EarthCARE Product Definitions
-JAXA L2 Product Format-

Change Record

Issue	Date	Sheet	Description of Change
draft 1	Feb, 2015	All	First issue
A	Feb, 2017	3.5, APPENDIX 4 - APPENDIX10	Change the data structure and name of product.
		APPENDIX9, APPENDIX10	Update the Product format of CPR-ATLID-MSI compound product and 4-sensor compound product.
B draft 1	June, 2017	3.3	Update the contents of Quality information.
C	Sept, 2019	3.5.2	Modify the explanation of Tables 3.5-3 and 3.5-4.
		3.5.3	Update Figures 3.5-3 and 3.5-4 and remove the line of "dataBlockSize" in Table 3.5-5.
		3.5.4	Remove "TBD" and put the contents of the specific product header.
		4	Update Table 4-1 according to the changes of APPRNDIX1 – 3.
		APPENDIX1 - 2	Put the contents of Section 3 in each appendix.
		APPENDIX3	Remove all the contents of APPENDIX3.
		APPENDIX4 - 10	Remove Sections 3.3 and 3.4.2 and totally update Table 3.4-1 (currently Table 3.3-1) in each appendix.
SAM-2022009 (MAS-130030D)	Sept, 2020	APPENDIX 1,2,4,5,8,9	Add new related documents. Modify the descriptions of processing overview. Change/add input files. Change/add representative physical quantities. Add/Modify dimension definitions.
		All	Fix typos.
SAM-2022009 A (MAS-130030E draft 1)	Jun, 2022	APPENDIX7	Update the unit of measure in Table 3.3-1, No.13 from "km" to "m".
	Sept, 2022	3.5.2	Fix the typo in the time format of "Validity_Period" and "Creation_Date". (MMDD -> MM-DD)
SAM-2022009 A (MAS-130030E)	Jan. 2023	2.2.1 3.2 3.4 3.5.1 3.5.2	Correct the observation height of CPR to be consistent with CPR Level 1 PDD. Update the description of frame overlaps. Updated the description of frame start and stop time fields of a product filename. Correct the description of SpecificProductHeader in Table 3.5-1 Update the time format of "Validity_Period" and "Creation_Date", Update the description of "Mission", "File_Class", And "Validity_Period"

		3.5.3 APPENDIX 7,10	Correct the number of characters of “File_Name” Update the time format of “sensingStartTime”, ”sensingStopTime”, “processingStartTime”, “processingStopTime”, “frameStartTime” and “frameStopTime” Update the description of “fileClass” and “acquisitionStation” Correct the input files for MSI L2a and 4-sensors L2b.
SAM-2022009B (MAS-130030F)		3.5.4	Update Element name (from InputFiles to InputFileList) of L-1 in Figure 3.5-5. Update Element name (from InputFiles to InputFileList) and Overview of row L-1 in Table 3.5-8
		APPENDIX 5,6,8,9	Update Table 3.3-1.
SAM-2022009C (MAS-130030G)	Dec. 2024	APPENDIX4,6, 7,10 APPENDIX4,6, 7 APPENDIX4, 10 APPENDIX6	3.3.1 in APPENDIX has been combined with 3.3. Table 3.3 update 2.2 input files update 3.1 Dimension Definitions update
SAM-2022009D (MAS-130030H)	Jan. 2025	Appendix1,2,5 Appendix 6 Appendix 1~10	Table 3.3 update Modify table 3.3 style and format Add product identifier on the appendix title
SAM-2022009E (MAS-130030J)	Mar 2025	1.1 3.3. Appendix1~10 Appendix1,2,5,8 Table 3.5.2 F-3 (Notes)	The version of the product formats (1.0) was specified. The definition of the quality information was updated. Update data volume Table 3.3 update DOIs for EarthCARE L2 products were added.
SAM-2022009F (MAS-130030K)	Aug. 2025	APPENDIX 4	Table 3.3-1 update (Rows No.39-No.58 are replaced by rows No.39-No.66)
SAM-2022009G (MAS-130030L)	Aug. 2025	APPENDIX10	Table 3.3-1 update (Updated below rows No.15)

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1. Overview

1.1 Purpose

This document describes the formats of high-level products that are generated by the EarthCARE mission operation system.

The version of the product formats defined in this document is 1.0 and must be reflected in the “formatMajorVersion” and “formatMinorVersion” of the MainProductHeader.

1.2 Related Documents

The following list shows the related documents.

(1) *SAM-2018016*

EarthCARE/CPR Level 1b Product File Definition Document

(2) EC-ICD-ASD-ATL-00021

EarthCARE Product Definitions Volume 2b　ATLID level1 Products Definitions

(3) EC-ICD-ASD-BBR-00022

EarthCARE Product Definitions Volume 3b　BBR level1 Products Definitions

(4) EC-ICD-ASD-MSI-00023

EarthCARE Product Definitions Volume 4b　MSI level1 Products Definitions

(5) *MAS-220023D*

EarthCARE Data Definitions

(6) *NDX-110018B*

EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD)

(7) EC-ICD-ASD-SY-00005

EarthCARE Product Definitions Volume 1 – Common Products Definitions

(8) EC-ICD-ESA-GS-0215

ESA-JAXA Ground Segment Operational Interface Agreement

(9) PE-TN-ESA-GS-0001

Earth Explorer Ground Segment - File Format Standard

(10) EC-TN-ESA-GS-0218

Tailoring of the Earth Observation File Format Standard for the EarthCARE Ground Segment

2. EarthCARE Overview

2.1 EarthCARE Overview

The EarthCARE satellite uses the four sensors shown in Table 2.1-1 to obtain observational data of a target at nearly the same time and location. The purpose of observations by the satellite is to find out the three-dimensional structures of clouds and aerosols in the earth atmosphere and to understand the interaction between them. This purpose is accomplished by using the sensors in Table 2.1-1 and from synergy (synchronous) observations with them. Obtained observational data is processed by a high-level software, and then processed not only into single-sensor products but also into compound products such as two-sensor products, three-sensor products, and four-sensor products.

There are two types of high-level products: standard products and research products. This document does not cover the research products.

Table 2.1-1 Overview of the sensors mounted in the EarthCARE

Sensor	Sensor overview
Cloud Profiling Radar (CPR)	Observes the vertical distributions of clouds and weak rain and their movements.
Atmospheric Lidar (ATLID)	Observes the vertical distributions of clouds and aerosols and their shape information.
Multi-Spectral Imager (MSI)	With sensitivities in the visible and infrared ranges, observes horizontal distributions of clouds and aerosols.
Broadband Radiometer (BBR)	Receives reflection and radiation of long waves and short waves in each broadband of them from the earth surface.

Table 2.1-2 includes specifications concerning the EarthCARE satellite orbit.

Table 2.1-2 Specifications of the EarthCARE satellite orbit

Item	Description	
Satellite orbit	Orbit type	Synchronous sub-recurrent orbit
	Local time of passing the descending node	14:00
	Orbit altitude	Approx. 393 km at normal observation time (above the equator)
	Orbit inclination	97.05 degrees
	Period	Approx. 92.5 minutes
	Number of days of recurrence	25 days

2.2 Observation Methods

This section describes the observation methods of the sensors in Table 2.1-1.

2.2.1 CPR

The CPR, jointly developed by JAXA and NICT, is the first satellite-borne millimeter-wave Doppler radar with the Doppler velocity measurement function. The CPR is equipped with a large antenna of 2.5 m ϕ. By transmitting a large amount of power, it can conduct observations with sensitivity about 10 times higher than that of the existing satellite-borne cloud radar (-35 dBZ to 21 dBZ).

Figure 2.2-1 is a conceptual image of CPR observation. The upper limits of observation altitudes are 16km, 18 km, and 20 km, which are switched depending on the latitude. The altitude resolution is 500 m. The diameter of the earth surface projection (footprint) is 750 m. The horizontal integral distance is 500 m. The horizontal resolution is 768 m for cross-track, and 840 m for along-track.

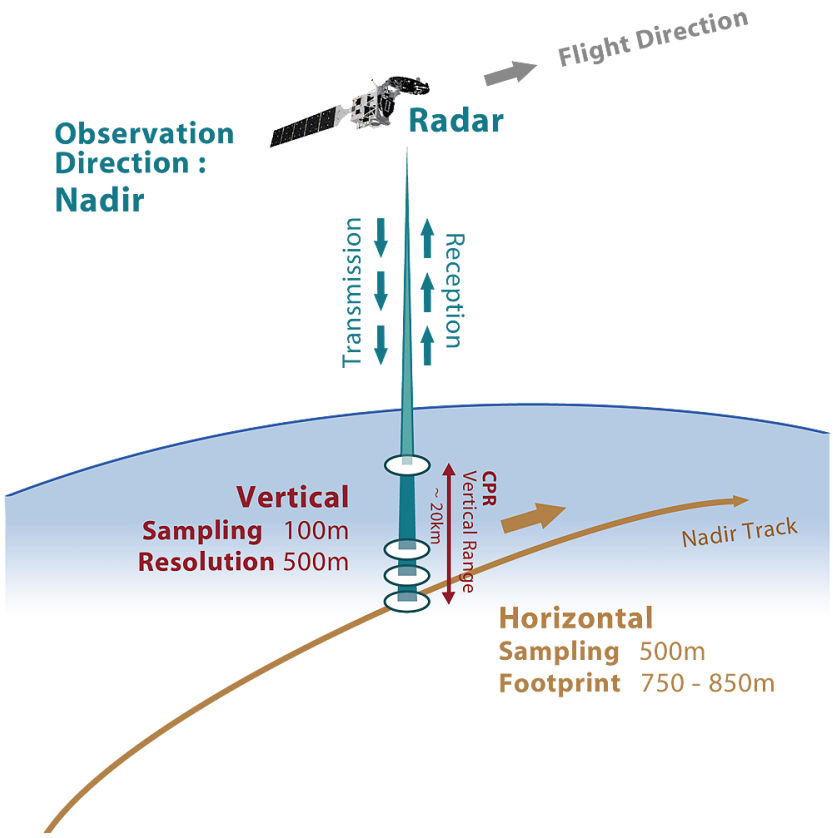

Figure 2.2-1 Conceptual image of CPR observation

2.2.2 ATLID

The ATLID, a high spectral resolution lidar (HSEL) developed by Europe, irradiates laser pulses in the ultraviolet region (355 nm) in an active method to receive scatter signals of particles, etc. Figure 2.2-2 is a conceptual image of ATLID observation. The altitude resolution is 100 to 300 m, and the footprint is 30 m.

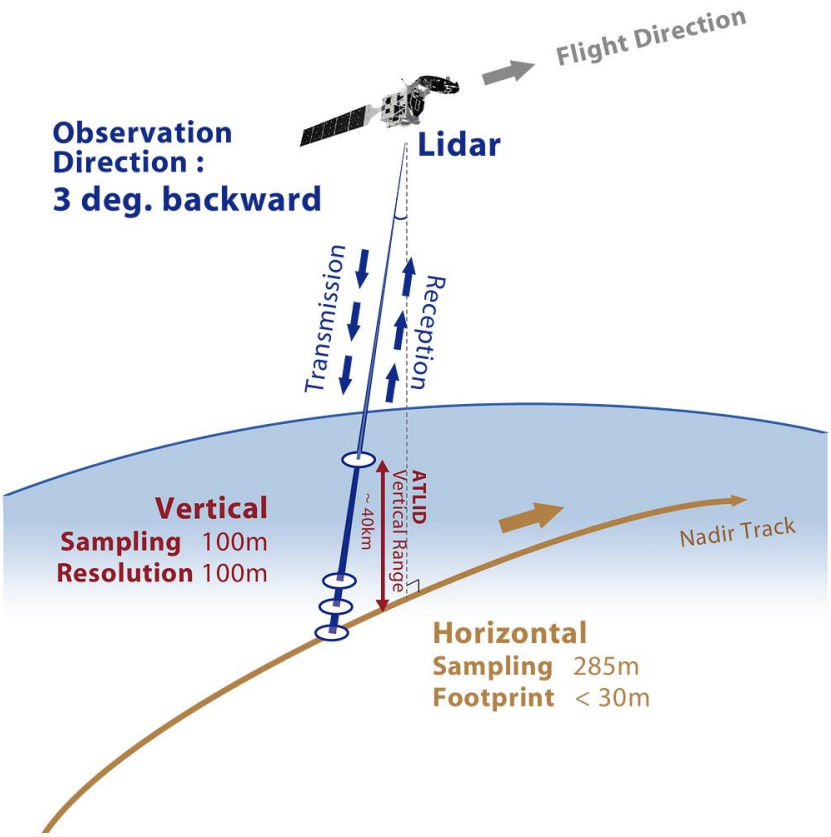

Figure 2.2-2 Conceptual image of ATLID observation

2.2.3 MSI

The MSI, developed by Europe, is an optical sensor that adopts the push broom scanner method. From measurement of reflection and radiation from the earth surface and atmosphere with the seven channels in the visible region to the thermal infrared region, the horizontal distribution of clouds or aerosols can be obtained. The sensor has the seven observation channels of 670 nm, 865 nm, 1.65 μm, 2.21 μm, 8.80 μm, 10.80 μm, and 12.00 μm. The observation width is 150 km. Figure 2.2-3 is a conceptual image of MSI observation.

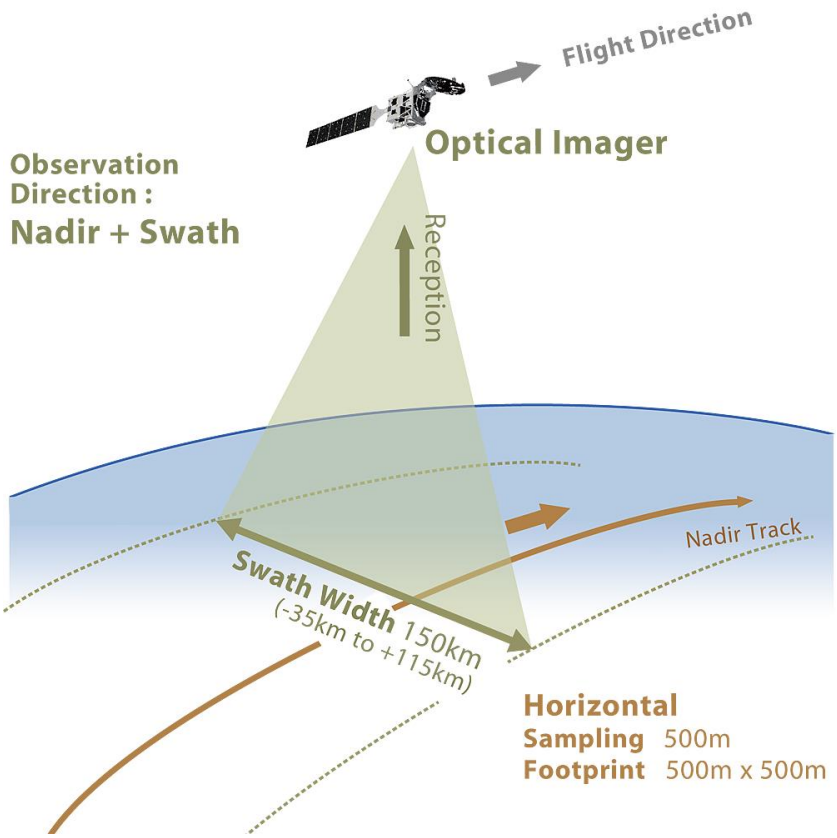

Figure 2.2-3 Conceptual image of MSI observation

2.2.4 BBR

The BBR is a radiometer developed by Europe. Observation data of the two channels is used to calculate the radiation flux of long-wave and short-wave bands.

Figure 2.2-4 is a conceptual image of BBR observation. The footprint is 10 km, and the observation channels are 0.25 μm to 50 μm and 0.25 μm to 4 μm, with a precision of 1.5 $Wm^{-2}sr^{-1}$ and 2.5 $Wm^{-2}sr^{-1}$, respectively.

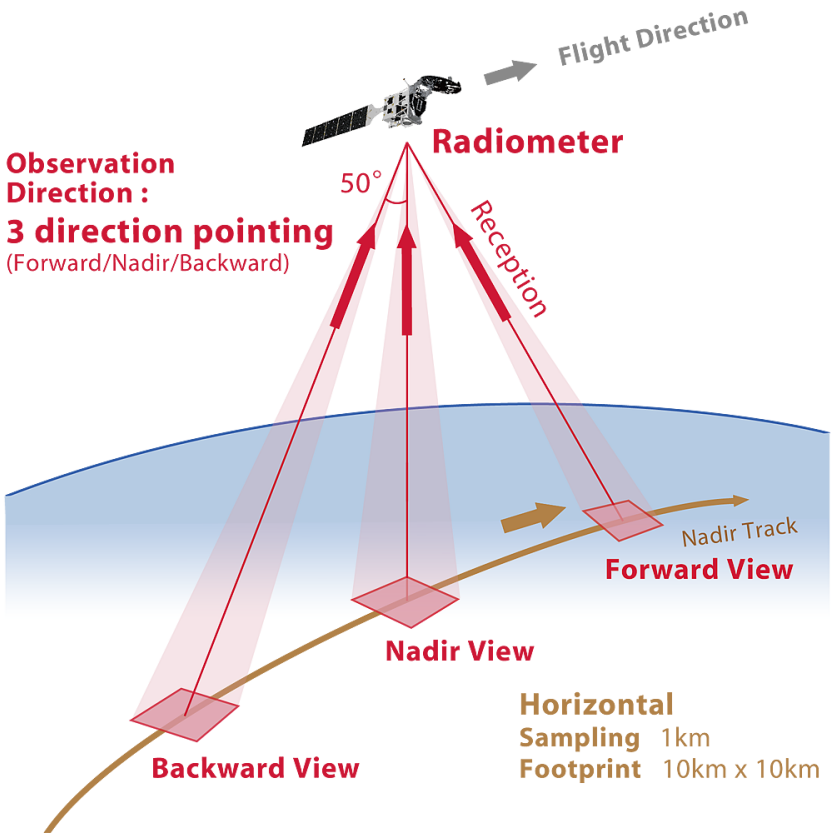

Figure 2.2-4 Conceptual image of BBR observation

3. Product Overview

This section describes the concept of EarthCARE products.

3.1 Level Definitions

Table 3.1-1 shows the definitions of the EarthCARE product levels. This section describes only for high-level products. For details, see related document (5). Chapter 4 describes details of each product of the EarthCARE.

Table 3.1-1 EarthCARE product level definitions

Product level	Definition
Level 2a product	This product is calculated as physical quantities of various types from input of a single-sensor level 1 product or level 2a product. This product includes physical quantities that have been converted into parameters based on sensor-specific physical quantities represented by a level 1 product. These parameters represent type classifications, physical characteristics, etc. of clouds and aerosols as atmospheric phenomena.
Level 2b product	This product is a compound product that is calculated as physical quantities of various types from input of a level 1 product or level 2a product by multiple sensors. This product is also called a synergy product. This product is calculated from observation data of multiple sensors such as upward flow in a cloud and radiation flux.
Auxiliary product	This product is cut out from an X-MET product, which is auxiliary data(non-satellite data that is required for product processing (meteorological observation data, sea surface temperature data, etc.)), according to the sensor observation region of the EarthCARE. The products of this level include those provided by JAXA/this system and those generated by ESA and provided to JAXA (ESA products).

3.2 Frame Definitions

The file unit of JAXA standard products and ESA products is defined by the unit called a frame.

The frame is defined as 1/8 orbit. The frame utilizes a one-eighth-orbit frame scheme, offset by a one-half frame-width (i.e. 22.5 degrees on latitude) from equator crossings (ANX/DNX) and North and South poles.

The frame boundaries are at 22.5 degrees and 67.5 degrees on north and south latitudes.

One circuit begins at the time of passing the ascending node, and two eight frames are defined as "A," "B," "C," "D," "E," "F," "G," and "H" in sequence.

The boundary latitudes of each frame are defined in Table 3.2-1.

Table 3.2-1 Boundary latitudes of each frame

Frame	Start latitude	(Midpoint)	End latitude
A	-22.5	0	22.5
B	22.5	45	67.5
C	67.5	North edge	67.5
D	67.5	45	22.5
E	22.5	0	-22.5
F	-22.5	-45	-67.5
G	-67.5	South edge	-67.5
H	-67.5	-45	-22.5

Figure 3.2-1 shows an image of concept of the frame. Detailed definition of the frame and overlap are specified by related document (7) and (8). Overlaps are added before and after each frame of Level 1 products as described in the related document (1), whereas no overlaps are added to Level 2a/2b products.

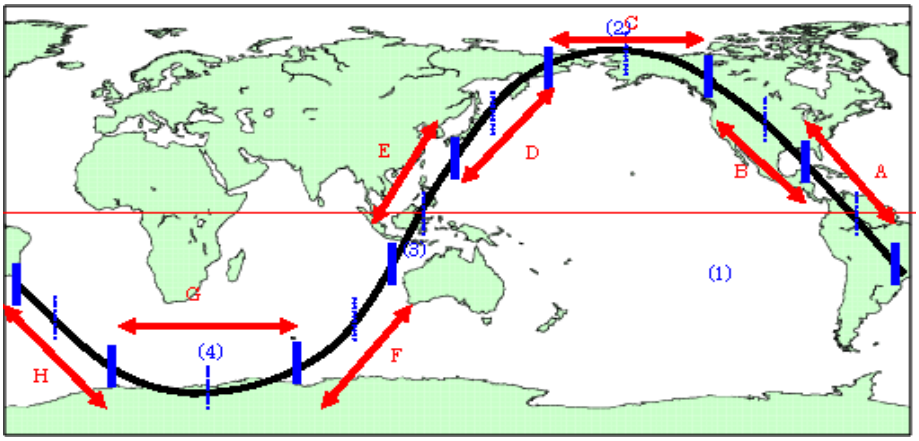

Figure 3.2-1 Frame definitions over the entire globe

3.3 Quality Information

A JAXA high level product retains information of the quality, which is represented by GOOD, FAIR, and NG. Details of the three qualities are the following.

GOOD (G) : The significant anomaly is not recognized for all quality items for a certain frame, which is suitable to provide.

FAIR (F) : Some significant anomalies are recognized for quality items for a certain frame. But it is suitable to provide.

NG(N) : The quality is defined as “NG” if the product has only invalid rays. The NG flag for high level products is used just for products using CPR L1b as an input file (CPR_ECO, CPR_CLP, and AC_CLP).

The quality information is set to the following variables of the products:

Meta data “specificProductHeader” -> "productQualityFlag"

The quality information flag is used for CPR_ECO, CPR_CLP, AC_CLP, and AUX-2DH, AUX-3MH. The three products using CPR L1b (CPR_ECO, CPR_CLP, and AC_CLP) duplicate quality information from the input file of CPR L1b.

The quality flags of AUX-2DH and AUX-3MH are as follows:

AUX-2DH: If the products are generated before 10th August 2025, the RFCO (Readiness For Collaborative Observation) date of ATLID, the products are GOOD. On and after the RFCO date of the ATLID, the quality is classified as Fair if the product is generated without ATLID L1b.

AUX-3MH: If the products are generated before 26th July 2025, the RFCO date of MSI, the products are GOOD. On and after the RFCO of MSI, the quality is classified as Fair if the product is generated without MSI L1c.

The above conditions are summarized in the following Table 3.3-1.

Table 3.3-1 Quality information conditions

Quality information / Products	Good	Fair	NG
Products using CPR L1b (CPR_ECO, CPR_CLP, and AC_CLP)	Duplicate from the input file of CPR L1b ※1 (inadequate data rate is less than standard inadequate data rate)	Duplicate from the input file of CPR L1b ※1 (inadequate data rate is larger than standard inadequate data rate)	Duplicate from the input file of CPR L1b ※1 (The input file of CPR L1b has only invalid rays)
AUX-2DH	All data before the RFCO date of ATLID, or the product is generated with ATLID L1b.	No ATLID L1b as an input file.	(not used)
AUX-3MH	All data before the RFCO date of MSI, or the product is generated with MSI L1c.	No MSI L1c as an input file.	(not used)
None of the above	(not used)	(not used)	(not used)

※1 For more details, see 1.2(1)

3.4 File Naming Rules

The granule ID is used as the file name. The file naming concept of EarthCARE high-level products (standard processing) are shown in "Figure 3.4-1 EarthCARE high-level products (standard processing) file naming rules,". Details of numbers in Figure 3.4-1 is explained in "Table 3.4-1 EarthCARE high-level products (standard processing) file naming rules."

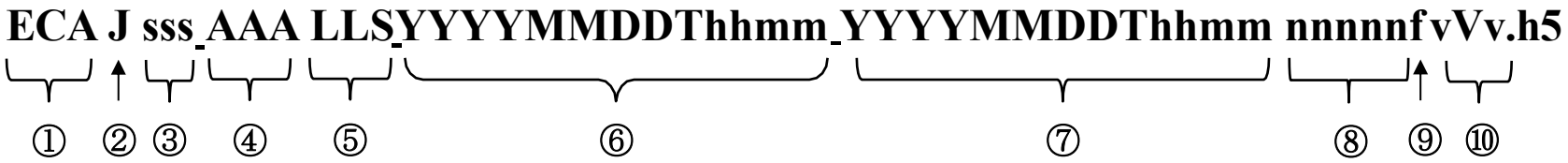

Figure 3.4-1 EarthCARE high-level products (standard processing) file naming rules

Table 3.4-1 EarthCARE high-level products (standard processing) file naming rules

No.	Name	Number of characters	Value
①	Mission ID (mission name+satellite identification)	3	ECA [fixed value]
②	Processing institute code	1	J [fixed value] J: JAXA
③	Sensor ID (sensor identification)	3	CPR: CPR, MSI: MSI, ATLID: ATL, BBR: BBR, CPR+ATLID: AC_, ATLID+MSI: AM_, BBR+MSI: BM_, ATLID+MSI+BBR: AMB, CPR+ATLID+MSI: ACM, CPR+ATLID+MSI+BBR: ALL, Meteorological data: AUX
④	File identifier	3	CPR One-sensor Echo Product: ECO CPR One-sensor Cloud Product: CLP MSI One-sensor Cloud Product: CLP ATLID One-sensor Cloud and Aerosol Product: CLA CPR-ATLID Synergy Cloud Product: CLP CPR-ATLID-MSI Synergy Cloud Product: CLP Four Sensors Synergy Radiation Budget Product: RAD ECMWF sensor grid product (for supply to users): AUX
⑤	Processing level	3	LL (2A: Level 2a, 2B: Level 2b/Synergy, XX: Level other than 0, 1, or 2 (including AUX)) S: Standard processing
⑥	Frame start time	13	UTC time, set to the same date and time with frameStartTime (M-44 of Table 3.5-5) without second. This field should also be identical to the same field of Level 1b product file. YYYY: Christian year MM: Month DD: Day in month hh: Hour 0 to 23 mm: Minute 0 to 59

No.	Name	Number of characters	Value
⑦	Frame end time	13	UTC time, set to the same date and time with frameStopTime (M-45 of Table 3.5-5) without second. This field should also be identical to the same field of Level 1b product file. YYYY: Christian year MM: Month DD: Day in month hh: Hour 0 to 23 mm: Minute 0 to 59
⑧	Orbit number	5	00001 to 99999 (5 digits, filled with leading 0's)
⑨	Frame ID	1	frame ID (A to H)
⑩	Product version	3	vAa v: Fixed A: Major product version (uppercase letters A to Z) a: Minor product version (lowercase letters a to z)

3.5 Product Data Structure

3.5.1 Overall structure

Figure 3.5-1 shows the overall structure of product data of a high-level product (standard processing). An HDF5 file consists of the meta part, which includes attribute information, and the data part, which includes product data. In each product, the header part stores meta part and the data set part stores observational data, latitude/longitude, data concerning science, and other items.

The meta part, common to all the high-level products, is divided into three items. Table 3.5-1 provides an overview of each item in the meta part. In addition, Sections 3.5.2 to 3.5.4 provide the data structures of the items of (1) to (3), respectively. The contents of the data part vary depending on individual high-level products of the EarthCARE. Therefore, details of the data part are described in the product format of each product, which is provided as appendixes.

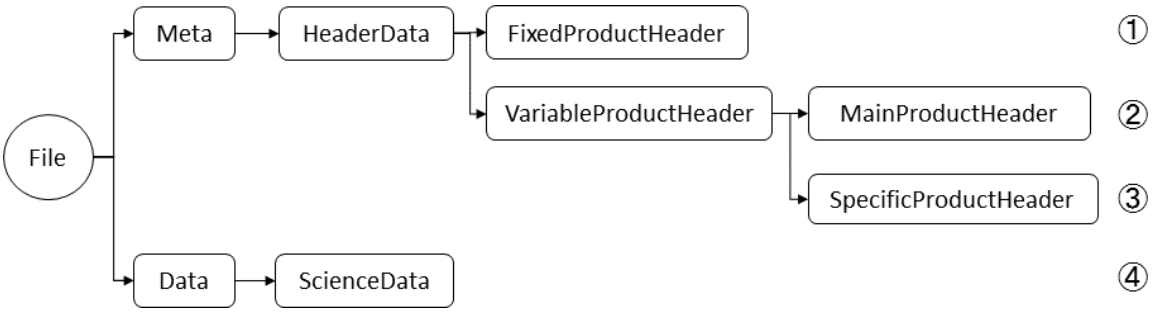

Figure 3.5-1 Product data structure (overall) of a high-level product (standard processing)

Table 3.5-1 Meta data description

Meta group	Description
FixedProductHeader	Contains information that is common to all of the products of the EarthCARE. Part of the information is the same as the contents of MainProductHeader.
MainProductHeader	Similar to FixedProductHeader, this item is commonly used throughout the EarthCARE. Part of the information is the same as the contents of FixedProductHeader. The contents are independent from the data level, and they are general information relevant to all the products.
SpecificProductHeader	SpecificProductHeader contains a description of the observational data set in the product.

3.5.2 FixedProductHeader

Figure 3.5-2 shows the structure ofFixedProductHeader.

FixedProductHeader includes elements and groups. Elements are the bottoms of a tree in the

FixedProductHeader. Groups have some elements in itself and one or more items are included.

The elements are indicated by white backgrounds, while the group is indicated by the gray background in the Figure 3.5-2. Table 3.5-2 includes descriptions of elements No. 1 to No. 8. Table 3.5-3 explains the elements of the Validity_Period group while Table 3.5-4 includes descriptions of the elements in the Source group. Data type of each element in the FixedProductHeader is character.

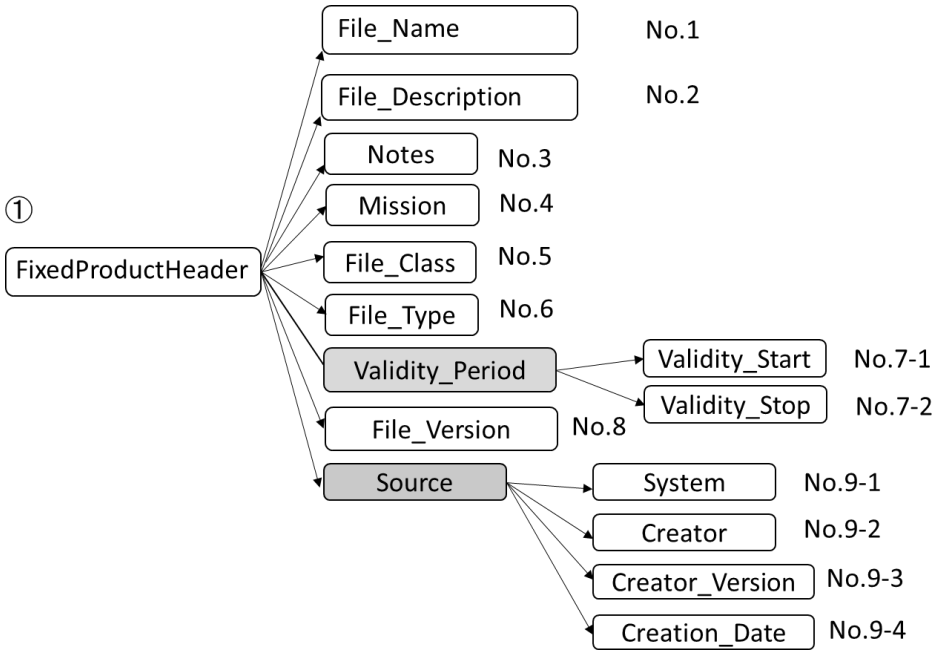

Figure 3.5-2 Product data structure of FixedProductHeader (part (1) in Figure 3.5-1)

Table 3.5-2 Elements of FixedProductHeader (1)

No.	Element name	Overview	Data size	Unit
F-1	File_Name	This is the logical file name without file extension of the product.	56	Unitless
F-2	File_Description	This is a one-line description of the File Type. Allowed descriptions are pre-defined for each project for each File Type defined. See "Earth Explorer Ground Segment - File Format Standard" - PE-TN-ESA-GS-0001 for details.	2000	Unitless
F-3	Notes	This is a textual description of the product/file. There are no prescriptions on its format provided it fits into the maximum allowed size. See "Earth Explorer Ground Segment - File Format Standard" - PE-TN-ESA-GS-0001 for details. For details, please refer to the related document (9). For a JAXA EarthCARE product, the DOI is described here. DOIs for JAXA EarthCARE L2 products are as follows: EarthCARE_CPR_L2A_CPR_ECO 10.57746/EO.01jdvd0xm10ema4rxwbpcd0dn1 EarthCARE_CPR_L2A_CPR_CLP 10.57746/EO.01jdvd2gqq34e6yz9p8kfe68x5 EarthCARE_ATLID_L2A_ATL_CLA 10.57746/EO.01jkwjk45jrx9frz6c11x4rs8e EarthCARE_MSI_L2A_MSI_CLP	2000	Unitless

		10.57746/EO.01jkwjkd9yt4shyz0z27drfve3 EarthCARE_L2B_AC__CLP 10.57746/EO.01jkwjeg2y0bqndnsvjvaaskaw EarthCARE_L2B_ACM_CLP 10.57746/EO.01jkwjjsm4b9a9qws9xpxjajnv EarthCARE_L2B_ALL_RAD 10.57746/EO.01jkwjp98y6mndbxt887cgcgw6		
F-4	Mission	The Mission field is fixed to "EarthCARE"	9	Unitless
F-5	File_Class	This describes the agency generating the product (ESA/JAXA), its latency (example:/offline/not applicable), the environment (operational, test, simulator, system verification), and the product baseline. See "Earth Explorer Ground Segment - File Format Standard" - PE- TN-ESA-GS-0001 for details. For EarthCARE each letter of the File Class has a specific meaning as follows: CCCC = ABDD where: A = Agency generating the file E ESA J JAXA B = Latency N Near-real time (placeholder only, currently not used) O Offline X Not applicable DD = Product baseline This is starting from AA for the first baseline, then continuing AB, AC, AD, … each time the baseline is changed. Set to AA if baseline concept does not apply to file.	4	Unitless
F-6	File_Type	This defines the file/product structure. All file/products of the same File Type share same structure. See "Earth Explorer Ground Segment - File Format Standard" - PE-TN-ESA-GS-0001 for details. The 10 character File Type can be subdivided into two sub-fields as follows: TTTTTTTTTT = FFFFDDDDDD where: FFFF = File Category DDDDDD = Semantic Descriptor	10	Unitless
F-7	Validity_Period	The Validity Period equals the time span between the time stamps of the frame start and frame stop, defined as frameStartTime and frameStopTime (M44 and M45) in Table 3.5-5. For the purposes of the Fixed Product Header times are in CCSDS time format: UTC=YYYY- MM-DDThh:mm:ss. See "Earth Explorer Ground Segment - File Format Standard" - PE- TN-ESA-GS-0001 for details. The default value for the start of a Validity Period is UTC=0000-00-00T00:00:00, for the end of a Validity Period is UTC=9999-99-99T99:99:99	See: Table 3.5-3	Unitless
F-8	File_Version	This field is retained for compatibility with "Earth Explorer Ground Segment - File Format Standard" - PE-TNESA-GS-0001. It was used to distinguish between different instances of files with the same validity. For EarthCARE products it has no meaning as the processing time is used to distinguish between product instances. It is therefore always set to "0001"..	4	Unitless
F-9	Source	This describes the (sub)system that generated the product/file. See "Earth Explorer Ground Segment - File Format Standard" - PE-TN-ESA- GS-0001 for details. A Source consists from F-9-1 to F-9-4 in table 3.5-3	See: Table 3.5-4	

Table 3.5-3 Elements of FixedProductHeader (2)

No.	Element name	Overview	Data size	Unit
F-7-1	Validity_Start	Validity_Start is the UTC time of the frame start.	23	Unitless
F-7-2	Validity_Stop	Validity_Stop is the UTC time of the frame stop.	23	Unitless

Table 3.5-4 Elements of FixedProductHeader (3)

No.	Element name	Overview	Data size	Unit
F-9-1	System	System in which the product has been generated. See "Earth Explorer Ground Segment - File Format Standard" - PE-TN-ESA-GS-0001 for details.	10	Unitless
F-9-2	Creator	Institute or processor that has generated the product. See "Earth Explorer Ground Segment - File Format Standard" - PE-TN-ESA-GS-0001 for details.	10	Unitless
F-9-3	Creator_Version	This is the version of the system that generated the product/file. As an example, version 23 must be written as "0023".	4	Unitless
F-9-4	Creation_Date	This is the creation date of the product/file. Creation dates are in CCSDS time format: UTC=YYYY-MM-DDThh:mm:ss.	23	Unitless

3.5.3 MainProductHeader

Figures 3.5-3 and 3.5-4 show the structure of MainProductHeader. Table 3.5-5 includes descriptions of the elements from No. 1 to No. 47. Table 3.5-6 and Table 3.5-7 include descriptions of the elements included in the frameStartCoodinates group and frameStopCoordinates group, respectively. Data type of each element in the MainProductHeader is character.

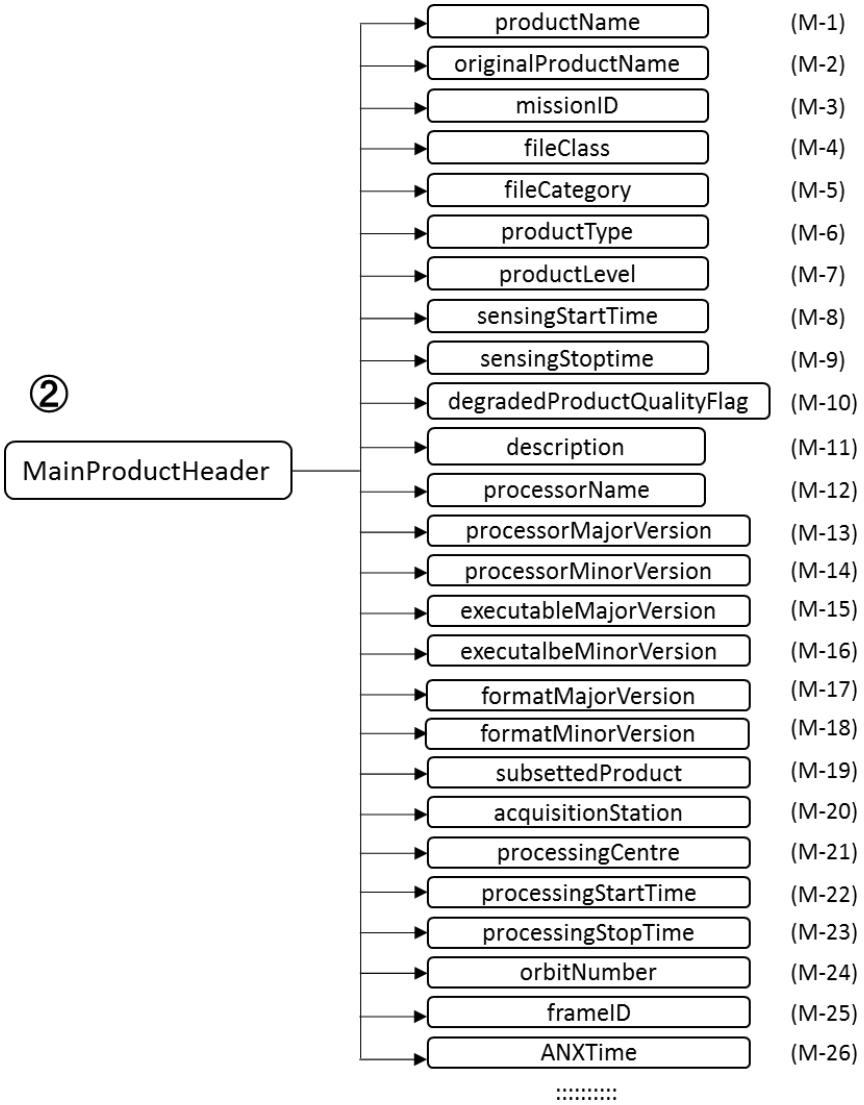

Figure 3.5-3 Product data structure of MainProductHeader (part (2) in Figure 3.5-1)

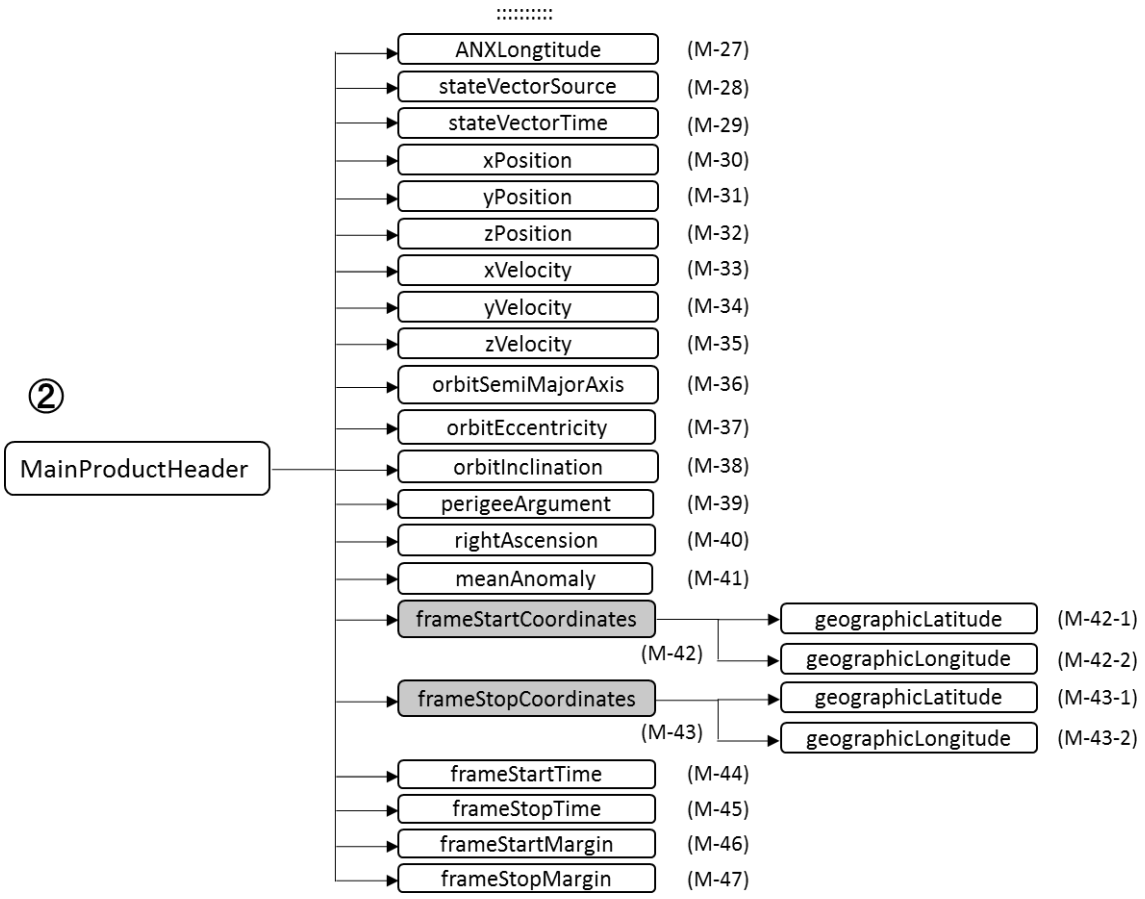

Figure 3.5-4 Product data structure of MainProductHeader (part (2) in Figure 3.5-1) (continued)

Table 3.5-5 Elements of MainProductHeader(1)

No.	Element name	Overview	Data size	Unit
M-1	productName	The productName field in the Main Product Header is identical to the File_Name field in the Fixed ProductHeader.	56	Unitless
M-2	originalProductName	This field should be left empty when the product is created. When renaming the product (which is necessary,e.g., for JAXA products received at the ESA PDGS) the (logical) file name before renaming should be reported here, but only in the XML header file. In the datablock file, this field shall remain empty. This way the datablock file does not have to be modified when the file is renamed.	56	Unitless
M-3	missionID	This is a project-specific field which is always set to 'ECA'.For EarthCARE: MMM = ECA Note: This is preferred to EC_ in order to avoid double underscores __ in file names (they may look like a single one depending on the font used).	3	mID
M-4	fileClass	This is a repetition of the file class element of the product file name. See [AD-02] for details. For EarthCARE each letter of the File Class has a specific meaning as follows: CCCC = ABDD where: A=Agency generating the file, E:ESA, J:JAXA, C: ECMWF(placeholder only, currently not used) B = Latency N:Near-real time (placeholder only, currently not used), O:Offline, X:Not applicable DD = Product baseline This is starting from AA for the first baseline, then updated for each new baseline. A newer baseline. A newer baseline comes after an older baseline (in alphabetic sort order), but baselines are not necessarily continuous, i.e., there can be jumps. Set to AA if baseline concept does not apply to file.	4	fCls
M-5	fileCategory	This is a repetition of the file category element of the product file name. For details, see document (10). The project-specific value is one of those shown below. For details, see 1.6.4 in related document (7). [xxxx_/MPL_/TLM_/GEO_/AUX_/REP_/ LOG_/MTD_/ATL_/BBR_/CPR_/MSI_/A C /AM /BM /ACM_/ALL_]	4	fCar
M-6	productType	This is a repetition of the product type element of the product file name. For details, see document (10).	4	pTy
M-7	productLevel	This is a repetition of the product level element of the product file name. For details, see document (10). The value is one of [0_/1A/1B/1C/1D/2A/2B].	2	pL
M-8	sensingStartTime	The sensing start time is the UTC time stamp of the least recent sample in the product, in CCSDS time format: UTC=YYYY- MM-DDThh:mm:ss. This is the actual sensing time, so it is affected by data gaps, instrument sampling, and frame marginsapplied, and it will be different between product levels. For synergistic products, the least recent (i.e., earliest) start sensing time (from the set of start sensing times for the various instruments) has to be used.	23	Unitless

No.	Element name	Overview	Data size	Unit
M-9	sensingStopTime	The sensing stop time is the UTC time stamp of the most recent sample in the product, in CCSDS time format: UTC=YYYY- MM-DDThh:mm:ss. This is the actual sensing time, so it is affected by data gaps, instrument sampling, and frame margins applied, and it will be different between product levels. For synergistic products, the most recent (i.e., latest) start sensing time (from the set of stop sensing times for the various instruments) has to be used.	23	Unitless
M-10	degradedProductQualityFlag	Boolean flag to assess the overall product quality identifying the presence of significant errors within the product. Set to TRUE (1) if significant errors are present in the product. 0: Indicates a false condition 1:Indicates a true condition	1	Unitless
M-11	description	A comment relevant to the product/file can be written here. There are no format constraints as long as the text fits into the maximum allowed size.	2000	Unitless
M-12	processorName	The name of the processor that generated the product, used the file etc. is provided here. For instance, this field could be set to "ex.: BBR PDGS L0 Processor". There are no format constraints as long as the text fits into the maximum allowed size.	2000	Unitless
M-13	processorMajorVersion	This is the major version of the overall processor that generates the product/file, comprising not only the executable(s) but also its configuration (e.g., selection of algorithm options, thresholds, static auxiliary inputs etc.). It is assumed that this overall processor configuration be uniquely identified through a "MajorVersion.Minor Version" for Configuration Control. At least a major version must be defined and be stored in this field. This version will be controlled by the host infrastructure, i.e., it shall neither be hardcoded in the processor nor be read from its configuration file.	2	Unitless
M-14	processorMinorVersion	This is the minor version of the overall processor that generates the product/file, comprising not only the executable(s) but also its configuration (e.g., selection of algorithm options, thresholds, static auxiliary inputs etc.). It is assumed that this overall processor configuration be uniquely identified through a "Major Version.Minor Version" for Configuration Control. If a Minor Version is not used, this field must be set to 0. This version will be controlled by the host infrastructure, i.e., it shall neither be hardcoded in the processor nor be read from its configuration file.	2	Unitless
M-15	executableMajorVersion	This is the major version of the executable (or combination of executables) that generates the product/file. It is assumed that any software generating files/products be uniquely identified through a "Major Version.Minor Version" for Configuration Control. At least a major version must be defined and be stored in this field. This version is determined by the executable itself, so it should not be read from the configuration file, but be coded in source code header files or other files used in	2	Unitless

No.	Element name	Overview	Data size	Unit
		building the executable in order not to be modifiable after the executable has been built.		
M-16	executableMinorVersion	This is the minor version of the executable (or combination of executables) that generates the product/file. It is assumed that any software generating files/products be uniquely identified through a "Major Version.Minor Version" for Configuration Control. If a Minor Version is not used, this field must be set to 0. This version is determined by the executable itself, so it should not be read from the configuration file, but be coded in source code header files or other files used in building the executable in order not to be modifiable after the executable has been built.	2	Unitless
M-17	formatMajorVersion	This is the major version of the format of the product/file. At least a major version must be defined and be stored in this field. Product definition documents must specify this format version for each product/file they are defining. The format version changes for any product format change, e.g., addition or removal of groups or datasets. The format version is updated only when the format actually changes, not when the Product definition document is updated for another reason. This version is determined by the executable itself (even in case a given executable supports more than one format version), so it should not be read from the configuration file, but be coded in source code header files or other files used in building the executable in order not to be modifiable after the executable has been built.	2	Unitless
M-18	formatMinorVersion	This is the minor version of the format of the product/file. If a Minor Version is not used, this field must be set to 0. Product definition documents must specify this format version for each product/file they are defining. The format version changes for any product format change, e.g., addition or removal of groups or datasets. The format version is updated only when the format actually changes, not when the Product definition document is updated for another reason. This version is determined by the executable itself (even in case a given executable supports more than one format version), so it should not be read from the configuration file, but be coded in source code header files or other files used in building the executable in order not to be modifiable after the executable has been built.	2	Unitless
M- 19	subsettedProduct	This is used to mark products extracted from a base product without further processing, i.e. just as an extraction of data. In this case the field "parent product 1" shall be the name of the base product. If used set to true, else to false. 0: Indicates a false condition 1: Indicates a true condition	2	Unitless
M-20	acquisitionStation	This is the Acquisition Station (e.g., Kiruna) where the downlink occurred. The Acquisition Station is project-specific, i.e. not mandated in the Earth Explorer File Format Standard.	10	Unitless

No.	Element name	Overview	Data size	Unit
		Examples for possible values are Kiruna, Inuvik, Combined, however, these values are only indicative and product readers should accept any value.		
M-21	processingCentre	This is the Processing Centre where the product was generated. This is identical to the field Source.System in the fixed product header, see No11.	10	Unitless
M-22	processingStart Time	This is the processing start time of the product, i.e. when the first product sample was processed on ground. This is the actual sensing time, so it is affected by data gaps and instrument sampling. For synergistic products, the least recent start sensing time (from the set of start sensing times for the various instruments) has to be used. "UTC=YYYY-MM-DDThh:mm:ss"	23	Unitless
M-23	processingStop Time	This is the processing stop time of the product, i.e. when the last product sample was processed on ground. This is the actual sensing time, so it is affected by data gaps and instrument sampling. For synergistic products, the most recent start sensing time (from the set of stop sensing times for the various instruments) has to be used. "UTC=YYYY-MM-DDThh:mm:ss "	23	Unitless
M-24	orbitNumber	This is the orbit number for the current product (excluding margins added for overlap between products). It is the same number as used in the file instance ID of the file name, see "Tailoring of the Earth Explorer File Format Standard for the EarthCARE Ground Segment" - EC-TN-ESA-GS-0218. for details.	4	Unitless
M-25	frameID	This is the frame identifier for the current product (A, B, C, D, ...). It is the same letter as used in the file instance ID of the file name, see "Tailoring of the Earth Explorer File Format Standard for the EarthCARE Ground Segment" - EC-TN-ESA-GS-0218. for details.	1	Unitless
M-26	ANXTime	This is the UTC date/time of the ANX at the start of the current orbit (given by orbitNumber), in CCSDS time format: YYYY-MM-DDThh:mm:ss.ssssss. This means, all frames within the given orbit will have the same ANXTime, i.e. the ones at the start of the first frame.	26	Unitless
M-27	ANXLongitude	This is the longitude of the ANX at the start of the current orbit (given by orbitNumber), i.e., the longitude at ANXTime. This means, all frames within the given orbit will have the same ANXLongitude, i.e. the ones at the start of the first frame.	8	deg.
M-28	stateVectorSou rce	This field describes where the State Vector used for generating the product comes from [UndefinedSource/GENERATEDxxxxxx/FOS_PREDICTEDxx/FOS_RESTITUTEDx/ONBOARD_GPSxxxx]	15	Unitless
M- 29	stateVectorTime	UTC Time, in CCSDS time format: YYYY-MM-DDThh:mm:ss.ssssss, associated to the satellite state vector given in Cartesian form in the following six fields position ([xyz]Position) and velocity	26	Unitless

No.	Element name	Overview	Data size	Unit
		([xyz]Velocity), and as Kepler elements in the six fields after that (orbitSemiMajorAxis to meanAnomaly). The state vector given is close to ANX at the start of the orbit indicated by orbitNumber. It is the state vector closest to ANX from the orbit file used on input, independently whether it is slightly before are slightly after ANX.		
M-30	xPosition	The position (in meters) on ground along the x-axis in the WGS84 Reference System of the least recent sample in the product. If not used set to 0.	8	m
M-31	yPosition	The position (in meters) on ground along the y-axis in the WGS84 Reference System of the least recent sample in the product. If not used set to 0.	8	m
M-32	zPosition	The position (in meters) on ground along the z-axis in the WGS84 Reference System of the least recent sample in the product. If not used set to 0.	8	m
M-33	xVelocity	The velocity (in meters/second) on ground along the x-axis in the WGS84 Reference System of the least recent sample in the product. If not used set to 0.	8	m/s
M-34	yVelocity	The velocity (in meters/second) on ground along the y-axis in the WGS84 Reference System of the least recent sample in the product. If not used set to 0.	8	m/s
M-35	zVelocity	The velocity (in meters/second) on ground along the z-axis in the WGS84 Reference System of the least recent sample in the product. If not used set to 0.	8	m/s
M-36	orbitSemiMajorAxis	This is the semi major axis (in meters) of the first orbit covered in the product (field orbitStart).	8	m
M-37	orbitEccentricity	This is the eccentricity of the first orbit covered in the product (field orbitStart).	8	Unitless
M-38	orbitInclination	This is the inclination (in 10-3 decimal degrees, i.e. decimal millidegrees) of the first orbit covered in the product (field orbitStart).	8	deg.
M-39	perigeeArgument	This is the argument of perigee (in 10-3 decimal degrees, i.e. decimal millidegrees) for the first orbit covered in the product (field orbitStart).	8	deg.
M-40	rightAscension	This is the right ascension (in 10-3 decimal degrees, i.e. decimal millidegrees) for the first orbit covered in the product (field orbitStart).	8	deg.
M-41	meanAnomaly	This is the mean anomaly (in 10-3 decimal degrees, i.e. decimal millidegrees) of the satellite at the acquisition of the first sample contained in the product.	8	deg.
M-42	frameStartCoordinates	These are the geographic coordinates (latitude and longitude) of the subsatellite point at the frame start. The frame start latitude is determined by the number of frames per orbit and the latitude offset of the start of the first frame in an orbit (frame A). This theoretical frame start latitude (e.g., +22.5 deg. for frame B, for the case of 8 frames per orbit and a latitude offset of −22.5 deg. for frame A start) is used here, independent of data gaps or instrument sampling. The frame start longitude is the longitude of the point where the subsatellite track crosses the frame start latitude. Frame boundary coordinates are solely determined by the satellite orbit, i.e.	-	-

No.	Element name	Overview	Data size	Unit
		instrument viewing directions or instrument sampling do not affect this field. This will be the same value for all product levels. See also table 3.5-5 for the items of the group		
M-43	frameStopcoordinates	These are the geographic coordinates (latitude and longitude) of the subsatellite point at the frame end. The frame stop latitude is determined by the number of frames per orbit and the latitude offset of the start of the first frame in an orbit (frame A). This theoretical frame stop latitude (e.g., +67.5 deg. for frame B, for the case of 8 frames per orbit and a latitude offset of −22.5 deg. for frame A start) is used here, independent of data gaps or instrument sampling. The frame stop longitude is the longitude of the point where the subsatellite track crosses the frame stop latitude. Frame boundary coordinates are solely determined by the satellite orbit, i.e. instrument viewing directions or instrument sampling do not affect this field. This will be the same value for all product levels. See also table 3.5-6 for the items of the group.	-	-
M-44	frameStartTime	This is the UTC time when the subsatellite track crosses the frame start latitude, in CCSDS time format: UTC=YYYY-MM- DDThh:mm:ss. Frame boundary times are solely determined by the satellite orbit, i.e.instrument viewing directions or instrument sampling do not affect this field. This will be the same value for all product levels.	23	Unitless
M-45	frameStopTime	This is the UTC time when the subsatellite track crosses the frame stop latitude, in CCSDS time format: UTC=YYYY-MM- DDThh:mm:ss. Frame boundary times are solely determined by the satellite orbit, i.e. instrument viewing directions or instrument sampling do not affect this field. This will be the same value for all product levels.	23	Unitless
M-46	frameStartMargin	This is the length along-track of the data which have been added to the product before the frame start, in km. This is an approximate value only, so it should be given in full km (no fractional part). This is because the actual margin is derived using a fixed time offset from frame start while the satellite ground speed varies slightly along the orbit, and because of the finite instrument sampling. Set to zero (0.0) if no margin is added.	8	km
M-47	frameStopMargin	This is the length along-track of the data which have been added to the product after the frame end, in km. This is an approximate value only, so it should be given in full km (no fractional part). This is because the actual margin is derived using a fixed time offset from frame start while the satellite ground speed varies slightly along the orbit, and because of the finite instrument sampling. Set to zero (0.0) if no margin is added.	8	km

Table 3.5-6 Elements of MainProductHeader (2)

No.	Element name	Overview	Data size	Unit
M-43-1	geographicLatitude	Geodetic latitude in decimal degrees	1	deg.
M-43-2	geographicLongitude	Geocentric longitude in decimal degrees	1	deg.

Table 3.5-7 Elements of MainProductHeader (3)

No.	Element name	Overview	Data size	Unit
M-44-1	geographicLatitude	Geodetic latitude in decimal degrees	1	deg.
M-44-2	geographicLongitude	Geocentric longitude in decimal degrees	1	deg.

3.5.4 SpecificProductHeader

Figure 3.5-5 shows the structure of SpecificProductHeader. Table 3.5-8 includes descriptions of the elements. Data type of each element in the SpecificProductHeader is character.

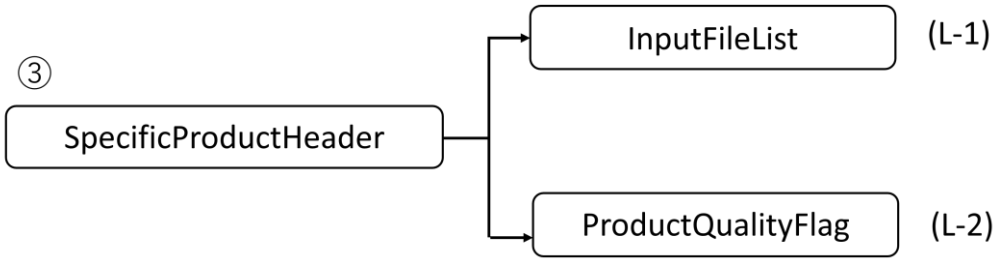

Figure 3.5-5 Product data structure of SpecificProductHeader (part (3) in Figure 3.5-1)

Table 3.5-8 Elements of SpecificProductHeader (1)

No.	Element name	Overview	Data size	Unit
L-1	InputFileList	This is a string containing the logical file names (without extension) of all input files used by the processor to generate the product, one file name per line.	8192	Unitless
L-2	ProductQuality Flag	This is the information of quality of the generated product, represented as “Good” or “Fair”. See Section 3.3 for details.	10	Unitless

4. Product Formats

Appendixes 1 to 10 provide a product format of each product. Table 4-1 shows the correspondence between the appendix numbers and the products.

Table 4-1 Correspondence between appendix numbers and products

Appendix No.	Target product of description
Appendix 1	ECMWF AUX-2D product (AUX__2D)
Appendix 2	ECMWF AUX-3D product (AUX__3D)
Appendix 3	blank
Appendix 4	CPR Echo level 2a standard product (CPR_ECO)
Appendix 5	CPR Cloud level 2a standard product (CPR_CLP)
Appendix 6	ATLID level 2a standard product (ATL_CLA)
Appendix 7	MSI level 2a standard product (MSI_CLP)
Appendix 8	CPR-ATLID compound level 2b standard product (AC__CLP)
Appendix 9	CPR-ATLID-MSI compound level 2b standard product (ACM_CLP)
Appendix 10	4-sensor compound level 2b standard product (ALL_RAD)

EarthCARE Product Definitions
-JAXA L2 Product Format-

APPENDIX 1
ECMWF sensor grid product

(ECMWF AUX-2D, AUX__2D)

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1. Related Documents

The following list shows the related document.

(1) EC-ICD-ESA-SYS-555

EarthCARE product definitions. Volume 8: ECMWF meteorological fields (X-MET)

(2) EC-ICD-ESA-SYS-556

2. Processing Overview

2.1. Processing Overview

The ECMWF AUX-2D product contains meteorological parameters generated by ECMWF deterministic forecast runs for the EarthCARE orbital track and overpass time, via EarthCARE ECMWF meteorological fields (X-MET) Product. The parameters of the ECMWF AUX-2D are provided on the X-JSG grids directly below the satellite.

2.2. Input Files

Table 2.2-1 shows input files for generation processing of an ECMWF CPR grid product.

Table 2.2-1 Input files for ECMWF data processing (CPR grid)

Input file	File format
Level 1d (X-JSG) product	netCDF
Level 1d (X-MET) product	netCDF
Level 1b (ATLID) product	netCDF
Meteorological value data	binary
ECMWF re-analysis data	GRIB

2.3. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities involved in generation processing of an ECMWF CPR grid product. Derived results are stored in the ECMWF CPR grid product (HDF file).

Table 2.3-1 Representative physical quantities derived in ECMWF data processing (CPR grid)

Representative physical quantity	Unit
Temperature	K
Atmospheric pressure	Pa
Humidity	%
Wind	m/s

3. Product Format

This chapter describes ScienceData in the data part of the product format of ECMWF AUX-2D. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for ScienceData.

Table 3.1-1 Dimension definitions (data part of the ECMWF AUX-2D product)

Item	Definition
nalt	Number of sampling grids on along-track dimension for JSG
nz1	Number of sampling grids on vertical dimension
nz2	Number of sampling grids on vertical dimension

3.2. Data Volume

Table 3.2-1 shows data volume of the ECMWF AUX-2D product.

Table 3.2-1 Data volume of the ECMWF AUX-2D product

Product name	Data Volume
ECMWF AUX-2D product	18MB

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the ECMWF AUX-2D (AUX-2DH) product.

Table 3.3-1 Format of ScienceData in the ECMWF AUX-2D product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	FillValue	Description
1	Geo	time	time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nalt	–	–	–	–	–	-	Time
2	Geo	height	height	m	real	4	nalt	nz2	–	–	–	–	-	Altitude of pixel center above WGS84 ellipsoid
3	Geo	latitude	latitude	degree_north	real	8	nalt	–	–	–	–	–	-	Latitude of pixel centre
4	Geo	longitude	longitude	degree_east	real	8	nalt	–	–	–	–	–	-	Longitude of pixel center
5	Geo	elevation	elevation	m	real	4	nalt	–	–	–	–	–	-	Terrain elevation for JSG pixel centre above WGS84 ellipsoid
6	Geo	day_night_flag	day night flag	–	Integer	1	nalt	–	–	–	–	–	-	Day = 1; Night = 0 for JSG pixel centre
7	Geo	land_water_flag	land water flag	–	integer	1	nalt	–	–	–	–	–	-	Land = 1; Water = 0 for JSG pixel centre
8	Geo	lidarCount	lidarCount	–	Integer	1	nalt	–	–	–	–	–	-	Number of lidar shots in this pixel
9	Geo	radarCount	radarCount	–	integer	1	nalt	–	–	–	–	–	-	Number of radar shots in this pixel
10	Geo	alongTrackIndex	alongTrackIndex	–	Integer	4	nalt	–	–	–	–	–	-	Index of the along track dimension
11	Geo	nz	vertical dimension	–	real	4	–	nz2	–	–	–	–	-	Vertical dimension
12	Geo/Scan_Time	DayOfMonth	Day of Month	–	integer	1	nalt	-	–	–	–	–	-	Day of Month
13	Geo/Scan_Time	DayOfYear	Day of Year	–	integer	2	nalt	-	–	–	–	–	-	Day of Year
14	Geo/Scan_Time	Hour	Hour	–	integer	1	nalt	-	–	–	–	–	-	Hour
15	Geo/Scan_Time	MilliSecond	MilliSecond	–	integer	4	nalt	-	–	–	–	–	-	MilliSecond
16	Geo/Scan_Time	Minute	Minute	–	integer	1	nalt	-	–	–	–	–	-	Minute
17	Geo/Scan_Time	Month	Month	–	integer	1	nalt	-	–	–	–	–	-	Month
18	Geo/Scan_Time	Second	Second	–	integer	1	nalt	-	–	–	–	–	-	Second
19	Geo/Scan_Time	SecondOfDay	Second of Day	–	integer	1	nalt	-	–	–	–	–	-	Second of Day
20	Geo/Scan_Time	Year	Year	–	integer	2	nalt	-	–	–	–	–	-	Year

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	FillValue	Description
21	Data	pressure	pressure	Pa	real	4	nalt	nz1	–	–	–	–	9.96920996838686E+36	Mid-layer pressure
22	Data	temperature	Temperature	K	real	4	nalt	nz1	–	–	–	–	9.96920996838686E+36	Temperature
23	Data	specificHumidity	Specific humidity	kg/kg	real	4	nalt	nz1	–	–	0	1	9.96920996838686E+36	Specific humidity
24	Data	ozoneMassMixingRatio	Ozone mass mixing ratio	kg/kg	real	4	nalt	nz1	–	–	0	1	9.96920996838686E+36	Ozone mass mixing ratio
25	Data	surfacePressure	Surface pressure	Pa	real	4	nalt	–	–	–	–	–	-	Surface pressure
26	Data	seaSurfaceTemperature	seaSirfaceTemperature	K	real		nalt	–	–	–	–	–	-	Sea surface temperature
27	Data	10MetreUWindComponent	10 metre U wind component	m/s	real	4	nalt	–	–	–	–	–	-	10 metre U wind component
28	Data	10MetreVWindComponent	10 metre V wind component	m/s	real	4	nalt	–	–	–	–	–	-	10 metre V wind component
29	Data	2MetreTemperature	2 metre temperature	K	real	4	nalt	–	–	–	–	-	-	2 metre temperature
30	Data	quality_flag	Quality flag	-	integer		nalt	–	–	–	–	-	-	0: GOOD, 1: NG or error
31	Data	totalColumnOzone	Total column ozone	kg/m**2	real	4	nalt	–	–	–	–	–	-	Total column ozone
32	Data	totalColumnWaterVapour	Total column water vapour	kg/m**2	real	4	nalt							Total column water vapour

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APPENDIX 2

ECMWF sensor grid product

(ECMWF AUX-3D, AUX__3D)

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1. Related Documents

The following list shows the related document.

(1) EC-ICD-ESA-SYS-555

EarthCARE product definitions. Volume 8: ECMWF meteorological fields (X-MET)

(2) EC-ICD-ESA-SYS-556

EarthCARE product definitions. Volume 9: ECMWF meteorological fields (X-JSGT)

2. Processing Overview

2.1. Processing Overview

The ECMWF AUX-3D product contains meteorological parameters generated by ECMWF deterministic forecast runs for the EarthCARE orbital track and overpass time, via EarthCARE ECMWF meteorological fields (X-MET) Product. The parameters of the ECMWF AUX-3D are provided on the X-JSG grids but 10 km across-track interval.

2.2. Input Files

Table 2.2-1 shows input files for generation processing of an ECMWF CPR grid product.

Table 2.2-1 Input files for ECMWF data processing (CPR grid)

Input file	File format
Level 1d (X-JSG) product	netCDF
Level 1d (X-MET) product	netCDF
Meteorological value data	binary
ECMWF re-analysis data	GRIB

2.3. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities involved in generation processing of an ECMWF CPR grid product. Derived results are stored in the ECMWF CPR grid product (HDF file).

Table 2.3-1 Representative physical quantities derived in ECMWF data processing (CPR grid)

Representative physical quantity	Unit
Temperature	K
Atmospheric pressure	Pa
Humidity	%
Wind	m/s

3. Product Format

This chapter describes ScienceData in the data part of the product format of ECMWF AUX-3D. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for ScienceData.

Table 3.1-1 Dimension definitions (data part of the ECMWF AUX-3D product)

Item	Definition
nalt	Number of sampling grids on along-track dimension
nact	Number of sampling grids on across-track dimension
nz	Number of sampling grids on vertical dimension

3.2. Data Volume

Table 3.2-1 shows data volume of the ECMWF AUX-3D product.

Table 3.2-1 Data volume of the ECMWF AUX-3D product

Product name	Data Volume
ECMWF AUX-3D product	3MB

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the ECMWF AUX-3D product.

Table 3.3-1 Format of ScienceData in the ECMWF AUX-3D product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	time	time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nalt	-	-	-	-	-	-	Time
2	Geo	geometricalHeight	Geometrical Height	m	real	4	nalt	nact	nz	-	-	-	-	Geometrical Height
3	Geo	latitude	latitude	degree_north	real	8	nalt	nact	-	-	-	-	-	Latitude of the pixel center
4	Geo	longitude	longitude	degree_east	real	8	nalt	nact	-	-	-	-	-	Longitude of the pixel center
5	Geo	elevation	elevation	m	real	4	nalt	nact	-	-	-	-	-	Terrain elevation for the pixel centre above WGS84 ellipsoid
6	Geo	day_night_flag	day night flag	-	integer	1	nalt	nact	-	-	-	-	-	Day = 1; Night = 0 for pixel centre
7	Geo	land_water_flag	land water flag	-	integer	1	nalt	nact	-	-	-	-	-	Land = 1; Water = 0 for pixel centre
8	Geo	lidarCount	lidarCount	-	integer	1	nalt	-	-	-	-	-	-	Number of lidar shots in this pixel
9	Geo	radarCount	radarCount	-	integer	1	nalt	-	-	-	-	-	-	Number of radar shots in this pixel
10	Geo	alongTrackIndex	Along track index	-	integer	4	nalt	-	-	-	-	-	-	Index of the along track dimension
11	Geo	acrossTrackIndex	Across track index	-	integer	4	-	nact	-	-	-	-	-	Index of the cross track dimension
12	Geo	nz	vertical dimension	-	real	4	-	-	nz	-	-	-	-	vertical dimension
13	Geo/Scan_Time	Year	Year	-	integer	2	nalt	-	-	-	-	-	-	Year
14	Geo/Scan_Time	Month	Month	-	integer	1	nalt	-	-	-	-	-	-	Month
15	Geo/Scan_Time	DayOfMonth	Day of Month	-	integer	1	nalt	-	-	-	-	-	-	Day of Month
16	Geo/Scan_Time	Hour	Hour	-	integer	1	nalt	-	-	-	-	-	-	Hour
17	Geo/Scan_Time	Minute	Minute	-	integer	1	nalt	-	-	-	-	-	-	Minute
18	Geo/Scan_Time	Second	Second	-	integer	1	nalt	-	-	-	-	-	-	Second
19	Geo/Scan_Time	Millisecond	Millisecond	-	real	4	nalt	-	-	-	-	-	-	Millisecond

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
20	Geo/Scan_Time	DayOfYear	Day of Year	-	integer	2	nalt	-	-	-	-	-	-	DayofYear
21	Geo/Scan_Time	SecondOfDay	Second of Day	-	integer	4	nalt	-	-	-	-	-	-	Second of Day
22	Data	pressure	pressure	Pa	real	4	nalt	nact	nz	-	-	-	9.96920996838686E+36	Mid-layer pressure
23	Data	temperature	Temperature	K	real	4	nalt	nact	nz	-	-	-	9.96920996838686E+36	Temperature
24	Data	specificHumidity	Specific humidity	kg/kg	real	4	nalt	nact	nz	-	0	1	9.96920996838686E+36	Specific humidity
25	Data	ozoneMassMixingRatio	Ozone mass mixing ratio	kg/kg	real	4	nalt	nact	nz	-	0	1	9.96920996838686E+36	Ozone mass mixing ratio
26	Data	surfacePressure	Surface pressure	Pa	real	4	nalt	nact	-	-	-	-	-	Surface pressure
27	Data	10MetreUWindComponent	10 metre U wind component	m/s	real	4	nalt	nact	-	-	-	-	-	10 metre U wind component
28	Data	10MetreVWindComponent	10 metre V wind component	m/s	real	4	nalt	nact	-	-	-	-	-	10 metre V wind component
29	Data	2MetreTemperature	2 metre temperature	K	real	4	nalt	nact	-	-	-	-	-	2metre temperature
30	Data	totalColumnOzone	Total column ozone	kg/m**2	real	4	nalt	nact	-	-	-	-	-	Total column ozone
31	Data	totalColumnWaterVapour	Total column water vapour	kg/m**2	real	4	nalt	nact	-	-	-	-	-	Total column water vapour
32	Data	quality_flag	Quality Flag	-	integer	1	nalt	nact	-	-	-	-	-	0: GOOD, 1: NG or error

EarthCARE Product Definitions
-JAXA L2 Product Format-

APPENDIX 4

CPR One-sensor Echo

Product

(CPR_ECO)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The CPR L1b products contains corrections due to the variation of radar performance and satellite movement. However, the errors caused by physical characteristic of the echo and physical environment still remain in both L1 products (reflectivity factor and Doppler velocities). The CPR L2a Echo product high-level processing thus provides basic physical corrections such as clutter echo correction and gas attenuation corrections are supplied for reflectivity factor, and Doppler folding correction is provided for, Doppler velocity

2.2. Input Files

Table 2.2-1 shows input files for CPR L2a Echo processing.

Table 2.2-1 Input files for CPR L2a Echo processing

Input file	File format
CPR level 1b standard product	HDF
Data for performance analysis	HDF
ECMWF AUX-2D data	HDF

2.3. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities derived in CPR L2a Echo processing. The derived results are stored in the CPR Echo level 2a standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in CPR L2a Echo processing

Representative physical quantity	Unit
Radar reflectivity factor (1km integration)	dBZ
Doppler velocity (1km integration)	m/s
Integrated gaseous attenuation from TOA	dB
Normalized radar cross section (1km integration)	dB
Doppler spectrum width (1km integration)	m/s

3. Product Format

This chapter describes the Science Data in the data part of the L2a product format of EarthCARE CPR Echo. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for the Science Data.

Table 3.1-1 Dimension definitions (data part of CPR Echo)

Item	Definition
nray2	Number of rays, which is along the observation orbit of the satellite sensor (CPR) (Sampling interval: 1 km)
nbin	Number of bins, which is perpendicular to the observation orbit of the satellite sensor (CPR)
nbin_jsg	Number of Joint Standard Grid (JSG) vertical bins

3.2. Data Volume

Table 3.2-1 shows data volume of CPR L2a Echo product.

Table 3.2-1 Data volume of CPR L2a Echo product

Product name	Data Volume
CPR L2a Echo product	72MB

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the CPR L2a Echo product.

Table 3.3-1 Format of ScienceData in the CPR L2a
Echo product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	number_of_ray	Number of ray within L2a products		integer	2	1	-	-	-	-	-	65535	Number of Ray for L2a product (nray2), which is reduced from L1b product due to 1km horizontal integration and margin overlapped
2	Geo	maximum_number_of_bin	Maximum range bin number for L2a products (218 or 544)		integer	2	1	-	-	-	-	-	65535	Maximum Range Bin Number for L2a product (218 or 514)
3	Geo	jsg_maximum_number_of_bin	Maximum range bin number for L2a JSG products		integer	2	1	-	-	-	-	-	65535	Maximum Range Bin Number for L2a JSG Product
4	Geo	latitude	Latitude	degree_north	real	8	nray2	-	-	-	-90	90	9.9692099683868690e+36	Latitude of center position of integration
5	Geo	longitude	Longitude	degree_east	real	8	nray2	-	-	-	-180	180	9.9692099683868690e+36	Longitude of center position of integration
6	Geo	time	Time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray2	-	-	-	-	-	9.9692099683868690e+36	Time(seconds) since 1 Jan 2000 00:00:00.
7	Geo	day_night_flag	Day night flag	-	integer	1	nray2	-	-	-	0	1	255	Day Night Flag (0:night, 1:day) .This flag is a copy of AUX-2DH.
8	Geo	land_water_flag	Land water flag	-	integer	1	nray2	-	-	-	0	1	255	Land Water Flag (0:water, 1:land). This flag is a copy of AUX-2DH.
9	Geo	land_water_fraction_1km	Land water fraction (1km)	-	real	4	nray2	-	-	-	0.0	1.0	9.9692099683868690e+36	Land Water Fraction (0:water 1:land) (1km integration)
10	Geo	land_water_fraction_10km	Land water fraction (10km)	-	real	4	nray2	-	-	-	0.0	1.0	9.9692099683868690e+36	Land Water Fraction (0:water 1:land) (10km integration)
11	Geo	range_to_intercept	Distance to the reference elipsoid (WGS84)	m	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Range from the satellite to the reference ellipsoid (WGS84)
12	Geo	surface_elevation	Surface elevation (WGS84)	m	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Surface elevation from reference ellipsoid (WGS84)
13	Geo	surface_elevation_1km	Surface elevation (WGS84; 1km integration, mean)	m	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Surface elevation from reference ellipsoid (WGS84) (1km integration, mean)
14	Geo	surface_elevation_10km	Surface elevation (WGS84; 10km integration, mean: deviation: slope)	m: m: -	real	4	nray2	-	-	3	-	-	9.9692099683868690e+36	Surface elevation from reference ellipsoid (WGS84) (10km integration, mean: deviation: slope)
15	Geo	surface_elevation_quality_flag_1km	Surface elevation quality flag (1km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Quality Flag (Warning flag) for Surface Elevation (1km integration) (Bit0: Cliff, difference> threshold)
16	Geo	surface_elevation_quality_flag_10km	Surface elevation quality flag (10km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Quality Flag (Warning flag) for Surface Elevation (10km integration) (Bit0: Cliff difference > threshold, Bit1: roughness > threshold)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
17	Geo	range_to_first_bin	Range to first sampling bin	m	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Range from the satellite to the first sampling bin
18	Geo	range_bin_size	Range bin size determined by sampling	m	real	4	1	-	-	-	-	-	9.9692099683868690e+36	Range Bin Size (length) determined by sampling
19	Geo	bin_height	Height of each sampling bin	m	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Height of each sampling bin from the reference ellipsoid (WGS84)
20	Geo	jsg_bin_height	Height of each JSG vertical bin	m	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	Height of each JSG vertical bin from the reference ellipsoid (WGS84)
21	Data	integrated_radar_reflectivity_1km	Radar reflectivity factor (1km integration)	dBZ	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Radar Reflectivity Factor (1km integration)
22	Data	integrated_radar_reflectivity_10km	Radar reflectivity factor (10km integration)	dBZ	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Radar Reflectivity Factor (10km integration)
23	Data	integrated_radar_reflectivity_flag_1km	Quality flag for radar reflectivity (1km integration)	-	integer	4	nray2	-	nbin	-	-	-	4294967295	Quality Flag (Warning flag) for Radar reflectivity factor (1km integration, Bit0: using valid integration number, Bit1: using SNR as threshold)
24	Data	integrated_radar_reflectivity_flag_10km	Quality flag for radar reflectivity (10km integration)	-	integer	4	nray2	-	nbin	-	-	-	4294967295	Quality Flag (Warning flag) for Radar reflectivity factor (10km integration, Bit0: using valid integration number, Bit1: using SNR as threshold)
25	Data	surface_estimation_flag_1km	Quality flag for Surface estimation(1km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Quality Flag (Waning flag) for Surface Estimation (1km, integration, Bit0: difference with DEM , Bit1: large attenuation, Bit2: NRCS > threshold)
26	Data	surface_estimation_flag_10km	Quality flag for Surface estimation(10km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Quality Flag (Warning flag) for Surface Estimation (10km integration, Bit0: using valid number of NRCS(1km integration))
27	Data	clutter_echo_1km	Estimated clutter echo intensity(1km integration)	dBZ	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Estimated Clutter echo intensity using Radar reflectivity factor correction (1km integration)
28	Data	clutter_echo_10km	Estimated clutter echo intensity(10km integration)	dBZ	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Estimated Clutter echo intensity using Radar reflectivity factor correction (10km integration)
29	Data	surface_bin_number_1km	Estimated surface range bin number (1km integration)	-	integer	2	nray2	-	-	-	-	-	65535	Estimated surface range bin number (1km integration)
30	Data	surface_bin_number_10km	Estimated surface range bin number (10km integration)	-	integer	2	nray2	-	-	-	-	-	65535	Estimated surface range bin number (10km integration)
31	Data	surface_bin_fraction_1km	Estimated surface bin fraction (1km integration)	-	real	4	nray2	-	-	-	-0.5	0.5	9.9692099683868690e+36	Estimated surface bin fraction (1km integration)
32	Data	surface_bin_fraction_10km	Estimated surface bin fraction (10km integration)	-	real	4	nray2	-	-	-	-0.5	0.5	9.9692099683868690e+36	Estimated surface bin fraction (10km integration)
33	Data	normalized_radar_cross_section_1km	Normalized radar cross section (1km integration)	dB	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Normalized radar cross section (1km integration)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
34	Data	normalized_radar_cross_section_10km	Normalized radar cross section (10km integration)	dB	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Normalized radar cross section (10km integration)
35	Data	signal_to_noise_ratio_1km	Signal to noise ratio of reflectivity (1km integration)	dB	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Signal to noise ratio of reflectivity (1km integration)
36	Data	signal_to_noise_ratio_10km	Signal to noise ratio of reflectivity (10km integration)	dB	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Signal to noise ratio of reflectivity (10km integration)
37	Data	integrated_doppler_velocity_1km	Doppler velocity (1km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Doppler velocity (before folding correction) (1km integration)
38	Data	integrated_doppler_velocity_10km	Doppler velocity (10km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Doppler velocity (before folding correction) (10km integration)
39	Data	integrated_doppler_velocity_1km_bias_corr	Bias Corrected Doppler velocity (1km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Bias corrected Doppler velocity (before folding correction) (1km integration)
40	Data	integrated_doppler_velocity_10km_bias_corr	Bias Corrected Doppler velocity (10km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Bias corrected Doppler velocity (before folding correction) (10km integration)
41	Data	spectrum_width_1km	Doppler Spectrum width (1km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Doppler Spectrum width (1km integration)
42	Data	spectrum_width_10km	Doppler Spectrum width (10km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Doppler Spectrum width (10km integration)
43	Data	doppler_velocity_quality_flag_1km	Quality Flag for Doppler velocity (1km integration)	-	integer	4	nray2	-	nbin	-	-	-	4294967295	Quality Flag (Warning flag) for Doppler Velocity (1km integration, Bit0: less valid number of integration)
44	Data	doppler_velocity_quality_flag_10km	Quality Flag for Doppler velocity (10km integration)	-	integer	4	nray2	-	nbin	-	-	-	4294967295	Quality Flag (Warning flag) for Doppler Velocity (10km integration, Bit0: less valid number of integration)
45	Data	doppler_velocity_quality_flag_1km_bias_corr	Bias Corrected Quality Flag for Doppler velocity (1km integration)	-	integer	4	nray2	-	nbin	-	-	-	4294967295	Quality Flag (Warning flag) for Bias corrected Doppler Velocity (1km integration, Bit0: less valid number of integration)
46	Data	doppler_velocity_quality_flag_10km_bias_corr	Bias Corrected Quality Flag for Doppler velocity (10km integration)	-	integer	4	nray2	-	nbin	-	-	-	4294967295	Quality Flag (Warning flag) for Bias corrected Doppler Velocity (10km integration, Bit0: less valid number of integration)
47	Data	nyquist_velocity	Nyquist velocity determined by PRF	m/s	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Nyquist velocity determined by PRF
48	Data	integrated_gaseous_attenuation	Integrated gaseous attenuation from TOA	dB	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Integrated gaseous attenuation from TOA
49	Data	unfolded_doppler_velocity_1km	Unfolded Doppler velocity (1km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Unfolded Doppler velocity (1km integration)
50	Data	unfolded_doppler_velocity_10km	Unfolded Doppler velocity (10km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Unfolded Doppler velocity (10km integration)
51	Data	unfolded_doppler_velocity_1km_bias_corr	Bias Corrected Unfolded Doppler velocity (1km integration)	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Bias corrected and Unfolded Doppler velocity (1km integration)
52	Data	unfolded_doppler_velocity_10km_bias_corr	Bias Corrected Unfolded Doppler velocity (10km	m/s	real	4	nray2	-	nbin	-	-	-	9.9692099683868690e+36	Bias corrected and Unfolded Doppler

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
			integration)											velocity (10km integration)
53	Data	path_integrated_attenuation_1km	Estimated Path integrated attenuation at the surface (1km integration)	dB	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Path integrated attenuation at the surface estimated from NRCS attenuation (1km integration)
54	Data	path_integrated_attenuation_10km	Estimated Path integrated attenuation at the surface (10km integration)	dB	real	4	nray2	-	-	-	-	-	9.9692099683868690e+36	Path integrated attenuation at the surface estimated from NRCS attenuation (10km integration)
55	Data	path_integrated_attenuation_flag_1km	Quality Flag for estimated Path integrated Attenuation (1km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Quality Flag (Warning flag) for estimated Path integrated attenuation (1km integration, Low 4bits: quality flag, High 4bits: method flag)
56	Data	path_integrated_attenuation_flag_10km	Quality Flag for estimated Path integrated Attenuation (10km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Quality Flag (Warning flag) for estimated Path integrated attenuation (10km integration, Low 4bits: quality flag, High 4bits: method flag)
57	Data	L2_quality_flag_1km	L2 Quality Flag (1km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	L2 Quality Flag (1km integration)
58	Data	L2_quality_flag_10km	L2 Quality Flag (10km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	L2 Quality Flag (10km integration)
59	Data	mirror_echo_flag_1km	Mirror Echo Flag (1km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Mirror Echo Flag (1km integration, 0: free from mirror contamination, 0x01 (1): mirror images possible, 0x11 (17): mirror images certain, 0x02 (2): MS tails possible, 0x22 (34): MS tails certain)
60	Data	mirror_echo_flag_10km	Mirror Echo Flag (10km integration)	-	integer	4	nray2	-	-	-	-	-	4294967295	Mirror Echo Flag (1km integration, 0: free from mirror contamination, 0x01 (1): mirror images possible, 0x11 (17): mirror images certain, 0x02 (2): MS tails possible, 0x22 (34): MS tails certain)
61	Data	jsg_radar_reflectivity_1km_with_correction	JSG radar reflectivity factor (1km integration)	dBZ	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	JSG radar reflectivity factor (Both clutter and gaseous attenuation are corrected.) (1km integration)
62	Data	jsg_radar_reflectivity_10km_with_correction	JSG radar reflectivity factor (10km integration)	dBZ	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	JSG radar reflectivity factor (Both clutter and gaseous attenuation are corrected.) (10km integration)
63	Data	jsg_doppler_velocity_1km_with_correction	JSG Doppler Velocity (1km integration)	m/s	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	JSG Doppler Velocity (The folded Doppler velocity is corrected.) (1km integration)
64	Data	jsg_doppler_velocity_10km_with_correction	JSG Doppler Velocity (10km integration)	m/s	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	JSG Doppler Velocity (The folded Doppler velocity is corrected.) (10km integration)
65	Data	jsg_doppler_velocity_1km_with_correction_bias_corr	JSG Bias Corrected Doppler Velocity (1km integration)	m/s	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	JSG Bias corrected Doppler Velocity (The folded Doppler velocity is corrected.) (1km integration)
66	Data	jsg_doppler_velocity_10km_with_correction_bias_corr	JSG Bias Corrected Doppler Velocity (10km integration)	m/s	real	4	nray2	-	nbin_jsg	-	-	-	9.9692099683868690e+36	JSG Bias corrected Doppler Velocity (The folded Doppler velocity is corrected.) (10km integration)

EarthCARE Product Definitions
-JAXA L2 Product Format-

APPENDIX 5

CPR One-sensor Cloud

Product

(CPR_CLP)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The CPR L2a cloud product high-level processing calculates various physical quantities from information contained in a CPR L1b product and CPR L2a echo product. The calculated physical quantities include the cloud mask, cloud particle type, cloud water content, cloud ice content, water cloud particle effective size, ice cloud particle effective size, optical thickness, and quality information.

2.2. Input Files

Table 2.2-1 shows input files for CPR L2a Cloud processing.

Table 2.2-1 Input files for CPR L2a Cloud processing

Input file	File format
CPR level 1b standard product	HDF
CPR Echo L2a standard product	HDF
Level 1d (X-JSG) product	HDF
ECMWF AUX-2D data	HDF

2.1. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities derived in CPR L2a Cloud processing. The derived results are stored in the CPR L2a Cloud standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in CPR L2a Cloud processing

Representative physical quantity	Unit
Cloud mask (Radar only) (1 km)	-
Cloud particle type (Radar only) (1 km)	-
Effective radius of liquid water cloud (1km)	μm
Liquid water content (1km)	g/m^3
Effective radius of ice cloud (1km)	μm
Ice water content (1km)	g/m^3
Optical thickness (1km)	-

3. Product Format

This chapter describes the "Science Data part," which is data in the L2a product format of EarthCARE CPR Cloud. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for the Science Data.

Table 3.1-1 Dimension definitions (data part of CPR cloud)

Item	Definition
nray2	Number of rays, which is along the observation orbit of the satellite sensor (CPR) (Sampling interval: 1 km)
nbin	Number of Joint Standard Grid (JSG) vertical bins

3.2. Data Volume

Table 3.2-1 shows data volume of CPR L2a Cloud product.

Table 3.2-1 Data volume of CPR Cloud L2a product

Product name	Data Volume
CPR L2a Cloud product	28 MB

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the CPR L2a Cloud product.

Table 3.3-1 Format of ScienceData in the CPR L2a Cloud product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	time	Time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray2	–	–	–	–	–	9.9692099683868690e+36	Representative Time of each ray. Sequential seconds counted from 1/1/2000.
2	Geo	latitude	Latitude	degree_north	real	8	nray2	–	–	–	-90	90	9.9692099683868690e+36	Latitude
3	Geo	longitude	Longitude	degree_east	real	8	nray2	–	–	–	-180	180	9.9692099683868690e+36	Longitude
4	Geo	height	Height	m	real	4	nray2	–	nbin	–	–	–	9.9692099683868690e+36	Midpoint of the range bin
5	Geo	surface_elevation	Surface elevation (WGS84)	m	real	4	nray2	–	–	–	–	–	9.9692099683868690e+36	Representative surface elecation (m) from the WGS84 surface at each ray
6	Geo	day_night_flag	Day night flag	–	integer	1	nray2	-	-	–	0	1	-127	Day-Nighgt Flag (0:night, 1:day) This flag is a copy of AUX-2DH.
7	Geo	land_water_flag	Land water flag	–	integer	1	nray2	-	-	–	0	1	-127	Land-Water Flag (0:water, 1:land) This flag is a copy of AUX-2DH.
8	Data	cloud_ air_velocity_10km	Air vertical velocity (10km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	air vertical velocity(10km)
9	Data	cloud_ air_velocity_1km	Air vertical velocity (1km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	air vertical velocity(1km)
10	Data	cloud_doppler_ velocity_10km	Cloud Doppler Velocity (10km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	Cloud Doppler Velocity(10km)
11	Data	cloud_doppler_ velocity_1km	Cloud Doppler Velocity (1km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	cloud doppler velocity(1km)
12	Data	cloud_effective_radius1_10 km	Effective Radius 1(10km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 1 (1km)
13	Data	cloud_effective_radius1_1k m	Effective Radius 1(1km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 2 (10km)
14	Data	cloud_effective_radius2_10 km	Effective Radius 2(10km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 2 (1km)
15	Data	cloud_effective_radius2_1k m	Effective Radius 2(1km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 1 (10km)
16	Data	cloud_gasattenuation_1km	gas attenuation(1km)	dBZ	real	4	mray2	-	nbin	-	-60	40	9.969209968386860E+36	gas attenuation (1km)
17	Data	cloud_ice_content_10km	Ice Water Content (10km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Ice Water Content (10km)
18	Data	cloud_ice_content_10km_unc ertainty	Uncertainty in Ice Water Content (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Content (10km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
19	Data	cloud_ice_content_1km	Ice Water Content (1km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Ice Water Content (1km)
20	Data	cloud_ice_content_1km_uncertainty	Uncertainty in Ice Water Content (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Content (1km)
21	Data	cloud_ice_effective_radius_10km	Effective Radius of Ice Cloud (10km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Ice Cloud (10km)
22	Data	cloud_ice_effective_radius_10km_uncertainty	Uncertainty in Effective Radius of Ice Cloud (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Ice Cloud (10km)
23	Data	cloud_ice_effective_radius_1km	Effective Radius of Ice Cloud (1km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Ice Cloud (1km)
24	Data	cloud_ice_effective_radius_1km_uncertainty	Uncertainty in Effective Radius of Ice Cloud	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Ice Cloud
25	Data	cloud_ice_water_path_10km	Ice water path (10km)	g/m^2	real	4	nray2	–	-	-	0	20000	9.9692099683868690e+36	Ice water path (10km)
26	Data	cloud_ice_water_path_1km	Ice water path (1km)	g/m^2	real	4	nray2	–	-	-	0	20000	9.9692099683868690e+36	Ice water path (1km)
27	Data	cloud_mask_cpr_1km	Cloud Mask (Radar only) (1 km)	–	integer	1	nray2	–	nbin	1	0	40	-127	CPR cloud mask value (1 km) (0:clear, 20:weak echo, 30:good echo, 40:strong echo)
28	Data	cloud_mask_cpr_10km	Cloud Mask (Radar only) (10 km)	–	integer	1	nray2	–	nbin	1	0	40	-127	Cloud mask (Radar only) (10 km)
29	Data	cloud_number_concentration1_10km	cloud number concentration 1 (10km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 1 (10km)
30	Data	cloud_number_concentration1_1km	cloud number concentration 1 (1km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 1 (1km)
31	Data	cloud_number_concentration2_10km	cloud number concentration 2 (10km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 2 (10km)
32	Data	cloud_number_concentration2_1km	cloud number concentration 2 (1km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 2 (1km)
33	Data	cloud_particle_category_cpr_10km	CPR cloud particle category(10km)	-	integer	1	nray2	–	nbin	-	0	20	-2147483647	CPR cloud particle category (10km)
34	Data	cloud_particle_category_cpr_1km	CPR cloud particle category(1km)	-	integer	1	nray2	–	nbin	-	0	20	-2147483647	CPR cloud particle category (1km)
35	Data	cloud_particle_type_cpr_1km	Cloud Particle Type (Radar only) (1 km)	–	integer	1	nray2	–	nbin	1	0	8	-127	CPR cloud particle type (1 km) (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5:liquid drizzle, 6:mixet–phase drizzle, 7: rain, 8: snow)
36	Data	cloud_particle_type_cpr_10km	Cloud Particle Type (Radar only) (10 km)	–	integer	1	nray2	–	nbin	1	0	6	-127	CPR cloud particle type (10 km) (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5:liquid drizzle, 6:mixet–phase drizzle, 7: rain, 8: snow)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
37	Data	cloud_phase1_10km	cloud phase1 (10km)	-	integer	1	nray2	–	nbin	-	0	2	-127	cloud phase1 (10km)
38	Data	cloud_phase1_1km	cloud phase1 (1km)	-	integer	1	nray2	–	nbin	-	0	2	-127	cloud phase1 (1km)
39	Data	cloud_phase2_10km	cloud phase2 (10km)	-	integer	1	nray2	–	nbin	-	0	2	-127	cloud phase2 (10km)
40	Data	cloud_phase2_1km	cloud phase2 (1km)	-	integer	1	nray2	–	nbin	-	0	2	-127	cloud phase2 (1km)
41	Data	cloud_radar_reflectivity_10km	attenuated radar reflectivity factor (10km)	dBZ	real	4	nray2	–	nbin	-	-60	40	9.9692099683868690e+36-	attenuated radar reflectivity factor (10km)
42	Data	cloud_radar_reflectivity_1km	attenuated radar reflectivity factor (1km)	dBZ	real	4	nray2	–	nbin	-	-60	40	9.9692099683868690e+36-	attenuated radar reflectivity factor (1km)
43	Data	cloud_terminal_velocity1_10km	cloud terminal velocity1 10km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity1(10km)
44	Data	cloud_terminal_velocity1_1km	cloud terminal velocity1 1km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity1(1km)
45	Data	cloud_terminal_velocity2_10km	cloud terminal velocity2 10km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity2(10km)
46	Data	cloud_terminal_velocity2_1km	cloud terminal velocity2 1km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity2(1km)
47	Data	cloud_water_content1_10km	cloud water content1(10km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content1 (10km)
48	Data	cloud_water_content1_1km	cloud water content1(1km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content1 (1km)
49	Data	cloud_water_content2_10km	cloud water content2(10km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content2 (10km)
50	Data	cloud_water_content2_10km	cloud water content2(1km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content2 (1km)
51	Data	cloud_water_content_10km	Liquid Water Content (10km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Liquid Water Content (1km)
52	Data	cloud_water_content_10km_uncertainty	Uncertainty in Liquid Water Content (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Content (10km)
53	Data	cloud_water_content_1km	Liquid Water Content (1km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Liquid Water Content (1km)
54	Data	cloud_water_content_1km_uncertainty	Uncertainty in Liquid Water Content (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Content (1km)
55	Data	cloud_water_effective_radius_1km	Effective Radius of Liquid Water Cloud (1km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Liquid Water Cloud (1km)
56	Data	cloud_water_effective_radius_1km_uncertainty	Uncertainty in Effective Radius of Liquid Water Cloud (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Liquid Water Cloud (1km)
57	Data	cloud_water_effective_radius_10km	Effective Radius of Liquid Water Cloud (10km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Liquid Water Cloud (10km)
58	Data	cloud_water_effective_radius_10km_uncertainty	Uncertainty in Effective Radius of Liquid Water Cloud (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Liquid Water Cloud (10km)
59	Data	cloud_water_path_10km	cloud water path (10km)	g/m^2	real	4	nray2	–	nbin	-	0	20000	9.9692099683868690e+36	Liquid Water Path(10km)
60	Data	cloud_water_path_1km	cloud water path (1km)	g/m^2	real	4	nray2	–	nbin	-	0	20000	9.9692099683868690e+36	Liquid Water Path(1km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
61	Data	GRID_pressure_1km	GRID pressure 1km	Pa	real	4	nray2	–	nbin	-	0	2000	9.9692099683868690e+36	Pressure (1km)
62	Data	GRID_relativeHumidity_1km	GRID relativeHumidity 1km	%	real	4	nray2	–	nbin	-	0	100	9.9692099683868690e+36	Relative Humidity (1km)
63	Data	GRID_specificHumidity_1km	GRID specificHumidity 1km	kg/kg	real	4	nray2	–	nbin	-	0	1	9.9692099683868690e+36	Specific Humidity (1km)
64	Data	GRID_temperature_1km	GRID temperature 1km	K	real	4	nray2	–	nbin	-	-	-	9.9692099683868690e+36	Temperature(1km)
65	Data	L2_quality_flag_10km	L2 Quality Flag Method (10km)	-	integer		nray2	-	-	-	-	-	-2147483647	L2 Quality Flag Method (10km)
66	Data	L2_quality_flag_1km	L2 Quality Flag Method (1km)	-	integer		nray2	-	-	-	-	-	-2147483647	L2 Quality Flag Method (1km)
67	Data	optical_thickness_10km	Optical Thickness (10km)	–	real	4	nray2	–	–	1	0	1000	9.9692099683868690e+36	Optical Thickness for Water + Ice clouds (10km)
68	Data	optical_thickness_1km	Optical Thickness (1km)	–	real	4	nray2	–	–	1	0	1000	9.9692099683868690e+36	Optical Thickness for Water + Ice clouds (1km)
69	Data	quality_flag_1km	Quality Flag (1km)	–	integer	2	nray2	–	nbin	10	0	100	-32767	Quality Flag (1km)
70	Data	quality_flag_10km	Quality Flag (10km)	–	integer	2	nray2	–	nbin	10	0	100	-32767	Quality Flag (10km)
71	Data	total_cloud_ice_number_concentration_10km	Total Cloud Ice Number Concentration (10km)	1/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	Total cloud ice number concentration(10km)
72	Data	total_cloud_ice_number_concentration_1km	Total Cloud Ice Number Concentration (1km)	g/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	Total cloud ice number concentration(1km)
73	Data	total_cloud_terminal_velocity_10km	total cloud terminal velocity (10km)	m/s	real	4	nray2	-	nbin	-	-20	0	9.969209968386860E+36	Sedimentation velocity (10km)
74	Data	total_cloud_terminal_velocity_1km	total cloud terminal velocity (1km)	m/s	real	4	nray2	-	nbin	-	-20	0	9.969209968386860E+36	Sedimentation velocity (1km)
75	Data	total_cloud_water_number_concentration_10km	total cloud water number concentration(10km)	1/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	total cloud water number concentration(10km)
76	Data	total_cloud_water_number_concentration_1km	total cloud water number concentration (10km)	1/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	total cloud water number concentration(1km)

EarthCARE Product Definitions
-JAXA L2 Product Format-

APPENDIX 6

ATLID One-sensor Cloud and

Aerosol Product

(ATL_CLA)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The ATLID L2a product high-level processing processes input of an ATLID level 1b product to perform processing using the level 2 algorithm and obtains optical characteristics of aerosols and clouds. These characteristics include the extinction coefficient, backscatter coefficient, depolarization ratio, and lidar ratio of aerosols and cloud.

2.2. Input Files

Table 2.2-1 shows input files for ATLID L2a processing.

Table 2.2-1 Input files for ATLID L2a processing

Input file	File format
ATLID level 1b standard product	HDF
Level 1d (X-JSG) product	netCDF
ECMWF AUX data	binary

2.3. Representative Physical Quantities

Table 2.3.-1 shows representative physical quantities derived in ATLID L2a processing. The derived results are stored in the ATLID level 2a standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in ATLID L2a processing

Representative physical quantity	Unit
Extinction coefficient	/km
Backscatter coefficient	/km/sr
Depolarization ratio	%
Lidar ratio	-

3. Product Format

This chapter describes the "ScienceData part," which is data in the L2a product format of EarthCARE ATLID. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for ScienceData.

Table 3.1-1 Dimension definitions (data part of ATLID)

Item	Definition
nray1	Number of ray, which is along the observation orbit of the satellite sensor (CPR) (full grid) (Sampling interval: 0.2 km)
nray2	Number of ray, which is along the observation orbit of the satellite sensor (CPR) (Sampling interval: 1 km)
nray3	Number of ray, which is along the observation orbit of the satellite sensor (CPR) (low grid) (Sampling interval: 10 km)
nbin1	Number of bin, which is perpendicular to the observation orbit of the satellite sensor (CPR) (Sampling interval: 0.1 km)

3.1. Data Volume

Table 3.2-1 shows data volume of the ATLID L2a product.

Table 3.2-1 Data volume of the ATLID L2a product

Product name	Data Volume
ATLID L2a product	50MB

3.2. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the ATLID L2a product.

Table 3.3-1 Format of ScienceData in the ATLID L2a product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	latitude	Latitude (1km)	degree_north	real	8	nray2	–	–	–	-90	90	9.9692099683868690e+36	Latitude (1 km)
2	Geo	latitude_03km	Latitude (0.3km)	degree_north	real	8	nray1	–	–	–	-90	90	9.9692099683868690e+36	Latitude (0.3 km)
3	Geo	longitude	Longitude (1km)	degree_east	real	8	nray2	–	–	–	-180	180	9.9692099683868690e+36	Longitude (1 km)
4	Geo	longitude_03km	Longitude (0.3km)	degree_east	real	8	nray1	–	–	–	-180	180	9.9692099683868690e+36	Longitude (0.3 km)
5	Geo	time	Time (1km)	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray2	–	–	–	–	–	9.9692099683868690e+36	Sequential seconds counted from 1 Jan 2000 00:00:00. (1 km)
6	Geo	time_03km	Time (0.3km)	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray1	–	–	–	–	–	9.9692099683868690e+36	Sequential seconds counted from 1 Jan 2000 00:00:00. (0.3 km)
7	Geo	height	Height	m	real	4	nray1	–	nbin1	–	–	–	9.9692099683868690e+36	Midpoint of the range bin
8	Geo	surface_elevation	Surface elevation (WGS84; 0.3km)	m	real	4	nray1	–	–	–	–	–	9.9692099683868690e+36	Representative surface elevation (m) from the WGS84 surface at each ray (0.3 km)
9	Geo	day_night_flag	Day night flag	–	integer	1	nray2	–	–	–	0	1	-127	Day-Night Flag (0:night, 1:day)
10	Geo	land_water_flag	Land water flag	–	integer	1	nray2	–	–	–	0	1	-127	Land-Water Flag (0:water, 1:land)
11	Data	feature_mask_03km	Feature Mask (0.3km)	–	integer	1	nray1	–	nbin1	–	-99	2	-127	"Feature mask (0.3 km) 00. Invalid (no data, noisy) 02. Clear air or Aerosol 03. Cloud 10: Surface 11: Subsurface 12. Fully attenuated 13: Unknown "
12	Data	feature_mask_1km	Feature Mask (1km)	–	integer	1	nray2	–	nbin1	–	-99	2	-127	"Feature mask (1 km) 00. Invalid (no data, noisy) 02. Clear air or Aerosol 03. Cloud 10: Surface 11: Subsurface 12. Fully attenuated 13: Unknown "
13	Data	feature_mask_10km	Feature Mask (10km)	–	integer	1	nray2	–	nbin1	–	-99	3	-127	"Feature mask (10 km) 00. Invalid (no data, noisy) 01. Clear air 02. Aerosol 03. Cloud 10: Surface 11: Subsurface 12. Fully attenuated 13: Unknown"

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
14	Data	target_mask_1km	Target Mask (1km)	-	integer	1	nray2	-	nbin1	-	-99	9	-127	"Target mask (1 km) 00. Invalid (no data, noisy) 02. Clear air or Aerosol 11. Warm water cloud 12. Supercooled water cloud 13. 2D ice plate cloud 14. 3D ice cloud 19. Unknown clouds"
15	Data	target_mask_10km	Target Mask (10km)	-	integer	1	nray2	-	nbin1	-	-99	29	-127	"Target mask (10 km) 00. Invalid (no data, noisy) 01. Clear air 11. Warm water cloud 12. Supercooled water cloud 13. 2D ice plate cloud 14. 3D ice cloud 19 = Unknown clouds 21. Marine 22. Smoke 23. Dust 24. Dusty mixture 25. Pollution 26. Pristine 29. Unknown aerosols"
16	Data	cloud_extinction_1km	Extinction (1km)	/m	real	4	nray2	-	nbin1	-	0	10	9.9692099683868690e+36	Cloud extinction coefficient (1 km)
17	Data	cloud_backscatter_1km	Backscatter (1km)	/m/sr	real	4	nray2	-	nbin1	-	0	1	9.9692099683868690e+36	Cloud backscatter coefficient (1 km)
18	Data	cloud_depolarization_1km	Depolarization (1km)	%	real	4	nray2	-	nbin1	-	0	100	9.9692099683868690e+36	Cloud depolarization ratio (1 km)
19	Data	cloud_lidar_ratio_1km	Lidar Ratio (1km)	sr	real	4	nray2	-	nbin1	-	0	200	9.9692099683868690e+36	Cloud lidar ratio (1 km)
20	Data	cloud_extinction_10km	Extinction (10km)	/m	real	4	nray2	-	nbin1	-	0	10	9.9692099683868690e+36	Cloud extinction coefficient (10 km)
21	Data	cloud_backscatter_10km	Backscatter (10km)	/m/sr	real	4	nray2	-	nbin1	-	0	1	9.9692099683868690e+36	Cloud backscatter coefficient (10 km)
22	Data	cloud_depolarization_10km	Depolarization (10km)	%	real	4	nray2	-	nbin1	-	0	100	9.9692099683868690e+36	Cloud depolarization ratio (10 km)
23	Data	cloud_lidar_ratio_10km	Lidar Ratio (10km)	sr	real	4	nray2	-	nbin1	-	0	200	9.9692099683868690e+36	Cloud lidar ratio (10 km)
24	Data	aerosol_extinction_10km	Extinction (10km)	/m	real	4	nray2	-	nbin1	-	0	10	9.9692099683868690e+36	Aerosol extinction coefficient (10 km)
25	Data	aerosol_backscatter_10km	Backscatter (10km)	/m/sr	real	4	nray2	-	nbin1	-	0	1	9.9692099683868690e+36	Aerosol backscatter coefficient (10 km)
26	Data	aerosol_depolarization_10km	Depolarization (10km)	%	real	4	nray2	-	nbin1	-	0	100	9.9692099683868690e+36	Aerosol depolarization ratio (10 km)
27	Data	aerosol_lidar_ratio_10km	Lidar Ratio (10km)	sr	real	4	nray2	-	nbin1	-	0	200	9.9692099683868690e+36	Aerosol lidar ratio (10 km)
28	Data	PBL_height_1km	Planetary Boundary Layer Height (1km)	m	real	4	nray2	-	-	-	-5000	100000	9.9692099683868690e+36	Planetary boundary layer height (1 km)
29	Data	PBL_height_10km	Planetary Boundary Layer Height (10km)	m	real	4	nray2	-	-	-	-5000	100000	9.9692099683868690e+36	Planetary boundary layer height (10 km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
30	Data	quality_flag_03km	Quality Flag Method (0.3km)	-	integer	1	nray1	-	nbin1	-	0	5	-127	"Quality flag method (0.3 km) 0 = all channels are invalid (noisy or no data) 1 = all channels are significant 2 = 2ch (Mie co-polar, Rayleigh) are significant 3 = 2ch (Mie co-polar, Mie cross-polar) are significant 4 = 2ch (Rayleigh, Mie cross-polar) are significant 5 = 1ch (Mie co-polar) is significant 6 = 1ch (Rayleigh) is significant 7 = 1ch (Mie cross-polar) is significant"
31	Data	quality_flag_1km	Quality Flag Method (1km)	-	integer	1	nray2	-	nbin1	-	0	5	-127	"Quality flag method (1 km) 0 = all channels are invalid (noisy or no data) 1 = all channels are significant 2 = 2ch (Mie co-polar, Rayleigh) are significant 3 = 2ch (Mie co-polar, Mie cross-polar) are significant 4 = 2ch (Rayleigh, Mie cross-polar) are significant 5 = 1ch (Mie co-polar) is significant 6 = 1ch (Rayleigh) is significant 7 = 1ch (Mie cross-polar) is significant"
32	Data	quality_flag_10km	Quality Flag Method (10km)	-	integer	1	nray2	-	nbin1	-	0	5	-127	"Quality flag method (10 km) 0 = all channels are invalid (noisy or no data) 1 = all channels are significant 2 = 2ch (Mie co-polar, Rayleigh) are significant 3 = 2ch (Mie co-polar, Mie cross-polar) are significant 4 = 2ch (Rayleigh, Mie cross-polar) are significant 5 = 1ch (Mie co-polar) is significant 6 = 1ch (Rayleigh) is significant 7 = 1ch (Mie cross-polar) is significant"

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APPENDIX 7

MSI One-sensor Cloud Product

(MSI_CLP)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The MSI L2a product high-level processing processes input of MSI level 1c products to perform processing using the level 2 algorithm and calculates various values. The calculated values include the cloud optical thickness, cloud particle effective size, cloud-top temperature, cloud-top height, and cloud-top atmospheric pressure.

2.2. Input Files

Table 2.2-1 shows input files for MSI L2a processing.

Table 2.2-1 Input files for MSI L2a processing

Input file	File format
MSI level 1c standard product	netCDF
ECMWF AUX data	binary

2.3. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities derived in MSI L2a processing. The derived results are stored in the MSI level 2a standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in MSI L2a processing

Representative physical quantity	Unit
Cloud optical thickness	-
Cloud particle effective size	μm
Cloud-top temperature	K
Cloud-top height	km
Cloud-top atmospheric pressure	hPa

3. Product Format

This chapter describes the "ScienceData part," which is data in the L2a product format of EarthCARE MSI. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for ScienceData.

Table 3.1-1 Dimension definitions (data part of the MSI product)

Item	Definition
NLsat	Number of lines for observational data of the satellite sensor
NPsat	Number of pixels for observational data of the satellite sensor

3.2. Data Volume

Table 3.2-1 shows data volume of the MSI L2a product.

Table 3.2-1 Data volume of the MSI L2a product

Product name	Data Volume
MSI L2a product	60MB

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the MSI L2a product.

Table 3.3-1 Format of ScienceData in the MSI L2a product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	latitude	Latitude	degree_north	real	8	NLsat	NPsat	–	–	-90.0	90.0	9.9692099683868690e+36	Latitude
2	Geo	longitude	Longitude	degree_east	real	8	NLsat	NPsat	–	–	-180.0	180.0	9.9692099683868690e+36	Longitude
3	Geo	day_night_flag	Day night flag	–	integer	1	NLsat	NPsat	–	–	0	1	-127	Day-Night Flag (0:night, 1:day)
4	Geo	land_water_flag	Land water flag	–	integer	1	NLsat	NPsat	–	–	0	1	-127	Land-Water Flag (0:water, 1:land)
5	Geo	time	Time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	NLsat	NPsat	–	–	–	–	9.9692099683868690e+36	Sequential seconds counted from 1 Jan 2000 00:00:00.
6	Geo	relative_azimuth_angle	Relative Azimuth Angle	degree	real	4	NLsat	NPsat	–	–	0	180.0	9.9692099683868690e+36	Relative Azimuth Angle
7	Geo	solar_zenith_angle	Solar Zenith Angle	degree	real	4	NLsat	NPsat	–	–	0	180.0	9.9692099683868690e+36	Solar Zenith Angle
8	Geo	satellite_zenith_angle	Satellite Zenith Angle	degree	real	4	NLsat	NPsat	–	–	0	90.0	9.9692099683868690e+36	Satellite Zenith Angle
9	Data	cloud_optical_thickness	Cloud Optical Thickness	–	real	4	NLsat	NPsat	–	–	0	150	9.9692099683868690e+36	Cloud Optical Thickness. Fill error value for the pixels except water cloud.
10	Data	cloud_effective_radius_band 3	Cloud Effective Radius at 1.6μm	micro m	real	4	NLsat	NPsat	–	–	0	100	9.9692099683868690e+36	Cloud Effective Radius at 1.6μm. Fill error value for the pixels except water cloud.
11	Data	cloud_effective_radius_band 4	Cloud Effective Radius at 2.2μm	micro m	real	4	NLsat	NPsat	–	–	0	100	9.9692099683868690e+36	Cloud Effective Radius at 2.2μm. Fill error value for the pixels except water cloud.
12	Data	cloud_top_temperature	Cloud Top Temperature	K	real	4	NLsat	NPsat	–	–	150.0	350.0	9.9692099683868690e+36	Cloud Top Temperature. Fill error value for the pixels except water cloud.
13	Data	cloud_top_height	Cloud Top Height	m	real	4	NLsat	NPsat	–	–	0.0	20000.0	9.9692099683868690e+36	Cloud Top Height. Fill error value for the pixels except water cloud.
14	Data	cloud_top_pressure	Cloud Top Pressure	hPa	real	4	NLsat	NPsat	–	–	1.0	1100.0	9.9692099683868690e+36	Cloud Top Pressure. Fill error value for the pixels except water cloud.
15	Data	quality_flag	Quality Assurance Flag	–	integer	1	NLsat	NPsat	–	–	0	255	–	Quality Assurance Flag. (000 = No data, 001 = Night , 010 = Clear, 011 = Unsatisfied condition, 100 = Retrieval failed, 101 = Successful with low confidence, 110 = Successful with high confidence)
16	Data	cloud_flag_bitfield	Cloud Flag Bit Field	–	integer	4	NLsat	NPsat	–	–	0	4294967295	–	Cloud Flag Bit Field; 0: Algorithm Execute (0=Not executed, 1=Executed), 1-3: Clear Confidence Level (000=Cloudy, 111=Confident Clear), 4: Day/Night Flag (0=Night, 1=Day), 5-6: Land/Water Flag (00=Water, 01=Coastal, 10=Desert, 11=Land), 7:Snow/Ice Probablity (0=Yes, 1=No), 8-9:Sunglint(00=Sun glint, 11=No), 10:Heavy Aerosol (0=Yes, 1=No), 11:Cirrus Probability (0=Yes, 1=No), 12: Cloud Inhomogeneity (0=Inhomogeneous, 1=Uniform), 13-14: Cloud Phase (00=Uncertain, 01=Water, 10=Ice, 11=Mixed), 15: Snow Screening (0=NG, 1=OK)

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-JAXA L2 Product Format-

APPENDIX 8

CPR-ATLID Synergy Cloud Product

(AC_CLP)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The CPR-ATLID compound level 2b standard processing processes input of level 1b and level 2a files of the CPR and ATLID to estimate physical quantities about clouds (Table 2.2-2) from the synergy observation of the CPR and ATLID.

2.2. Input Files

Table 2.2-1 shows input files for CPR ATLID L2b processing.

Table 2.2-1 Input files for CPR-ATLID L2b processing

Input file	File format
CPR level 1b standard product	HDF
CPR level 2a Echo standard product	HDF
CPR level 2a Cloud standard product	HDF
ATLID level 1b standard product	HDF
ATLID level 2a standard product	HDF
Level 1d (X-ISG) product	HDF
ECMWF AUX-2D data	HDF

2.3. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities derived in CPR ATLID L2b processing. The derived results are stored in the CPR ATLID L2b standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in CPR-ATLID L2b processing

Representative physical quantity	Unit
Cloud mask (CPR-ATLID) (1 km)	--
Cloud particle type (CPR-ATLID) (1 km)	-
Effective radius of liquid water cloud (1km)	μm
Liquid water content (1km)	g/m^3
Effective radius of ice cloud (1km)	μm
Ice water content (1km)	g/m^3
Optical thickness (1km)	-

3. Product Format

This chapter describes the "Science Data part," which is data in the L2b product format of EarthCARE CPR-ATLID. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for the Science Data.

Table 3.1-1 Dimension definitions (data part of the CPR-ATLID product)

Item	Definition
nray2	Number of rays, which is along the observation orbit of the satellite sensor (CPR) (Sampling interval: 1 km)
nbin	Number of Joint Standard Grid (JSG) vertical bins

3.2. Data Volume

Table 3.2-1 shows data volume of the CPR-ATLID L2b product.

Table 3.2-1 Data volume of the CPR-ATLID L2b product

Product name	Data Volume
CPR-ATLID L2b product	30MB

3.3. Details of the Product Format

This Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the CPR-ATLID L2b product.

Table 3.3-1 Format of ScienceData in the CPR-ATLID L2b product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	time	Time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray2	–	–	–	–	–	9.9692099683868690e+36	Representative Time of each ray. Sequential seconds counted from 1/1/2000.
2	Geo	latitude	Latitude	degree_north	real	8	nray2	–	–	–	-90	90	9.9692099683868690e+36	Latitude (degree)
3	Geo	longitude	Longitude	degree_east	real	8	nray2	–	–	–	-180	180	9.9692099683868690e+36	Longitude (degree)
4	Geo	height	Height	m	real	4	–	–	nbin	–	–	–	9.9692099683868690e+36	Midpoint of the range bin
5	Geo	surface_elevation	Surface elevation (WGS84)	m	real	4	nray2	–	–	–	–	–	9.9692099683868690e+36	Representative surface elecation (m) from the WGS84 surface at each ray
6	Geo	day_night_flag	Day night flag	–	integer	1	nray2	1	1	–	0	1	-127	Day-Nighgt Flag (0:night, 1:day) This flag is a copy of AUX-2DH.
7	Geo	land_water_flag	Land water flag	–	integer	1	nray2	1	1	–	0	1	-127	Land-Water Flag (0:water, 1:land) This flag is a copy of AUX-2DH.
8	Data	cloud_ air_velocity_10km	Air vertical velocity (10km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	air vertical velocity(10km)
9	Data	cloud_ air_velocity_1km	Air vertical velocity (1km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	air vertical velocity(1km)
10	Data	cloud_doppler_ velocity_10km	Cloud Doppler Velocity (10km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	Cloud Doppler Velocity(10km)
11	Data	cloud_doppler_ velocity_1km	Cloud Doppler Velocity (1km)	m/s	real	4	nray2	-	nbin	1	-20	20	9.969209968386860E+36	cloud doppler velocity(1km)
12	Data	cloud_effective_radius1_10 km	Effective Radius 1(10km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 1 (1km)
13	Data	cloud_effective_radius1_1k m	Effective Radius 1(1km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 2 (10km)
14	Data	cloud_effective_radius2_10 km	Effective Radius 2(10km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 2 (1km)
15	Data	cloud_effective_radius2_1k m	Effective Radius 2(1km)	um	real	4	nray2	-	nbin	-	0	10000	9.969209968386860E+36	effective radius 1 (10km)
16	Data	cloud_gasattenuation_1km	gas attenuation(1km)	dBZ	real	4	mray2	-	nbin	-	-60	40	9.969209968386860E+36	gas attenuation (1km)
17	Data	cloud_ice_content_10km	Ice Water Content (10km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Ice Water Content (10km)
18	Data	cloud_ice_content_10km_unc ertainty	Uncertainty in Ice Water Content (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Content (10km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
19	Data	cloud_ice_content_1km	Ice Water Content (1km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Ice Water Content (1km)
20	Data	cloud_ice_content_1km_uncertainty	Uncertainty in Ice Water Content (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Content (1km)
21	Data	cloud_ice_effective_radius_10km	Effective Radius of Ice Cloud (10km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Ice Cloud (10km)
22	Data	cloud_ice_effective_radius_10km_uncertainty	Uncertainty in Effective Radius of Ice Cloud (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Ice Cloud (10km)
23	Data	cloud_ice_effective_radius_1km	Effective Radius of Ice Cloud (1km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Ice Cloud (1km)
24	Data	cloud_ice_effective_radius_1km_uncertainty	Uncertainty in Effective Radius of Ice Cloud	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Ice Cloud
25	Data	cloud_ice_water_path_10km	Ice water path (10km)	g/m^2	real	4	nray2	–	-	-	0	20000	9.9692099683868690e+36	Ice water path (10km)
26	Data	cloud_ice_water_path_1km	Ice water path (1km)	g/m^2	real	4	nray2	–	-	-	0	20000	9.9692099683868690e+36	Ice water path (1km)
27	Data	cloud_mask_cpr_atlid_1km	C4 Cloud Mask (CPR or ATLID) (1 km)	–	integer	1	nray2	–	nbin	1	0	40	-127	CPR cloud mask value (1 km) (0:clear, 20:weak echo, 30:good echo, 40:strong echo)
28	Data	cloud_mask_cpr_atlid_10km	C4 Cloud Mask (CPR or ATLID) (10 km)	–	integer	1	nray2	–	nbin	1	0	40	-127	CPR cloud mask value (1 km) (0:clear, 20:weak echo, 30:good echo, 40:strong echo)
29	Data	cloud_number_concentration1_10km	cloud number concentration 1 (10km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 1 (10km)
30	Data	cloud_number_concentration1_1km	cloud number concentration 1 (1km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 1 (1km)
31	Data	cloud_number_concentration2_10km	cloud number concentration 2 (10km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 2 (10km)
32	Data	cloud_number_concentration2_1km	cloud number concentration 2 (1km)	1/m^3	real	4	nray2	–	nbin	-	0	1E21	9.9692099683868690e+36	cloud number concentration 2 (1km)
33	Data	cloud_particle_category_atlid_10km	ATLID cloud particle category(10km)	-	integer	1	nray2	–	nbin	-	0	20	-2147483647	ATLID cloud particle category (10km)
34	Data	cloud_particle_category_atlid_1km	CPR-ATLID cloud particle category(1km)	-	integer	1	nray2	–	nbin	-	0	20	-2147483647	ATLID cloud particle category (1km)
35	Data	cloud_particle_category_cpr_atlid_10km	CPR-ATLID cloud particle category(10km)	-	integer	1	nray2	–	nbin	-	0	20	-2147483647	CPR-ATLID cloud particle category (10km)
36	Data	cloud_particle_category_cpr_atlid_1km	ATLID cloud particle category(1km)	-	integer	1	nray2	–	nbin	-	0	20	-2147483647	CPR-ATLID cloud particle category (1km)
37	Data	cloud_particle_type_atlid_1km	Cloud Particle Type (ATLID) (1 km)	–	integer	1	nray2	–	nbin	1	0	8	-127	ATLID cloud particle type (1 km) (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5:liquid drizzle, 6:mixet–phase drizzle, 7: rain, 8: snow)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
38	Data	cloud_particle_type_atlid_10km	Cloud Particle Type (ATLID) (10 km)	-	integer	1	nray2	-	nbin	1	0	6	-127	CPR-ATLID cloud particle type (10 km) (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5:liquid drizzle, 6:mixet-phase drizzle, 7: rain, 8: snow)
39	Data	cloud_particle_type_cpr_atrlid_10k m	Cloud Particle Type (CPR or ATLID) (10 km)	-	integer	1	nray2	-	nbin	1	0	6	-127	CPR-ATLID cloud particle type (10 km) (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5:liquid drizzle, 6:mixet-phase drizzle, 7: rain, 8: snow)
40	Data	cloud_particle_type_cpr_atlid_1k m	Cloud Particle Type (CPR or ATLID) (1 km)	-	integer	1	nray2	-	nbin	1	0	6	-127	ATLID cloud particle type (1 km) (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5:liquid drizzle, 6:mixet-phase drizzle, 7: rain, 8: snow)
41	Data	cloud_phase1_10km	cloud phase1 (10km)	-	integer	1	nray2	-	nbin	-	0	2	-127	cloud phase1 (10km)
42	Data	cloud_phase1_1km	cloud phase1 (1km)	-	integer	1	nray2	-	nbin	-	0	2	-127	cloud phase1 (1km)
43	Data	cloud_phase2_10km	cloud phase2 (10km)	-	integer	1	nray2	-	nbin	-	0	2	-127	cloud phase2 (10km)
44	Data	cloud_phase2_1km	cloud phase2 (1km)	-	integer	1	nray2	-	nbin	-	0	2	-127	cloud phase2 (1km)
45	Data	cloud_radar_reflectivity_10km	attenuated radar reflectivity factor (10km)	dBZ	real	4	nray2	-	nbin	-	-60	40	9.9692099683868690e+36-	attenuated radar reflectivity factor (10km)
46	Data	cloud_radar_reflectivity_1km	attenuated radar reflectivity factor (1km)	dBZ	real	4	nray2	-	nbin	-	-60	40	9.9692099683868690e+36-	attenuated radar reflectivity factor (1km)
47	Data	cloud_terminal_velocity1_10km	cloud terminal velocity1 10km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity1(10km)
48	Data	cloud_terminal_velocity1_1km	cloud terminal velocity1 1km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity1(1km)
49	Data	cloud_terminal_velocity2_10km	cloud terminal velocity2 10km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity2(10km)
50	Data	cloud_terminal_velocity2_1km	cloud terminal velocity2 1km	m/s	real	4	nray2	-	nbin	1	-20	0	9.969209968386860E+36	cloud terminal velocity2(1km)
51	Data	cloud_water_content1_10km	cloud water content1(10km)	g/m^3	real	4	nray2	-	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content1 (10km)
52	Data	cloud_water_content1_1km	cloud water content1(1km)	g/m^3	real	4	nray2	-	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content1 (1km)
53	Data	cloud_water_content2_10km	cloud water content2(10km)	g/m^3	real	4	nray2	-	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content2 (10km)
54	Data	cloud_water_content2_10km	cloud water content2(1km)	g/m^3	real	4	nray2	-	nbin	1	0	10	9.9692099683868690e+36	Cloud Water Content2 (1km)
55	Data	cloud_water_content_10km	Liquid Water Content (10km)	g/m^3	real	4	nray2	-	nbin	1	0	10	9.9692099683868690e+36	Liquid Water Content (1km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
56	Data	cloud_water_content_10km_uncertainty	Uncertainty in Liquid Water Content (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Content (10km)
57	Data	cloud_water_content_1km	Liquid Water Content (1km)	g/m^3	real	4	nray2	–	nbin	1	0	10	9.9692099683868690e+36	Liquid Water Content (1km)
58	Data	cloud_water_content_1km_uncertainty	Uncertainty in Liquid Water Content (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Content (1km)
59	Data	cloud_water_effective_radius_1km	Effective Radius of Liquid Water Cloud (1km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Liquid Water Cloud (1km)
60	Data	cloud_water_effective_radius_1km_uncertainty	Uncertainty in Effective Radius of Liquid Water Cloud (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Liquid Water Cloud (1km)
61	Data	cloud_water_effective_radius_10km	Effective Radius of Liquid Water Cloud (10km)	micro m	real	4	nray2	–	nbin	1	0	10000	9.9692099683868690e+36	Effective Radius of Liquid Water Cloud (10km)
62	Data	cloud_water_effective_radius_10km_uncertainty	Uncertainty in Effective Radius of Liquid Water Cloud (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Liquid Water Cloud (10km)
63	Data	cloud_water_path_10km	cloud water path (10km)	g/m^2	real	4	nray2	–	nbin	-	0	20000	9.9692099683868690e+36	Liquid Water Path(10km)
64	Data	cloud_water_path_1km	cloud water path (1km)	g/m^2	real	4	nray2	–	nbin	-	0	20000	9.9692099683868690e+36	Liquid Water Path(1km)
65	Data	GRID_pressure_1km	GRID pressure 1km	Pa	real	4	nray2	–	nbin	-	0	2000	9.9692099683868690e+36	Pressure (1km)
66	Data	GRID_relativeHumidity_1km	GRID relativeHumidity 1km	%	real	4	nray2	–	nbin	-	0	100	9.9692099683868690e+36	Relative Humidity (1km)
67	Data	GRID_specificHumidity_1km	GRID specificHumidity 1km	kg/kg	real	4	nray2	–	nbin	-	0	1	9.9692099683868690e+36	Specific Humidity (1km)
68	Data	GRID_temperature_1km	GRID temperature 1km	K	real	4	nray2	–	nbin	-	-	-	9.9692099683868690e+36	Temperature(1km)
69	Data	L2_quality_flag_10km	L2 Quality Flag Method (10km)	-	integer		nray2	-	-	-	-	-	-2147483647	L2 Quality Flag Method (10km)
70	Data	L2_quality_flag_1km	L2 Quality Flag Method (1km)	-	integer		nray2	-	-	-	-	-	-2147483647	L2 Quality Flag Method (1km)
71	Data	optical_thickness_10km	Optical Thickness (10km)	–	real	4	nray2	–	–	1	0	1000	9.9692099683868690e+36	Optical Thickness for Water + Ice clouds (10km)
72	Data	optical_thickness_1km	Optical Thickness (1km)	–	real	4	nray2	–	–	1	0	1000	9.9692099683868690e+36	Optical Thickness for Water + Ice clouds (1km)
73	Data	quality_flag_1km	Quality Flag (1km)	–	integer	2	nray2	–	nbin	10	0	100	-32767	Quality Flag (1km)
74	Data	quality_flag_10km	Quality Flag (10km)	–	integer	2	nray2	–	nbin	10	0	100	-32767	Quality Flag (10km)
75	Data	radar_lider_flag_10km	CPR-ATLID Mask Flag (10km)	–	integer		nray2	–	nbin	-	1	4	-127	CPR-ATLID Mask Flag (10km)
75	Data	radar_lider_flag_1km	CPR-ATLID Mask Flag (1km)	–	integer		nray2	–	nbin	-	1	4	-127	CPR-ATLID Mask Flag (1km)
76	Data	total_cloud_ice_number_concentration_10km	Total Cloud Ice Number Concentration (10km)	1/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	Total cloud ice number concentration(10km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
77	Data	total_cloud_ice_number_concentration_1km	Total Cloud Ice Number Concentration (1km)	g/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	Total cloud ice number concentration(1km)
78	Data	total_cloud_terminal_velocity_10km	total cloud terminal velocity (10km)	m/s	real	4	nray2	-	nbin	-	-20	0	9.969209968386860E+36	Sedimentation velocity (10km)
79	Data	total_cloud_terminal_velocity_1km	total cloud terminal velocity (1km)	m/s	real	4	nray2	-	nbin	-	-20	0	9.969209968386860E+36	Sedimentation velocity (1km)
80	Data	total_cloud_water_number_concentration_10km	total cloud water number concentration(10km)	1/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	total cloud water number concentration(10km)
81	Data	total_cloud_water_number_concentration_1km	total cloud water number concentration (10km)	1/m^3	real	4	nray2	-	nbin	1	0	1E21	9.969209968386860E+36	total cloud water number concentration(1km)

EarthCARE Product Definitions
-JAXA L2 Product Format-

APPENDIX 9

CPR-ATLID-MSI Synergy

Cloud Product

(ACM_CLP)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The CPR-ATLID-MSI compound level 2b standard processing processes input of level 1b, level 2a, and level 2b files of the CPR, ATLID, and MSI (Table 2.2-1) to estimate physical quantities about clouds (Table 2.3-1) from the synergy observation of the CPR, ATLID, and MSI.

2.2. Input Files

Table 2.2-1 shows input files for CPR-ATLID-MSI L2b processing.

Table 2.2-1 Input files for CPR-ATLID-MSI L2b processing

Input file	File format
CPR level 1b standard product	HDF
CPR level 2a Echo standard product	HDF
CPR level 2a Cloud standard product	HDF
ATLID level 1b standard product	HDF
ATLID level 2a standard product	HDF
MSI level 1c standard product	HDF
MSI level 2a standard product	HDF
CPR-ATLID level 2b standard product	HDF
Level 1d (X-JSG) product	HDF
ECMWF AUX-2D data	HDF

2.3. Representative Physical Quantities

Table 2.2-2 shows representative physical quantities derived in CPR-ATLID-MSI L2b processing. The derived results are stored in the CPR-ATLID-MSI L2b standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in CPR-ATLID-MSI L2a processing

Representative physical quantity	Unit
Cloud mask (CPR-ATLID-MSI) (1 km)	-
Cloud particle type (CPR-ATLID-MSI) (1 km)	-
Effective radius of liquid water cloud (1km)	um
Liquid water content (1km)	g/m3
Effective radius of ice cloud (1km)	um
Ice water content (1km)	g/m^3
Optical thickness (1km)	-
Liquid water path (1km)	g/m^2
Ice water path (1km)	g/m^2

3. Product Format

This chapter describes the "Science Data part," which is data in the L2b product format of EarthCARE CPR-ATLID-MSI. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 Dimension definitions (data part of the CPR-ATLID-MSI L2b product)

Item	Definition
nray2	Number of rays, which is along the observation orbit of the satellite sensor (CPR) (Sampling interval: 1 km)
nbin	Number of Joint Standard Grid (JSG) vertical bins

3.2. Data Volume

Table 3.2-1 shows data volume of the CPR-ATLID-MSI L2b product.

Table 3.2-1 Data volume of the CPR-ATLID-MSI L2b product

Product name	Data Volume
CPR-ATLID-MSI L2b product	13MB(TBD)

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the CPR-ATLID-MSI L2b product.

Table 3.3-1 Format of ScienceData in the CPR-ATLID-MSI L2b product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	time	Time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray2	–	–	–	–	–	9.9692099683868690e+36	Representative Time of each ray. Sequential seconds counted from 1/1/2000.
2	Geo	latitude	Latitude	degree_north	real	8	nray2	–	–	–	-90	90	9.9692099683868690e+36	Latitude (degree)
3	Geo	longitude	Longitude	degree_east	real	8	nray2	–	–	–	-180	180	9.9692099683868690e+36	Longitude (degree)
4	Geo	height	Height	m	real	4	–	–	nbin	–	–	–	9.9692099683868690e+36	Midpoint of the range bin
5	Geo	surface_elevation	Surface elevation (WGS84)	m	real	4	nray2	–	–	–	–	–	9.9692099683868690e+36	Representative surface elecation (m) from the WGS84 surface at each ray
6	Geo	day_night_flag	Day night flag	–	integer	1	nray2	1	1	–	0	1	-127	Day-Nighgt Flag (0:night, 1:day) This flag is a copy of AUX-2DH.
7	Geo	land_water_flag	Land water flag	–	integer	1	nray2	1	1	–	0	1	-127	Land-Water Flag (0:water, 1:land) This flag is a copy of AUX-2DH.
8	Data	radar_lider_flag_1km	CPR-ATLID Mask Flag (1km)	–	integer	1	nray2	–	nbin	–	1	4	-127	Used Sensor Flag (1:radar only, 2:lidar only, 3:radar and lidar, 4:radar or lidar) to retrieve cloud microphysics, e.g. 1:Cloud only detected by radar
9	Data	radar_lider_flag_10km	CPR-ATLID Mask Flag (10km)	–	integer	1	nray2	–	nbin	–	1	4	-127	Used Sensor Flag (1:radar only, 2:lidar only, 3:radar and lidar, 4:radar or lidar) to retrieve cloud microphysics, e.g. 1:Cloud only detected by radar
10	Data	cloud_mask_cpr_atlid_msi_1km	Cloud Mask CPR-ATLID-MSI (1km)	–	integer	1	nray2	–	nbin	1	0	1	-127	CPR-ATLID-MSI synergy cloud mask (-9:missing, 0:clear, 1:cloudy)
11	Data	cloud_mask_cpr_atlid_msi_10km	Cloud Mask CPR-ATLID-MSI (10km)	–	integer	1	nray2	–	nbin	1	0	1	-127	CPR-ATLID-MSI synergy cloud mask (-9:missing, 0:clear, 1:cloudy)
12	Data	cloud_particle_type_cpr_atlid_msi_1km	Cloud Particle Type CPR-ATLID-MSI (1km)	–	integer	1	nray2	–	nbin	1	0	13	-127	CPR-ATLID-MSI synergy cloud particle type (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5=mixture of 3d ice and 2d plate, 6:liquid drizzle, 7:mixed-phase drizzle, 8:rain, 9:snow, 10:water+liquid drizzle, 11 water+rain, 12:mixed-phase, 13:unknown)
13	Data	cloud_particle_type_cpr_atlid_msi_uncertainty_1km	Uncertainty in Cloud Particle Type CPR-ATLID-MSI (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Cloud Particle Type CPR-ATLID-MSI (1km)
14	Data	cloud_particle_type_cpr_atlid_msi_10km	Cloud Particle Type CPR-ATLID-MSI (10km)	–	integer	1	nray2	–	nbin	1	0	13	-127	CPR-ATLID-MSI synergy cloud particle type (0:clear, 1:warm water, 2:supercooled water, 3:3d ice, 4:2d plate, 5=mixture of 3d ice and 2d plate, 6:liquid drizzle, 7:mixed-phase drizzle, 8:rain, 9:snow, 10:water+liquid drizzle, 11 water+rain, 12:mixed-phase, 13:unknown)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
15	Data	cloud_particle_type_cpr_atlid_msi_uncertainty_10km	Uncertainty in Cloud Particle Type CPR-ATLID-MSI (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Cloud Particle Type CPR-ATLID-MSI (10km)
16	Data	cloud_water_effective_radius_1km	Effective Radius of Liquid Water Cloud (1km)	micro m	real	4	nray2	–	nbin	1	0	10000 (TBD)	9.9692099683868690e+36	Effective Radius of Liquid Water Cloud (1km)
17	Data	cloud_water_effective_radius_1km_uncertainty	Uncertainty in Effective Radius of Liquid Water Cloud (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Liquid Water Cloud (1km)
18	Data	cloud_water_effective_radius_10km	Effective Radius of Liquid Water Cloud (10km)	micro m	real	4	nray2	–	nbin	1	0	10000 (TBD)	9.9692099683868690e+36	Effective Radius of Liquid Water Cloud (10km)
19	Data	cloud_water_effective_radius_10km_uncertainty	Uncertainty in Effective Radius of Liquid Water Cloud (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Liquid Water Cloud (10km)
20	Data	cloud_water_content_1km	Liquid Water Content (1km)	g/m^3	real	4	nray2	–	nbin	1	0	10g/m^3(TBD)	9.9692099683868690e+36	Liquid Water Content (1km)
21	Data	cloud_water_content_1km_uncertainty	Uncertainty in Liquid Water Content (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Content (1km)
22	Data	cloud_water_content_10km	Liquid Water Content (10km)	g/m^3	real	4	nray2	–	nbin	1	0	10g/m^3(TBD)	9.9692099683868690e+36	Liquid Water Content (10km)
23	Data	cloud_water_content_10km_uncertainty	Uncertainty in Liquid Water Content (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Content (10km)
24	Data	cloud_ice_effective_radius_1km	Effective Radius of Ice Cloud (1km)	micro m	real	4	nray2	–	nbin	1	0	10000 (TBD)	9.9692099683868690e+36	Effective Radius of Ice Cloud (1km)
25	Data	cloud_ice_effective_radius_1km_uncertainty	Uncertainty in Effective Radius of Ice Cloud (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Ice Cloud (1km)
26	Data	cloud_ice_effective_radius_10km	Effective Radius of Ice Cloud (10km)	micro m	real	4	nray2	–	nbin	1	0	10000 (TBD)	9.9692099683868690e+36	Effective Radius of Ice Cloud (10km)
27	Data	cloud_ice_effective_radius_10km_uncertainty	Uncertainty in Effective Radius of Ice Cloud (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Effective Radius of Ice Cloud (10km)
28	Data	cloud_ice_content_1km	Ice Water Content (1km)	g/m^3	real	4	nray2	–	nbin	1	0	10g/m^3(TBD)	9.9692099683868690e+36	Ice Water Content (1km)
29	Data	cloud_ice_content_1km_uncertainty	Uncertainty in Ice Water Content (1km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Content (1km)
30	Data	cloud_ice_content_10km	Ice Water Content (10km)	g/m^3	real	4	nray2	–	nbin	1	0	10g/m^3(TBD)	9.9692099683868690e+36	Ice Water Content (10km)
31	Data	cloud_ice_content_10km_uncertainty	Uncertainty in Ice Water Content (10km)	%	real	4	nray2	–	nbin	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Content (10km)
32	Data	optical_thickness_1km	Optical Thickness (1km)	–	real	4	nray2	–	–	1	0	1000(TBD)	9.9692099683868690e+36	Optical Thickness for Water + Ice clouds (1km)
33	Data	optical_thickness_1km_uncertainty	Uncertainty in Optical Thickness (1km)	%	real	4	nray2	–	–	1	0	100	9.9692099683868690e+36	Uncertainty in Optical Thickness (1km)
34	Data	optical_thickness_10km	Optical Thickness (10km)	–	real	4	nray2	–	–	1	0	1000(TBD)	9.9692099683868690e+36	Optical Thickness for Water + Ice clouds (10km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
35	Data	optical_thickness_10km_uncertainty	Uncertainty in Optical Thickness (10km)	%	real	4	nray2	-	-	1	0	100	9.9692099683868690e+36	Uncertainty in Optical Thickness (10km)
36	Data	cloud_water_path_1km	Liquid Water Path (1km)	g/m^2	real	4	nray2	-	-	1	0	20000 (TBD)	9.9692099683868690e+36	Liquid Water Path (1km)
37	Data	cloud_water_path_1km_uncertainty	Uncertainty in Liquid Water Path (1km)	%	real	4	nray2	-	-	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Path (1km)
38	Data	cloud_water_path_10km	Liquid Water Path (10km)	g/m^2	real	4	nray2	-	-	1	0	20000 (TBD)	9.9692099683868690e+36	Liquid Water Path (10km)
39	Data	cloud_water_path_10km_uncertainty	Uncertainty in Liquid Water Path (10km)	%	real	4	nray2	-	-	1	0	100	9.9692099683868690e+36	Uncertainty in Liquid Water Path (10km)
40	Data	cloud_ice_water_path_1km	Ice Water Path (1km)	g/m^2	real	4	nray2	-	-	1	0	20000 (TBD)	9.9692099683868690e+36	Ice Water Path (1km)
41	Data	cloud_ice_water_path_1km_uncertainty	Uncertainty in Ice Water Path (1km)	%	real	4	nray2	-	-	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Path (1km)
42	Data	cloud_ice_water_path_10km	Ice Water Path (10km)	g/m^2	real	4	nray2	-	-	1	0	20000 (TBD)	9.9692099683868690e+36	Ice Water Path (10km)
43	Data	cloud_ice_water_path_10km_uncertainty	Uncertainty in Ice Water Path (10km)	%	real	4	nray2	-	-	1	0	100	9.9692099683868690e+36	Uncertainty in Ice Water Path (10km)
44	Data	quality_flag_1km	Quality Flag (1km)	-	integer	2	nray2	-	nbin	10	TBD	TBD	TBD	Quality Flag (1km)
45	Data	quality_flag_10km	Quality Flag (10km)	-	integer	2	nray2	-	nbin	10	TBD	TBD	TBD	Quality Flag (10km)
__	Data	cloud_effective_radius1_1km	Reff1_1	micro m	real	4	nray2	-	nbin	1	0	10000	9.969209968386860E+36	Effective Radius1 of Liquid or Ice Cloud(1km)
__	Data	cloud_effective_radius1_1km_uncertainty	Reff1_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in Effective Radius1 of Liquid or Ice Cloud (1km)
__	Data	cloud_effective_radius2_1km	Reff2_1	micro m	real	4	nray2	-	nbin	1	0	10000	9.969209968386860E+36	Effective Radius2 of Liquid or Ice Cloud(1km)
__	Data	cloud_effective_radius2_1km_uncertainty	Reff2_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in Effective Radius2 of Liquid or Ice Cloud (1km)
__	Data	cloud_water_content1_1km	CWC1_1	g/m^3	real	4	nray2	-	nbin	1	0	10	9.969209968386860E+36	Liquid water content or ice water content corresponding to cloud_effective_radius1
__	Data	cloud_water_content1_1km_uncertainty	CWC1_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in CWC1
__	Data	cloud_water_content2_1km	CWC2_1	g/m^3	real	4	nray2	-	nbin	1	0	10	9.969209968386860E+36	Liquid water content or ice water content corresponding to cloud_effective_radius2
__	Data	cloud_water_content2_1km_uncertainty	CWC2_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in CWC2
__	Data	cloud_phase1_1km	Cphase1_1	-	integer	1	nray2	-	nbin	1	-9	2	-127	phase of cloud effective radius1
__	Data	cloud_phase2_1km	Cphase2_1	-	integer	1	nray2	-	nbin	1	-9	2	-127	phase of cloud effective radius2
__	Data	cloud_number_concentration1_1km	NC1_1	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	number concentration of Cloud1 in the case of ice or water(1km)
__	Data	cloud_number_concentration1_1km_uncertainty	NC1_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in NC1 (1km)

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
	Data	cloud_number_concentration2_1km	NC2_1	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	Number concentration of Cloud2(1km)
	Data	cloud_number_concentration2_1km_uncertainty	NC2_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in NC2 (1km)
	Data	total_cloud_ice_number_concentration_1km	TINC_1	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	Total number concentration of Ice Cloud
	Data	total_cloud_ice_number_concentration_1km_uncertainty	TINC_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in total number concentration of Ice Cloud
	Data	total_cloud_water_number_concentration_1km	TWNC_1	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	Total number concentration of Water Cloud
	Data	total_cloud_water_number_concentration_1km_uncertainty	TWNC_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in total number concentration of water Cloud
	Data	ice_particle_category_1km	IPC_1	-	integer	4	nray2	-	nbin	1	-9	20	-1.270000000000000E+02	ice particle category (ex. Voronoi, droxtal, 2D-column, 2D-plate etc.)
	Data	cloud_doppler_velocity_1km	CDV1	m/s	real	4	nray2	-	nbin	1	-99	20	9.969209968386860E+36	cloud doppler velocity(1km)
	Data	cloud_doppler_velocity_1km_uncertainty	CDV1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud doppler velocity(1km)
	Data	cloud_terminal_velocity1_1km	CTV1_1	m/s	real	4	nray2	-	nbin	1	-99	0	9.969209968386860E+36	cloud terminal velocity(1km) corresponding to cloud_effective_radius_1
	Data	cloud_terminal_velocity1_1km_uncertainty	CTV1_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud terminal velocity(1km) corresponding to cloud_effective_radius_1
	Data	cloud_terminal_velocity2_1km	CTV2_1	m/s	real	4	nray2	-	nbin	1	-99	0	9.969209968386860E+36	cloud terminal velocity(1km) corresponding to cloud_effective_radius_2
	Data	cloud_terminal_velocity2_1km_uncertainty	CTV2_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud terminal velocity(1km) corresponding to cloud_effective_radius_2
	Data	total_cloud_terminal_velocity_1km	TCTV_1	m/s	real	4	nray2	-	nbin	1	-99	0	9.969209968386860E+36	total cloud terminal velocity(1km)
	Data	total_cloud_terminal_velocity_1km_uncertanty	TCTV_1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	unceratainty in total cloud terminal velocity(1km)
	Data	cloud_air_velocity_1km	CAV1	m/s	real	4	nray2	-	nbin	1	-99	20	9.969209968386860E+36	cloud air velocity(1km)
	Data	cloud_air_velocity_1km_uncertainty	CAV1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud air velocity(1km)
	Data	cloud_particle_type_atlid_1km	CtypeATL1	-	integer	1	nray2	-	nbin	1	-9	20	-127	atlid cloud particle type
	Data	cloud_particle_type_atlid_uncertainty_1km	CtypeATL1_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in atlid cloud particle type

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
	Data	cloud_effective_radius1_10km	Reff1_10	micro m	real	4	nray2	-	nbin	1	0	10000	9.969209968386860E+36	Effective Radius1 of Liquid or Ice Cloud(10km)
	Data	cloud_effective_radius1_10km_uncertainty	Reff1_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in Effective Radius1 of Liquid or Ice Cloud (10km)
	Data	cloud_effective_radius2_10km	Reff2_10	micro m	real	4	nray2	-	nbin	1	0	10000	9.969209968386860E+36	Effective Radius2 of Liquid or Ice Cloud(10km)
	Data	cloud_effective_radius2_10km_uncertainty	Reff2_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in Effective Radius2 of Liquid or Ice Cloud (10km)
	Data	cloud_water_content1_10km	CWC1_10	g/m^3	real	4	nray2	-	nbin	1	0	10	9.969209968386860E+36	Liquid water content or ice water content corresponding to cloud_effective_radius1
	Data	cloud_water_content1_10km_uncertainty	CWC1_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in CWC1
	Data	cloud_water_content2_10km	CWC2_10	g/m^3	real	4	nray2	-	nbin	1	0	10	9.969209968386860E+36	Liquid water content or ice water content corresponding to cloud_effective_radius2
	Data	cloud_water_content2_10km_uncertainty	CWC2_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in CWC2
	Data	cloud_phase1_10km	Cphase1_10	-	integer	1	nray2	-	nbin	1	-9	2	-127	phase of cloud effective radius1
	Data	cloud_phase2_10km	Cphase2_10	-	integer	1	nray2	-	nbin	1	-9	2	-127	phase of cloud effective radius2
	Data	cloud_number_concentration1_10km	NC1_10	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	number concentration of Cloud1 in the case of ice or water(10km)
	Data	cloud_number_concentration1_10km_uncertainty	NC1_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in NC1 (10km)
	Data	cloud_number_concentration2_10km	NC2_10	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	Number concentration of Cloud2(10km)
	Data	cloud_number_concentration2_10km_uncertainty	NC2_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in NC2 (10km)
	Data	total_cloud_ice_number_concentration_10km	TINC_10	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	Total number concentration of Ice Cloud
	Data	total_cloud_ice_number_concentration_10km_uncertainty	TINC_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in total number concentration of Ice Cloud
	Data	total_cloud_water_number_concentration_10km	TWNC_10	1/m^3	real	4	nray2	-	nbin	1	0	1E+20	9.969209968386860E+36	Total number concentration of Water Cloud
	Data	total_cloud_water_number_concentration_10km_uncertainty	TWNC_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	Uncertainty in total number concentration of water Cloud
	Data	ice_particle_category_10km	IPC_10	-	integer	4	nray2	-	nbin	1	-9	20	-1.270000000000000E+02	ice particle category (ex. Voronoi, droxtal, 2D-column, 2D-plate etc.)
	Data	cloud_doppler_velocity_10km	CDV10	m/s	real	4	nray2	-	nbin	1	-99	20	9.969209968386860E+36	cloud doppler velocity(10km)
	Data	cloud_doppler_velocity_10km_uncertainty	CDV10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud doppler velocity(10km)
	Data	cloud_terminal_velocity1_10km	CTV1_10	m/s	real	4	nray2	-	nbin	1	-99	0	9.969209968386860E+36	cloud terminal velocity(10km) corresponding to cloud_effective_radius_1

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
	Data	cloud_terminal_velocity1_10km_uncertainty	CTV1_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud terminal velocity(10km) corresponding to cloud_effective_radius_1
	Data	cloud_terminal_velocity2_10km	CTV2_10	m/s	real	4	nray2	-	nbin	1	-99	0	9.969209968386860E+36	cloud terminal velocity(10km) corresponding to cloud_effective_radius_2
	Data	cloud_terminal_velocity2_10km_uncertainty	CTV2_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud terminal velocity(10km) corresponding to cloud_effective_radius_2
	Data	total_cloud_terminal_velocity_10km	TCTV_10	m/s	real	4	nray2	-	nbin	1	-99	0	9.969209968386860E+36	total cloud terminal velocity(10km)
	Data	total_cloud_terminal_velocity_10km_uncertanty	TCTV_10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	unceratainty in total cloud terminal velocity(10km)
	Data	cloud_air_velocity_10km	CAV10	m/s	real	4	nray2	-	nbin	1	-99	20	9.969209968386860E+36	cloud air velocity(10km)
	Data	cloud_air_velocity_10km_uncertainty	CAV10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in cloud air velocity(10km)
	Data	cloud_particle_type_atlid_10km	CtypeATL10	-	integer	1	nray2	-	nbin	1	-9	20	-127	atlid cloud particle type
	Data	cloud_particle_type_atlid_uncertainty_10km	CtypeATL10_uncertainty	%	real	4	nray2	-	nbin	1	0	100	9.969209968386860E+36	uncertainty in atlid cloud particle type

EarthCARE Product Definitions
-JAXA L2 Product Format-

APPENDIX 10

Four Sensors Synergy

Radiation Budget Product

(ALL_RAD)

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1. Related Documents

The following list shows the related document.

(1) EarthCARE JAXA Level 2 Algorithm Theoretical Basis Document (L2 ATBD) (NDX-110018B)

2. Processing Overview

2.1. Processing Overview

The four-sensor compound level 2b standard processing processes input of level 1b and level 2a files of the CPR, ATLID, MSI, and BBR (Table 2.2-1) to estimate physical quantities about clouds and aerosols (Table 2.2-2) from the synergy observation of the CPR, ATLID, MSI, and BBR.

2.2. Input Files

Table 2.2-1 shows input files for CPR-ATLID-MSI-BBR four-sensor compound level L2b processing.

Table 2.2-1 Input files for four-sensor compound level L2b processing

Input file	File format
CPR level 2a Echo standard product	HDF
CPR level 2a Cloud standard product	HDF
ATLID level 2a standard product	HDF
MSI level 1c standard product	HDF
MSI level 2a standard product	HDF
ECMWF AUX-3D data	HDF

2.3. Representative Physical Quantities

Table 2.3-1 shows representative physical quantities derived in CPR-ATLID-MSI-BBR four-sensor compound level L2b processing. The derived results are stored in the CPR-ATLID-MSI-BBR four-sensor compound level L2b processing standard product (HDF file).

Table 2.3-1 Representative physical quantities derived in four-sensor compound level L2b processing

Representative physical quantity	Unit
Short-wave radiation flux	W/m2
Long-wave radiation flux	W/m2
Short-wave heating rate	K/day
Long-wave heating rate	K/day
Aerosol direct radiative forcing	W/m2

3. Product Format

This chapter describes the "ScienceData part," which is data in the CPR-ATLID-MSI-BBR four-sensor compound L2b product format of EarthCARE. As to the meta part, the common part describes it.

3.1. Dimension Definitions

Table 3.1-1 shows the definitions of the dimensions used for ScienceData.

Table 3.1-1 Dimension definitions (data part of the four-sensor compound L2b product)

Item	Definition
nray4sns	Number of ray, which is along the observation orbit of the satellite sensor
nswath4sns	Number of swath, which is placed widthwise to the observation orbit of the satellite sensor

3.2. Data Volume

Table 3.2-1 shows data volume of the CPR-ATLID-MSI-BBR four-sensor compound L2b product.

Table 3.2-1 Data volume of the four-sensor compound L2b product

Product name	Data Volume
CPR-ATLID-MSI-BBR four-sensor compound L2b product	0.8MB(TBD)

3.3. Details of the Product Format

Table 3.3-1 shows data name, unit, type, dimension, valid range, fill value, and description of ScienceData in the CPR-ATLID-MSI-BBR four-sensor compound L2b product.

Table 3.3-1 Format of ScienceData in the CPR-ATLID-MSI-BBR four-sensor compound L2b product

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
1	Geo	time	Time	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray4sns	nswath4sns	-	-	-	-	9.9692099683868690e+36	Sequential seconds counted from 1 Jan 2000 00:00:00.
2	Geo	latitude	Latitude	degree_north	real	8	nray4sns	nswath4sns	-	-	-90	90	9.9692099683868690e+36	Latitude
3	Geo	longitude	Longitude	degree_east	real	8	nray4sns	nswath4sns	-	-	-180	180	9.9692099683868690e+36	Longitude
4	Geo	height	Height	m	real	4	-	nswath4sns	40	-	-	-	9.9692099683868690e+36	Midpoint of the range bin
5	Geo	surface_elevation	Surface elevation (WGS84)	m	real	4	nray4sns	nswath4sns	-	-	-	-	9.9692099683868690e+36	Representative surface elevation (m) from the WGS84 surface
6	Geo	land_water_flag	Land water flag	-	integer	1	nray4sns	nswath4sns	-	-	0	1	-127	Land-Water Flag (0:water, 1:land)
7	Geo	day_night_flag	Day night flag	-	integer	1	nray4sns	nswath4sns	-	-	0	1	-127	Day-Night Flag (0:night, 1:day)
8	Geo	time_1km	Time (1km)	seconds since 2000-1-1 00:00:00.0 0:00	real	8	nray4sns	nswath4sns	-	-	-	-	9.9692099683868690e+36	Sequential seconds counted from 1 Jan 2000 00:00:00.
9	Geo	latitude_1km	Latitude (1km)	degree_north	real	8	nray4sns	nswath4sns	-	-	-90	90	9.9692099683868690e+36	Latitude
10	Geo	longitude_1km	Longitude (1km)	degree_east	real	8	nray4sns	nswath4sns	-	-	-180	180	9.9692099683868690e+36	Longitude
11	Geo	surface_elevation_1km	Surface elevation (WGS84) (1km)	m	real	4	nray4sns	nswath4sns	-	-	-	-	9.9692099683868690e+36	Representative surface elevation (m) from the WGS84 surface
12	Geo	land_water_flag_1km	Land water flag (1km)	-	integer	1	nray4sns	nswath4sns	-	-	0	1	-127	Land-Water Flag (0:water, 1:land)
13	Geo	day_night_flag_1km	Day night flag (1km)	-	integer	1	nray4sns	nswath4sns	-	-	0	1	-127	Day-Night Flag (0:night, 1:day)
14	Data	quality_flag	Quality Flag	-	integer	1	nray4sns	nswath4sns	-	10	0	254	255	Quality Flag (TBD).
15	Data	radiative_flux_shortwave_downward_toa_all_sky	Downward SW radiative flux at TOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at top of atmosphere for all-sky.
16	Data	radiative_flux_shortwave_upward_toa_all_sky	Upward SW radiative flux at TOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at top of atmosphere for all-sky.
17	Data	radiative_flux_shortwave_downward_boa_all_sky	Downward SW radiative flux at BOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at bottom of atmosphere for all-sky.
18	Data	radiative_flux_shortwave_upward_boa_all_sky	Upward SW radiative flux at BOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at bottom of atmosphere for all-sky.

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
19	Data	radiative_flux_longwave_upward_toa_all_sky	Upward LW radiative flux at TOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at top of atmosphere for all-sky.
20	Data	radiative_flux_longwave_downward_boa_all_sky	Downward LW radiative flux at BOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward longwave radiative flux at bottom of atmosphere for all-sky.
21	Data	radiative_flux_longwave_upward_boa_all_sky	Upward LW radiative flux at BOA for all-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at bottom of atmosphere for all-sky.
22	Data	radiative_flux_shortwave_downward_toa_clear_sky	Downward SW radiative flux at TOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at top of atmosphere for clear-sky.
23	Data	radiative_flux_shortwave_upward_toa_clear_sky	Upward SW radiative flux at TOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at at top of atmosphere for clear-sky.
24	Data	radiative_flux_shortwave_downward_boa_clear_sky	Downward SW radiative flux at BOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at bottom of atmosphere for clear-sky.
25	Data	radiative_flux_shortwave_upward_boa_clear_sky	Upward SW radiative flux at BOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at bottom of atmosphere for clear-sky.
26	Data	radiative_flux_longwave_upward_toa_clear_sky	Upward LW radiative flux at TOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at top of atmosphere for clear-sky.
27	Data	radiative_flux_longwave_downward_boa_clear_sky	Downward LW radiative flux at BOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward longwave radiative flux at bottom of atmosphere for clear-sky.
28	Data	radiative_flux_longwave_upward_boa_clear_sky	Upward LW radiative flux at BOA for clear-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at bottom of atmosphere for clear-sky.
29	Data	radiative_flux_shortwave_downward_toa_cloudy_sky	Downward SW radiative flux at TOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at top of atmosphere for cloudy-sky.
30	Data	radiative_flux_shortwave_upward_toa_cloudy_sky	Upward SW radiative flux at TOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at at top of atmosphere for cloudy-sky.
31	Data	radiative_flux_shortwave_downward_boa_cloudy_sky	Downward SW radiative flux at BOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at bottom of atmosphere for cloudy-sky.
32	Data	radiative_flux_shortwave_upward_boa_cloudy_sky	Upward SW radiative flux at BOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at bottom of atmosphere for cloudy-sky.
33	Data	radiative_flux_longwave_upward_toa_cloudy_sky	Upward LW radiative flux at TOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at top of atmosphere for cloudy-sky.
34	Data	radiative_flux_longwave_downward_boa_cloudy_sky	Downward LW radiative flux at BOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward longwave radiative flux at bottom of atmosphere for cloudy-sky.
35	Data	radiative_flux_longwave_upward_boa_cloudy_sky	Upward LW radiative flux at BOA for cloudy-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at bottom of atmosphere for cloudy-sky.
36	Data	radiative_flux_shortwave_downward_toa_pristine_sky	Downward SW radiative flux at TOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at top of atmosphere for pristine-sky.

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
37	Data	radiative_flux_shortwave_upward_toa_pristine_sky	Upward SW radiative flux at TOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at top of atmosphere for pristine-sky.
38	Data	radiative_flux_shortwave_downward_boa_pristine_sky	Downward SW radiative flux at BOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at bottom of atmosphere for pristine-sky.
39	Data	radiative_flux_shortwave_upward_boa_pristine_sky	Upward SW radiative flux at BOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at bottom of atmosphere for pristine-sky.
40	Data	radiative_flux_longwave_upward_toa_pristine_sky	Upward LW radiative flux at TOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at top of atmosphere for pristine-sky.
41	Data	radiative_flux_longwave_downward_boa_pristine_sky	Downward LW radiative flux at BOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward longwave radiative flux at bottom of atmosphere for pristine-sky.
42	Data	radiative_flux_longwave_upward_boa_pristine_sky	Upward LW radiative flux at BOA for pristine-sky	Wm^-2	real	4	nray4sns	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at bottom of atmosphere for pristine-sky.
43	Data	radiative_heating_rate_shortwave_all_sky	SW radiative heating rate for all-sky	K/day	real	4	nray4sns	nswath4sns	39	-	-100	100	9.9692099683868690e+36	Shortwave radiative heating rate for all-sky.
44	Data	radiative_heating_rate_shortwave_clear_sky	SW radiative heating rate for clear-sky	K/day	real	4	nray4sns	nswath4sns	39	-	-100	100	9.9692099683868690e+36	Shortwave radiative heating rate for clear-sky.
45	Data	radiative_heating_rate_longwave_all_sky	LW radiative heating rate for all-sky	K/day	real	4	nray4sns	nswath4sns	39	-	-100	100	9.9692099683868690e+36	Longwave radiative heating rate for all-sky.
46	Data	radiative_heating_rate_longwave_clear_sky	LW radiative heating rate for clear-sky	K/day	real	4	nray4sns	nswath4sns	39	-	-100	100	9.9692099683868690e+36	Longwave radiative heating rate for clear-sky.
47	Data	aerosol_radiative_forcing_shortwave_toa_all	SW aerosol radiative forcing at TOA with clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave aerosol radiative forcing at top of atmosphere with clouds.
48	Data	aerosol_radiative_forcing_shortwave_boa_all	SW aerosol radiative forcing at BOA with clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave aerosol radiative forcing at bottom of atmosphere with clouds.
49	Data	aerosol_radiative_forcing_longwave_toa_all	LW aerosol radiative forcing at TOA with clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave aerosol radiative forcing at top of atmosphere with clouds.
50	Data	aerosol_radiative_forcing_longwave_boa_all	LW aerosol radiative forcing at BOA with clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave aerosol radiative forcing at bottom of atmosphere with clouds.
51	Data	aerosol_radiative_forcing_shortwave_toa_clear	SW aerosol radiative forcing at TOA without clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave aerosol radiative forcing at top of atmosphere without clouds.
52	Data	aerosol_radiative_forcing_shortwave_boa_clear	SW aerosol radiative forcing at BOA without clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave aerosol radiative forcing at bottom of atmosphere without clouds.
53	Data	aerosol_radiative_forcing_l	LW aerosol radiative	Wm^-2	real	4	nray4	nswat	-	-	-100	100	9.9692099683868690e+3	Longwave aerosol radiative forcing at top

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
		ongwave_toa_clear	forcing at TOA without clouds				sns	h4sns					6	of atmosphere without clouds.
54	Data	aerosol_radiative_forcing_longwave_boa_clear	LW aerosol radiative forcing at BOA without clouds	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave aerosol radiative forcing at bottom of atmosphere without clouds.
55	Data	cloud_radiative_forcing_shortwave_toa_polluted	SW cloud radiative forcing at TOA with aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave cloud radiative forcing at top of atmosphere with aerosols.
56	Data	cloud_radiative_forcing_shortwave_boa_polluted	SW cloud radiative forcing at BOA with aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave cloud radiative forcing at bottom of atmosphere with aerosols.
57	Data	cloud_radiative_forcing_longwave_toa_polluted	LW cloud radiative forcing at TOA with aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave cloud radiative forcing at top of atmosphere with aerosols.
58	Data	cloud_radiative_forcing_longwave_boa_polluted	LW cloud radiative forcing at BOA with aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave cloud radiative forcing at bottom of atmosphere with aerosols.
59	Data	cloud_radiative_forcing_shortwave_toa_clean	SW cloud radiative forcing at TOA without aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave cloud radiative forcing at top of atmosphere without aerosols.
60	Data	cloud_radiative_forcing_shortwave_boa_clean	SW cloud radiative forcing at BOA without aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Shortwave cloud radiative forcing at bottom of atmosphere without aerosols.
61	Data	cloud_radiative_forcing_longwave_toa_clean	LW cloud radiative forcing at TOA without aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave cloud radiative forcing at top of atmosphere without aerosols.
62	Data	cloud_radiative_forcing_longwave_boa_clean	LW cloud radiative forcing at BOA without aerosols	Wm^-2	real	4	nray4sns	nswath4sns	-	-	-100	100	9.9692099683868690e+36	Longwave cloud radiative forcing at bottom of atmosphere without aerosols.
63	Data	quality_flag_1km	Quality Flag (1km)	-	integer	1	nray4sns1km	nswath4sns	-	10	0	254	255	Quality Flag (TBD).
64	Data	radiative_flux_shortwave_downward_toa_all_sky_1km	Downward SW radiative flux at TOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at top of atmosphere for all-sky.
65	Data	radiative_flux_shortwave_upward_toa_all_sky_1km	Upward SW radiative flux at TOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at top of atmosphere for all-sky.
66	Data	radiative_flux_shortwave_downward_boa_all_sky_1km	Downward SW radiative flux at BOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward shortwave radiative flux at bottom of atmosphere for all-sky.
67	Data	radiative_flux_shortwave_upward_boa_all_sky_1km	Upward SW radiative flux at BOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward shortwave radiative flux at bottom of atmosphere for all-sky.

No.	Group	Parameters	Long Name	Units	Data type/byte		Dimensions				Min. value	Max. value	_FillValue	Description
68	Data	radiative_flux_longwave_upward_toa_all_sky_1km	Upward LW radiative flux at TOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at top of atmosphere for all-sky.
69	Data	radiative_flux_longwave_downward_boa_all_sky_1km	Downward LW radiative flux at BOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Downward longwave radiative flux at bottom of atmosphere for all-sky.
70	Data	radiative_flux_longwave_upward_boa_all_sky_1km	Upward LW radiative flux at BOA for all-sky (1km)	Wm^-2	real	4	nray4sns1km	nswath4sns	-	-	0	2000	9.9692099683868690e+36	Upward longwave radiative flux at bottom of atmosphere for all-sky.