DOCUMENT

Swarm Users - Data Access Manual

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CHANGE LOG

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Removed a typo in the Change Record Section referring to Level-2 Cat-1 Validation Products instead of Intermediate Products. Document internal sections layout re-arranged.	1	2	27/05/2015
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CHANGE RECORD

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Document generation	16/05/2014	all	all
Document updated to reflect new FTP data server structure. Removed also Level-2 Cat-1 Intermediate Products distribution	01/10/2014	7	Section 1.2.1
		11,12	Section 3 Table 3
		13	Table 5
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Document internal sections layout re-arranged. Removed a typo in the Change Record Section referring to Level-2 Cat-1 Validation Products instead of Intermediate Products. Applicable documents version updated. Clarified that also for Level2daily there are both Current & Previous folders	27/05/2015	All	All
Updated Applicable Document versions.	10/11/2015	7, 14, 17	Section 1.2.1 Section 3 (Table-6)

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Issue 1		Revision 5	
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Added footnote clarification on file extension of those Swarm L1B products not converted in CDF: native extension is used instead of generic .DBL file for products in SP3 and RINEX format. Added footnote clarification that Swarm L2C2 products will be distributed still in EEF, but with their native extension i.e. .CDF instead of .DBL.			
Updated Applicable Documents Updated with new Swarm Products: - DNSxPOD_2_ - ACCxCAL_2_ - ACCxVAL_2_ Updated with Auxiliary Data Availability (ORBxCNT_) Updated with Advanced Data Availability Updated Swarm FTP Server Data Structure Figures	29/07/2016	8, 9, 11-18	Section 1.2 Table-4 & Table-6 Section 2, Table-1 Section 3, Table-3 Section 3, Figure 1 Section 3, Figure 2
Updated Applicable Documents Improved description for products DNSxPOD_2_ and DNSxWND_2_	31/12/2016	8, 18	Section 1.2.1 Section 3
Updated FTP structure details	09/06/2017	11,14,15,16	Section 3
Updated FTP structure snapshots	19/06/2017	13-17	Section 3
Document updated with FTP anonymous access	21/06/2018	6,10	Section 1,3

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1 INTRODUCTION

The purpose of this document is to describe the data access mechanism available for the Swarm Users from the Swarm Dissemination FTP server (swarm-diss.eo.esa.int), including FTP structure, product types available, and their formats.

In accordance with ESA Earth Observation Data Policy, all Swarm Level 1b and Level 2 products are freely accessible to all users via anonymous FTP.

Users can contact EO Help Desk for any request or further clarifications (eohelp@esa.int).

1.1 Acronyms and Terminology

1.1.1 Acronyms

ACC	Accelerometer
ASM	Absolute Scalar Magnetometer
EFI	Electrical Field Instrument
EO	Earth Observation
ESA	European Space Agency
GPS	Global Positioning System
GPSR	GPS Receiver
L1B	Level-1 Processors/Products
L2 CAT-2	Level-2 Cat-2 Processors/Products
L2 CAT-1	Level-2 Cat-1 Products
L2PS	Level-2 Processing System
PDGS	Payload Data Ground Segment
S/C	Spacecraft
VFM	Vector Magnetometer

1.1.2 Terminology

This document and its appendixes use the following terms:

- L1b file naming convention is defined in [RD 1], [RD 2], and [AD 1]documents.

- L2 file naming convention is defined in [RD 1], [RD 2], and [AD 2] documents

- Ground Segment to indicate the main elements of the Swarm Ground Segment (GS), under ESA control; they are the Flight Operations Segment (FOS) and the Payload Data Ground

Segment (PDGS)

- <u>Product Baseline</u> is the baseline associated to a specific product file and satellite. In Swarm the Product Baseline depends on its level, processors version, satellite source, and relative Calibration and Charactisation Data Base. The Product Baseline is identified by the first two of the four digits placed at the end of the file name, i.e. the first two digits of the File_Version field represent the Product Baseline, while the last two represent an incremental counter.

- <u>Mission</u> to indicate the Swarm system includes the Swarm Satellites, the Swarm Ground Segment and the Swarm Users. *The Swarm mission is referred to as "the Mission" throughout this document*

- <u>Payload Data Ground Segment</u> (PDGS) to indicate the system responsible for Swarm:

    o Data Processing, Archiving and Dissemination

    o Data Quality Control

    o Ground Performances Monitoring

    o User Services

    o Instrument Calibration

- <u>Swarm Level-1b Data</u>: The level 1b products will consist of time series of relevant quantities as observed along the orbit, corrected, calibrated and converted to physical units. The data will be converted to engineering units using the best possible characterization data available.

- <u>Swarm Level-2 Data</u>: While the Level-1b products are produced per spacecraft, the Level-2 products will benefit from the use of the 3 satellites of the Swarm constellation. The Level-2 products are generated from 2 sources (PDGS and L2PS) and they will all be archived in the PDGS. Two different categories of Swarm Level 2 products have been defined:

    o <u>Swarm CAT-1 products</u>: Complex algorithms contributing to the generation of a Level 2 product of the various sources of the Earth's magnetic field, of thermo-spheric products, and for Precise Orbit determination. The products will be

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processed by the L2PS (consortium composed by scientists) under ESA responsibility, and will be distributed by the PDGS.

Swarm CAT-1 Level-2 Products can be further divided into:

- Level-2 Cat-1 Products

- Level-2 Cat-1 Validation Products (providing products validation reporting)

   o Swarm CAT-2 products: Algorithms leading to a Level 2 product with minimum delay with respect to the generation of the corresponding Level 1b data. The generation of CAT-2 products is designed to run automatically. The CAT-2 products will be generated and distributed by PDGS.

- Users to indicate any registered users e.g. researchers and/or applications developers using Swarm data.

1.2 Documents

1.2.1 Applicable Documents

[AD 1]   Swarm L1B Product Definition, SW-RS-DSC-SY-0007, V5.20

[AD 2]   Swarm Product specification for L2 Products and Auxiliary Products, SW-DS-DTU-GS-0001, Issue 2T

[AD 3]   Swarm CDF Converter Data Format Document, SW-ID-GMV-GS-0006, 3.9

[AD 4]   RINEX: The Receiver Independent Exchange Format Version 3.00 http://igscb.jpl.nasa.gov/igscb/data/format/rinex300.pdf

[AD 5]   Swarm Orbit Counter Specifications Document (AUXxORBCNT)

1.2.2 Reference Documents

[RD 1]   Earth Explorer File Format Standards, Doc. No: PE-TN-ESA-GS-0001, 1.4

[RD 2]   Tailoring of File Format Standards to Swarm Mission, Doc. No: SW-TN-ESA-GS-0074, 1.5

2 SWARM DATA

The Swarm data provided to the users via the Swarm PDGS external server consist of:

Data Types	Description
Level 1B	Calibrated, validated instrument data and Swarm Orbit Counter Data file
Level 2 (CAT-1 & CAT-2)	Validated scientific data and models

Advanced Data Set	This is a data set including advanced data e.g.
	• ASM/VFM Residuals
	• Provisional Plasma Data
	   o Langmuir Data
	   o Thermal Ion Images Data
	• 2 Hz TII Cross-track Data
	• 16Hz Plasma Density Data
	• 2Hz Langmuir Extended Data

Table 1 - Swarm Data Types

Detailed list of Swarm data and relevant description is available in chapter 3.

The format specification of Swarm data provided to the users is defined in [AD 1] - [AD 4] and [AD 5]

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3 SWARM DATA ACCESS

The Swarm users will have access to Swarm Level-1B and Swarm Level-2 CAT-1 and CAT-2 products available on the Swarm PDGS external server.

The following tables provide information about how to access the Swarm data.

The table below provides the information to access the PDGS external server where products are available:

Parameter	Value
Server Host Name (IP)	swarm-diss.eo.esa.int
Protocol	FTP
Access Type	Anonymous
Transfer Mode	Binary
Strategy	Pull
Compression	ZIP
Applicable Clean-Up Policy	None

Table 2 - Swarm FTP Server Network Access Parameters

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Products are grouped in separated directories as shown in the table below. To be noted that:

- The Product Baseline is the version associated to a specific product file and satellite

- The "**Entire_mission_data**" folder which will contain the full data coverage of the entire mission, regardless of any consideration of interoperability among the same product type. In other words the data might have been produced with strategies or knowledge that does not make the products necessarily interoperable for certain type of science. This information can still be captured by looking at the Product Baseline number.

- The "**Latest_baselines**" folder which will contain interoperable products generated in a consistent way with the application of all significant data quality improvements, but not necessarily covering the entire mission.

Data Level	Description

Level 1B	`Level1b\Latest_baselines\<Simplified type>`[1]`[\(Sat_{A,B,C}]\<data file>`
	
	`Level1b\Entire_mission_data\<Simplified type>[\(Sat_{A,B,C}]\<data file>`

Level 2	`Level2daily\Latest_baselines\<Product group>[\<Sub-group>]\Sat_{A,B,C}\<data file>`[2] `Level2daily\Entire_mission_data\<Product group>[\<Sub-group>]\Sat_{A,B,C}\<data file>` `Level2longterm\<Product group>\<data file>`[3]
Advanced	`<Advanced Data Type>\<data use purpose >`

Table 3 –Products Directories

The <data file> represents the Swarm data file name according to the Swarm data files naming convention defined in [RD 1] and [RD 2]. The directories will contain both files generated on a daily basis during routine operations and files generated via a reprocessing campaign.

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[1] Where <Simplified Type> is Swarm Level-1B Product Type without "_1B" or "ORBCNT"

[2] Containing L2 data, where <Product Group> & < Sub-Group> is as described in **Table 4 –Level-2 Daily Grouping**

[3] Containing L2 data where <Product Group> is as described in **Table 4 –Level-2 Daily Grouping**

Product Group / Sub-Group			Type[4]
Level2daily	ACC	AE	ACCxAE__2
		CAL	ACCxCAL_2
		POD	ACCxPOD_2_
		VAL	ACCxVAL_2
	EEF	TMS	EEFxTMS_2F
	FAC	TMS	FACxTMS_2F FAC_TMS_2F
	IBI	TMS	IBIxTMS_2F
	POD	RD	SP3xCOM_2_
		KIN	SP3xKIN_2
		VAL	SP3xVAL_2
	TDW	WND	DNSxWND_2
		VAL	TDWxVAL_2
		POD	DNSxPOD_2_
	TEC	TMS	TECxTMS_2F

Table 4 –Level-2 Daily Grouping

Product Group		Type [5]
Level2longterm	MCO	MCO_SHA_2y MCO_VAL_2y
	MCR	MCR_1DM_2_ MCR_3DM_2_ MC1_VAL_2_ MC3_VAL_2
	MIN	MIN_1DM_2_ MIN_3DM_2a MIN_3DM_2b MI1_VAL_2_ MI3_VAL_2
	MIO	MIO_SHA_2y MIO_VAL_2y
	MLI	MLI_SHA_2y MLI_VAL_2y
	MMA	MMA_SHA_2C MMA_SHA_2F MMA_VAL_2C

Table 5 - Level-2 Long Term Grouping

Examples of the Swarm FTP server structure are provided in next figures.

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[4] In the column type of the previous tables, "x" is the Satellite placeholder (x=A,B,C) and "y" is L2PS chain placeholder (y=C,D,E,F_).

[5] In the column type of the previous tables, "x" is the Satellite placeholder (x=A,B,C) and "y" is L2PS chain placeholder (y=C,D,E,F_).

Filename ∧		Filesize	Filetype	Last modified	Permissions	Owner/Group
..						
Advanced			Directory	06/19/17 10:05:05	0755	2000 2000
Level1b			Directory	06/19/17 10:05:01	0755	2000 2000
Level2daily			Directory	06/19/17 10:05:02	0755	2000 2000
Level2longterm			Directory	06/19/17 10:05:02	0755	2000 2000

Figure 1 - Swarm FTP Data Structure

Remote site: /Level1b/Entire_mission_data

```
▼  /
   ▼    Level1b
      ►      Entire_mission_data
         ?  Latest_baselines
      ?  Level2daily
      ?  Level2longterm
```

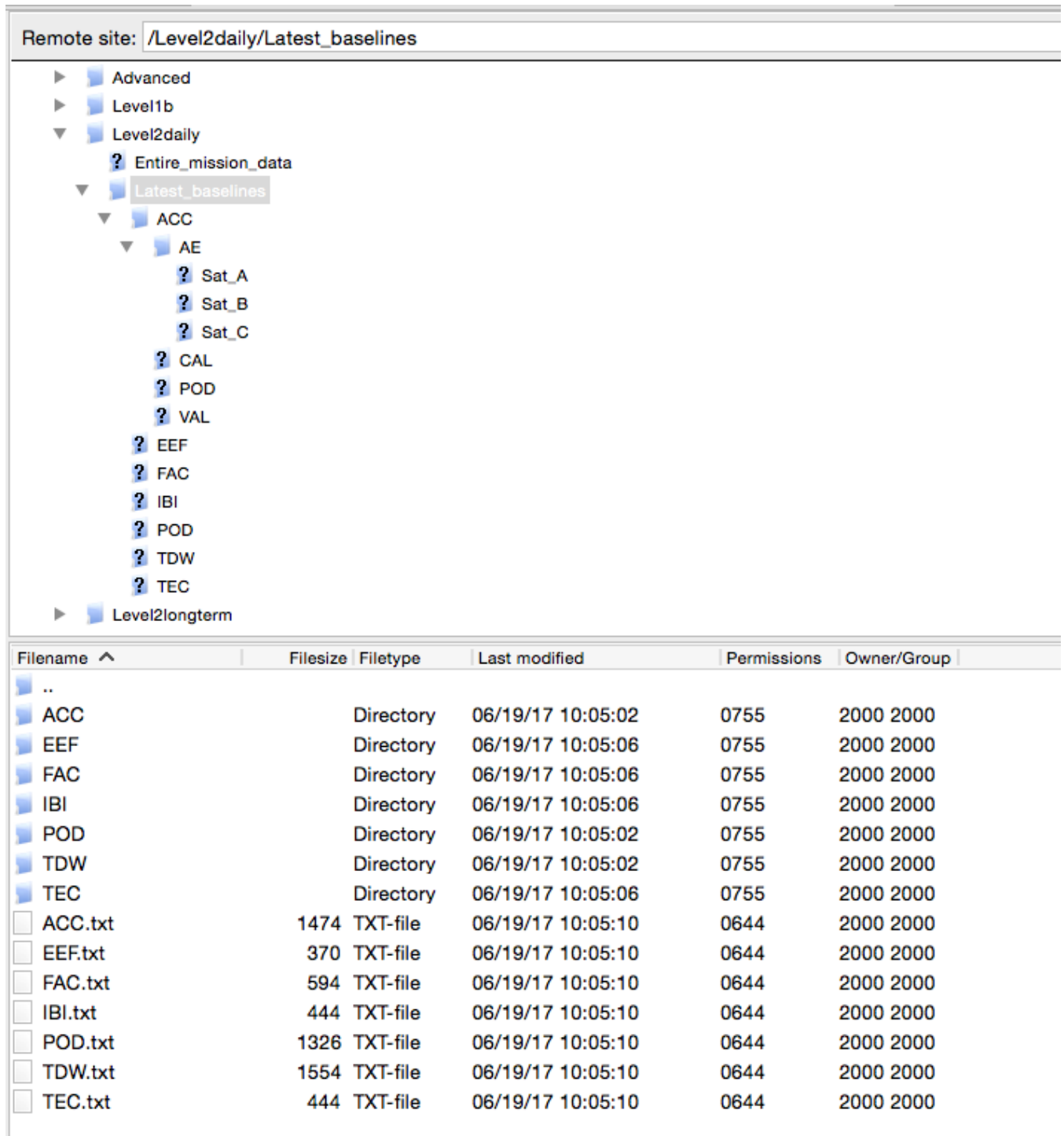| Filename ∧	Filesize	Filetype	Last modified	Permissions	Owner/Group
..					
ASMxAUX		Directory	06/21/17 10:59:05	0755	2000 2000
EFIx_PL		Directory	06/21/17 10:59:05	0755	2000 2000
GPSxNAV		Directory	06/21/17 10:59:05	0755	2000 2000
GPSx_RN		Directory	06/21/17 10:59:05	0755	2000 2000
GPSx_RO		Directory	06/21/17 10:59:05	0755	2000 2000
LP_x_CA		Directory	06/21/17 10:59:05	0755	2000 2000
MAGx_CA		Directory	06/21/17 10:59:05	0755	2000 2000
MAGx_HR		Directory	06/21/17 10:59:05	0755	2000 2000
MAGx_LR		Directory	06/21/17 10:59:05	0755	2000 2000
MODx_SC		Directory	06/21/17 10:59:05	0755	2000 2000
STRxATT		Directory	06/21/17 10:59:05	0755	2000 2000
VFMxAUX		Directory	06/21/17 11:42:11	0755	2000 2000
ASMxAUX.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
EFIx_PL.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
GPSxNAV.txt	222	txt-file	06/21/17 10:59:06	0644	2000 2000
GPSx_RN.txt	222	txt-file	06/21/17 10:59:06	0644	2000 2000
GPSx_RO.txt	222	txt-file	06/21/17 10:59:06	0644	2000 2000
LP_x_CA.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
MAGx_CA.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
MAGx_HR.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
MAGx_LR.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
MODx_SC.txt	222	txt-file	06/21/17 10:59:06	0644	2000 2000
STRxATT.txt	234	txt-file	06/21/17 10:59:06	0644	2000 2000
VFMxAUX.txt	234	txt-file	06/21/17 11:42:11	0644	2000 2000

Figure 2- Swarm Level-1 Data Structure

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Filename ^	Filesize	Filetype	Last modified	Permissions	Owner/Group
..					
ACC		Directory	06/19/17 10:05:02	0755	2000 2000
EEF		Directory	06/19/17 10:05:06	0755	2000 2000
FAC		Directory	06/19/17 10:05:06	0755	2000 2000
IBI		Directory	06/19/17 10:05:06	0755	2000 2000
POD		Directory	06/19/17 10:05:02	0755	2000 2000
TDW		Directory	06/19/17 10:05:02	0755	2000 2000
TEC		Directory	06/19/17 10:05:06	0755	2000 2000
ACC.txt	1474	TXT-file	06/19/17 10:05:10	0644	2000 2000
EEF.txt	370	TXT-file	06/19/17 10:05:10	0644	2000 2000
FAC.txt	594	TXT-file	06/19/17 10:05:10	0644	2000 2000
IBI.txt	444	TXT-file	06/19/17 10:05:10	0644	2000 2000
POD.txt	1326	TXT-file	06/19/17 10:05:10	0644	2000 2000
TDW.txt	1554	TXT-file	06/19/17 10:05:10	0644	2000 2000
TEC.txt	444	TXT-file	06/19/17 10:05:10	0644	2000 2000

Figure 3- Swarm Daily Level-2 Data Structure

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Figure 4 - Swarm Long Term Level-2 Data Structure

Figure 5 - Swarm Advanced Data Structure

To be noted that a TXT file is also provided to provide the list of data files available at that time in the corresponding directory. This file is automatically updated whenever the corresponding directory content is changed.

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The list of Swarm products available and relevant format is provided in the table below:

Swarm Product	Swarm Data File Description	Product type	Format	Specification Document
	ASM auxiliary data, 50 Hz	ASMxAUX_1B	CDF	[AD 1] & [AD 3]
	Plasma data, 2 or 16 Hz	EFIx_PL_1B	CDF	[AD 1] & [AD 3]
	GPS RINEX Navigation data, 2 hours	GPSx_RN_1B	RINEX[6]	[AD 1] & [AD 4]
	GPS RINEX Observation data, 0.1 Hz	GPSx_RO_1B	RINEX	[AD 1] & [AD 4]
	GPS RINEX Observation data, 1 Hz	GPSxNAV_1B	SP3[7]	[AD 1] & [AD 4]
	Langmuir Probe offset calibration data	LP_x_CA_1B	CDF	[AD 1] & [AD 3]
	Magnetic Calibration data, 0.25 Hz	MAGx_CA_1B	CDF	[AD 1] & [AD 3]
	Magnetic Vector Data, 50 Hz	MAGx_HR_1B	CDF	[AD 1] & [AD 3]
	Magnetic Vector Data, 1 Hz	MAGx_LR_1B	CDF	[AD 1] & [AD 3]
	Ephemeris of spacecraft, 1 Hz	MODx_SC_1B	SP3	[AD 1] & [AD 4]
	Attitude of S/C, 1Hz	STRxATT_1B	CDF	[AD 1] & [AD 3]
	VFM auxiliary data, 50 Hz	VFMxAUX_1B	CDF	[AD 1] & [AD 3]
	Swarm Orbit Data Counter	AUXxORBCNT_	ASCII	[AD 5]
Level-2 Cat-1 Products	CAT-1: Time series of accelerometer observations	ACCx_AE_2_	CDF	[AD 2]
	CAT-1: Accelerometer calibration parameters	ACCxCAL_2_	CDF	[AD 2]
	CAT-1: Time series of non-gravitational accelerations	ACCxPOD_2_	CDF	[AD 2]

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[6] The Swarm GPS related L1b products will be delivered within the compressed ZIP package in their native format: RINEX products i.e. files with "rnx" extensions. The corresponding .HDR data file will be still distributed as part of the compressed ZIP package.

[7] The Ephemerides (position) related Swarm L1b products will be delivered within the compressed package in in SP3c format with ".sp3" extension. The corresponding .HDR data file will be still distributed as part of the compressed ZIP package.

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Swarm Product	Swarm Data File Description	Product type	Format	Specification Document
	CAT-1: time series of neutral thermospheric density and wind speed from precise orbit determination and accelerometer data	DNSxWND_2_	CDF	[AD 2]
	CAT-1: time series of neutral thermospheric density from precise orbit determination data only	DNSxPOD_2_	CDF	[AD 2]
	CAT-1: Spherical harmonic model	MCO_SHA_2C	ASCII Listing (SHC)	[AD 2]
	CAT-1: Spherical harmonic model	MCO_SHA_2D	ASCII Listing (SHC)	[AD 2]
	CAT-1: Spherical harmonic model	MCO_SHA_2F	ASCII Listing (SHC)	[AD 2]
	CAT-1: 1D C-response maps	MCR_1DM_2_	ASCII Listing	[AD 2]
	CAT-1: 3D C-response maps	MCR_3DM_2_	ASCII Listing	[AD 2]
	CAT-1: 1D model of mantle conductivity	MIN_1DM_2_	ASCII Listing	[AD 2]
	CAT-1: 3D model of mantle conductivity	MIN_3DM_2a	ASCII Listing	[AD 2]
	CAT-1: 3D model of mantle conductivity	MIN_3DM_2b	ASCII Listing	[AD 2]
	CAT-1: Spherical harmonic model	MIO_SHA_2C	ASCII Listing	[AD 2]
	CAT-1: Spherical harmonic model	MIO_SHA_2D	ASCII Listing	[AD 2]
	CAT-1: Spherical harmonic model	MLI_SHA_2C	ASCII Listing (SHC)	[AD 2]
	CAT-1: Spherical harmonic model	MLI_SHA_2D	ASCII Listing (SHC)	[AD 2]
	CAT-1: Extended spherical harmonic model	MLI_SHA_2E	ASCII Listing (SHC)	[AD 2]
	CAT-1: Spherical harmonic model	MMA_SHA_2C	CDF	[AD 2]
	CAT-1: Spherical harmonic model	MMA_SHA_2F	CDF	[AD 2]
	CAT-1: time series of position and velocity	SP3xCOM_2_	ASCII Listing (SP3)	[AD 2]

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Swarm Product	Swarm Data File Description	Product type	Format	Specification Document
	Kinematic orbit solution for CoM Satellites	SP3xKIN_2_	ASCII Listing (SP3)	[AD 2]
Level-2 Cat-1 Validation Products	CAT-1: Validation report on 1D C-response	MC1_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on 3D C-response	MC3_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on core magnetic field	MCO_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on core magnetic field	MCO_VAL_2C	PDF	[AD 2]
	CAT-1: Validation report on core magnetic field	MCO_VAL_2D	PDF	[AD 2]
	CAT-1: Validation report on 1D mantle conductivity	MI1_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on 3D mantle conductivity	MI3_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on ionospheric magnetic model	MIO_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on ionospheric magnetic model	MIO_VAL_2C	PDF	[AD 2]
	CAT-1: Validation report on ionospheric magnetic model	MIO_VAL_2D	PDF	[AD 2]
	CAT-1: Validation report on lithospheric field	MLI_VAL_2_	PDF	[AD 2]
	CAT-1: Validation report on lithospheric field	MLI_VAL_2C	PDF	[AD 2]
	CAT-1: Validation report on lithospheric field	MLI_VAL_2D	PDF	[AD 2]
	CAT-1: Validation report on lithospheric field	MLI_VAL_2E	PDF	[AD 2]

Swarm Product	Swarm Data File Description	Product type	Format	Specification Document
	CAT-1: Validation report magnetospheric magnetic model	MMA_VAL_2C	PDF	[AD 2]
Level-2 Cat-1 Validation Products	CAT-1: Validation report for ACCxCAL_2_	ACCxVAL_2_	PDF	[AD 2]
	CAT-1: Validation report for SP3xCOM_2_	SP3xVAL_2_	PDF	[AD 2]
	CAT-1: Validation report for DNSxWND_2_	TDWxVAL_2_	PDF	[AD 2]
Level-2 Cat-2 Products	Dayside Equatorial Electric Field	EEFxTMS_2F	CDF	[AD 3]
	Ionospheric Field-Aligned Current Combined	FAC_TMS_2F	CDF	[AD 3]
	Ionospheric Field-Aligned Current	FACxTMS_2F	CDF	[AD 3]
	Ionospheric Bubble Index	IBIxTMS_2F	CDF	[AD 3]
	Ionospheric Total Electron Content	TECx_TMS_2F	CDF	[AD 3]

Table 6 - Swarm Products List and Format

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