microwindows MDS	N2O5 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #10 Retrieval Microwindows MDS	F12 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #11 Retrieval Microwindows MDS	CCL4 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #12 Retrieval Microwindows MDS	COF2 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #13 Retrieval Microwindows MDS	F14 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #14 Retrieval Microwindows MDS	F22 MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #15 Retrieval Microwindows MDS	HCN MICROWINDOWS LUT MDS
DSD (M) for LUT for VMR #16, ... to VMR #30 Retrieval Microwindows MDS	SPARE MICROWINDOWS LUT MDS

12.6.14.1.1 General GADS

The format of the General GADS is defined below.

Table 12.6.14.1.1-1 General GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Number of p,T microwindows[N_{PT}]**	-	2	us	1
3	**Number of species #j VMR microwindows [$N_{V(j)}$] (j = 1 , ... , 30)**	-	60	us	30*us

N	Description	Units	Byte Length	Data Type	Dim.
4	**Number of absorbers for which lookup tables are included [N_{gas}]**	-	2	us	1
5	**HITRAN code of included absorber #i (i = 1, ... , Ngas)**	-	$N_{gas}\times 2$	us	N_{gas}
TOTAL			**variable**		

12.6.14.1.2 p,T Retrieval Microwindows ADS

This ADS contains N_{pT} ADSRs. The format of each ADSR is defined below.

Table 12.6.14.1.2-1 p,T Retrieval Microwindows ADSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Attachment flag**[a]	-	1	uc	1
3	**Label of microwindow** [b] (8 character string)	ascii	8	uc	8
4	**Number of LUTs included for this microwindow [NLUT]**	-	2	us	1
5	**Offset of MDSR within Lookup Table for p, T Retrieval Microwindows MDS containing LUT for absorber #i, i = 1, ..., Ngas** [c]	-	Ngas×4	sl	Ngas
TOTAL			**variable**		

a. 0: at least 1 LUT is contained for this microwindow
1: no LUT is contained for this microwindow
b. Same label as in MIP_MW2_AX
c. -1: no LUT for this absorber contained

12.6.14.1.3 VMR Retrieval Microwindows ADS

There is one "VMR #j Retrieval Microwindows ADS" for each of the 30 species (j = 1, ..., 30), ordered H2O, N2O, HNO3, CH4, O3, NO2, F11, ClONO2, N2O5, F12, CCl4, COF2, F14, F22, HCN, and 15 spare species. Each ADS concerning species #j contains $N_{v(j)}$ ADSRs. The format of each ADSR is defined below.

Table 12.6.14.1.3-1 VMR Retrieval Microwindows ADSR

N	Description	Units	Byte Length	Data Type	Dim.

1	**Time of creation**	-	12	mjd	1
2	**Attachment flag**[a]	-	1	uc	1
3	**Label of microwindow**[b] (8 character string)	-	8	uc	8
4	**Number of LUTs included for this microwindow [NLUT]**	-	2	us	1
5	**Offset of MDSR within the Lookup Tables for VMR #j Retrieval Microwindows MDS containing LUT for absorber #i, i = 1, ..., Ngas**[c]	-	Ngas×4	sl	Ngas
TOTAL			**variable**		

a. **0: at least 1 LUT is contained for this microwindow**
1: no LUT is contained for this microwindow
b. **Same label as in MIP_MW2_AX**
c. **-1: no LUT for this absorber contained**

12.6.14.1.4 Lookup Tables for p,T Retrieval Microwindows MDS

This MDS contains one MDSR for each LUT for p,T microwindows. The format of each MDSR is defined below.

Table 12.6.14.1.4-1 Lookup Tables for p,T Retrieval Microwindows MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	-	4	ul	1
3	**Quality indicator (PCD)**	-	1	sc	1
4	**HITRAN code of gas**	-	2	us	1
5	**Tabulation code**[a]	-	2	us	1
6	**Number of base vectors [Nbv]**	-	4	ul	1
7	**Number of -ln(pressure) tabulation points [Np]**	-	4	ul	1
8	**Lowest -ln(pressure) point**	hPa	4	fl	1
9	**Spacing of -ln(pressure) tabulation**	-	4	fl	1
10	**Number of temperature tabulation points [NT]**	-	4	ul	1
11	**Lowest temperature point**	K	4	fl	1
12	**Spacing of temperature tabulation**	K	4	fl	1
13	**Number of wavenumber points [Nwn]**	-	4	ul	1

N	Description	Units	Byte Length	Data Type	Dim.
14	**Wavenumber of first point**	cm^{-1}	4	fl	1
15	**Spacing between wavenumber points**	cm^{-1}	4	fl	1
16	**U-Matrix**	-	Nwn× (Nbv×4)	fl	Nwn×Nbv
17	**K-Matrices**	cm^2/ molec	Nbv× (NT× (Np×4))	fl	Nbv× (NT×Np)
TOTAL			**variable**		

a. **0: LIN**
1: LOG
2: 4RT

12.6.14.1.5 Lookup Tables for VMR Retrieval Microwindows MDSs

The structures of the Lookup Tables for VMR #1 to #30 Retrieval Microwindows MDSs are the same as the Lookup Tables for p,T Retrieval Microwindows MDS described in Table 12.6.14.1.4-1 above. Each MDS corresponds to a different species. Each MDS contains the number of MDSRs such that there is one MDSR for each LUT for species VMR retrieval microwindow (each MDS may have a different number of MDSRs).

12.6.15 A Priori Pointing Information File

This file contains pre-computed externally provided pointing covariance data.

FILE ID: **MIP_PI2_AX**

TYPE: Auxiliary

USE: Level 2 processing

UPDATED: Every several months

SIZE: MPH (1247 bytes) + SPH (658 bytes) + DSRs (164634 bytes[15]) = 166 539 bytes.

12.6.15.1 12.6.15.1 Format

The high level format of the file is shown below:

[15] Size estimate assumes $N_{mpd} = 20$, $D_m = 32$.

Table 12.6.15.1-1 A Priori Pointing Information data structure

MPH
Auxiliary Data SPH (see Volume 16) with 2 DSDs: • *DSD for General GADS* • *DSD for the Inverse LOS VCM Matrices MDS*
General GADS
Inverse LOS VCM Matrices MDS

The following table defines the entries for the DS_NAME field in the DSDs of the SPH. When written to the DS_NAME field, all entries are left justified with unused characters set to blank space characters:

Table 12.6.15.1-2 Entries for DS_NAME

Description	DS_NAME
Data Set Descriptors for attached Data Sets	
DSD (G) for General GADS	POINTING GENERAL DATA
DSD (M) for Inverse LOS VCM Matrices MDS	LOS VCM MATRICES MDS

12.6.15.1.1 General GADS

The format of the GADS is defined below.

Table 12.6.15.1.1-1 General GADS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**Number of MPD ranges for which data is contained [Nmpd]**	-	2	us	1
3	**MPD ranges for which matrices are contained**	-	Nmpd×16	do	Nmpd×2
4	**Offset of DSR in MDS containing VCM for MPD range #i, i = 1, ..., Nmpd** [a]	-	Nmpd×4	sl	Nmpd
TOTAL			**variable**		

a. -1: No VCM for current MPD range contained.

The MDS contains one MDSR for each MPD range. The format of the MDSR is defined below.

Table 12.6.15.1.1-2 Inverse LOS VCM Matrices MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**Time of creation**	-	12	mjd	1
2	**DSR length**	bytes	4	ul	1
3	**Quality indicator (PCD)**	-	1	sc	1
4	**Dimension of current matrix[D_m]**	-	2	us	1
5	**VCM Matrix**	-	$D_m^2 \times 8$	do	D_m^2
TOTAL			**variable**		

12.6.16 ENVISAT-1 Orbit Data Files

Orbit data files are described in Volume 16 (FOS files) and in Volume 9 (DORIS products).

12.6.17 ECMWF Data Files

The ECMWF Data Files are described in Volume 16.

12.7 PRODUCT SUMMARY SHEETS

The data on the following pages is extracted from the product summary information contained in the DDT data base.

MIPAS Line of Sight (LOS) Level 0

PRODUCT ID	MIP_LS__0P
PRODUCT NAME	MIPAS Line of Sight (LOS) Level 0
DESCRIPTION	The LOS Calibration Mode is used infrequently (approximately once per week) to point at pre-selected stars to acquire reference data. The LOS pointing calibration will be used to determine, in ground processing, the corrections needed to compensate for pointing errors. The LOS Level 0 product contains time-ordered AISPs acquired while the instrument is operated in LOS Mode. While in LOS Calibration Mode, only Nominal Output data format is possible.
APPLICATIONS	Instrument calibration and validation
DELIVERY TIME	NRT version of the product is available from the PDHS 3 hours after data acquisition. OFL (fully consolidated) version is available from LRAC 2 weeks after acquisition.
COVERAGE	No geographical coverage. Points at stars only. Expected duration of Mode is 1 orbit (100')
THROUGHPUT	1 product per week
PRODUCT SIZE	depends on number of stars observed. Maximum size approx. 100 minutes at 550 kps = 413 MB / product + header
GEOMETRICAL SAMPLING	N/A
GEOMETRIC RESOLUTION	N/A
GEOMETRIC ACCURACY	N/A
RADIOMETRIC RESOLUTION	N/A
RADIOMETRIC ACCURACY	N/A
AUXILIARY DATA	Time correlation parameters; Orbit state vectors.
ALGORITHMS USED	Time correlation; Satellite positioning.
NOTES	Product produced systematically. No further PDS products are created directly from this product. Product is used as auxiliary data for creation of other MIPAS products.

MIPAS Raw Data and SPE Self Test Mode

PRODUCT ID	MIP_RW__0P
PRODUCT NAME	MIPAS Raw Data and SPE Self Test Mode
DESCRIPTION	The product contains time ordered AISPs acquired when the instrument is in Raw Data output format or SPE Self-Test modes.
APPLICATIONS	Instrument monitoring and validation.
DELIVERY TIME	NRT version is available from the PDHS 3 hours after data acquisition. The OFL (fully consolidated) version is available to internal ESA users from the LRAC 2 weeks after data acquisition.
COVERAGE	SPE: N/A Raw Data: orbit segment
THROUGHPUT	SPE: SPE Self-Test performed infrequently. Test duration max. of approx. 3.5 minutes. Raw Data: data generation at 8 Mbps (HR data generation)
PRODUCT SIZE	SPE: << 1MB /product Raw Data: max. downlink time assumed of 30' at PDHS-E per orbit x 8 Mbps = 1800 MB/ product
GEOMETRICAL SAMPLING	SPE: N/A Raw Data: same as for Nominal Level 0
GEOMETRIC RESOLUTION	SPE: N/A Raw Data: same as for Nominal Level 0
GEOMETRIC ACCURACY	SPE: N/A Raw Data: same as for Nominal Level 0
RADIOMETRIC RESOLUTION	SPE: N/A Raw Data: same as for Nominal Level 0
RADIOMETRIC ACCURACY	SPE: N/A Raw Data: same as for Nominal Level 0
AUXILIARY DATA	Time correlation parameters; Orbit state vectors.
ALGORITHMS USED	Time correlation; satellite positioning.
NOTES	Product produced systematically when data is acquired in either mode. No other PDS products are produced from this data. SPE data is Nominal Output except in special cases where Raw Data output may be requested.

MIPAS Nominal Level 0

PRODUCT ID	MIP_NL__0P
PRODUCT NAME	MIPAS Nominal Level 0
DESCRIPTION	The MIPAS Nominal Level 0 product contains time ordered AISPs which were acquired while the instrument is in Measurement Mode with the Nominal Output data format chosen. Measurement Mode is the normal operating mode of the instrument. The instrument converts the spectral radiances into an interferogram. There is one interferogram for each observed scene.
APPLICATIONS	Archived product forming basis for all higher level processing
DELIVERY TIME	This product is available from the PDHS within 3 hours from data take. It is available from the LRAC starting 2 weeks after data take.
COVERAGE	Global. Tangent height range 5 km to 50 km.
THROUGHPUT	One product per orbit. 550 kbps data generation
PRODUCT SIZE	Approx. 320 MB per orbit
GEOMETRICAL SAMPLING	3 km step size, 16 height steps per scan.
GEOMETRIC RESOLUTION	2.5 km (vertical) x 25 km (horiz.) (rearward looking) 2.5 km (vertical) x 30 km (horiz) (sideways looking) depth of measurement = 300 to 500 km depending on atmospheric properties
GEOMETRIC ACCURACY	LOS pointing stability (single spectrum): < 0.3 km/4s Relative pointing stability (one elevation scan): < 0.9 km/4s Absolute pointing stability (individual scene spectrum): < 1.92 km horizontal pointing accuracy (single spectrum): 9 km/4s
RADIOMETRIC RESOLUTION	Spectral resolution: 0.035 cm-1; Sample spacing 0.025 cm-1; Radiometric Sensitivity: 2.70 nW/cm-1/sr/cm-2
RADIOMETRIC ACCURACY	685 - 1500 cm-1: 2*NESR + 5% of true source spectral radiance 1570 - 2410 cm-1: 2*NESR + X% of true source spectral radiance X to be linearly interpolated between 2 at 1570 cm-1 and 3 at 2410 cm-1.
AUXILIARY DATA	Orbit state vectors, SBT/UTC time correlation parameters
ALGORITHMS USED	Satellite positioning, Time correlation.
NOTES	NESR = Noise equivalent spectral radiance when the instrument is viewing the blackbody source; In a typical data collection orbit, 16 scene measurements will be recorded in sequence for different atmospheric elevations, followed by two deep space measurements. This takes approximately 80 seconds and repeats for the duration of measurement in the orbit. This gives 75 scans per orbit.

MIPAS Geolocated and Calibrated Spectra

PRODUCT ID	MIP_NL__1P
PRODUCT NAME	MIPAS Geolocated and Calibrated Spectra
DESCRIPTION	This is the base Level 1B product for MIPAS and includes calibrated spectra with calibration and housekeeping information.
APPLICATIONS	Engineering foundation product enabling the derivation (via higher level processing) of ozone profiles and atmospheric constituents.
DELIVERY TIME	NRT product available from PDHS within 3 hours from data take. OFL product available from the LRAC starting 2 weeks after data take.
COVERAGE	Global. Tangent height range 5 km to 50 km.
THROUGHPUT	1 product/orbit (100')
PRODUCT SIZE	approx. 312 MB/orbit (including header and aux. data)
GEOMETRICAL SAMPLING	3 km step size, 16 height steps per scan (nominal)
GEOMETRIC RESOLUTION	2.5 km (vertical) x 25 km (horiz.) (rearward looking) 2.5 km (vertical) x 30 km (horiz) (sideways looking) depth of measurement = 300 to 500 km depending on atmospheric properties
GEOMETRIC ACCURACY	LOS pointing stability (single spectrum): < 0.3 km/4s Relative pointing stability (one elevation scan): < 0.9 km/4s Absolute pointing stability (individual scene spectrum): < 1.92 km horizontal pointing accuracy (single spectrum): 9 km/4s
RADIOMETRIC RESOLUTION	Spectral resolution: 0.035 cm-1; Sample spacing 0.025 cm-1; Radiometric Sensitivity: 2.70 nW/cm-1/sr/cm-2
RADIOMETRIC ACCURACY	685 - 1500 cm-1: 2*NESR + 5% of true source spectral radiance 1570 - 2410 cm-1: 2*NESR + X% of true source spectral radiance X to be linearly interpolated between 2 at 1570 cm-1 and 3 at 2410 cm-1.
AUXILIARY DATA	Time correlation parameters; Orbit state vectors; Summary Quality ADS Geolocation ADS Scan Information ADS Offset Calibration ADS, Gain ADS #1 and #2 ILS and Spectral Calibration GADS LOS Calibration GADS Processing Parameters GADS
ALGORITHMS USED	Geolocation; Radiometric Calibration; Spectral Calibration; ILS Calibration; Data Validation.
NOTES	NESR = Noise equivalent spectral radiance when the instrument is viewing the blackbody source; Product produced systematically from Nominal Level 0 product.

MIPAS Temperature, Pressure and Atmospheric Constituents Profiles

PRODUCT ID	MIP_NL__2P
PRODUCT NAME	MIPAS Temperature , Pressure and Atmospheric Constituents Profiles
DESCRIPTION	This product contains estimates of temperature distribution and ozone profile based on the calibrated spectra together with appropriate look-up table data.
APPLICATIONS	Measurement of temperature, pressure and atmospheric constituent profiles
DELIVERY TIME	NRT product available from PDHS within 3 hours from data take. OFL product available from PAC starting 4 weeks after data take.
COVERAGE	Global. Tangent height range 5 km to 50 km.
THROUGHPUT	1 product/orbit (100')
PRODUCT SIZE	Approx: 5.5 MB/orbit (including header and aux. data)
GEOMETRICAL SAMPLING	3 km step size, 16 height steps per scan.
GEOMETRIC RESOLUTION	Vertical resolution of p, T, and VMR profiles: 3.4 km
GEOMETRIC ACCURACY	LOS pointing stability (single spectrum): < 0.3 km/4s Relative pointing stability (one elevation scan): < 0.9 km/4s Absolute pointing stability (individual scene spectrum): < 1.92 km horizontal pointing accuracy (single spectrum): 9 km/4s
RADIOMETRIC RESOLUTION	N/A
RADIOMETRIC ACCURACY	N/A
AUXILIARY DATA	Time correlation parameters; Orbit state vectors; Summary Quality ADS Scan Geolocation ADS PCD Information for Individual Scans ADS Microwindows occupation matrices ADS Residual Spectra GADS; Instrument and Processing Parameters ADS
ALGORITHMS USED	Geophysical retrieval
NOTES	Produced systematically from Level 1B data

MIPAS Extracted Temperature, Pressure and Atmospheric Constituents Profiles

PRODUCT ID	MIP_NLE_2P
PRODUCT NAME	MIPAS Extracted Temperature, Pressure and Atmospheric Constituents Profiles
DESCRIPTION	This Level 2 product consists of a number of geophysical parameters which have been extracted from the Temperature, Pressure, and Atmospheric Constituents Profiles product for NRT dissemination to Meteo users.
APPLICATIONS	NRT atmospheric monitoring.
DELIVERY TIME	The product is disseminated in NRT only and is available from the PDHS 3 hours after data acquisition.
COVERAGE	Full orbit
THROUGHPUT	1 product per orbit (approx. 100 minutes)
PRODUCT SIZE	Approx. 0.6 MB/product
GEOMETRICAL SAMPLING	3 km step size, 16 height steps per scan.
GEOMETRIC RESOLUTION	Vertical resolution of p, T, and VMR profiles: 3.4 km
GEOMETRIC ACCURACY	LOS pointing stability (single spectrum): < 0.3 km/4s Relative pointing stability (one elevation scan): < 0.9 km/4s Absolute pointing stability (individual scene spectrum): < 1.92 km horizontal pointing accuracy (single spectrum): 9 km/4s
RADIOMETRIC RESOLUTION	N/A
RADIOMETRIC ACCURACY	N/A
AUXILIARY DATA	Time correlation parameters; Orbit state vectors; Instrument and Processing Parameters ADS
ALGORITHMS USED	Extraction of parameters
NOTES	Produced systematically from the MIPAS Temperature, Pressure and Atmospheric Constituents product. Product may be converted to BUFR format outside the PDS for distribution to Meteo users.

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