ATL L1 PRODUCT DEFINITIONS

VOLUME B: CALIBRATION PRODUCTS

ECGP

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DOCUMENT STATUS SHEET

Version	Date	Pages	Changes
01.00	15/05/2015	21	Version for the TRR2 First issue of the document. Calibration products information is extracted from EC.ICD.GMV.ATL.00001 0.1 Draft and included in this Volume.
01.01	22/07/2015	19	Version for the TRR2 Close-out Following RIDs have been implemented: • RID-TRR2-43: Clarified that the headers are also included in the netCDF4/HDF5 datablock (sections 4.6, 4.7, 4.8 and 4.9) • RID-TRR2-42: Sections 4 of version 01.00 removed. Subsections 7.x of version 01.00 reviewed. • RID-TRR2-47: Packaging of L0 and L1 products in a ZIP file. • Additional changes:
01.02	01/12/2015	19	Version for the TRR2 Close-out (II) • ATL_BEC_1B removed from the document as requested in ECGP TRR-V2 MoM (EC.MN.GMV.SY.00017)
01.03	11/03/2016	19	Version for the AR2 Following changes have been implemented: • Unused dimensions removed from the Table 4.1 (i.e. latlon and tempPres) • PDGS ICD document updated in the list of applicable documents • Field names updated to be in line with the new ASD XML Library 13.4
02.00	27/03/2017	16	Redline version generated by ESA + Additonal changes from GMV • Interface change for the ATLID calibration products implementing EarthCARE metadata convention.
02.01	14/07/2017	17	Version for the ECGP V3.1: • No packaging as ZIP. • Product Format Version Specified in the scope section. • JIRA Issue ECGP-86;EC-GSCDR-198 sensing time in annotation header without GPS o time_synchronisation_status field added to ATL_FSC_1B data block, ATL_CSC_1B data block and ATL_DCC_1B data block • JIRA Issue ECGP-88; EC-GSCDR-212 ATL_NOM_1B SPH parameters o SPH aligned with EC.TN.ASF.ATL.00034 V08.00
02.02	22/11/2017	17	Version for the ECGP V3.2: o Following missing fields included in DCC product: mie_offset_standard_deviation, rayleigh_offset_standard_deviation, crosspolar_offset_standard_deviation
02.03	08/12/2017	17	Version for the ECGP V3.2 part1 closeout: o Missing variable in CSC added: number_valid_area o JIRA issue ECGP-87: Missing data type for frequency corrected, and missing fields added o Time units corrected
02.04	12/12/2017	17	Version for the ECGP V3.2 part1 closeout: o JIRA issue ECGP-87:
02.05	26/10/2018	17	Version for the ECGP V3.2 part2: • PDD version upgraded to 03.02 due to the changes in the SPH • Applicable documents version and dates reviewed • JIRA issue ECGP-206 • JIRA issue ECGP-220 (and sub-tickets) related to the new SPH contents and format
02.06	06/06/2019	18	Version for the ECGP V3.2 part2 AR Close-out. • PDD version upgraded to 03.03 due to the changes in some field names • *BRCCount in SPH updated. • ECGP-258: Text related to the internal representation of the data is removed. • ECGP-257: o Table 4.1 (Dimensions) replicated for each calibration product type (each one with its corresponding dimensions). o Changes in CSC: ▪ step1 removed because it is related to FSC ▪ step2 renamed as step and changed to 124

Version	Date	Pages	Changes
			▪ effective_upper_limit_scan, valid_steps_identification , frequency and rayleigh_cross_talk do not have the along_track dimension ▪ h2 dimension removed because it is not used in the CSC ▪ height_raw (h1) dimension changed to 256 as required in the ATBD (and renamed to h) o Changes in FSC: ▪ step2 removed because it is related to CSC ▪ step1 renamed as step ▪ h2 dimension removed because it is not used in the FSC ▪ height_raw (h1) dimension changed to 256 as required in the ATBD (and renamed to h) o Changes in DCC: ▪ step1 and step2 dimensions removed ▪ height_raw (h1) dimension changed to 256 as required in the ATBD (and renamed to h) ▪ h2 dimension removed because it is not used in the DCC • ECGP-242: o Description of InitialBRCcount updated. o Terminology MDS/ADS/QDS obsolete. Document reviewed to avoid using such terminology o Quality Counters in the SPH reviewed to count "error" profiles.
02.07	12/09/2022	20	Version for the ECGP ATL V4. o New variables added to the Calibration products

02.08	10/09/2023	21	Version for the ECGP ATL V4.2-rc1
			• Format of the Specific Product Header in the HDR file has changed.
			Instead of writing the variables in the SPH as
			`<variableName>value</variableName>`
			they are written like:
			`<variableName>`
			`<description>description text</description>`
			`<units>if applicable</units>`
			`<scalar>value</scalar>`
			`</variableName>`
			• Description and Units are also written in the h5 (in previous version it was not).
			Product format version has been bumped to 4.0 because this change breaks backward compatibility if a processor is reading information from the SPH in the HDR file.

02.09	25/04/2024	22	Version for the ECGP ATL V4.3-rc1 • [ECSYSTEM-874] Added geoid_offset to products. formatMinorVersion has been incremented because this change adds new field to the products. • [ECSYSTEM-876] Added output parameters related to KNMI crosstalk algorithm update
02.09	25/04/2024	22	Version for the ECGP ATL V4.6-rc1 • [ECL1-683] RedundIDE added to the Datablock in ATL_DCC_1B • [ECL1-693] RedundTxA added to the Datablock in ATL_FSC_1B

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LIST OF TABLES AND FIGURES

1. INTRODUCTION

1.1. PURPOSE

This document has been produced in the frame of the "EarthCARE Ground Processor" project and its purpose is to describe the format and content of the L1 Calibration products for the ATLID processor.

1.2. SCOPE

This document has been derived from the original ICD where all interfaces (commanding, monitoring, input and output data) were described. In this document, the information related to ATLID L1 Calibration Products has been extracted from the original ICD and has been included in this dedicated document.

The versions of the product formats defined in this document are:

- ATL_CSC_1B: 04.01
- ATL_FSC_1B: 04.02
- ATL_DCC_1B: 04.02

and must be reflected in the "formatMajorVersion" and "formatMinorVersion" of the MainProductHeader.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1. APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.X]:

Table 2.1: Applicable Documents

Ref.	Title	Code	Version	Date
[AD.1]	Earth Observation Mission CFI Software - General Software User Manual	EO-MA-DMS-GS-0002	4.1	07/05/2010
[AD.2]	ECSIM Interface Control Document	ECSIM-DMS-TEC-ICD01-R	1.7	18/11/2008
[AD.3]	Architecture of the ESSS and ECGP	EC.TN.ASD.SY.00017	7	19/12/2014
[AD.4]	Volume 0 Products Definitions - Introduction	EC.ICD.ASD.SY.00004	8	12/12/2014
[AD.5]	Volume 1 Products Definitions - Common Products Definitions	EC.ICD.ASD.SY.00005	12	25/07/2019
[AD.6]	ESSS and ECGP Common Interface Control Document	EC.ICD.ASD.SY.00009	8	09/12/2014
[AD.7]	Requirements for the ESSS & ECGP	EC.RS.ASD.SYS.00007	8	26/5/2010
[AD.8]	ATLID ECGP Algorithm Theoretical Baseline Document	EC.TN.ASF.ATL.00034	12	01/08/2023
[AD.9]	EarthCARE PDGS Generic IPF Interface Specifications	EACA-GSEG-EOPG-TN-15-0001	01.04	01/09/2017
[AD.10]	Space Engineering - Software	ECSS-E-ST-40	C	6/03/2009
[AD.11]	Volume 2a Products Definitions – ATLID L0 Products Definitions	EC.ICD.ASD.ATL.00018	6	11/12/2014
[AD.12]	Volume 6 Products Definitions – Auxiliary Data	EC.ICD.ASD.SY.00025	6	12/12/2014
[AD.13]	Earth Explorer Ground Segment File Format Standard	PE-TN-ESA-GS-0001	2.0	03/05/2012
[AD.14]	ECGP Interface Control Document (ICD)	EC.ICD.GMV.SY.00001	04.06	28/09/2024
[AD.15]	ATL L1 Product Definitions Volume A: Nominal Products	EC.ICD.GMV.ATL.00001	02.10	19/12/2024

2.2. REFERENCE DOCUMENTS

The following documents, although not part of this document, amplify or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.X]:

Table 2.2: Reference Documents

Ref.	Title	Code	Version	Date
[RD.1]	List of Acronyms and Abbreviations	EC.LI.ASD.SY.00001	4	10/01/2013

3. TERMS, DEFINITIONS AND ABBREVIATED TERMS

3.1. DEFINITIONS

Concepts and terms used in this document and needing a definition are included in the following table:

Table 3.1: Definitions

Concept / Term	Definition

3.2. ACRONYMS

General EarthCARE abbreviations are in [RD.1]. Specific abbreviations used in this document are given below.

Acronyms used in this document and needing a definition are included in the following table:

Table 3.2: Acronyms

Acronym	Definition
ATLID	ATmospheric LIDar
BBR	EarthCARE Broadband Radiometer
CCDB	Characterisation/Calibration Database
ECGP	EarthCARE Level-1 Ground Processor
ESSS	EarthCARE Satellite System Simulator
FHN	Friedrichshafen – Germany
GERB	Geostationary Earth Radiation Budget
GUI	Graphical User Interface
HMI	Human-Machine Interface
H/W	Hardware
ICD	Interface Control Document
IMDD	Instrument Measurement Data Definition
ISP	Instrument Source Packet
LW	Long-Wave
MDS	Measurement Data Stream
MSI	MultiSpectral Imager
PCD	Product Confidence Data
PDD	Product Definition Document
PDGS	Payload Data Ground Segment
SCOE	Spacecraft Check-Out Equipment
SRDB	Spacecraft Reference Data Base
SW	Short-Wave
S/W	Software
TDS	Test Data Set
TOA	Top Of Atmosphere
TW	Total Wave
UV	Ultra-Violet
WGS	World Geodetic System

4. ATLID L1 CALIBRATION PRODUCTS

ATLID L1 Calibration Products are generated by the ATLID L1 Processor.

4.1. TRANSFER MECHANISM

All EarthCARE Products are composed by two physical files:

- One XML for the headers (*filname*.HDR)
- One binary file for the records containing the data (*filename*.h5)

Both files are located into a folder with the same name (i.e. *filename)*.

4.2. FILE NAMING CONVENTION

The file naming convention for the EarthCARE Products is described in [AD.5].

4.3. SIZE AND FREQUENCY OF TRANSFERS

As 1/8 of the orbit is the nominal time frame for the EarthCARE L1 products, the size of the ATLID L1 products is given for such time frame i.e. 1/8 of the orbit. Following table summarises the sizes and frequency of generation of ATLID L1 Calibration products. This information has been extracted from ECGP ATL L1 V2 implementation.

Table 4.1: ATLID L1 calibration products size and frequency of transfers

Product type	Size	Frequency of transfer	Comments
ATL_CSC_1B	114 MB	Once at BOL and in case of contingency	Coarse spectral calibration
ATL_FSC_1B	47 MB	Once a week	Fine spectral calibration
ATL_DCC_1B	24 MB	Once a month	Dark current calibration

4.4. DATA DEFINITION

ATLID L1 Products have different components, but there is a common structure for all of them. In this structure is included the Fixed Product Header and the Main Product Header which are identical for all products and so it is described below.

4.5. DATA STRUCTURE

ATLID L1 Products have different components, but there is a common structure for all of them. This structure is presented in the table below.

Table 4.2: L1 Product logical structure

HeaderData
FixedProductHeader
VariableProductHeader
MainProductHeader
SpecificProductHeader
ScienceData

According to the above structure, the products are physically composed by:

- Headers (FixedProductHeader and VariableProductHeader) included in the XML file
- ScienceData included in the netCDF4/HDF5 binary file (which also contains the headers)

There are three different ATLID Calibration Products, sharing this structure. In this structure it is included the Fixed Product Header and the Main Product Header which are identical for all products and so it is described only once below.

4.6. ATL_CSC_1B

This is the Coarse Spectral calibration ATLID L1 product. It is separated in the four components described below.

4.6.1. ATL_CSC_1B FIXED PRODUCT HEADER

The Fixed Product Header is common for all ECGP products and is defined in Products Definitions Volume 1 [AD.5].

4.6.2. ATL_CSC_1B MAIN PRODUCT HEADER

The Main Product Header for the ATLID L1B Products is identical to the Main Product Header defined in Products Definitions Volume 1 [AD.5] but with following predefined values specific to ATLID L1B CSC product:

- fileCategory = "ATL_"
- productType = "CSC_"
- productLevel = "1B"

4.6.3. ATL_CSC_1B SPECIFIC PRODUCT HEADER

The Specific Product Header for the EarthCARE L1 Products follows the specification defined in section 6.1 of [AD.5], which defines following elements:

In case of ATL_CSC_1B, the SpecificProductHeader sub-group contains:

Table 4.3: ATL CSC L1 SPH structure

Group/Field Name	# Dims	Dimensions	Type	Units	Description
InputFileList	0	-	NC_STRING	N/A	String containing the logical file names (without extension) of all input files used by the processor to generate the product.
ConfigurationParameters	0	-	NC_STRING	N/A	Copy of the processor configuration file
QualityStatistics	0	-	NetCDF Group	N/A	This group contains an arbitrary number of quality statistics parameters. See following table

Table 4.4: ATL CSC L1 QualityStatistics group

Group/Field Name	# Dims	Dimensions	Type	Units	Description
CSC L1b product SPH - pre-processing results					
InitialBRCCount	0	-	NC_INT	unitless	Number of ISPs from the L0 product being processed in the L1 product (i.e. falling within the sensing start/stop range chosen for the L1)
ValidBRCCount	0	-	NC_INT	unitless	Number of ACDM validated ISPs from the L0 product being processed in the L1 product (i.e. falling within the sensing start/stop range chosen for the L1)
NominalBRCCount	0	-	NC_INT	unitless	Total number of nominal Basic Repetition Cycles (echo measurements resulting from 1 or several shots depending on Number of accumulation parameter)
CoarseBRCCount	0	-	NC_INT	unitless	Numbers of Coarse Spectral Calibration ISPs treated in the L0 product

Group/Field Name	# Dims	Dimensions	Type	Units	Description
FineBRCCount	0	-	NC_INT	unitless	Numbers of Fine Spectral Calibration ISPs treated in the L0 product
DarkBRCCount	0	-	NC_INT	unitless	Number of Dark Calibration ISPs treated in the L0 product
DetectionSaturationCount	0	-	NC_INT	unitless	Total number of saturated echoes
LaserTuningQualityCount	0	-	NC_INT	unitless	Total number of echoes measured with tuned laser Basic Repetition Cycles
CoAlQualityCount	0	-	NC_INT	unitless	Total number of echoes measured with co-aligned Basic Repetition Cycles
CSC L1b product SPH – data analysis counts					
FloorEchoCount	0	-	NC_INT	unitless	Total number of echoes which cannot be used for estimation of spectral cross-talk in Rayleigh
EpsAverStaticLength	0	-	NC_INT	unitless	Number of neutralised ISPs with reference to the Epsilon moving average process, at the beginning and at the end of the L1B product
CSC L1b product SPH – metadata					
ScanStepMinLength	0	-	NC_INT	unitless	Minimal number of valid data for spectral fitting
CSC_measurementStep	0	-	NC_INT	unitless	Number of step in the spectral scanning
MinNbStepsPerArea	0	-	NC_INT	unitless	Minimal number of step inside an area
CSC_XtalkThreshold	0	-	NC_FLOAT	unitless	Relative ratio on the epsilon amplitude for the threshold

4.6.4. ATL_CSC_1B DATABLOCK

Following table contains all dimensions used in the definition of the ATLID L1 CSC products.
"Name" is used in the description of the product datablock below (for brevity).
"Dimension label" is the actual name of the dimension in the NetCDF product.

Table 4.5: ATLID CSC NetCDF Dimensions

Name	Description	N Elements	Dimension label
t	Dimension used to define variables depending on the number of samples recorded during the measurement time	variable	along_track
h	Dimension used to define variables storing values for all atmospheric samples along the echo profile (altitude dependant). This dimension is used for raw signals only.	256	height_raw
step	Number of CSC Calibration steps	124	step
valid_area	Number of detected step intervals where a minimal epsilon can be found	variable [4..128]	valid_area
h2	Dimension used to define variables storing values for data samples inside each raw data profile.	254	height

The Datablock of this product is formatted as NetCDF/HDF5 file and have following fields:

Table 4.6: ATLID CSC L1 Datablock structure

Field Name	#Dims	Dimensions	Type	Units	Description
time	1	t	NC_DOUBLE	seconds since 2000-1-1	Considered UTC time reference for the measured profile nx (EchoProfileDate)

Field Name	#Dims	Dimensions	Type	Units	Description
				00:00:0 0.0 0:00	
mie_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Mie channel
rayleigh_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Rayleigh channel
crosspolar_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Crosspolar channel
floor_index	1	t	NC_UBYTE	unitless	Index of the floor sample in the profile #nx
rayleigh_raw_spectral_crosstalk	1	t	NC_FLOAT	unitless	Instantaneous Spectral cross-talk parameter for the Rayleigh channel
rayleigh_raw_spectral_cross_talk_invalid_flag	1	t	NC_BYTE	unitless	Floor echo is well detected (strong echo identified, which can be used for spectral cross-talk in Rayleigh estimation) 1 = invalid (weak echo), 0 = valid (strong echo)
frequency	1	step	NC_INT	MHz	Frequencies associated to each calibration step
rayleigh_cross_talk	1	step	NC_FLOAT	unitless	Obtained Rayleigh crosstalk for each calibration step
effective_upper_limit_scan	0	-	NC_INT	unitless	Upper limit of the valid CSC range [0..128]
valid_steps_identification	1	step	NC_BYTE	unitless	Identification table of the valid steps
first_step_identifier	1	valid_area	NC_INT	unitless	ID of first step of each detected step interval
last_step_identifier	1	valid_area	NC_INT	unitless	ID of last step of each detected step interval
minimum_step_identifier	1	valid_area	NC_INT	unitless	ID of the step of the minimal epsilon inside each detected step interval
minimum_step_frequency	1	valid_area	NC_INT	unitless	RLH frequency of the minimum step of each detected step interval
minimum_step_crosstalk	1	valid_area	NC_FLOAT	unitless	Spectral cross-talk of the minimum step of each detected step interval
number_valid_area	0	-	NC_INT	unitless	Number of detected step intervals where a minimal epsilon can be found
state_vector_quality_status	1	t	NC_INT	unitless	S/C State Vector Quality field copied from the ISP Private Science Data Header
time_synchronisation_status	1	t	NC_BYTE	unitless	Long name: Instrument time synchronisation status Status of the time synchronisation between the instrument and the satellite Bit 3: Time Type 0 = Elapsed Time (ET); 1 = OBT Bit 4: Sync. Source 0 = internal; 1 = external Bit 5: Ext. Sync. Source Detail 0 = MIL-Bus Major Frame; 1 = 1Hz Pulse Bit 6: Sync. Status 0 = NoSync; 1 = InSync Bit 7: …Synchronization Enabled/Disabled 0 = Disabled; 1 = Enabled
nbMeas	1	step	NC_INT	unitless	Number of measurements used to compute average cross-talk
Cal_Setpoint	1	t	NC_INT	unitless	ID of the frequency of emitter (Calibration setpoint1)
sample_range	2	t, h2	NC_FLOAT	m	Range
sample_latitude	2	t, h2	NC_DOUBLE	degree_north	Latitude

Field Name	#Dims	Dimensions	Type	Units	Description
sample_longitude	2	t, h2	NC_DOUBLE	degree_east	Longitude
sample_altitude	2	t, h2	NC_FLOAT	m	Altitude (WGS84)
sensor_latitude	1	t	NC_DOUBLE	degree_north	Sensor latitude
sensor_longitude	1	t	NC_DOUBLE	degree_east	Sensor_longitude
sensor_altitude	1	t	NC_FLOAT	m	Sensor altitude (WGS84)
ellipsoid_latitude	1	t	NC_DOUBLE	degree_north	Ellipsoid latitude
ellipsoid_longitude	1	t	NC_DOUBLE	degree_east	Ellipsoid longitude
surface_elevation	1	t	NC_FLOAT	m	Surface elevation (WGS84)
land_flag	1	t	NC_BYTE	unitless	Land flag 0: water 1: land
intersection_error_flag	1	t	NC_BYTE	unitless	Line-of-sight / ellipsoid intersection error flag 0: OK 1: error
layer_temperature	2	t, h2	NC_FLOAT	K	Layer temperature
layer_pressure	2	t, h2	NC_FLOAT	Pa	Layer pressure
solar_elevation_angle	1	t	NC_FLOAT	degree	Solar elevation angle (at line-of-sigh / ellipsoid intersection)
atmospheric_interpolation_error_flag	2	t, h2	NC_BYTE	unitless	Atmospheric interpolation error flag 0: OK 1: error
geoid_offset	1	t	NC_FLOAT	m	Height of the geoid over the ellipsoid

4.7. ATL_FSC_1B

This is the Fine Spectral calibration ATLID L1 product. It is separated in the four components described below.

4.7.1. ATL_FSC_1B FIXED PRODUCT HEADER

The Fixed Product Header is common for all ECGP products and is defined in Products Definitions Volume 1 [AD.5].

4.7.2. ATL_FSC_1B MAIN PRODUCT HEADER

The Main Product Header for the ATLID L1B Products is identical to the Main Product Header defined in Products Definitions Volume 1 [AD.5] but with following predefined values specific to ATLID L1B FSC product:

- fileCategory = "ATL_"
- productType = "FSC_"
- productLevel = "1B"

4.7.3. ATL_FSC_1B SPECIFIC PRODUCT HEADER

The Specific Product Header for the EarthCARE L1 Products follows the specification defined in section 6.1 of [AD.5], which defines following elements:

In case of ATL_FSC_1B, the SpecificProductHeader sub-group contains:

Table 4.7: ATL FSC L1 SPH structure

Group/Field Name	# Dims	Dimensions	Type	Units	Description
InputFileList	0	-	NC_STRING	N/A	String containing the logical file names (without extension) of all input files used by the processor to generate the product.
ConfigurationParameters	0	-	NC_STRING	N/A	Copy of the processor configuration file
QualityStatistics	0	-	NetCDF Group	N/A	This group contains an arbitrary number of quality statistics parameters. See following table

Table 4.8: ATL FSC L1 QualityStatistics group

Group/Field Name	# Dims	Dimensions	Type	Units	Description
FSC L1b product SPH - pre-processing results					
InitialBRCCount	0	-	NC_INT	unitless	Number of ISPs from the L0 product being processed in the L1 product (i.e. falling within the sensing start/stop range chosen for the L1)
ValidBRCCount	0	-	NC_INT	unitless	Number of ACDM validated ISPs from the L0 product being processed in the L1 product (i.e. falling within the sensing start/stop range chosen for the L1)
NominalBRCCount	0	-	NC_INT	unitless	Total number of nominal Basic Repetition Cycles (echo measurements resulting from 1 or several shots depending on Number of accumulation parameter)
CoarseBRCCount	0	-	NC_INT	unitless	Numbers of Coarse Spectral Calibration ISPs treated in the L0 product
FineBRCCount	0	-	NC_INT	unitless	Numbers of Fine Spectral Calibration ISPs treated in the L0 product
DarkBRCCount	0	-	NC_INT	unitless	Number of Dark Calibration ISPs treated in the L0 product
DetectionSaturationCount	0	-	NC_INT	unitless	Total number of saturated echoes
LaserTuningQualityCount	0	-	NC_INT	unitless	Total number of echoes measured with tuned laser Basic Repetition Cycles
CoAlQualityCount	0	-	NC_INT	unitless	Total number of echoes measured with co-aligned Basic Repetition Cycles
FSC L1b product SPH – data analysis counts					
FloorEchoCount	0	-	NC_INT	unitless	Total number of echoes which cannot be used for estimation of spectral cross-talk in Rayleigh
EpsAverStaticLength	0	-	NC_INT	unitless	Number of neutralised ISPs with reference to the Epsilon moving average process, at the beginning and at the end of the L1B product
FSC L1b product SPH – metadata					
ScanStepMinLength	0	-	NC_INT	unitless	Minimal number of valid data for spectral fitting
FSC_measurementStep	0	-	NC_INT	unitless	Number of step in the FSC spectral scanning
FitNbStepsPerScanSide	0	-	NC_INT	unitless	Half extend of the fitting range for the Epsilon minimal value
InitialFcommand	0	-	NC_INT	unitless	Total number of echoes measured with a nominal laser energy

4.7.4. ATL_FSC_1B DATABLOCK

Following table contains all dimensions used in the definition of the ATLID L1 FSC products.
"Name" is used in the description of the product datablock below (for brevity).
"Dimension label" is the actual name of the dimension in the NetCDF product.

Table 4.9: ATLID FSC NetCDF Dimensions

Name	Description	N Elements	Dimension label
t	Dimension used to define variables depending on the number of samples recorded during the measurement time	variable	along_track
h	Dimension used to define variables storing values for all atmospheric samples along the echo profile (altitude dependant). This dimension is used for raw signals only.	256	height_raw
step	Number of FSC Calibration steps	41	step
valid_area	Number of detected step intervals where a minimal epsilon can be found	variable [4..128]	valid_area
h2	Dimension used to define variables storing values for data samples inside each raw data profile.	254	height

The Datablock of this product is formatted as NetCDF/HDF5 file and have following fields:

Table 4.10: ATLID FSC Datablock structure

Field Name	#Dims	Dimensions	Type	Units	Description
time	1	t	NC_DOUBLE	seconds since 2000-1-1 00:00:00.0 0:00	Considered UTC time reference for the measured profile nx (EchoProfileDate)
mie_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Mie channel
rayleigh_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Rayleigh channel
crosspolar_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Crosspolar channel
floor_index	1	t	NC_UBYTE	unitless	Index of the floor sample in the profile #nx
rayleigh_raw_spectral_crosstalk	1	t	NC_FLOAT	unitless	Instantaneous Spectral cross-talk parameter for the Rayleigh channel
rayleigh_raw_spectral_cross_talk_invalid_flag	1	t	NC_BYTE	unitless	Floor echo is well detected (strong echo identified, which can be used for spectral cross-talk in Rayleigh estimation) 1 = invalid (weak echo), 0 = valid (strong echo)
frequency	1	step	NC_INT	MHz	Frequencies associated to each calibration step
rayleigh_crosstalk	1	step	NC_FLOAT	unitless	Valid ordinates to be used in the parabolic fit
effective_upper_limit_scan	0	–	NC_BYTE	unitless	Upper limit of the valid CSC range [0..128]
valid_steps_identification	1	step	NC_BYTE	unitless	Identification table of the valid steps
valid_steps_counter	0	–	NC_BYTE	unitless	Number of valid steps that can be used in the parbolic fit
minimum_step_identifier	0	–	NC_BYTE	unitless	Index (= nFSC) of the minimal EpsFSC(*) value
minimum_step_crosstalk	0	–	NC_FLOAT	unitless	Ordinate of the minimal EpsFSC(*) value
optimum_crosstalk	0	–	NC_FLOAT	unitless	Estimated optimal cross-talk for the FSC fit
minimum_abscissa_raw	0	-	NC_INT	unitless	Setpoint of the minimal EpsFSC(*) value

Field Name	#Dims	Dimensions	Type	Units	Description
minimum_abscissa_fitted	0	-	NC_INT	unitless	Setpoint of the best Tx/Rx frequency tuning
minimum_frequency_raw	0	-	NC_INT	unitless	RLH frequency ID of the minimal EpsFSC(*) value
minimum_frequency_fitted	0	-	NC_INT	unitless	RLH frequency ID of the best Tx/Rx frequency tuning
fine_spectral_calibration_set_point_table	1	step	NC_INT	unitless	Valid abscissa to be used in the parabolic fit (setpoint values)
state_vector_quality_status	1	t	NC_INT	unitless	S/C State Vector Quality field copied from the ISP Private Science Data Header
time_synchronisation_status	1	t	NC_BYTE	unitless	Long name: Instrument time synchronisation status Status of the time synchronisation between the instrument and the satellite Bit 3: Time Type 0 = Elapsed Time (ET); 1 = OBT Bit 4: Sync. Source 0 = internal; 1 = external Bit 5: Ext. Sync. Source Detail 0 = MIL-Bus Major Frame; 1 = 1Hz Pulse Bit 6: Sync. Status 0 = NoSync; 1 = InSync Bit 7: …Synchronization Enabled/Disabled 0 = Disabled; 1 = Enabled
ccdb_redundancy_flag	1	t	NC_BYTE	unitless	Flag to identify the redundancy configuration. Bit 0 (LSB): TLE Redundancy Selection -> 0=nominal, 1=redundant
Cal_Setpoint	1	t	NC_INT	unitless	ID of the frequency of emitter (Calibration setpoint1)
sample_range	2	t, h2	NC_FLOAT	m	Range
sample_latitude	2	t, h2	NC_DOUBLE	degree_north	Latitude
sample_longitude	2	t, h2	NC_DOUBLE	degree_east	Longitude
sample_altitude	2	t, h2	NC_FLOAT	m	Altitude (WGS84)
sensor_latitude	1	t	NC_DOUBLE	degree_north	Sensor latitude
sensor_longitude	1	t	NC_DOUBLE	degree_east	Sensor_longitude
sensor_altitude	1	t	NC_FLOAT	m	Sensor altitude (WGS84)
ellipsoid_latitude	1	t	NC_DOUBLE	degree_north	Ellipsoid latitude
ellipsoid_longitude	1	t	NC_DOUBLE	degree_east	Ellipsoid longitude
surface_elevation	1	t	NC_FLOAT	m	Surface elevation (WGS84)
land_flag	1	t	NC_BYTE	unitless	Land flag 0: water 1: land
intersection_error_flag	1	t	NC_BYTE	unitless	Line-of-sight / ellipsoid intersection error flag 0: OK 1: Error
layer_temperature	2	t, h2	NC_FLOAT	K	Layer temperature
layer_pressure	2	t, h2	NC_FLOAT	Pa	Layer pressure

Field Name	#Dims	Dimensions	Type	Units	Description
solar_elevation_angle	1	t	NC_FLOAT	degree	Solar elevation angle (at line-of-sigh / ellipsoid intersection)
atmospheric_interpolation_error_flag	2	t, h2	NC_BYTE	unitless	Atmospheric interpolation error flag 0: OK 1: Error
geoid_offset	1	t	NC_FLOAT	m	Height of the geoid over the ellipsoid
rayleigh_spectral_crosstalk_surface_evaluations	1	step	NC_FLOAT	unitless	Spectral cross-talk on Rayleigh channel estimated from surface return
rayleigh_spectral_crosstalk_surface_evaluations_error	1	step	NC_FLOAT	unitless	Error associated with the Rayleigh spectral crosstalk surface return estimates
valid_surface_rayleigh_spectral_crosstalk_segment_flag	1	step	NC_BYTE	unitless	Validity flag for the Rayleigh spectral crosstalk surface return estimates 1 = invalid, 0 = valid
rayleigh_spectral_crosstalk_STRAP_evaluations	1	step	NC_FLOAT	unitless	Spectral cross-talk on Rayleigh channel estimated via STRAP method
rayleigh_spectral_crosstalk_STRAP_evaluations_error	1	step	NC_FLOAT	unitless	Error associated with the Rayleigh spectral crosstalk STRAP estimates
valid_STRAP_rayleigh_spectral_crosstalk_segment_flag	1	step	NC_BYTE	unitless	Validity flag for the Rayleigh spectral crosstalk STRAP estimates 1 = invalid, 0 = valid

4.8. ATL_DCC_1B

This is the Dark Current Calibration ATLID L1 product. It is separated in the four components described below.

4.8.1. ATL_DCC_1B FIXED PRODUCT HEADER

The Fixed Product Header is common for all ECGP products and is defined in Products Definitions Volume 1 [AD.5].

4.8.2. ATL_DCC_1B MAIN PRODUCT HEADER

The Main Product Header for the ATLID L1B Products is identical to the Main Product Header defined in Products Definitions Volume 1 [AD.5] but with following predefined values specific to ATLID L1B DCC product:

- fileCategory = "ATL_"
- productType = "DCC_"
- productLevel = "1B"

4.8.3. ATL_DCC_1B SPECIFIC PRODUCT HEADER

The Specific Product Header for the EarthCARE L1 Products follows the specification defined in section 6.1 of [AD.5], which defines following elements:

In case of ATL_DCC_1B, the SpecificProductHeader sub-group contains:

Table 4.11: ATL DCC L1 SPH structure

Group/Field Name	# Dims	Dimensions	Type	Units	Description
InputFileList	0	-	NC_STRING	N/A	String containing the logical file names (without extension) of all input files used by the processor to generate the product.

Group/Field Name	# Dims	Dimensions	Type	Units	Description
ConfigurationParameters	0	-	NC_STRING	N/A	Copy of the processor configuration file
QualityStatistics	0	-	NetCDF Group	N/A	This group contains an arbitrary number of quality statistics parameters. See following table

Table 4.12: ATL DCC L1 QualityStatistics group

Group/Field Name	# Dims	Dimensions	Type	Units	Description
DCC L1b product SPH - pre-processing results					
InitialBRCCount	0	-	NC_INT	unitless	Number of ISPs from the L0 product being processed in the L1 product (i.e. falling within the sensing start/stop range chosen for the L1)
ValidBRCCount	0	-	NC_INT	unitless	Number of ACDM validated ISPs from the L0 product being processed in the L1 product (i.e. falling within the sensing start/stop range chosen for the L1)
NominalBRCCount	0	-	NC_INT	unitless	Total number of nominal Basic Repetition Cycles (echo measurements resulting from 1 or several shots depending on Number of accumulation parameter)
CoarseBRCCount	0	-	NC_INT	unitless	Numbers of Coarse Spectral Calibration ISPs treated in the L0 product
FineBRCCount	0	-	NC_INT	unitless	Numbers of Fine Spectral Calibration ISPs treated in the L0 product
DarkBRCCount	0	-	NC_INT	unitless	Number of Dark Calibration ISPs treated in the L0 product
DetectionSaturationCount	0	-	NC_INT	unitless	Total number of saturated echoes
LaserTuningQualityCount	0	-	NC_INT	unitless	Total number of echoes measured with tuned laser Basic Repetition Cycles
CoAlQualityCount	0	-	NC_INT	unitless	Total number of echoes measured with co-aligned Basic Repetition Cycles
DCC L1b product SPH – data analysis counts					
OffsetAssessmentValidityRay	0	-	NC_BYTE	unitless	Bit vector indicating the success of the offset evaluation on Ray channel
OffsetAssessmentValidityMie	0	-	NC_BYTE	unitless	Bit vector indicating the success of the offset evaluation on Mie channel
OffsetAssessmentValidityCro	0	-	NC_BYTE	unitless	Bit vector indicating the success of the offset evaluation on Cro channel
DCC L1b product SPH – metadata					
AccumulationNumber	0	-	NC_BYTE	unitless	Number of accumulated profiles to build one DRD
DCCsampleNumber	0	-	NC_UINT64	unitless	Number of BRC profiles used
Ray_HRquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for HR samples
Mie_HRquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for HR samples
Cro_HRquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for HR samples
Ray_LRquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for LR samples
Mie_LRquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for LR samples

Group/Field Name	# Dims	Dimensions	Type	Units	Description
Cro_LRquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for LR samples
Ray_BKGquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for BKG samples
Mie_BKGquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for BKG samples
Cro_BKGquality	0	-	NC_FLOAT	unitless	DCC operation quality criteria for BKG samples

4.8.4. ATL_DCC_1B DATABLOCK

Following table contains all dimensions used in the definition of the ATLID L1 DCC products.
"Name" is used in the description of the product datablock below (for brevity).
"Dimension label" is the actual name of the dimension in the NetCDF product.

Table 4.13: ATLID DCC NetCDF Dimensions

Name	Description	N Elements	Dimension label
T	Dimension used to define variables depending on the number of samples recorded during the measurement time	variable	along_track
h	Dimension used to define variables storing values for all atmospheric samples along the echo profile (altitude dependant). This dimension is used for raw signals only.	256	height_raw
valid_area	Number of detected step intervals where a minimal epsilon can be found	variable [4..128]	valid_area
h2	Dimension used to define variables storing values for data samples inside each raw data profile.	254	height

The Datablock of this product is formatted as NetCDF/HDF5 file and have following fields:

Table 4.14: ATLID DCC L1 Datablock structure

Field Name	#Dims	Dimensions	Type	Units	Description
time	1	T	NC_DOUBLE	seconds since 2000-1-1 00:00:00.0 0:00	Considered UTC time reference for the measured profile nx (EchoProfileDate)
mie_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Mie channel
rayleigh_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Rayleigh channel
crosspolar_raw_signal	2	t, h	NC_USHORT	BU	Raw data corresponding to unprocessed signal on Crosspolar channel
mie_offset	0	–	NC_FLOAT	BU	Detection offset levels on the Mie channel
rayleigh_offset	0	–	NC_FLOAT	BU	Detection offset levels on the Rayleigh channel
crosspolar_offset	0	–	NC_FLOAT	BU	Detection offset levels on the Crosspolar channel
mie_offset_standard_deviation	0		NC_FLOAT	BU	Offset standard deviation on Mie channel corresponding to DSNU calibration mode
rayleigh_offset_standard_deviation	0		NC_FLOAT	BU	Offset standard deviation on Rayleigh channel corresponding to DSNU calibration mode
crosspolar_offset_standard_deviation	0		NC_FLOAT	BU	Offset standard deviation on Crosspolar channel corresponding to DSNU calibration mode

Field Name	#Dims	Dimensions	Type	Units	Description
mie_offset_variation	1	T	NC_FLOAT	BU	Offset acquisition on the MIE channel
rayleigh_offset_variation	1	T	NC_FLOAT	BU	Offset acquisition on the RAY channel
crosspolar_offset_variation	1	T	NC_FLOAT	BU	Offset acquisition on the CRO channel
mie_dsnu_average_map	1	h	NC_FLOAT	BU	Obtained DSNU map for Mie co-polar detector
rayleigh_dsnu_average_map	1	h	NC_FLOAT	BU	Obtained DSNU map for Rayleigh detector
crosspolar_dsnu_average_map	1	h	NC_FLOAT	BU	Obtained DSNU map for crosspolar detector
mie_dark_noise_map	1	h	NC_FLOAT	BU	Error on DSNU map assessment/ Detection Noise assessed [LSB] for Mie co-polar detector
rayleigh_dark_noise_map	1	h	NC_FLOAT	BU	Error on DSNU map assessment/ Detection Noise assessed [LSB] for Rayleigh detector
crosspolar_dark_noise_map	1	h	NC_FLOAT	BU	Error on DSNU map assessment/ Detection Noise assessed [LSB] for crosspolar detector
state_vector_quality_status	1	t	NC_INT	unitless	S/C State Vector Quality field copied from the ISP Private Science Data Header
time_synchronisation_status	1	t	NC_BYTE	unitless	Long name: Instrument time synchronisation status Status of the time synchronisation between the instrument and the satellite Bit 3: Time Type 0 = Elapsed Time (ET); 1 = OBT Bit 4: Sync. Source 0 = internal; 1 = external Bit 5: Ext. Sync. Source Detail 0 = MIL-Bus Major Frame; 1 = 1Hz Pulse Bit 6: Sync. Status 0 = NoSync; 1 = InSync Bit 7: …Synchronization Enabled/Disabled 0 = Disabled; 1 = Enabled
ccdb_redundancy_flag	1	t	NC_BYTE	unitless	Flag to identify the redundancy configuration. Bit 0 : IDE Redundancy Selection -> 0=nominal, 1=redundant
nbMeas	1	step	NC_INT	unitless	Number of measurements used to compute average cross-talk
Cal_Setpoint	1	t	NC_INT	unitless	ID of the frequency of emitter (Calibration setpoint1)
sample_range	2	t, h2	NC_FLOAT	m	Range
sample_latitude	2	t, h2	NC_DOUBLE	degree_north	Latitude
sample_longitude	2	t, h2	NC_DOUBLE	degree_east	Longitude
sample_altitude	2	t, h2	NC_FLOAT	m	Altitude (WGS84)
sensor_latitude	1	t	NC_DOUBLE	degree_north	Sensor latitude
sensor_longitude	1	t	NC_DOUBLE	degree_east	Sensor_longitude
sensor_altitude	1	t	NC_FLOAT	m	Sensor altitude (WGS84)
ellipsoid_latitude	1	t	NC_DOUBLE	degree_north	Ellipsoid latitude

Field Name	#Dims	Dimensions	Type	Units	Description
ellipsoid_longitude	1	t	NC_DOUBLE	degree_east	Ellipsoid longitude
surface_elevation	1	t	NC_FLOAT	m	Surface elevation (WGS84)
land_flag	1	t	NC_BYTE	unitless	Land flag 0: water 1: land
intersection_error_flag	1	t	NC_BYTE	unitless	Line-of-sight / ellipsoid intersection error flag 0: OK 1: Error
layer_temperature	2	t, h2	NC_FLOAT	K	Layer temperature
layer_pressure	2	t, h2	NC_FLOAT	Pa	Layer pressure
solar_elevation_angle	1	t	NC_FLOAT	degree	Solar elevation angle (at line-of-sigh / ellipsoid intersection)
atmospheric_interpolation_error_flag	2	t, h2	NC_BYTE	unitless	Atmospheric interpolation error flag 0: OK 1: Error
geoid_offset	1	t	NC_FLOAT	m	Height of the geoid over the ellipsoid
rayleigh_spectral_crosstalk_surface_evaluations	1	step	NC_FLOAT	unitless	Spectral cross-talk on Rayleigh channel estimated from surface return
rayleigh_spectral_crosstalk_surface_evaluations_error	1	step	NC_FLOAT	unitless	Error associated with the Rayleigh spectral crosstalk surface return estimates
valid_surface_rayleigh_spectral_crosstalk_segment_flag	1	step	NC_BYTE	unitless	Validity flag for the Rayleigh spectral crosstalk surface return estimates 1 = invalid, 0 = valid
rayleigh_spectral_crosstalk_STRAP_evaluations	1	step	NC_FLOAT	unitless	Spectral cross-talk on Rayleigh channel estimated via STRAP method
rayleigh_spectral_crosstalk_STRAP_evaluations_error	1	step	NC_FLOAT	unitless	Error associated with the Rayleigh spectral crosstalk STRAP estimates
valid_STRAP_rayleigh_spectral_crosstalk_segment_flag	1	step	NC_BYTE	unitless	Validity flag for the Rayleigh spectral crosstalk STRAP estimates 1 = invalid, 0 = valid

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