GOSAT-GW/TANSO-3
Level 1 Product Description Document

Version 1.01

GOSAT-GW/TANSO-3 Level 1 Product Description Document
Contents

1. Introduction 1
1.1. Outline 1
1.2. Related Documents 1
1.3. HDF5 Library 1
2. Overview of products 2
2.1. Processing Level and Stored Data 2
2.2. Observation/Calibration Modes 3
2.3. Observation data 3
2.4. Product scene 8
2.5. Storing observation data 9
2.5.1. Observation data 9
2.5.2. Time and geolocation Information 10
2.5.3. Wavelength information 12
2.5.4. Product Quality 14
2.5.5. Common Format Specifications 18
2.6. Processing Result Storage Unit 20
3. Product Format 21
3.1. File name convention 21
3.1.1. File name convention of TANSO-3 Level 1 (HDF5 format) 21
3.1.2. The file name convention of processing result (XML format) 23
3.2. Product File (HDF5 Format) Data Structure 24
3.2.1. Global attributes 27
3.2.2. Metadata group 27
3.2.3. Common group 28
3.2.4. SceneInfo Group 31
3.2.5. Common, Band1, Band2, and Band3 geolocation-related groups 31
3.2.6. Group related to the observation data for Band 1, Band 2, and Band 3 48
3.3. Data Structure of the Processing Result File (XML Format) 49
3.3.1. Metadata 50
3.3.2. Observation 50
4. Format Details 51

1. Introduction

1.1. Outline

This document describes the format of Level 1 products for the TANSO-3 (Total Anthropogenic and Natural emissions mapping Spectrometer-3) sensor onboard the GOSAT-GW (Global Observing SATellite for Greenhouse gases and Water cycle), a satellite dedicated to observing greenhouse gases and the water cycle.

TANSO-3 Level 1 products are provided in HDF5 (Hierarchical Data Format, version 5). This document specifies the formats for the following Level 1 products.

- TANSO-3 Level 1A product
- TANSO-3 Level 1B product
- TANSO-3 Level 1A calibration product
- TANSO-3 Level 1B calibration product

1.2. Related Documents

The related documents for the formats specified in this document are listed below.

(1) HDF5 Format Specification Version 3.0
(2) NetCDF Climate and Forecast (CF) Metadata Conventions Ver1.7
(3) Attribute Convention for Data Discovery Ver.1.3

1.3. HDF5 Library

Products described in this document require HDF5 library version 1.12 or later.

2. Overview of products

2.1. Processing Level and Stored Data

TANSO-3 Level 1 data processing is defined as follows:

Level 1A:

Generation of TANSO-3 Level 1A products containing scene data extracted from TANSO-3 Level 0 data, along with radiometric correction parameters, geolocation information, wavelength adjustment data, and other essential details required to produce Level 1B products. For more information on scenes, refer to Section 2.4.

Level 1B:

Generation of TANSO-3 Level 1B products that include spectral radiance data by applying radiometric correction, geometric correction, wavelength adjustment, and other processing steps to sensor output values (digital numbers, DN) contained in TANSO-3 Level 1A products.

Table 2.1-1 shows the stored data for TANSO-3 Level 1A and Level 1B products.

Table 2.1-1 Main data items in Level 1 Products

Product	Description	Stored Data
Level 1A product	The product contains sensor output values (DN), geolocation information, satellite orbit and attitude data, telemetry data such as temperature, and solar and lunar position information.	・Catalog information ・HK data (Housekeeping data) ・Scene information ・Frame information ・Satellite position information ・Solar position information ・Lunar position information ・Image geometry information ・Sensor instrument information ・Product quality ・Sensor output values (DN)
Level 1B product	The product contains spectral radiance ($W/m^2 \cdot sr \cdot \mu m^{-1}$), derived from Level 1A data (DN) by applying radiometric and wavelength adjustment. It also includes wavelength information.	・Catalog information ・HK data ・Scene information ・Frame information ・Satellite position information ・Solar position information ・Lunar position information ・Image geometry information ・Product quality ・Pixel attribute information ・Spectral radiance ($W/m^2/sr/\mu m$) ・Wavelength information

2.2. Observation/Calibration Modes

The Observation and Calibration Modes of TANSO-3 are shown in Table 2.2-1.

Table 2.2-1 Observation and Calibration Mode

Type	Operation mode	Description
Observation Mode	Wide Mode	Imaging by scanning at the satellite nadir.
	Focus Mode (1km, 2km, 3km)	Imaging by scanning the line of sight using TANSO-3's internal two-axis scanner mirror to pass through the target imaging point.
Calibration Mode	Solar Calibration Mode	Observation of sunlight entering the TANSO-3 solar input port via a diffuser plate, with the scan mirror and scanner mirror in the Focus Collimating Unit.
	Solar Diffuser Calibration Mode	Solar calibration for diffuser plate calibration.
	Lunar Calibration Mode	Imaging by scanning the line of sight toward the moon in the AT(Along Track) or CT(Cross Track) direction, near the time of the full moon.
	Bright Target Calibration Mode	Non-binning observation of the ground under daylight conditions in both wide and Focus Modes.
	Dark Calibration Mode	Non-binning imaging of shaded ocean areas under nighttime conditions in both wide and Focus Modes near the new moon.

2.3. Observation data

The types of TANSO-3 observation data for each Observation and Calibration Mode are shown in Table 2.3.1. TANSO-3 acquires observation data in three bands (Band 1-3). The number of valid samples in the spatial direction is determined by the Observation and Calibration Mode. The number of valid samples in the wavelength direction is determined by the wavelength binning number set by observation request. The following sections (1) to (3) describe TANSO-3 observations.

Table 2.3-1 TANSO-3 Observation data

	Band 1				Band 2				Band 3			
Observation target	NO_2				O_2A				WCO_2/WCH_4			
Observation wavelength band (nm)	420-490				747-783				1,590-1,654			
Ground resolution at nadir point (km)	10/3/2/1				10/3/2/1				10/3/2/1			
Observation/Calibration Mode	Wide / Focus 1 km	Focus 2 km	Focus 3 km	(Calibration) Non-binning	Wide / Focus 1 km	Focus 2 km	Focus 3 km	(Calibration) Non-binning	Wide / Focus 1 km	Focus 2 km	Focus 3 km	(Calibration) Non-binning
Number of valid samples in the spatial direction	96	48	32	768 (typ) 864 (max)	96	48	32	864 (typ) 960 (max)	96	48	32	672
Number of valid samples in the wavelength direction	2048 for wavelength binning 1 (Non-binning) 1024 for wavelength binning 2 204 for wavelength binning 10				2048 for wavelength binning 1 (Non-binning) 1024 for wavelength binning 2				1024 for wavelength binning 1 (Non-binning) 512 for wavelength binning 2			

(1) Observation Overview

Figure 2-1 shows TANSO-3 observation overview. The data observed during a single imaging cycle is referred to as a frame. Each frame contains two-dimensional observational data, consisting of spatial and wavelength directions. The data for one observation scene is a three-dimensional dataset, combining multiple frames within the scene.

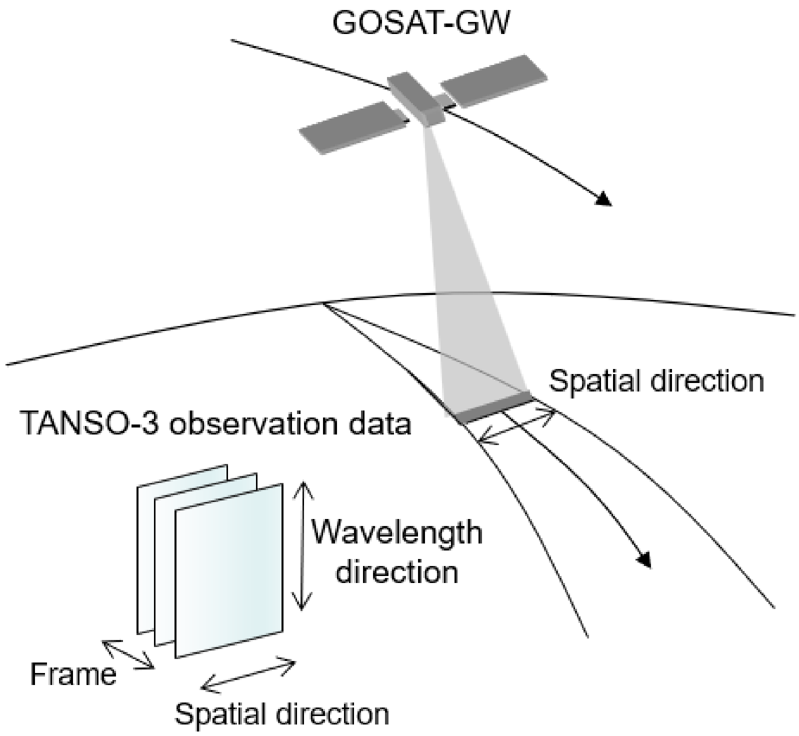

Figure 2-1 TANSO-3 Observation image

(2) Frame data

Figure 2-2 illustrates the observation data for a single frame. For each frame, valid pixels from FPGA Processing Region 2 and two offset verification pixels without exposure to light (FPGA Processing Regions 1 and 3, hereafter referred to as Dark Pixel 1 and Dark Pixel 2) are downlinked. The valid region shown in the figure corresponds to the valid samples in the spatial or wavelength direction listed in Table 2.3-1.

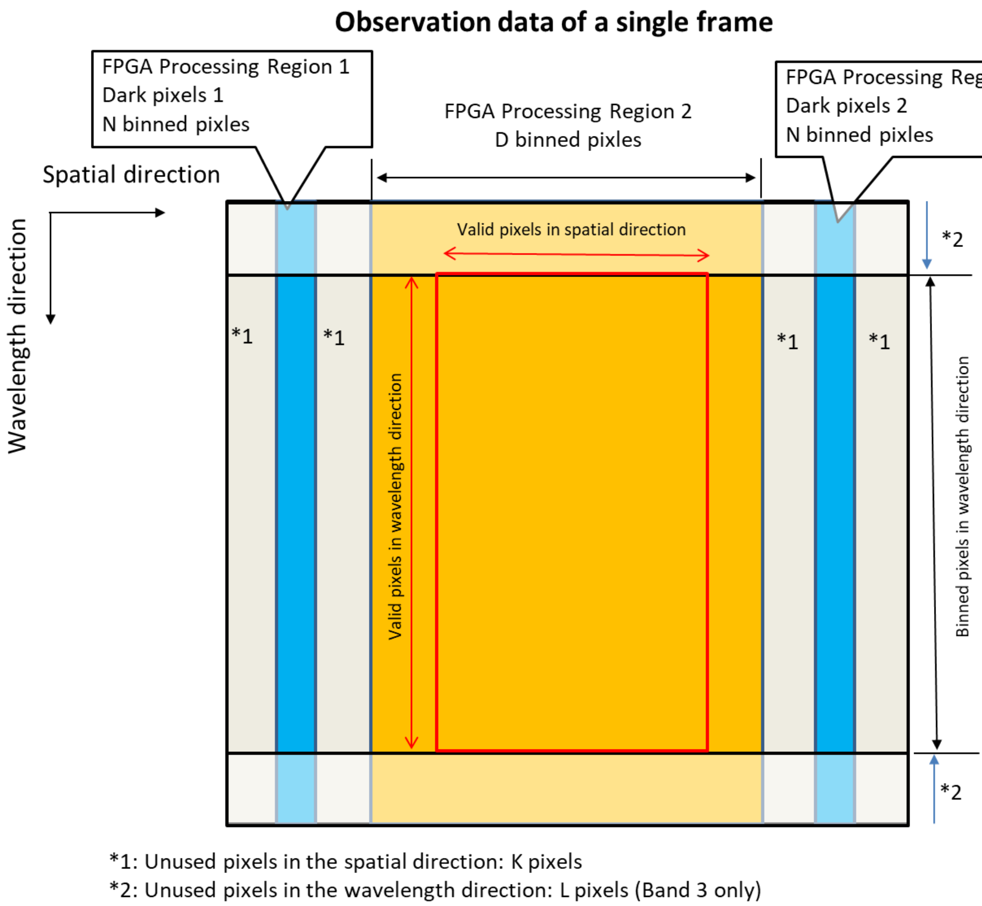

Figure 2-2 Frame data

Figure 2-3 illustrates an example of the data to be downlinked. A "Line" indicates a single segment along the wavelength direction within one observation frame. The FPGA Processing Region 1, 2, and 3 for each line is stored in packets and downlinked to the ground. Each packet contains all spatial binned pixels for a specific wavelength bin. In the missing data check described in Section 2.5.4, the number of missing lines is counted relative to the total number of lines in one frame.

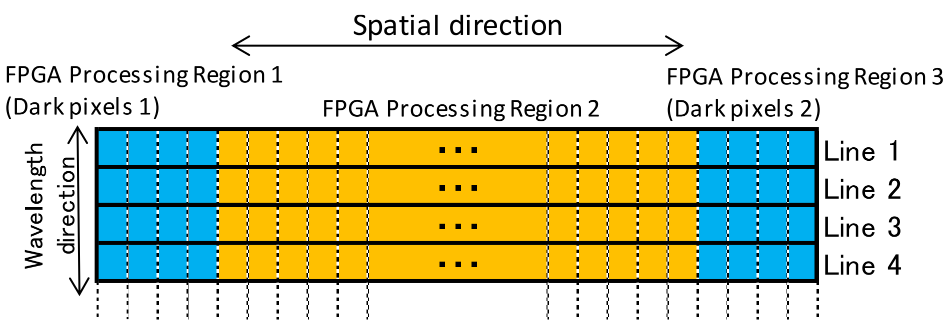

Figure 2-3 Downlink data

(3) Binning

TANSO-3 performs on-board binning (combining multiple pixels into a single binned pixel to improve the signal-to-noise ratio). Figure 2-4 shows an example of the binning blocks.

The binning blocks are defined by spatial binned pixels and wavelength binned pixels, which are aligned with the spatial and wavelength directions, respectively. The number of pixels in one binning block is determined by the Observation Mode and the wavelength binning number specified in Table 2.3-1. “Non-binning” means not performing binning and transmitting pixel values directly.

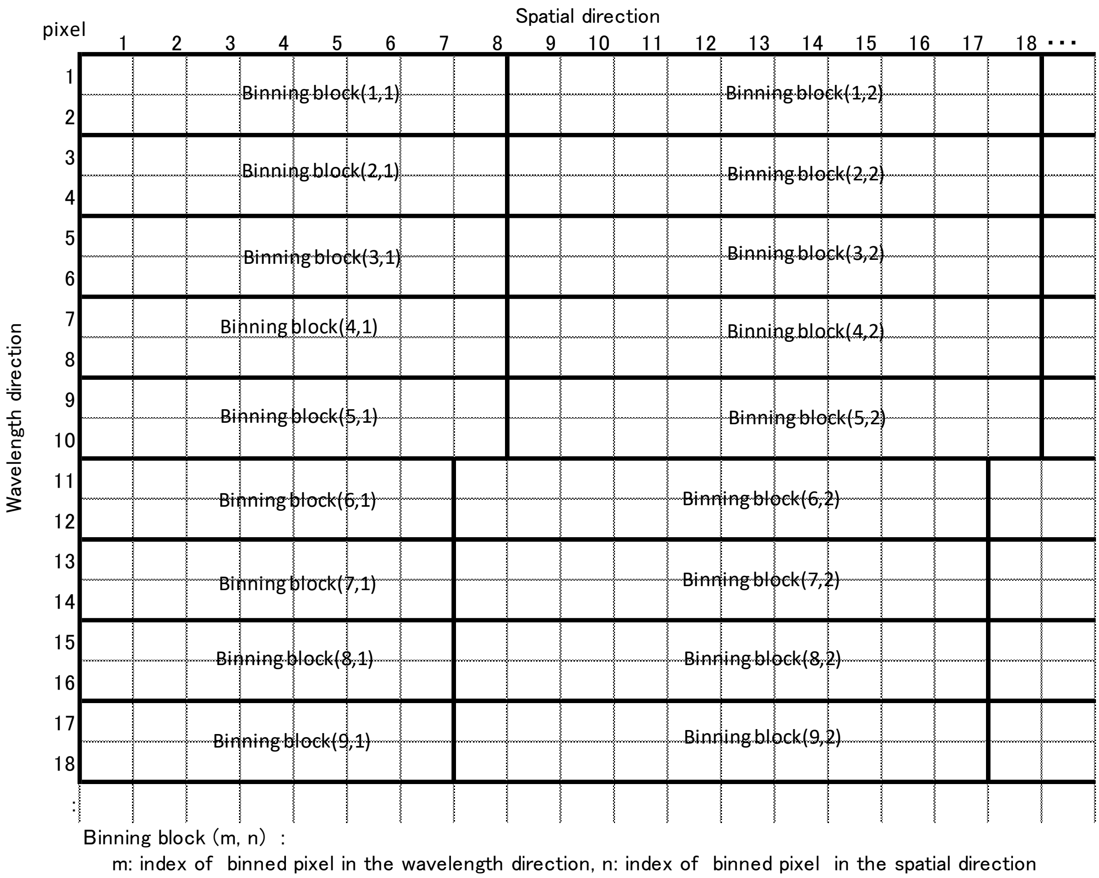

Figure 2-4 Binning blocks

2.4. Product scene

TANSO-3 Level 1A and Level 1B products are produced for each scene identified by an Observation Request ID. Figure 2-5 illustrates the relationship between TANSO-3 observations and product scenes. Each TANSO-3 observation is identified by an Observation ID. One or more Observation IDs are grouped into a product and managed by assigning an Observation Request ID. In nominal Wide Mode, same Observation Request ID is assigned to all Observation IDs within the same orbital revolution (from one descending node to the next). In Observation Focus Mode and Calibration Modes, a unique Observation Request ID is assigned to each Observation ID.

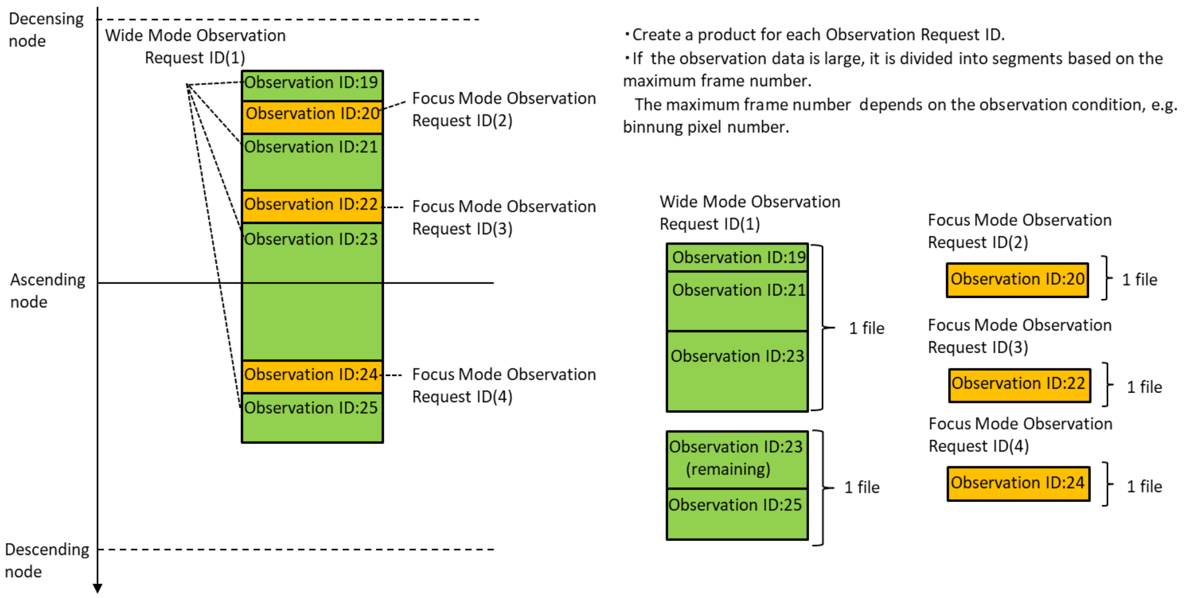

Figure 2-5 Observation and product scene of TANSO-3

Products contain all data specified in the Observation Request ID. No invalid values are filled for gaps between Observation IDs.

To prevent excessively large file sizes, observation data is divided into segments based on the predefined maximum frame number, ensuring that each Level 1B product remains under 4 GB. The segment file is called a "segmented scene". Due to file segmentation, a single Observation ID may span multiple files.

The filename of the product includes the orbital path number at the observation start time. The path number is an integer from 1 to 44, assigned to the satellite's ground track (within a cycle), and is incremented at each ascending node.

2.5. Storing observation data

2.5.1. Observation data

Observation data are organized under the /SoundingData group within /Band1, /Band2, and /Band3. The data structure has dimensions of frames, spatial, and wavelength. Figure 2-6 illustrates the image data of a single TANSO-3 frame and its storage layout. The FPGA Processing Region 2, dark pixels 1, and dark pixels 2 are stored in separate datasets. In a Level 1A product, each pixel value is stored as a 2-byte(16-bit) integer. In a Level 1B product, each pixel value is stored as a 4-byte(32-bit) floating-point number.

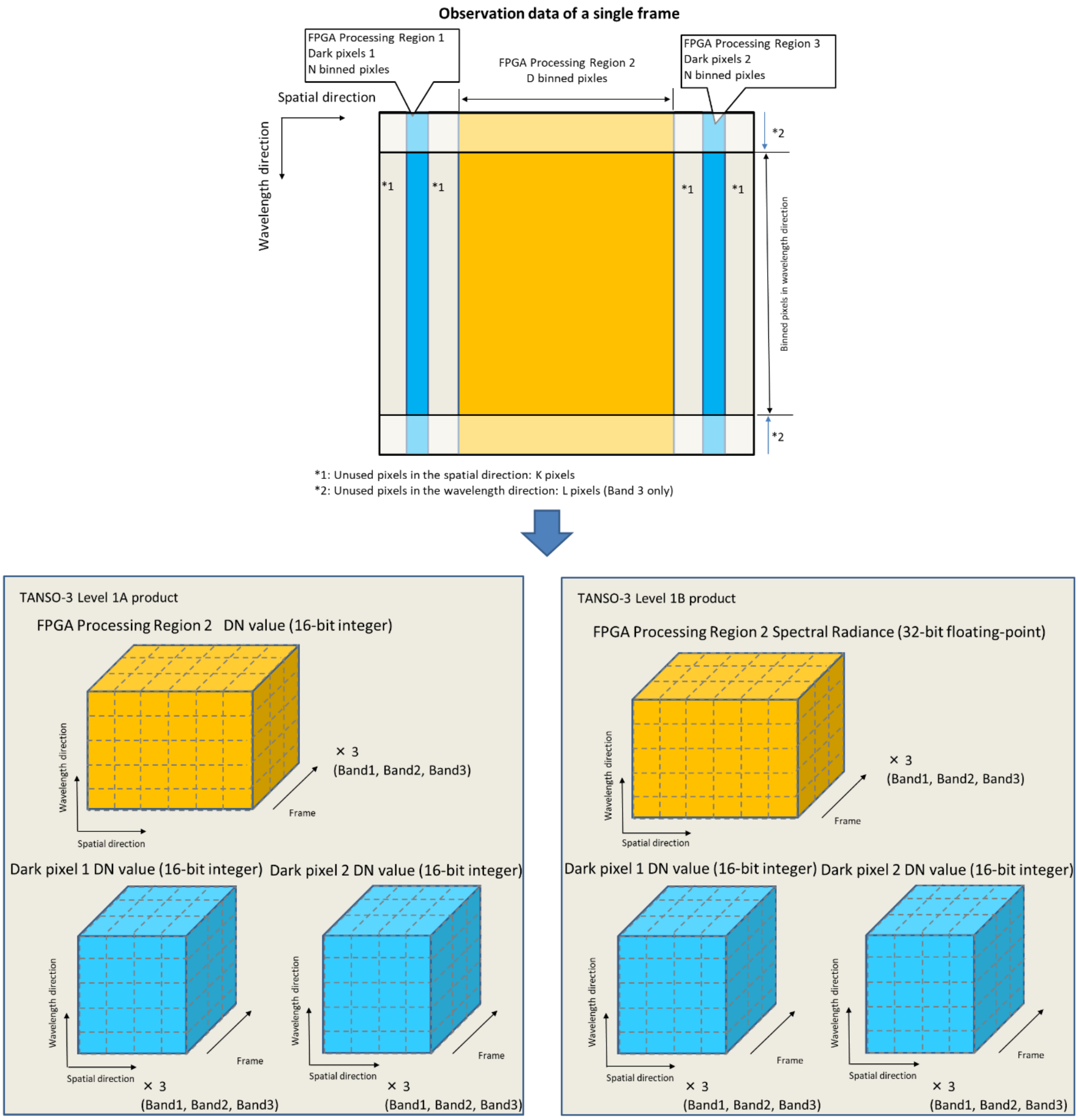

Figure 2-6 Observation data for a single TANSO-3 frame and the product storage

Observation data arrays are stored to match the common frame extracted from the observation data of Bands 1 to 3. Figure 2-7 illustrates the band data and the extracted common frame. Missing data in the frame direction and wavelength direction are filled with invalid values.

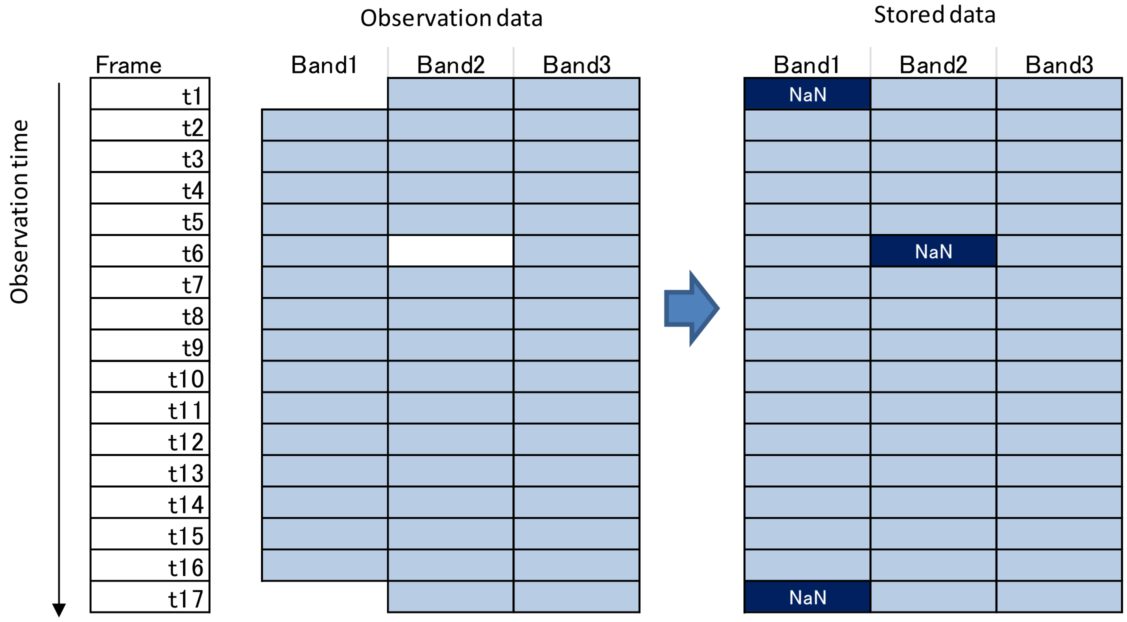

Figure 2-7 Frame and image data storage

Table 2.5-1 shows the special values to store pixel value. Level 1A process identified missing data, saturated data and defective data and store pixel value with special values. If a defective pixel is missing, it is treated as missing data.

Table 2.5-1 Special pixel values

	Level 1A 16-bit Integer Valid value 14 bit: 0～16383	Level 1B (32-bit Floating-point number)
Missing data	-9999	-9.99e+30
Saturation	-9998	-9.99e+20
Defect	-9997	-9.99e+10

To indicate frames containing saturation or missing band data, indicator flags are stored in the /FrameInfo group under /Band1, /Band2, and /Band3.

2.5.2. Time and geolocation Information

Geolocation information and orbital position at observation time are stored in common or band groups under /Common, /Band1, /Band2, and /Band3. The common group contains values identical to those of a representative band.

Figure 2-8 illustrates the relationship between the observation data and the time and geolocation information. The relationship between the observation timestamp, geolocation information, and image data is defined by HDF5 dataset attributes.

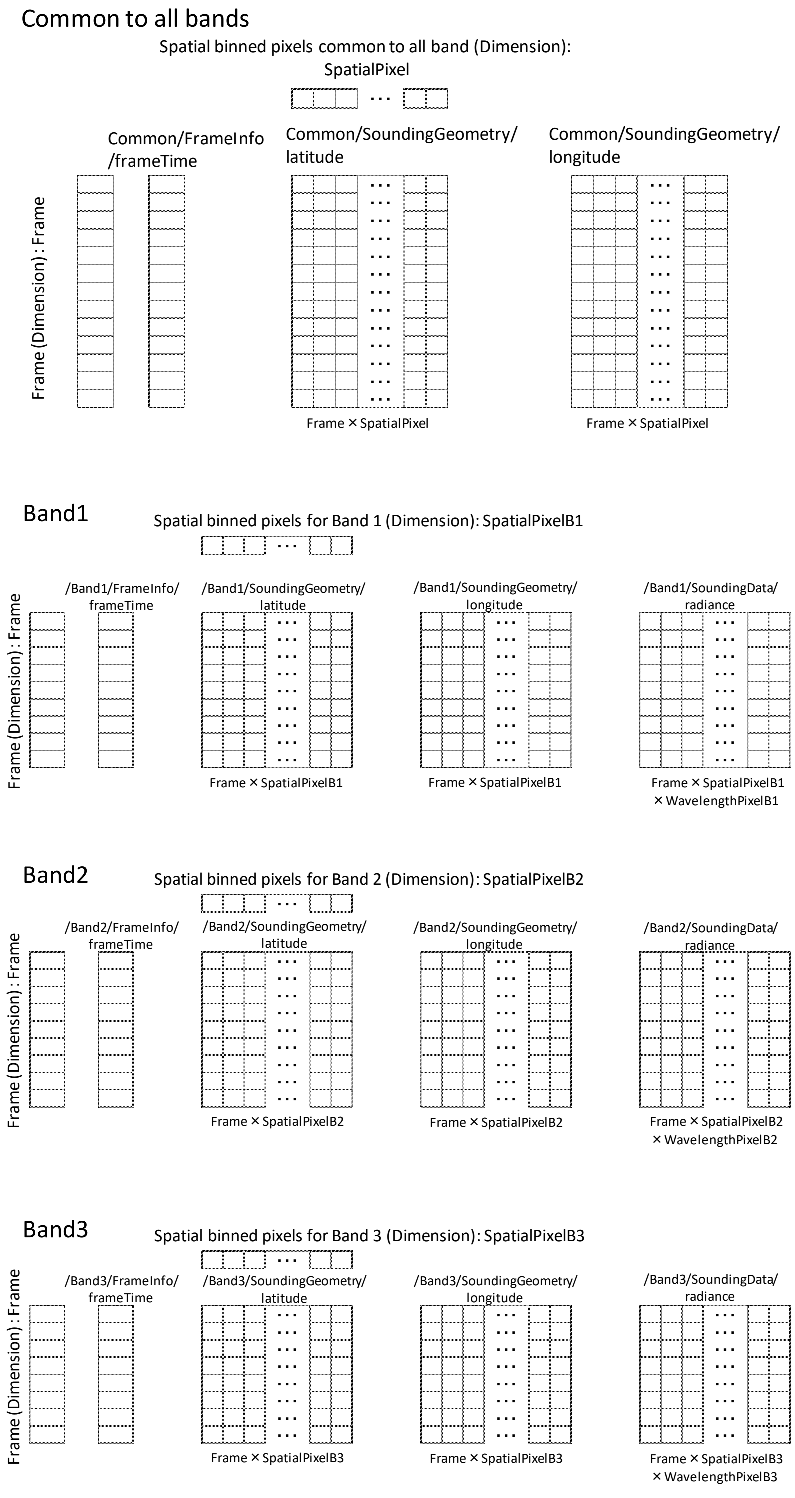

Figure 2-8 Storage of Time and Location Information

Geolocation information (latitude and longitude) is stored for the center and the four corners of each binned pixel. For users requiring higher-accuracy geolocation recalculation, the data listed in Table 2.5-2 are included in the product. For calculation of the line-of-sight vector and position information based on the data listed in Table 2.5-2, the methods are described in Sections 3.2.5.5 and 3.2.5.6.

Table 2.5-2 Data to calculate geolocation information

Data	Dimensions	Storage group
Line-of-sight vector in the Optical Unit coordinate system $a(Ba, m, n)$	Spatial × wavelength (× x, y, z)	/Common/Instrument /Band1/Instrument /Band2/Instrument /Band3/Instrument (Refer to Table 2.1-1 for sensor instrument information.)
Transformation matrix from the Optical Unit coordinate system to the TANSO-3 coordinate system P_1	1 (×3×3)	
Transformation matrix from the Pointing Control Unit coordinate system to the TANSO-3 coordinate system $P_2(t)$	frames (×3×3)	
Transformation matrix from the TANSO-3 coordinate system to the satellite coordinate system P_3	1 (×3×3)	
Initial orientation of the Pointing Control Unit's AT axis, CT axis, and mirror normal vectors (in the Pointing Control Unit coordinate system)$\boldsymbol{x_{po0}}, \boldsymbol{y_{po0}}, \boldsymbol{n_A}$	3	
Correction coefficient for the motor angle for optical path switching $C_{MX}(m,n), C_{MY}(m,n), C_{MZ}(m,n)$	Spatial × wavelength (× x, y, z)	
Nominal motor drive angle for optical path switching e $\phi_{nominal}$	1	
Motor drive angle for optical path switching ϕ_{MCM}	frames	/Common/SoundingGeometry /Band1/SoundingGeometry /Band2/SoundingGeometry /Band3/SoundingGeometry (Refer to Table 2.1-1 for the image geometry information.)
Pointing control angles θ, ω	frames	/Common/SoundingGeometry /Band1/SoundingGeometry /Band2/SoundingGeometry /Band3/SoundingGeometry (Refer to Table 2.1-1 for the image geometry information.)
Transformation matrix from the satellite coordinate system to the ECR coordinate system $P_E(t)$	frames (×3×3)	
Satellite position in the ECR coordinate system $p_{ECR}(t)$	frames (× x, y, z)	
Geodetic coordinate system	WGS84	/Metadata (Refer to Table 2.1-1 for catalog information.)

2.5.3. Wavelength information

The wavelength of the observed data is calculated by Eq. 2-1.

$$\lambda_{sat}\left(Ba, T_j(t), m, n\right) = \lambda_0(Ba, m, n) + \sum_{j=1}^{9} W_j\left(Ba, T_j(t), m, n\right)$$

$$W_j\left(Ba, T_j(t), m, n\right) = \sum_{k=1}^{3} p_2(j, Ba, m, n, k)(T_j(t) - T_{nominal,j})^k$$

Eq. 2-1

Ba: Band
m: Wavelength bin index
n: Spatial bin index
t: Frame
$\lambda_{sat}\left(Ba, T_j(t), m, n\right)$: Wavelength after temperature correction (nm)
$T_j(t)$: Temperatures of each component j at frame t (°C)
$T_{nominal,j}$: Nominal temperature of each components j(°C)
$W_j\left(Ba, T_j(t), m, n\right)$: Coefficient of detector temperature polynomial for wavelength adjustment.
$p_2(j, Ba, m, n, k)$: Polynomial coefficient for calculating W
$\lambda_0(Ba, m, n)$: Reference wavelength (nm)

The reference wavelength $\lambda_0(Ba, m, n)$ for the band is stored in /Band1/SoundingData/wavelength, /Band2/SoundingData/wavelength, and /Band3/SoundingData/wavelength.

The polynomial coefficients $p_2(j, Ba, m, n, k)$ are used for the wavelength adjustment based on temperature per-frame and stored in /Band1/Instrument/wavelengthCorrTableP2, /Band2/Instrument/wavelengthCorrTableP2, and /Band3/Instrument/wavelengthCorrTableP2. $T_j(t)$ represents the temperatures of each component shown in Table 2.5-3 and is stored in the frame information of each band (/Band1/FrameInfo/temperature, /Band2/FrameInfo/temperature, and /Band3/FrameInfo/temperature).

Table 2.5-3 Temperatures T_j

Symbol	Corresponding temperature data	Note
T_0	Not used	/Band1/FrameInfo/temperature /Band2/FrameInfo/temperature /Band3/FrameInfo/temperature stored in order T_0 through T_9
T_1	TS_OPSS1_1_TEMP	
T_2	TS_OPSS1_2_TEMP	
T_3	TS_OPSS1_3_TEMP	
T_4	TS_OPSS2_1_TEMP	
T_5	TS_OPSS2_2_TEMP	
T_6	TS_OPSS2_3_TEMP	
T_7	TS_OPSS3_1_TEMP	
T_8	TS_OPSS3_2_TEMP	
T_9	TS_OPSS3_3_TEMP	

The nominal temperatures $T_{nominal,j}$ are stored in /Band1/Instrument/nominal_temperature, /Band2/Instrument/nominal_temperature, and /Band3/Instrument/nominal_temperature.

Doppler correction for wavelength is not applied in Level 1 processing.

2.5.4. Product Quality

The product includes quality information for each frame, for the Observation ID, and for the entire product.

2.5.4.1. Frame-level

A “missing flag” for a band is identified if one or more binned pixels from the band are missing in the frame. Table 2.5-4 shows the rule for identifying a “missing frame” for a band.

Table 2.5-4 Missing Flag

Test result	Description
0: Normal	No missing pixels in the frame.
1: Missing	One or more missing pixels in the frame.

For common band, Table 2.5-5 shows the rule for identifying a “missing flag”.

Table 2.5-5 Missing Flag for common band

Test result	Description
0: Normal	The missing flag is "Normal" for all bands in the frame.
1: Missing	One or more missing flags are "Missing" in the frame.

The product includes saturation flag for each frame. A “saturation flag” for a band is set if the proportion of saturated non-defective pixels within a frame exceeds a specified threshold. Table 2.5-6 shows the rule for identifying a “saturated flag” for a band.

Table 2.5-6 Saturation Flag

Test result	Description
0: Normal	Otherwise
1: Saturated	Pixel value (DN) ≥ (threshold set for each binned pixel) The proportion of saturated non-defective pixels within a frame exceeds a specified threshold.

For common band, Table 2.5-7 shows the rule for identifying a “saturation flag”.

Table 2.5-7 Saturated Frame for common band

Test result	Description
0: Normal	The saturation flag is "Normal" for all bands in the frame.
1: Saturated	One or more saturation flags are "Saturated" in the frame.

The missing flag and saturation flag for each frame are stored in the /FrameInfo.

2.5.4.2. Observation ID-level

The number of frames and the number of missing frames are aggregated for each observation ID and each target band under processing. After counting, calculate the missing frame rate for each band and Observation ID using the following formula.

Missing frame rate for the Observation ID =

Number of missing frames for the Observation ID / Total number of frames for the Observation ID

Eq. 2-2

If no observation data frames exist at all for an observation ID and observation mode under processing, set the number of missing frames to 0 and the missing frame rate to NaN. Based on the calculated missing frame rate for the Observation ID the quality is determined according to Table 2.5-8.

Table 2.5-8 Missing quality for an Observation ID

No.	Test result	Description
1	Good	The percentage of missing frames during the observation period (%) ≤ 10%
2	Fair	The percentage of missing frames during the observation period (%) ≤ 20%
3	Poor	The percentage of missing frames during the observation period (%) ≤ 50%
4	NG	The percentage of missing frames during the observation period (%) > 50%

As same as missing frame, the saturated frames are counted against the total number of frames for the Observation ID specified by the workorder. After counting, calculate the saturated frame rate for each band and Observation ID using the following formula.

Saturated frame rate for the Observation ID =
Number of saturated frames for the Observation ID / Total number of frames for the Observation ID

Eq. 2-3

Based on the calculated saturated frame rate for the Observation ID, the quality is determined according to Table 2.5-9.

Table 2.5-9 Saturation quality for an Observation ID

No.	Test result	Description
1	Good	Saturated frame rate during the observation period (%) ≤ 10%
2	Fair	Saturated frame rate during the observation period (%) ≤ 20%
3	Poor	Saturated frame rate during the observation period (%) ≤ 100%
4	NG	Saturated frame rate during the observation period (%) > 100% *1

*1 Not considered in this version.

Telemetry quality flags are counted during the observation period, from the time of the first frame to the time of the last frame for the specified Observation ID. The telemetry quality for the Observation ID is determined based on the criteria specified in Table 2.5-10. The thresholds used for this evaluation are shown in Table 2.5-11.

Table 2.5-10 Telemetry quality for an Observation ID

No.	Test result	Description
1	Good	NG/Abnormal rate during the observation period (%) ≤ P1%
2	Fair	NG/Abnormal rate during the observation period (%) ≤ P2%
3	Poor	NG/Abnormal rate during the observation period (%) ≤ P3%
4	NG	NG/Abnormal rate during the observation period (%) > P3%

Table 2.5-11 Telemetry quality threshold

No.	Item	Quality flag (Count quality flag for the period during which telemetry is utilized.)	Telemetry quality threshold *1		
			P1	P2	P3 *2
1	B1 detector temperature	/HKData/B1_DET_TEMP_A_QualityFlag /HKData/PCA_DET1_TEMP_B_QualityFlag	0	10	100
2	B2 detector temperature	/HKData/B2_DET_TEMP_A_QualityFlag /HKData/B2_DET_TEMP_B_QualityFlag	0	10	100
3	B3 detector temperature	/HKData/B3_DET_TEMP_A_QualityFlag /HKData/B3_DET_TEMP_B_QualityFlag	0	10	100
4	B3 amplifier temperature	/HKData/AD3_IP_TEMP_QualityFlag	0	10	100
5	B3 preamplifier temperature	/HKData/AD3_AMP_TEMP_QualityFlag	0	10	100
6	Satellite attitude	/AOCEStatus/AOCEStatusQuality	0	10	100
7	SCN-M angle (θX)	/PointingData/directionControlAngleCTQualityFlag	0	10	100
8	SCN-M angle (θY)	/PointingData/directionControlAngleATQualityFlag	0	10	100
9	MCM angle	/PointingData/opticalPathSwitchingMotorAngleQualityFlag	0	10	100
10	Automatic tracking flag	/AOCEStatus/autoTrackingFlag	10	20	100
11	Time information	/AOCEStatus/timeSystemFlag	0	10	100
12	B1 component temperatures	/HKData/TS3_OPSS1_1_TEMP_QualityFlag /HKData/TS3_OPSS1_2_TEMP_QualityFlag /HKData/TS3_OPSS1_3_TEMP_QualityFlag	0	10	100
13	B2 component temperatures	/HKData/TS3_OPSS2_1_TEMP_QualityFlag /HKData/TS3_OPSS2_2_TEMP_QualityFlag /HKData/TS3_OPSS2_3_TEMP_QualityFlag	0	10	100
14	B3 component temperatures	/HKData/TS3_OPSS3_1_TEMP_QualityFlag /HKData/TS3_OPSS3_2_TEMP_QualityFlag /HKData/TS3_OPSS3_3_TEMP_QualityFlag	0	10	100
15	Attitude angles	/Common/SatelliteGeometry/satRPYQualityFlag	0	10	100
16	Attitude angular velocity	/Common/SatelliteGeometry/satRPYQualityFlag/satRPYAngularVelocityQualityFlag	0	10	100

*1 Threshold for the proportion of NG/Abnormal during an Observation ID period (%)
*2 Not considered in this version.

The overall quality for each Observation ID is determined by Table 2.5-12.

Table 2.5-12 Overall quality for an Observation ID

No.	Test result	Description
1	Good	For the Observation ID, all the missing-quality, saturation-quality, and telemetry-quality are GOOD
2	Fair	For the Observation ID, the missing-quality, saturation-quality, and telemetry-quality flags have no NG or Poor values, but include Fair.
3	Poor	For the Observation ID, the missing-quality, saturation-quality, and telemetry-quality flags have no NG values, but include Poor.
4	NG	For the Observation ID, at least one of the missing-quality, saturation-quality, or telemetry-quality has NG values.

The number of missing frames, the missing frame rate and the overall quality for the Observation ID are stored in the dataset under the /SceneInfo group. The number of missing frames, the missing frame rate and the overall quality for the Observation ID are also stored in the processing result file.

2.5.4.3. Product-level

As in section 2.5.4.2, the overall quality of the product file is determined. The same criteria are used for the time period that covers the entire duration of the product file instead of the duration for each Observation ID.

The calculated overall quality of the product is stored in the dataset under the /Metadata group. The overall quality of the product is also stored in the processing result file.

2.5.5. Common Format Specifications

This section describes the common specifications for data definitions.

2.5.5.1. Definition of Data Types for Stored Data

The definitions of data types for stored data in the TANSO-3 Level 1 product format are shown in Table 2.5-13.

Table 2.5-13 Definition of Data Types

HDF5 type	Data type
H5T_STRING	more than 1-byte string
H5T_STD_I8LE	signed 1-byte integer (-128～127)
H5T_STD_U8LE	unsigned 1-byte integer (0～255)
H5T_STD_I16LE	signed 2-byte integer (-32768～32767)
H5T_STD_U16LE	unsigned 2-byte integer (0～65535)
H5T_STD_I32LE	signed 4-byte integer (-2147483648～2147483647)
H5T_STD_U32LE	unsigned 4-byte integer (0～4294967295)
H5T_IEEE_F32LE	4-byte floating-point number (Significant digits: 7 digits in decimal notation. Maximum absolute value: 3.402823e+38, The smallest absolute value greater than zero:1.175494e-38)
H5T_IEEE_F64LE	8-byte floating-point number (Significant digits: 15 digits in decimal notation. Maximum absolute value: 1.797693e+308, The smallest absolute value greater than zero: 2.225074e-308)

2.5.5.2. Compression

All datasets within the Level 1 product files (HDF5 format) listed in Tables 4-2 to 4-24 are to be compressed using gzip (level 9). The dimensions (one-dimensional datasets indicating the number of elements of data stored directly under the root group), as shown in Table 4-25, are stored without compression.

2.5.5.3. Definition of Time

UTC time is represented as a string in the format "YYYY-MM-DDThh:mm:ss.ffffffZ" or "YYYY-MM-DDThh:mm:ss.uuuZ". Here, YYYY-MM-DD denotes the year, month, and day; hh:mm indicates hours and minutes. "ss.ffffff" represents seconds with microsecond precision, while "ss.uuu" indicates seconds with millisecond precision. When time is expressed as total seconds, it is measured as the elapsed seconds since 23:59:59 on December 31, 2012.

2.5.5.4. Definition of Coordinate System

The coordinate system used in the datasets listed in Table 2.5-14 is defined as follows:

Table 2.5-14 Definition of the coordinates

Coordinate system		Definition
ECR (Earth-Centered, Earth-Fixed) Coordinates	The origin	Earth's center of mass
	X-axis	For the calculation of Earth rotation parameters, align the X-axis with the direction defined by the BIH (Bureau International de l'Heure). Define the basis vector a X_{ECR}.
	Y-axis	Z × X. Define the basis vector as Y_{ECR}.
	Z-axis	Align the basis vector parallel to the CTP (Conventional Terrestrial Pole), which is the Z-axis used by BIH as the reference for calculating Earth rotation parameters. Define the basis vector as Z_{ECR}.
J2000 coordinates	The origin	Earth's center of mass
	X-axis	The direction of the mean vernal equinox at the EPOCH. Define the basis vector as X_i.
EPOCH: 2000-01-01 12:00:00 TT (Terrestrial Time)	Y-axis	Z × X. Define the basis vector as Y_i.
	Z-axis	The direction perpendicular to the mean equatorial plane at the EPOCH (positive toward the North Pole). Define the basis vector as Z_i.
Satellite coordinate	The origin	Satellite center of mass
	X-axis	The perpendicular direction drawn from the satellite separation plane center toward the satellite side. Define the basis vector as X_{SAT}.
	Y-axis	Z × X. Define the basis vector as Y_{SAT}.
	Z-axis	A line within the satellite separation plane drawn from the center of the separation plane toward the scribe line. Define the basis vector as Z_{SAT}.
TANSO-3 coordinate	The origin	Defined within the TANSO-3 reference plane.
	X-axis	If there are no mounting errors to the satellite, it coincides with the satellite coordinate system. Define the basis vector as X_{TANSO}.
	Y-axis	If there are no mounting errors to the satellite, it coincides with the satellite coordinate system. Define the basis vector as Y_{TANSO}.
	Z-axis	If there are no mounting errors to the satellite, it coincides with the satellite coordinate system. Define the basis vector as Z_{TANSO}.
Optical Unit coordinate	The origin	Defined within the TANSO-3 coordinate system.
	X-axis	Defined within the TANSO-3 coordinate system. Define the basis vector as X_{OPS}.
	Y-axis	Defined within the TANSO-3 coordinate system. Define the basis vector as Y_{OPS}.
	Z-axis	Defined within the TANSO-3 coordinate system. Define the basis vector as Z_{OPS}.
Pointing Control Unit coordinate	The origin	Defined within the TANSO-3 coordinate system.
	X-axis	Defined within the TANSO-3 coordinate system. Define the basis vector as X_{MIR}.
	Y-axis	Defined within the TANSO-3 coordinate system. Define the basis vector as Y_{MIR}.
	Z-axis	Defined within the TANSO-3 coordinate system. Define the basis vector as Z_{MIR}.

2.5.5.5. Definition of Latitude and Longitude

Unless otherwise specified, the terms latitude and longitude used in this document refer to geographic latitude and geographic longitude.

2.5.5.6. Attributes of the Dataset

The dataset includes attributes based on the Climate and Forecast (CF) Conventions 1.7 and the Attribute Conventions for Data Discovery (ACDD) 1.3. The common attributes to be set are described below.

(1) Name (long_name)

The attribute long_name represents the dataset name.

(2) Standard name (standard_name)

The attribute standard_name stores a specific name selected from the CF Convention's standard name table to identify the standard physical quantity. The following physical quantities will be assigned accordingly.

・latitude, longitude, time(Total seconds), wavelength

(3) Units (units)

The attribute units are used to specify the units of physical quantities or observed variables in the dataset.

(4) Valid and invalid values (valid_min, valid_max, _FillValue)

The attributes valid_min and valid_max are used to specify the valid data range of the dataset values. Values outside the valid range are interpreted as invalid. A single invalid value is defined using the _FillValue attribute. The attributes valid_min, valid_max, and _FillValue are defined with the same data type as the dataset itself.

(5) Flag (flag_values, flag_meanings)

The attribute flag_values (an array of integers) lists all possible values of the dataset. The attribute flag_meanings describe the meaning of each corresponding value in flag_values as a space-separated string.

Example:

flag_values = [0, 1]
flag_meanings = "Normal Abnormal"

2.5.5.7. Attributes of the Product File

To provide users with an overview of the product, catalog attributes of the product file are stored as global attributes according to the HDF5 specification. For details on global attributes, refer to sections 3.2.1 and Chapter 4.

2.6. Processing Result Storage Unit

The processing result file is generated for each product file.

3. Product Format

3.1. File name convention

3.1.1. File name convention of TANSO-3 Level 1 (HDF5 format)

The filename definition for TANSO-3 Level 1 products (in HDF5 format) is shown in Table 3.1-1.

Table 3.1-1 Filename definition for TANSO-3 Level 1 products

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
T	A	N	S	O	3	_	Y	Y	Y	Y	M	M	D	D	h	h	m	m	P	P	P	X	x	x	y	y	z	n	n	n	n	N	N	_	L	L	R	0	0	_	A	A	A	B	B	B	.	h	5

Convention for each item is shown below:

- TANSO3: Sensor Name (Fixed)
- YYYYMMDDhhmm: Observation time of the first frame (year, month, day, hour, minute) (UT)
- PPP: Path number of the first frame (001-044)
- X: Observation request source
  - J: JAXA
  - N: NIES
  - I: Satellite Control System (Wide Mode observation)
  - M: TANSO-3 Mission Operation System (Unplanned)
- xxyyz: Operation mode
  - xx: Observation / Calibration Mode (Refer to Table 3.1-2.)
  - yy: Imaging Mode / resolution
    - ・WD: Wide Mode
    - ・WF: Wide Mode non-binning
    - ・F1: Focus Mode 1km
    - ・F2: Focus Mode 2km
    - ・F3: Focus Mode 3km
    - ・FF: Focus Mode non-binning
  - z: Wavelength binning state (Refer to Table 3.1-3.)
- nnnn: Observation Request Number (0001-9999)

  A sequential number starting from 0001. The number is assigned from a unique sequence defined by the observation date, request source, and operation mode.

  For observation request source J and N, the number is incremented for each Observation ID.

  For observation request source I (Wide Mode), the number is incremented for each revolution.

  For observation request source M, the number is incremented for each Observation ID.
- NN: Segment Number (00-99)

  Observation data is split into frames sized so that the maximum file size during nominal operation does not exceed 4 GB. The division number increments accordingly. If there is no division, it remains at 00.
- LL: Processing Level
  - 1A: Level 1A
  - 1B: Level 1B
- R: Orbit data used for processing
  - P: Using predicted orbit data
  - O: Using onboard GPS orbit data

D: Using determined orbit data

- 00: Reserved
- AAA: Algorithm Version (000-999)
- BBB: Parameter Version (000-999)
- h5: Extension (Fixed)

Table 3.1-2 Observation/Calibration Mode

XX	Observation/Calibration							Output bands		
	Nominal Observation	Solar Calibration	Solar Diffuser Calibration	Lunar Calibration (AT)	Lunar Calibration (CT)	Dark Calibration	Bright Target Calibration	B1	B2	B3
O1	○							○	○	○
O2	○								○	○
O3	○							○		
O4	○								○	
O5	○									○
O6	○							○	○	
O7	○							○		○
S1		○						○	○	○
S2		○							○	○
S3		○						○		
S4		○							○	
S5		○								○
S6		○						○	○	
S7		○						○		○
R1			○					○	○	○
R2			○						○	○
R3			○					○		
R4			○						○	
R5			○							○
R6			○					○	○	
R7			○					○		○
A1				○				○	○	○
A2				○					○	○
A3				○				○		
A4				○					○	
A5				○						○
A6				○				○	○	
A7				○				○		○
C1					○			○	○	○
C2					○				○	○
C3					○			○		
C4					○				○	
C5					○					○
C6					○			○	○	
C7					○			○		○
D1						○		○	○	○
D2						○			○	○
D3						○		○		
D4						○			○	
D5						○				○
D6						○		○	○	
D7						○		○		○
B1							○	○	○	○
B2							○		○	○
B3							○	○		
B4							○		○	
B5							○			○
B6							○	○	○	
B7							○	○		○

Table 3.1-3 Wavelength binning state

Z	Band1			Band2		Band3	
	10	2	1	2	1	2	1
1	○			○		○	
2	○			○			○
3	○				○	○	
4	○				○		○
5		○		○		○	
6		○		○			○
7		○			○	○	
8		○			○		○
9			○	○		○	
a			○	○			○
b			○		○	○	
c			○		○		○

3.1.2. The file name convention of processing result (XML format)

The filename definition for TANSO-3 Level 1 processing result is shown in Table 3.1-4.

Table 3.1-4 Filename definition for TANSO-3 Level 1 processing result files

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
T	A	N	S	O	3	_	Y	Y	Y	Y	M	M	D	D	h	h	m	m	P	P	P	X	x	x	y	y	z	n	n	n	n	N	N	_	L	L	R	0	0	_	A	A	A	B	B	B	.	x	m	l

The conventions for each item other than the extension are the same as in section 3.1.1. The details regarding the extension are provided below.

- Extension: xml (Fixed)

3.2. Product File (HDF5 Format) Data Structure

The overview of the data stored in the product file is shown in Table 3.2-1.

Table 3.2-1 Data structure of TANSO-3 Level 1 product (1/4)

Storage location	Stored data
Global attributes	Metadata information based on CF Convention 1.7 and ACDD 1.3 are stored as global attributes. The following data items are stored. ・Observation Request ID ・Project Name ・Organization Name / Responsible Person / Contact information ・License ・Product Creation Date and Time ・Observation Start/End Date and Time ・Observation area ・Keywords
Metadata group	Descriptions of the product type and content are stored as the following data items. ・Granule ID ・Satellite Name ・Sensor Name ・Operation Mode ・Date of product creation ・Processing Level ・Processing Algorithm / Parameter version ・Observation Start/End Date and Time ・Geodetic system ・Overall product quality ・Yaw steering status

Table 3.2-1 Data structure of TANSO-3 Level 1 product (2/4)

Storage location		Stored data
Common group		Common source information for Bands 1 through 3, such as orbit data and housekeeping data.
	OnboardOrbitData group	Satellite orbit information. The following data items are stored: ・Orbit data timestamp ・Satellite position and velocity
	AttitudeData group	Satellite attitude data. The following data items are stored: ・Attitude data timestamp ・Attitude angles (J2000 quaternion)
	AOCE Status group	AOCE status flags. The following data items are stored: ・AOCE status timestamp ・Various status flags ・AOCE status quality flag
	PointingData group	Pointing data used in Focus Mode. The following data items are stored: ・Motor drive angle determination timestamp ・Pointing control angles ・Pointing control angle quality
	SpacecraftTimeError group	Information used to correct the difference between satellite time and ground time.
	SiderealTimeInfo group	Parameters for calculating the Greenwich Sidereal Time.
	TransCoordMatrix group	Transformation matrix which converts from J2000.0 to TOD and ECR in consideration of polar motion.
	KinematicOrbitDataPredicted group	Predicted kinematic orbit data. ・Orbit data timestamp ・Satellite position (ECR/ECI in TOD)
	KinematicOrbitDataDetermined group	Determined kinematic orbit data. ・Orbit data timestamp ・Satellite position (ECR/ECI in TOD)
	SolarEphemeris group	Solar position and velocity data. ・Orbit data timestamp ・Sun position (ECI in TOD)
	LunarEphemeris group	Lunar position and velocity data. ・Orbit data timestamp ・Moon position (ECI in TOD)
	HKData group	Housekeeping data along with acquisition time, including: ・Sampling timestamp ・Temperatures of various components ・Equipment status ・HK data quality

Table 3.2-1 Data structure of TANSO-3 Level 1 product (3/4)

Storage location		Stored data
SceneInfo group		Scene information. The following data items are stored: ・Number of frames per Observation ID and per band ・Number of missing frames per Observation ID and per band ・Missing frame rate per Observation ID and per band ・Overall quality per Observation ID and per band
/Common or /Band1 or /Band2 or /Band3		
	FrameInfo group	Per-frame information. The following data items are stored: ・Observation time per frame (UTC) ・Missing quality per frame ・Saturation flag per frame ・Observation ID ・Yaw steering flag per frame ・Integration time ・Temperatures of various components per frame
	SatelliteGeometry group	Satellite position information at observation time. The following data will be stored: ・Satellite position and velocity (ECR/ECI in TOD) ・Attitude angles (roll, pitch, yaw) and quality flags ・Attitude angular velocities (roll, pitch, yaw) and quality flags ・Attitude quaternion (J2000) ・Transformation matrix from satellite coordinate system to ECR coordinate system ・Used orbit type
	SolarGeometry group	Apparent position and velocity of the Sun at the observation time (ECR/ECI in TOD). (*1) *1: The apparent position and velocity of the Sun take into account the light propagation time from the Sun to the Earth
	LunarGeometry group	Position and velocity of Moon at observation time (ECR/ECI in TOD).
	Instrument group	Equipment information. The following data items are stored: ・Line-of-sight vector in the Optical Unit coordinate system ・Transformation matrix from the Optical Unit coordinate system to the TANSO-3 coordinate system ・Transformation matrix from the TANSO-3 coordinate system to the satellite coordinate system ・Initial orientation of the Pointing Control Units: AT axis, CT axis, and mirror normal vector ・Coefficient of temperature polynomial for wavelength adjustment

Table 3.2-1 Data structure of TANSO-3 Level 1 product (4/4)

Storage location		Stored data
	SoundingGeometry group	Geometry information at observation time. The following data items are stored: ・Pointing control angles ・Line-of-sight vector in the spatial direction sector (ECR) ・Latitude and longitude per binned pixel ・Sensor incident angle and azimuth angle per binned pixel ・Solar incident angle and azimuth angle per binned pixel Note: Latitude, longitude, sensor incident angle, azimuth angle, and solar incident and azimuth angles are not stored in the following modes: Solar Calibration Mode, Solar Diffuser Calibration Mode, and Lunar Calibration Mode.
	SoundingData group	Observation data. The following data items are stored: **Level 1A:** ・Observation data (DN values) ・Dark pixels (DN values) **Level 1B:** ・Spectral radiance (W/m²/sr/μm) after applying radiometric correction ・Wavelength ・Dark pixels (DN values)
	PixelAttribute group	Pixel attribute information. The following data items are stored: ・Binning information ・Defective pixel information (Only Band 3) ・Coefficient of variation within the grid cell ・Wavelength number for calculating the coefficient of variation within the grid cell
Dimensions		Store datasets as one-dimensional arrays with the same size as each dimension of the respective dataset. These datasets are stored directly under the root group.

3.2.1. Global attributes

Global attributes provide an overview of the product and include catalog information used for data discovery. Metadata is stored in accordance with CF Convention 1.7 and ACDD 1.3 standards.

3.2.2. Metadata group

The Metadata group contains catalog information such as the product file type, observation time, overall product quality information, and other related details.

For information regarding product quality, please refer to section 2.5.4.

The yawSteeringFlag indicates whether yaw steering was performed during the observation time of the product file. The yawSteeringFlag in /Common/FrameInfo is ON if yaw steering occurs in at least one frame.

3.2.3. Common group

The Common group stores common source information for Bands 1 through 3, such as orbit data and housekeeping data. The Common group includes subgroups that store datasets.

Subgroups of the Common group are described in the following section.

3.2.3.1. OnboardOrbitData Group

The OnboardOrbitData group stores onboard orbit data in the ECR coordinate system, as well as the orbit data converted into the TOD coordinate system. The data interval is 1 second. If data is missing, gaps may appear between consecutive intervals in the sequence.

Following describes the method for converting onboard position vector $\mathbf{P_{PECR}}$ and velocity vector $\mathbf{V_{ECR}}$ in ECR coordinate system to position vector $\mathbf{P_{TOD}}$ and velocity vector $\mathbf{V_{TOD}}$ in TOD coordinate system.

(1) Conversion from the ECR coordinate system to the pseudo-Earth-fixed coordinate system

Using the polar motion transformation XY matrix stored in the TransCoordMatrix group, convert $\mathbf{P_{ECR}}$ and $\mathbf{V_{ECR}}$ to the pseudo-Earth-fixed coordinate system (without polar motion).

$$\mathbf{P_{PECR}} = \mathbf{XY}^t \cdot \mathbf{P_{ECR}}$$

Eq. 3-1

$$\mathbf{V_{PECR}} = \mathbf{XY}^t \cdot \mathbf{V_{ECR}}$$

Eq. 3-2

The superscript t denotes transpose. Since XY matrix is unitary, transpose of it is the same as its inversion.

(2) Conversion from the pseudo-Earth-fixed coordinate system to the ECI (TOD) coordinate system

Using the Greenwich Sidereal Time θ_g and its rate of change $\dot{\theta}_g$ stored in the SiderealTimeInfo group, perform the transformation to the TOD coordinate system.

$$\mathbf{P_{TOD}} = \begin{pmatrix} \cos(-\theta_g) & \sin(-\theta_g) & 0 \\ -\sin(-\theta_g) & \cos(-\theta_g) & 0 \\ 0 & 0 & 1 \end{pmatrix} \cdot \mathbf{P_{PECR}}$$

Eq. 3-3

$$\mathbf{V_{TOD}} = \begin{pmatrix} \cos(-\theta_g) & \sin(-\theta_g) & 0 \\ -\sin(-\theta_g) & \cos(-\theta_g) & 0 \\ 0 & 0 & 1 \end{pmatrix} \cdot \left(\mathbf{V_{PECR}} - \begin{bmatrix} 0 \\ 0 \\ \dot{\theta}_g \end{bmatrix} \otimes \mathbf{P_{PECR}} \right)$$

Eq. 3-4

Here, $\otimes$ represents the cross product of vectors.

3.2.3.2. AttitudeData Group

The AttitudeData group stores onboard attitude data. The attitude data is stored as a quaternion $Q = (q_0, q_1, q_2, q_3)$ in the J2000.0 reference frame. Here, q_0 is the scalar component, and (q_1, q_2, q_3) are the vector components. The data interval depends on the interval of the attitude determination times.

3.2.3.3. AOCEStatus Group

The AOCEStatus group stores the orbit control status along with the corresponding acquisition time. Additionally, it contains quality flags for the AOCE status, auto-tracking confirmation flags, and time information flags. The data interval depends on the type of ancillary data.

3.2.3.4. PointingData Group

The PointingData group stores the orientation of the Pointing Control Unit (AT direction pointing control angle ω [rad], CT direction pointing control angle θ [rad]) along with their acquisition times. It also stores the motor drive angles for optical path switching [rad]. Each angle is stored together with a quality flag determined by threshold evaluation. The data are sampled at 8 Hz. If data loss occurs, gaps may appear in the sampling intervals.

3.2.3.5. SpacecraftTimeError Group

The SpacecraftTimeError group stores information (time error data) used to correct the difference between satellite time and ground time. If the time system status at the observation time is GPS, this information is not necessary. The satellite time t is corrected using the following formula.

$$\text{Spacecraft time (after correction)} = \text{periodCount} \times \{\text{spacecraft } t - \text{refCount}\} + \text{groundTime}$$

Eq. 3-5

Here, periodCount, refCount, and groundTime are data items stored within the SpacecraftTimeError group, and their index should be within the valid data range (from startDate to endDate) including the target satellite timestamp t.

In addition, when comparing the start time of the scene to be processed in Level 1 processing, including the margin added internally in the processing, with the reference times stored in the time error data input for Level 1 processing, if all the reference times are earlier than the scene start time, the SpacecraftTimeError group shall not be generated or output in the product to be created.

3.2.3.6. SiderealTimeInfo Group

The SiderealTimeInfo group stores information related to Greenwich Sidereal Time. This information is used to convert from the True-Of Date (TOD) coordinate system to a pseudo-Earth-fixed coordinate system (without polar motion).

The Greenwich Sidereal Time θ_g at time t is expressed as follows:

$$\theta_g = \theta_{g0} + \dot{\theta}_g(t - t_0)$$

Eq. 3-6

Here, θ_{g0} is the sidereal time at the reference time t_0 and θ_{g0} and $\dot{\theta}_g$ is the rate of change of sidereal time.

The coordinate transformation matrix from TOD coordinate system to the pseudo-Earth-fixed coordinate system, $\mathbf{M}_{\mathbf{TOD\text{-}PECR}}$, is expressed as follows:

$$\mathbf{M}_{\mathrm{TOD-PECR}} = \begin{pmatrix} \cos(\theta_g) & \sin(\theta_g) & 0 \\ -\sin(\theta_g) & \cos(\theta_g) & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Eq. 3-7

3.2.3.7. TransCoordMatrix Group

The TransCoordMatrix group stores the coordinate transformation matrices: the matrix (PN matrix) for converting from the J2000.0 coordinate system to the TOD coordinate system, and the matrix (XY matrix) for converting from the pseudo-Earth-fixed coordinate system (without polar motion) to ECR coordinate system. The data interval is 60 seconds.

3.2.3.8. KinematicOrbitDataPredicted Group

The KinematicOrbitDataPredicted group stores the predicted orbit data in ECR and TOD coordinates and are distributed from kinematic orbit system. The data interval is consistently 60 seconds.

3.2.3.9. KinematicOrbitDataDetermined Group

The KinematicOrbitDataDetermined group stores the determined orbit data in ECR and TOD coordinates and are distributed from kinematic orbit system. The data interval is consistently 60 seconds. If determined orbit data are not interfaced during Level 1 processing, this group shall not be generated or output in the product to be created.

3.2.3.10. SolarEphemeris Group

The SolarEphemeris group stores the position data of the Sun in TOD coordinate system, distributed from orbital mechanics calculations. The data interval is consistently 60 seconds.

The position of Sun in this group represents its true position at each time, without accounting for the light travel time from the Sun to the Earth. To consider the light propagation delay, the group includes solar position data from approximately 499 seconds in the past.

3.2.3.11. LunarEphemeris Group

The LunarEphemeris group stores the true position data of the Moon in TOD coordinate system, distributed from orbital mechanics calculations. The data interval is consistently 60 seconds.

3.2.3.12. HKData Group

The HKData group stores telemetry data such as amplifier temperature and preamplifier temperature along with the corresponding telemetry acquisition times. Each component temperature is stored together with a quality flag determined by threshold evaluation.

3.2.4. SceneInfo Group

The SceneInfo group consolidates and stores data per Observation ID, including the number of frames per band, the number of missing frames per band, the missing rate per band, and the observation range.
For detail on Observation ID-level quality, refer to section 2.5.4.

For surface observations other than calibration, the group stores the latitude and longitude ranges for each Observation ID. The observation area for an Observation ID is represented as a 2D polygon in OGC Well-Known Text (WKT) Geometry format, whose vertices correspond to the outer boundary at the observation start and end times of the Observation ID.

3.2.5. Common, Band1, Band2, and Band3 geolocation-related groups

The Common, Band1, Band2, and Band3 groups store geolocation information corresponding to the observation data for each band. These groups organize the dataset into multiple subgroups. The following section describes the subgroups of the Common, Band1, Band2, and Band3 groups.

3.2.5.1. FrameInfo Group

The FrameInfo group stores information for each frame, including the common frame time (excluding band specific delay time and integration time), the observation time (accounting for band-specific delay time and integration time), the integration time, missing flags, yaw steering flag status, and temperatures of each component.
For detail of frame-level quality, refer to section 2.5.4.

3.2.5.2. SatelliteGeometry Group

The SatelliteGeometry group stores the satellite's position and velocity (in both ECR and TOD coordinates), satellite attitude, and the transformation matrix (satToECR_Matrix) for converting from the satellite coordinate system to the ECR (WGS84) coordinate system, all at the observation time. Satellite position and velocity are calculated by interpolating onboard orbit data stored in the OnboardOrbitData group at the observation time. However, if onboard orbit data is missing or insufficient at the scene border, extrapolation is not performed; Predicted orbit data from the KinematicOrbitDataPredicted group or determined orbit data from the KinematicOrbitDataDetermined group are used for interpolation. The type of orbit data used for interpolation is stored in satOrbitPrecision.

Satellite attitude is calculated by interpolating the quaternion in the J2000.0 coordinate system stored in the AttitudeData group. The roll, pitch, and yaw angles are calculated and stored. If attitude data is insufficient and the attitude at the observation time cannot be determined, the attitude data stores invalid values.

The transformation matrix from the satellite coordinate system to the ECR (WGS84) coordinate system (satToECR_Matrix) includes all of the following coordinate transformations: from the satellite coordinate system to the J2000.0 coordinate system based on satellite attitude, from J2000.0 to the TOD coordinate system accounting for precession and nutation, and from the TOD coordinate system to the ECR (WGS84) coordinate system

considering Earth's rotation and polar motion.
The matrix is derived in the following order:

(1) Transformation from the satellite coordinate system to the J2000 coordinate system
The transformation matrix $\mathbf{M}_{\mathrm{J2000-body}}$ which converts from the J2000.0 coordinate system to the satellite coordinate system, is expressed using the quaternion in J2000.0 as follows:

$$\mathbf{M}_{\mathbf{J2000\text{-}body}} = \begin{pmatrix} q_0^2+q_1^2-q_2^2-q_3^2 & 2(q_1q_2+q_0q_3) & 2(q_1q_3-q_0q_2) \\ 2(q_1q_2-q_0q_3) & q_0^2-q_1^2+q_2^2-q_3^2 & 2(q_2q_3+q_0q_1) \\ 2(q_1q_3+q_0q_2) & 2(q_2q_3-q_0q_1) & q_0^2-q_1^2-q_2^2+q_3^2 \end{pmatrix}$$

Eq. 3-8

The transformation matrix from the satellite coordinate system to the J2000.0 coordinate system, $\mathbf{M}_{\mathrm{body-J2000}}$ is the transpose of $\mathbf{M}_{\mathrm{J2000-body}}$ (The superscript t denotes transpose).

$$\mathbf{M}_{\mathbf{body-J2000}} = \left(\mathbf{M}_{\mathbf{J2000\text{-}body}}\right)^t = \begin{pmatrix} q_0^2+q_1^2-q_2^2-q_3^2 & 2(q_1q_2-q_0q_3) & 2(q_1q_3+q_0q_2) \\ 2(q_1q_2+q_0q_3) & q_0^2-q_1^2+q_2^2-q_3^2 & 2(q_2q_3-q_0q_1) \\ 2(q_1q_3-q_0q_2) & 2(q_2q_3+q_0q_1) & q_0^2-q_1^2-q_2^2+q_3^2 \end{pmatrix}$$

Eq. 3-9

The transformation of the line-of-sight vector from the satellite coordinate system, $\mathbf{v}_{\mathbf{body}}$, to the J2000.0 coordinate system, $\mathbf{v}_{\mathbf{J2000}}$, is calculated as follows:

$$\mathbf{v}_{\mathbf{J2000}} = \mathbf{M}_{\mathbf{body-J2000}} \cdot \mathbf{v}_{\mathbf{body}}$$

Eq. 3-10

(2) Transformation from the J2000.0 coordinate system to the TOD coordinate system
Using the PN matrix stored in the TransCoordMatrix group, the line-of-sight vector in the TOD coordinate system $\mathbf{v}_{\mathbf{TOD}}$ is calculated from $\mathbf{v}_{\mathbf{J2000}}$ in the J2000.0 coordinate system as follows:

$$\mathbf{v}_{\mathbf{TOD}} = \mathbf{PN} \cdot \mathbf{v}_{\mathbf{J2000}}$$

Eq. 3-11

(3) Transformation from the TOD coordinate system to the pseudo-Earth-fixed coordinate system (Earth-fixed coordinate system without considering polar motion)
The line-of-sight vector in the pseudo-Earth-fixed coordinate system (Earth-fixed coordinate system without considering polar motion) $\mathbf{v}_{\mathbf{PECR}}$ is calculated from $\mathbf{v}_{\mathbf{TOD}}$ in the TOD coordinate system as follows:

$$\mathbf{v}_{\mathbf{PECR}} = \mathbf{M}_{\mathbf{TOD-PECR}} \cdot \mathbf{v}_{\mathbf{TOD}}$$

Eq. 3-12

$\mathbf{M}_{\mathbf{TOD\text{-}PECR}}$ is the coordinate transformation matrix from the TOD coordinate system to the pseudo-Earth-fixed coordinate system. It utilizes the Greenwich sidereal time stored in the SiderealTimeInfo group (refer to section 3.2.3.6).

(4) Transformation from the pseudo-Earth-fixed coordinate system to the ECR coordinate system
Using the XY matrix stored in the TransCoordMatrix group, the line-of-sight vector in the pseudo-Earth-fixed coordinate system $\mathbf{v}_{\mathbf{PECR}}$ is converted to the ECR coordinate system $\mathbf{v}_{\mathbf{ECR}}$ as follows:

$$\mathbf{v}_{\mathbf{ECR}} = \mathbf{XY} \cdot \mathbf{v}_{\mathbf{PECR}}$$

Eq. 3-13

The satToECR_Matrix stored in the SatelliteGeometry group is the transformation matrix that converts a line-of-sight vector in the satellite coordinate system $\mathbf{v}_{\mathbf{body}}$ to the ECR (WGS84) coordinate system $\mathbf{v}_{\mathbf{ECR}}$, and the matrix is calculated by Eq. 3-10 through 3-14.
The matrix is expressed as $\mathbf{M}_{\mathrm{body-ECR}}$ in the following equation.

$$\mathbf{v}_{\mathbf{ECR}} = \mathbf{M}_{\mathbf{body-ECR}} \cdot \mathbf{v}_{\mathbf{body}} = \mathbf{XY} \cdot \mathbf{M}_{\mathbf{TOD-PECR}} \cdot \mathbf{PN} \cdot \mathbf{M}_{\mathbf{body-J2000}} \cdot \mathbf{v}_{\mathbf{body}}$$

Eq. 3-14

Here, the line-of-sight vector in the satellite coordinate system $\mathbf{v}_{\mathbf{body}}$ can be determined from the hardware information stored in the Instrument group and the pointing control angles θ and ω in the PointingData group (for Focus Mode). For details, refer to section 3.2.5.5.

3.2.5.3. SolarGeometry Group

The SolarGeometry group stores the apparent position and velocity of the Sun (in both ECR and TOD coordinate systems) at the observation time. The propagation time of light from the Sun to the Earth (a fixed value of 499 seconds) is taken into account.

The apparent position and velocity of the Sun at the observation time t are calculated as follows:

(1) From the Sun position and velocity in the ECI (TOD) coordinate system stored in the SolarEphemeris group, determine the Sun's position and velocity at time $t - 499$ s (i.e., 499 seconds before the observation time t).
(2) Convert the Sun position vector $\mathbf{P}_{\mathbf{TOD}}$ and velocity vector $\mathbf{V}_{\mathbf{TOD}}$ in TOD (ECI) coordinate system to $\mathbf{P}_{\mathbf{ECR}}$ and $\mathbf{V}_{\mathbf{ECR}}$ in the ECR coordinate system. Compute the Greenwich sidereal time θ_g at the observation time t from the data stored in the SiderealTimeInfo group. Using the computed θ_g, transform from the TOD coordinate system to the pseudo–Earth-fixed coordinate system (without polar motion).

$$\mathrm{P}_{\mathbf{PECR}} = \begin{pmatrix} \cos(\boldsymbol{\theta}_g) & \sin(\boldsymbol{\theta}_g) & \mathbf{0} \\ -\sin(\boldsymbol{\theta}_g) & \cos(\boldsymbol{\theta}_g) & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{1} \end{pmatrix} \cdot \mathrm{P}_{\mathbf{TOD}}$$

Eq. 3-15

$$\mathbf{V_{PECR}} = \begin{pmatrix} \cos(\boldsymbol{\theta_g}) & \sin(\boldsymbol{\theta_g}) & \mathbf{0} \\ -\sin(\boldsymbol{\theta_g}) & \cos(\boldsymbol{\theta_g}) & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{1} \end{pmatrix} \cdot \mathbf{P_{TOD}} - \begin{pmatrix} \mathbf{0} \\ \mathbf{0} \\ \dot{\boldsymbol{\theta}}_g \end{pmatrix} \otimes \mathbf{P_{PECR}}$$

Eq. 3-16

Next, considering polar motion is neglected, transform from the Earth-fixed coordinate system to the ECR coordinate system using the XY matrix stored in the TransCoordMatrix group.

$$\mathbf{P_{ECR}} = \mathbf{XY} \cdot \mathbf{P_{PECR}}$$

Eq. 3-17

$$\mathbf{V_{ECR}} = \mathbf{XY} \cdot \mathbf{V_{PECR}}$$

Eq. 3-18

3.2.5.4. LunarGeometry Group

The LunarGeometry group stores the true position and velocity of the Moon (in both ECR and TOD coordinate systems) at the observation time.

3.2.5.5. Instrument Group

The Instrument group stores the configuration settings for each of the instruments for Bands 1 through 3 as follows.

・Parameters related to the line-of-sight vector

The group stores the line-of-sight vectors for each binned pixel in the Optical Unit coordinate system, the transformation matrix from the Optical Unit coordinate system to the TANSO-3 coordinate system, and the transformation matrix from the TANSO-3 coordinate system to the satellite coordinate system. The line-of-sight vector for each binned pixel in the satellite coordinate system is calculated using the following method.

1. Correction of the line-of-sight vectors in the Optical Unit coordinate system using the motor drive angle for optical path switching.

   The line-of-sight vector $\boldsymbol{a}$ in the Optical Unit coordinate system is corrected using the motor drive angle for optical path switching.

$$\boldsymbol{a'} = \boldsymbol{P'_0}(\Delta\boldsymbol{\theta}) \cdot \boldsymbol{a}$$

Eq. 3-19

$\boldsymbol{a'}$: Line-of-sight vectors in the Optical Unit coordinate system after correction using the motor drive angle for optical-path switching.

$\boldsymbol{a}$: viewVectorOptics dataset, the line-of-sight vector in the optical instrument coordinate system before correction.

$\boldsymbol{P'_0}$: The rotation matrix for the correction angle $\Delta\theta$ of the motor drive angle for optical path switching.

$\boldsymbol{P'_0}(\Delta\theta)$ is calculated as follows.

$$\boldsymbol{P'_0}(\Delta\boldsymbol{\theta}) = \boldsymbol{R'_z}(\Delta\theta_z)\boldsymbol{R'_y}(\Delta\theta_y)\ \boldsymbol{R'_x}(\Delta\theta_x)$$

$$\mathbf{R'}_X(\boldsymbol{\theta}) = \begin{bmatrix} \mathbf{1} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{cos}\boldsymbol{\theta} & -\mathbf{sin}\boldsymbol{\theta} \\ \mathbf{0} & \mathbf{sin}\boldsymbol{\theta} & \mathbf{cos}\boldsymbol{\theta} \end{bmatrix}$$

$$\mathbf{R'}_Y(\boldsymbol{\theta}) = \begin{bmatrix} \mathbf{cos}\boldsymbol{\theta} & \mathbf{0} & \mathbf{sin}\boldsymbol{\theta} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} \\ -\mathbf{sin}\boldsymbol{\theta} & \mathbf{0} & \mathbf{cos}\boldsymbol{\theta} \end{bmatrix}$$

$$\mathbf{R'}_z(\boldsymbol{\theta}) = \begin{bmatrix} \mathbf{cos}\boldsymbol{\theta} & -\mathbf{sin}\boldsymbol{\theta} & \mathbf{0} \\ \mathbf{sin}\boldsymbol{\theta} & \mathbf{cos}\boldsymbol{\theta} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{1} \end{bmatrix}$$

Eq. 3-20

The correction angles $\Delta\theta_z$, $\Delta\theta_y$, and $\Delta\theta_x$, are calculated for each binned pixel (m, n) as follows.

$$\Delta\theta_x(m,n) = C_{MX}(m,n) \cdot \Delta\phi_{MCM}$$

$$\Delta\theta_y(m,n) = C_{MY}(m,n) \cdot \Delta\phi_{MCM}$$

$$\Delta\theta_z(m,n) = C_{MZ}(m,n) \cdot \Delta\phi_{MCM}$$

Eq. 3-21

Here,

$\Delta\theta_x(m,n)$、$\Delta\theta_y(m,n)$、$\Delta\theta_z(m,n)$:

The correction angles of the motor drive angle for optical path switching [rad], for the binned pixel at (m, n).

$C_{MX}(m,n), C_{MY}(m,n), C_{MZ}(m,n)$:

The coefficients for the motor drive angles for optical path switching, for the binned pixel at (m, n).
The coefficients for X, Y, and Z are stored in followings dataset respectively.
/Band1/Instrument/mcm_correction_coefficient
/Band2/Instrument/mcm_correction_coefficient
/Band3/Instrument/mcm_correction_coefficient

$\Delta\phi_{MCM}$:

The difference value [rad] between the nominal and actual motor drive angles for optical path switching at the observation time.

$\Delta\phi_{MCM}$ is calculated as follows.

$$\Delta\phi_{MCM} = -(\phi_{MCM} - \phi_{nominal})$$

Eq. 3-22

Here,

$\Delta\phi_{MCM}$: The difference [rad] between the nominal value and the actual motor drive angle for optical path switching for the frame.

ϕ_{MCM}: The motor drive angle for optical path switching for the frame.
The angles are stored in each band-specific group as follows:
/Band1/SoundingGeometry/opticalPathSwitchingMotorAngle
/Band2/SoundingGeometry/opticalPathSwitchingMotorAngle
/Band3/SoundingGeometry/opticalPathSwitchingMotorAngle

$\phi_{nominal}$: Nominal motor drive angle [rad] for optical-path switching. mcm_nominal_angle stores the angle according to the Imaging Mode (Focus Mode or Wide Mode).

2. Focus Mode

(1) Calculation of the line-of-sight vector $\boldsymbol{a_0}$, representing the Optical Unit output in the TANSO-3 coordinate system

Calculate the Optical Unit output line-of-sight vector in the TANSO-3 coordinate system by multiplying the vector $\boldsymbol{a'}$ in Eq. 3-19 with the transformation matrix P_1 to the TANSO-3 coordinate system.

$$\boldsymbol{a_0} = \boldsymbol{P_1} \cdot \boldsymbol{a'}$$

Eq. 3-23

Here,

$\boldsymbol{a_0}$: Line-of-sight vector representing the Optical Unit output in the TANSO-3 coordinate system.

$\boldsymbol{a'}$: Line-of-sight vector in the Optical Unit coordinate system after correction by the motor drive angle for optical path switching.

$\boldsymbol{P_1}$: Transformation matrix from the Optical Unit coordinate system to the TANSO-3 coordinate system (opticsToTANSO3Matrix)

(2) Calculation of the mirror normal vector $\boldsymbol{n_0}$ of the Pointing Control Unit in the TANSO-3 coordinate system

The mirror normal vector $\boldsymbol{n_0}$ of the Pointing Control Unit in the TANSO-3 coordinate system is calculated as follows.

$$\boldsymbol{n_0} = \boldsymbol{P_2} \cdot \boldsymbol{n''_A}$$

Eq. 3-24

Here,

$\boldsymbol{n_0}$: The mirror normal vector of the Pointing Control Unit in the TANSO-3 coordinate system.

$\boldsymbol{n''_A}$: The mirror normal vector of the Pointing Control Unit in the Pointing Control Unit coordinate system.

$\boldsymbol{P_2}$: Transformation matrix from the Pointing Control Unit coordinate system to the TANSO-3 coordinate system (pointingToTANSO3Matrix).

$\boldsymbol{n''_A}$ is calculated using AT/CT axes vectors $\boldsymbol{x_{po0}}, \boldsymbol{y_{po0}}$ (the Pointing Control Unit coordinate system) storing in Instrument group and the pointing control angles θ and ω at the observation time, interpolated the angles stored in PointingData group. The equation is as follows:

$$\boldsymbol{y_{po1}}=(\boldsymbol{y_{po0}} \cdot \boldsymbol{x_{po0}})\boldsymbol{x_{po0}} + \left(\boldsymbol{y_{po0}} - (\boldsymbol{y_{po0}} \cdot \boldsymbol{x_{po0}})\boldsymbol{x_{po0}}\right)\mathbf{cos}\boldsymbol{\theta} + \left(\boldsymbol{x_{po0}} \times \boldsymbol{y_{po0}}\right)\mathbf{sin}\boldsymbol{\theta}$$

Eq. 3-25

$$\boldsymbol{n'_A}=(\boldsymbol{n_A} \cdot \boldsymbol{x_{po0}})\boldsymbol{x_{po0}} + \left(\boldsymbol{n_A} - (\boldsymbol{n_A} \cdot \boldsymbol{x_{po0}})\boldsymbol{x_{po0}}\right)\mathbf{cos}\boldsymbol{\theta} + \left(\boldsymbol{x_{po0}} \times \boldsymbol{n_A}\right)\mathbf{sin}\boldsymbol{\theta}$$

Eq. 3-26

$$\boldsymbol{n''_A}=(\boldsymbol{n'_A} \cdot \boldsymbol{y_{po1}})\boldsymbol{y_{po1}} + \left(\boldsymbol{n'_A} - (\boldsymbol{n'_A} \cdot \boldsymbol{y_{po1}})\boldsymbol{y_{po1}}\right)\mathbf{cos}\boldsymbol{\omega} + \left(\boldsymbol{y_{po1}} \times \boldsymbol{n'_A}\right)\mathbf{sin}\boldsymbol{\omega}$$

Eq. 3-27

Here,

$\boldsymbol{x_{po0}}$: The AT axis vector in the Pointing Control Unit coordinate system at the initial position.

$\boldsymbol{y_{po0}}$: The CT axis vector in the Pointing Control Unit coordinate system at the initial position.

$\boldsymbol{n_A}$: The mirror normal vector of the Pointing Control Unit in the Pointing Control Unit coordinate system at the initial position.

θ: The CT pointing angle [rad] at the observation time, considering the delay time and integration time.

ω: The AT pointing angle [rad] at the observation time, considering the delay time and integration time.

(3) Calculation of the line-of-sight vector $\boldsymbol{b}$ in the TANSO-3 coordinate system

Using a_0 and n_0 from (1) and (2), the line-of-sight vector $\boldsymbol{b}$ in the TANSO-3 coordinate system is calculated as follows.

$$\boldsymbol{b} = \boldsymbol{a_0} - (\boldsymbol{2a_0} \cdot \boldsymbol{n_0}) \cdot \boldsymbol{n_0}$$

Eq. 3-28

Here,

b : Line-of-sight vector in TANSO-3 coordinate system.

a_0: Line-of-sight vector of the Optical Unit output in the TANSO-3 coordinate system

n_0 : Mirror normal vector of the Pointing Control Unit in the TANSO-3 coordinate system.

(4) Calculation of the line-of-sight vector $\boldsymbol{b_B}$ in the satellite coordinate system

The line-of-sight vector $\boldsymbol{b_B}$ in the satellite coordinate system is calculated as follows.

$$\boldsymbol{b_B} = \boldsymbol{P_3} \cdot \boldsymbol{b}$$

Eq. 3-29

3. Wide Mode

(1) Calculation of the line-of-sight vector $\boldsymbol{a_0}$ of the Optical Unit output in the TANSO-3 coordinate system

Using $\boldsymbol{a}'$ from Eq. 3-19 and the transformation matrix $\boldsymbol{P_1}$ to the TANSO-3 coordinate system, the line-of-sight vector of the Optical Unit output in the TANSO-3 coordinate system is calculated as follows.

$$\boldsymbol{a_0} = \boldsymbol{P_1} \cdot \boldsymbol{a}'$$

Eq. 3-30

Here,

$\boldsymbol{a_0}$: Line-of-sight vector of the Optical Unit output in the TANSO-3 coordinate system.

$\boldsymbol{a}'$: Line-of-sight vector in the Optical Unit coordinate system after correction by the motor drive angle for optical path switching.

$\boldsymbol{P_1}$: Transformation matrix from the Optical Unit coordinate system to the TANSO-3 coordinate system, named opticsToTANSO3Matrix.

(2) Calculation of the line-of-sight vector $\boldsymbol{b_B}$ in the satellite coordinate system

The line-of-sight vector $\boldsymbol{b_B}$ in the satellite coordinate system is calculated as follows.

$$\boldsymbol{b_B} = \boldsymbol{P_3} \cdot \boldsymbol{a_0}$$

Eq. 3-31

・Parameters related to temperature correction of the wavelength

The group stores the coefficients of the temperature polynomial used to correct the wavelength. For details, refer to section 2.5.3.

3.2.5.6. SoundingGeometry Group

The SoundingGeometry group stores the pointing control angles, the motor drive angle for optical path switching, line-of-sight vectors, latitude and longitude, as well as satellite zenith angles, azimuth angles, solar zenith angles, azimuth angles, and the distance between the sun and the observation point. The line-of-sight vectors and latitude/longitude are stored for the center and corners of each binned pixel.

The latitude and longitude of the segment center at the observation point are determined by extending the line-of-sight vector in the ECR coordinate system from the satellite position stored in the SatelliteGeometry group, finding the intersection point with the WGS84 ellipsoid as the observation location, and then calculating and storing the geographic longitude and latitude.

The line-of-sight vector in the satellite coordinate system is described in section 3.2.5.5. The transformation of the line-of-sight vector from the satellite coordinate system to the ECR coordinate system is detailed in section 3.2.5.2.

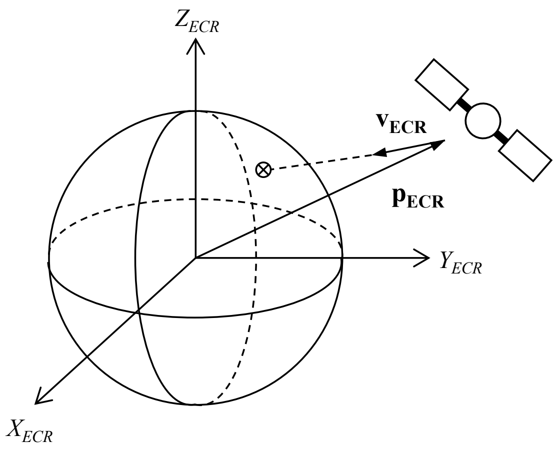

Figure 3-1 Observation position

When the line-of-sight vector in the ECR coordinate system is $\mathbf{v}_{\mathrm{ECR}} = [v_x, v_y, v_z]^t$ and the satellite position vector is $\mathbf{p}_{\mathrm{sat}} = [p_{sat\_x}, p_{sat\_y}, p_{sat\_z}]^t$, the observation point vector $\mathbf{p}_{\mathrm{obs}}$=$[p_{obs\_x}, p_{obs\_y}, p_{obs\_z}]^t$ on the Earth ellipsoid is calculated as follows:

$$\mathbf{p_{obs}} = \mathbf{p_{sat}} + \boldsymbol{k}\mathbf{v_{ECR}}$$

Eq. 3-32

The observation point $\mathbf{p_{obs}}$ and the Earth ellipsoid semi-major and minor axes R_e, R_p have the following relationship.

$$\frac{p_{obs\_x}^2 + p_{obs\_y}^2}{R_e^2} + \frac{p_{obs\_z}^2}{R_p^2} = 1$$

Eq. 3-33

By substituting Eq. 3-32 into Eq. 3-33, a quadratic equation in terms of $\boldsymbol{k}$ is obtained. The value of k can be determined using the following formula.

$$k = \frac{-b - \sqrt{b^2 - ac}}{a}$$
$$a = R_p^2\left(v_x^2 + v_y^2\right) + R_e^2 v_z^2$$
$$b = R_p^2\left(p_{sat\_x}v_x + p_{sat\_y}v_y\right) + R_e^2 p_{sat\_z}v_z$$
$$c = R_p^2\left(p_{sat\_x}^2 + p_{sat\_y}^2\right) + R_e^2 p_{sat_z}^2 - R_e^2 R_p^2$$

Eq. 3-34

The observation point $\mathbf{p_{obs}}$ is calculated by substituting the k into Eq. 3-32. The geographic longitude λ corresponding to $\mathbf{p_{obs}}$ is calculated as follows.

$$\lambda = \mathrm{atan2}(p_{obs\_y}, p_{obs\_x})$$

Eq. 3-35

The geographic latitude φ is calculated from the geocentric latitude ψ using the following relation.

$$\psi = \mathrm{asin}\left(\frac{p_{obs\_z}}{\sqrt{p_{obs\_x}^2 + p_{obs\_y}^2 + p_{obs\_z}^2}}\right)$$

$$\varphi = \mathrm{atan2}\left(\sin\psi, \frac{R_p^2}{R_e^2}\cos\psi\right)$$

Eq. 3-36

The definition of the atan2 function is provided in Eq. 3-42.

The definitions of the satellite and Sun's zenith and azimuth angles at the observation point are illustrated in Figure 3-2. When the observation point $\mathbf{p_{obs}} = (p_{obs\_x}, p_{obs\_y}, p_{obs\_z})^t$ has geographic longitude λ and latitude φ, the unit vectors in the zenith **z**, north **n**, and east **e** directions are defined as follows.

$$\mathbf{z} = \begin{pmatrix} \cos\varphi\cos\lambda \\ \cos\varphi\sin\lambda \\ \sin\varphi \end{pmatrix}$$

Eq. 3-37

$$\mathbf{n} = \begin{pmatrix} -\sin\varphi\cos\lambda \\ -\sin\varphi\sin\lambda \\ \cos\varphi \end{pmatrix}$$

Eq. 3-38

$$\mathbf{e} = \begin{pmatrix} -\sin\lambda \\ \cos\lambda \\ 0 \end{pmatrix}$$

Eq. 3-39

The zenith angle θ_z and azimuth angle φ_{AZ} are calculated using the position vector $\mathbf{p_{ECR}}$ of the satellite or Sun in the ECR coordinate system. (Note: $\mathbf{p_{ECR}} - \mathbf{p_{obs}}$ is the vector from the observation point toward the satellite or Sun)

$$\theta_z = \cos^{-1}\left(\frac{(\mathbf{P}_{\mathrm{ECR}} - \mathbf{P}_{\mathrm{OBS}}) \cdot \mathbf{z}}{|\mathbf{P}_{\mathrm{ECR}} - \mathbf{P}_{\mathrm{OBS}}|}\right)$$

Eq. 3-40

$$\varphi_{AZ} = \mathrm{atan2}((\mathbf{P}_{ECR} - \mathbf{P}_{obs}) \cdot \mathbf{e}, (\mathbf{P}_{ECR} - \mathbf{P}_{obs}) \cdot \mathbf{n})$$

Eq. 3-41

Because the azimuth angle φ_{AZ} is defined in the range 0 to 2π radians (0 to 360 degrees), add 2π to φ_{AZ} if φ_{AZ} is calculated as negative. The definition of the atan2 function is as follows.

$$\mathrm{atan}\,2(y,x) = \begin{cases} \tan^{-1}\left(\frac{y}{x}\right) & (x > 0) \\ \tan^{-1}\left(\frac{y}{x}\right) + \pi & (x < 0, y \geq 0) \\ \tan^{-1}\left(\frac{y}{x}\right) - \pi & (x < 0, y < 0) \\ \frac{\pi}{2} & (x = 0, y > 0) \\ -\frac{\pi}{2} & (x = 0, y < 0) \\ undefined & x = 0, y = 0 \end{cases}$$

Eq. 3-42

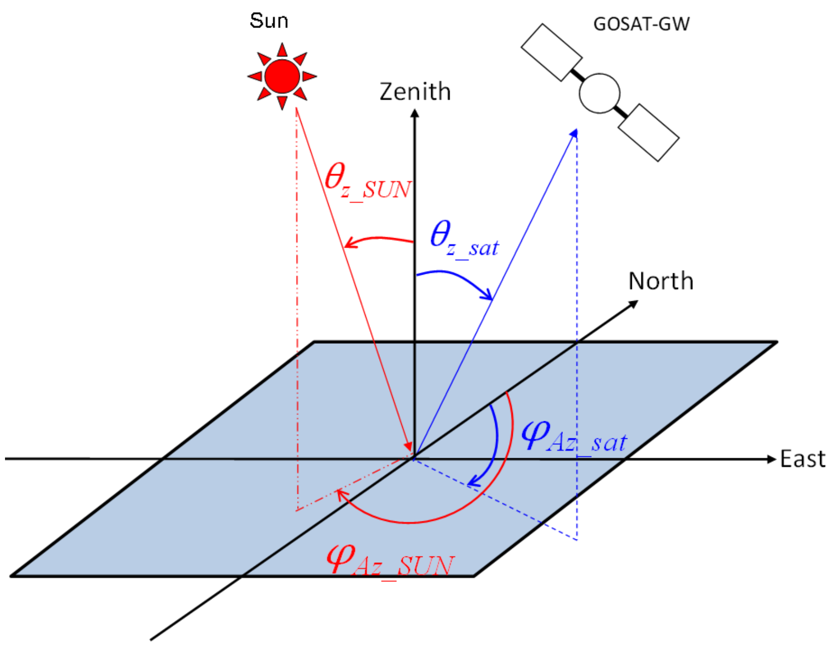

Figure 3-2 Zenith and azimuth angles of the satellite and the Sun

In calculating the values of each item stored in this group, for parameters related to the sun's position, such as the solar zenith angle, the apparent position is used by considering the light propagation time from the sun to the Earth (a fixed value).

The latitude and longitude of the four corners of the grid cell at the observation location are calculated and stored based on the geographic latitude and longitude $P_{i,m}$ of the eight surrounding grid-cell centers (where i is the frame number and m is the binned pixel number), along with the time of observation t_i and integration time T_i. The spatial relationship of the four corners is shown in Figure 3-3.

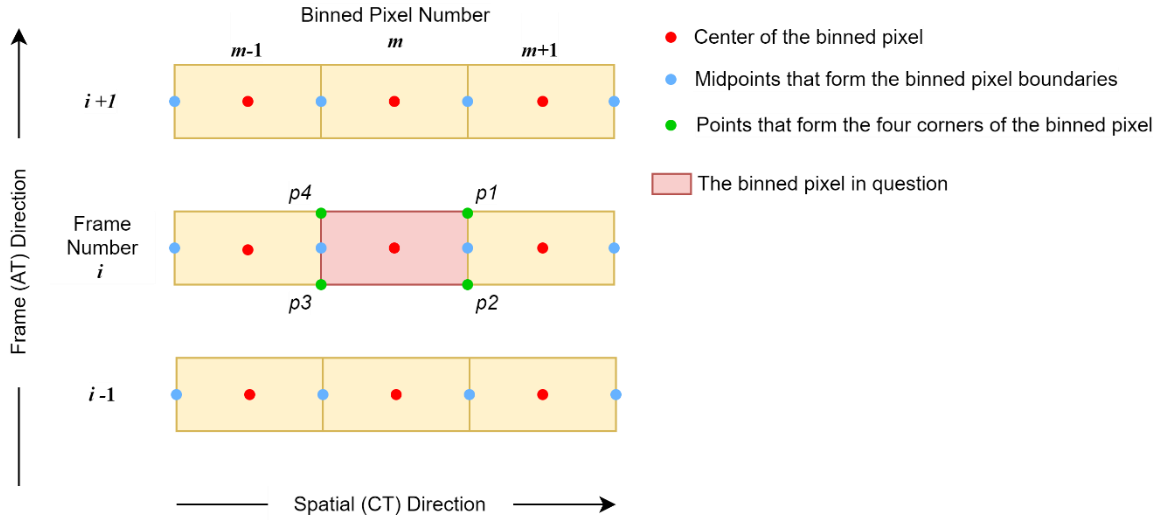

Figure 3-3 : Spatial relationship of the four corners

Hereafter, the satellite's direction of travel will be referred to as the AT-forward direction, and the opposite direction as the AT-backward direction. The side of the CT axis with grid number 0 will be referred to as the CT- direction, and the side with the maximum grid number as the CT+ direction.

The calculated latitudes and longitudes of the four corners are stored in a clockwise order starting from $p4$, which corresponds to the AT-forward and CT- direction ($p4$->$p1$->$p2$->$p3$). The calculation method is described below.

1. Longitude unwrapping
   In the longitude direction, to avoid discontinuities at the International Date Line boundary (-180°, 180°), apply an unwrap operation before interpolation to convert longitudes into continuous values.

2. Calculation of spatial (CT) direction grid boundaries
   Calculate the midpoint positions that serve as boundaries between grid cells in the spatial (CT) direction. Figure 3-4 illustrates the positional relationship of the midpoints' latitudes and longitudes in the CT direction.

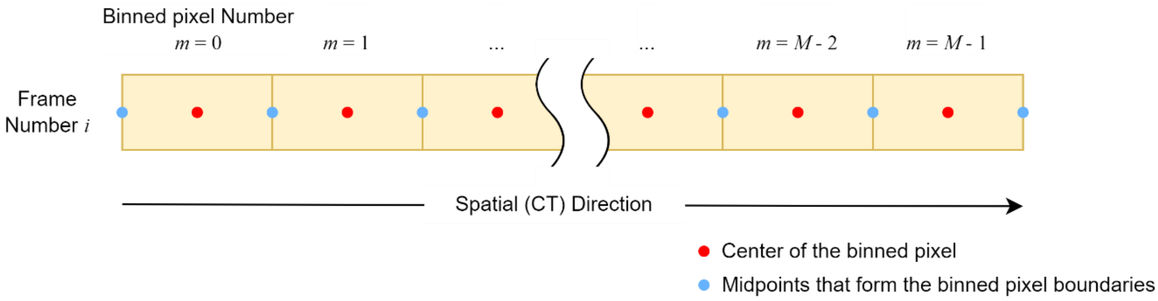

Figure 3-4 : Midpoint positions serving as boundaries between grid cells in the spatial (CT) direction

The midpoint positions of latitude and longitude in the CT direction are calculated using Eq. 3-43.

CT- direction:

$$P_{i,m-0.5} = \frac{(P_{i,m-1} + P_{i,m})}{2}$$

CT+ direction:

$$\boldsymbol{P_{i,m+0.5}} = \frac{\boldsymbol{(P_{i,m} + P_{i,m+1})}}{\boldsymbol{2}}$$

Eq. 3-43

However, at the ends of the spatial-direction grid (CT- at m = 0 and CT+ at m = M-1, where M is the number of spatial grid cells), these are calculated using Eq. 3-44.

CT- direction:

$$P_{i,-0.5} = \frac{P_{i,0} - \left(P_{i,1} - P_{i,0}\right)}{2} = 1.5\ \times P_{i,0} - 0.5 \times P_{i,1}$$

CT+ direction:

$$P_{i,M-0.5} = \frac{P_{i,M-1} + (P_{i,M-1} - P_{i,M-2})}{2} = 1.5\ \times P_{i,M-1} - 0.5 \times P_{i,M-2}$$

Eq. 3-44

3. Calculation of frame (AT) direction grid boundaries

Finally, calculate the midpoint positions that serve as boundaries for the frame (AT) direction grid. The frames stored in the product fall into two categories: those that are identical to the actual observation frames (number of accumulated frames = 1), and those in which one frame contains data from two actual observation frames (number of accumulated frames = 2). Table 3.2-2 shows the number of accumulated frames for each imaging mode.

Table 3.2-2 Number of accumulated frames for each observation/calibration mode and each imaging mode/resolution.

		Imaging Mode / Resolution					
Observation/Calibration Mode		WF	WD	FF	F1	F2	F3
	O	-	2	-	1	1	1
	S	-	-	1	-	-	-
	R	-	-	1	-	-	-
	A	1	-	1	-	-	-
	C	1	-	1	-	-	-
	D	1	1	1	1	1	1
	B	1	2	1	1	1	1

(1) When the number of accumulated frames = 1

Figure 3-5 shows the positions of the AT-direction midpoint latitude and longitude when the number of accumulated frames is 1.

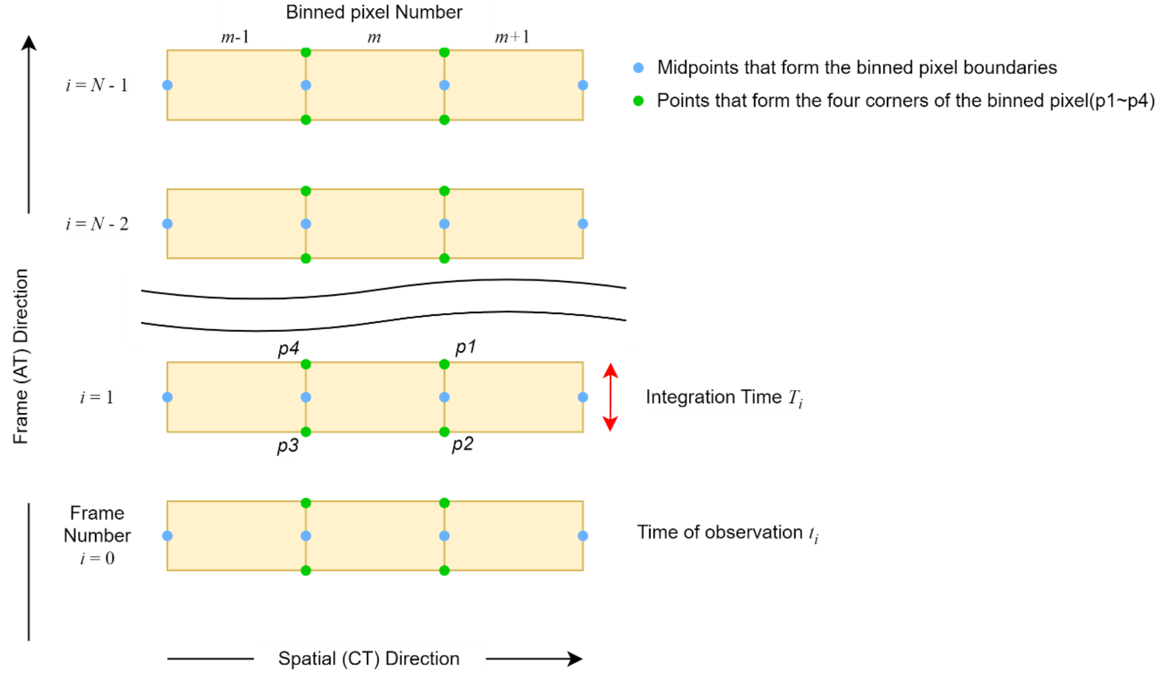

Figure 3-5 Positional relationship of the midpoint latitude and longitude in the Frame (AT) direction when the number of summed frames is 1.

The latitudes and longitudes of the four corner points (p1 to p4) when the number of accumulated frames is 1 are calculated using Eq. 3-45.

Forward direction in the AT axis / in the CT+ direction:

$$P_{p1} = P_{i,m+0.5} + \left(P_{i+1,m+0.5} - P_{i,m+0.5}\right)\frac{T_i \times 0.5}{t_{i+1} - t_i}$$

Rearward direction in the AT axis / in the CT+ direction:

$$P_{p2} = P_{i,m+0.5} + \left(P_{i-1,m+0.5} - P_{i,m+0.5}\right)\frac{T_i \times 0.5}{t_i - t_{i-1}}$$

Rearward direction in the AT axis / in the CT- direction:

$$P_{p3} = P_{i,m-0.5} + \left(P_{i-1,m-0.5} - P_{i,m-0.5}\right)\frac{T_i \times 0.5}{t_i - t_{i-1}}$$

Forward direction in the AT axis / in the CT- direction:

$$P_{p4} = P_{i,m-0.5} + \left(P_{i+1,m-0.5} - P_{i,m-0.5}\right)\frac{T_i \times 0.5}{t_{i+1} - t_i}$$

Eq. 3-45

However, for the end segments in the frame direction ($i = 0$ at the AT rear and $i = N - 1$ at the AT front, where N is the number of segments in the frame direction), calculations use Eq. 3-46.

AT forward direction

$p4$ when $i = N - 1$

$$P_{N-1,m-0.5} + \left(P_{N-1,m-0.5} - P_{N-2,m-0.5}\right)\frac{T_{N-1} \times 0.5}{t_{N-1} - t_{N-2}}$$

$p1$ when $i = N - 1$

$$P_{N-1,m+0.5} + \left(P_{N-1,m+0.5} - P_{N-2,m+0.5}\right)\frac{T_{N-1} \times 0.5}{t_{N-1} - t_{N-2}}$$

AT rearward direction

$p2$ when $i = 0$

$$P_{0,m+0.5} - \left(P_{1,m+0.5} - P_{0,m+0.5}\right)\frac{T_0 \times 0.5}{t_1 - t_0}$$

$p3$ when $i = 0$

$$P_{0,m-0.5} - \left(P_{1,m-0.5} - P_{0,m-0.5}\right)\frac{T_0 \times 0.5}{t_1 - t_0}$$

Eq. 3-46

When storing, the longitudes of the four corners are adjusted using wrap processing to fall within the range of [-180°, 180°].

(2) When the number of accumulated frames = 2

Figure 3-6 shows the positional relationship of the AT-direction midpoint latitude and longitude in the case where the number of accumulated frames is 2.

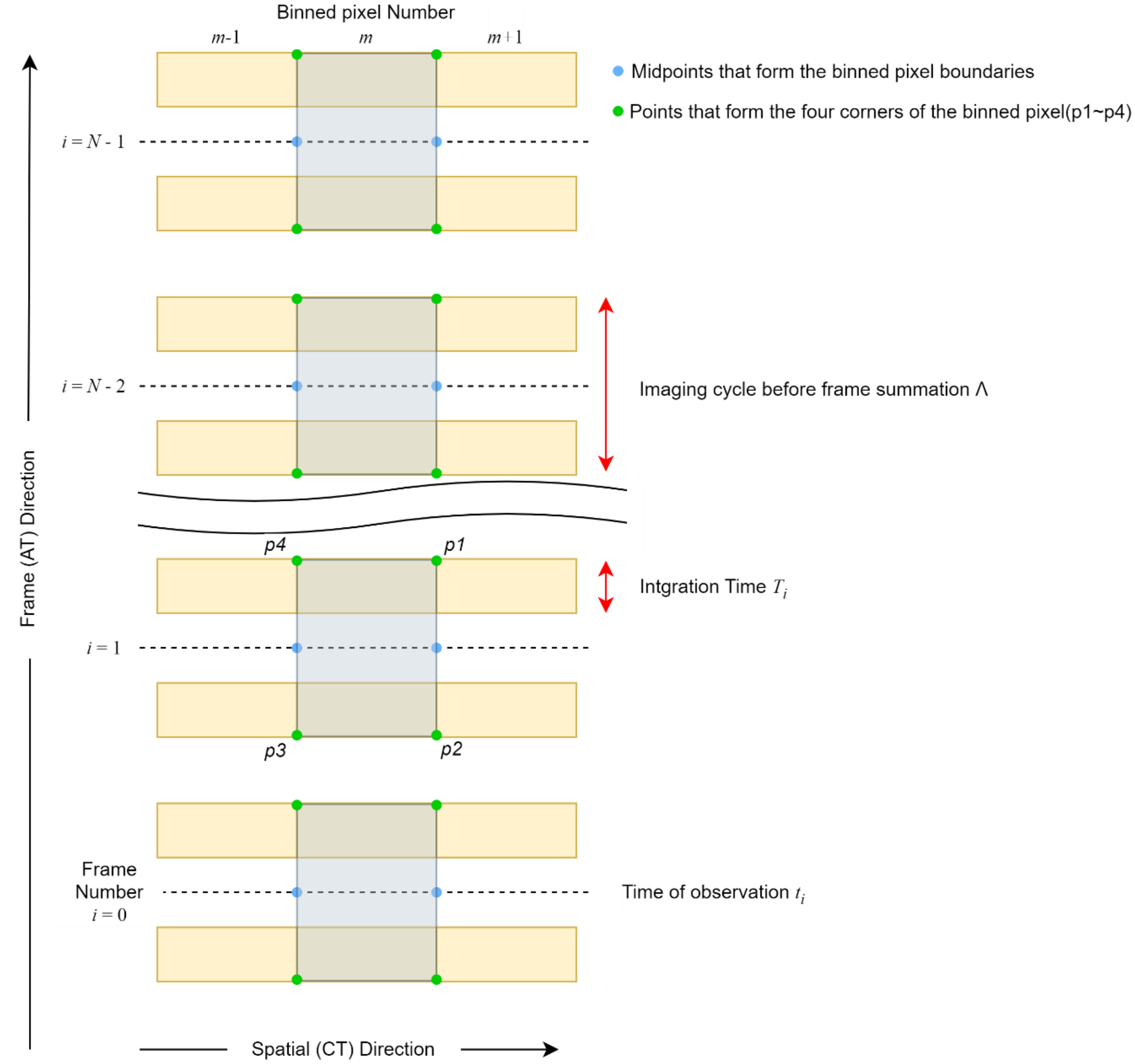

Figure 3-6 Positional relationship of the midpoint latitude and longitude in the Frame (AT) direction when the number of summed frames is 2.

When the number of accumulated frames is 2, the latitudes and longitudes of the four corners (p1 to p4) are calculated using Eq. 3-47, with Λ (= 0.714) representing the imaging interval [seconds] of the frames to be added.

AT forward / CT+ direction:

$$P_{p1} = P_{i,m+0.5} + (P_{i+1,m+0.5} - P_{i,m+0.5})\frac{(T_i + \Lambda) \times 0.5}{t_{i+1} - t_i}$$

AT rearward / CT+ direction:

$$P_{p2} = P_{i,m+0.5} + (P_{i-1,m+0.5} - P_{i,m+0.5})\frac{(T_i + \Lambda) \times 0.5}{t_i - t_{i-1}}$$

AT rearward / CT- direction:

$$P_{p3} = P_{i,m-0.5} + (P_{i-1,m-0.5} - P_{i,m-0.5})\frac{(T_i + \Lambda) \times 0.5}{t_i - t_{i-1}}$$

AT forward / CT- direction:

$$P_{p4} = P_{i,m-0.5} + (P_{i+1,m-0.5} - P_{i,m-0.5})\frac{(T_i + \Lambda) \times 0.5}{t_{i+1} - t_i}$$

Eq. 3-47

However, at both ends of the frame-direction segments (AT rearward for $i = 0$ and AT forward for $i = N - 1$), the calculation is performed using Eq. 3-48.

AT forward direction

$p4$ when $i = N - 1$

$$P_{N-1,m-0.5} + (P_{N-1,m-0.5} - P_{N-2,m-0.5})\frac{(T_{N-1} + \Lambda) \times 0.5}{t_{N-1} - t_{N-2}}$$

$p1$ when $i = N - 1$

$$P_{N-1,m+0.5} + (P_{N-1,m+0.5} - P_{N-2,m+0.5})\frac{(T_{N-1} + \Lambda) \times 0.5}{t_{N-1} - t_{N-2}}$$

AT rearward direction

$p2$ when $i = 0$

$$P_{0,m+0.5} - (P_{1,m+0.5} - P_{0,m+0.5})\frac{(T_0 + \Lambda) \times 0.5}{t_1 - t_0}$$

$p3$ when $i = 0$

$$P_{0,m-0.5} - (P_{1,m-0.5} - P_{0,m-0.5})\frac{(T_0 + \Lambda) \times 0.5}{t_1 - t_0}$$

Eq. 3-48

When storing the data, the longitudes of the four corners are adjusted to fall within the range [-180°, 180°] through wrap processing.

4. Calculation of the line-of-sight vectors for the four corners

The line-of-sight vectors for the four corners are computed from the satellite position vector P_{obs} and A_i − the ECR coordinate vectors obtained by converting the corner latitudes/longitudes P_{p_i} (where i ranges from 1 to 4) − and then stored.

From A_i and P_{obs}, the line-of-sight vector v_i toward each corner is expressed by Eq. 3-49.

$$v_i = A_i - P_{ops}$$

Eq. 3-49

By normalizing v_i into a unit vector, the line-of-sight vector V_i to be stored in this case is obtained.

$$V_i = \frac{v_i}{|v_i|}$$

Eq. 3-50

The ECR coordinate conversion of the corner latitude/longitude $P_{p_i} = (\phi_i[rad], \lambda_i[rad])$ is performed as follows.

$$A_i = (x_i, y_i, z_i) = \begin{cases} x_i = N \cdot \cos\phi_i \cdot \cos\lambda_i \\ y_i = N \cdot \cos\phi_i \cdot \sin\lambda_i \\ z_i = N \cdot (1 - e^2) \cdot \sin\phi_i \end{cases}$$

Eq. 3-51

Here, N is the radius of curvature in the east–west direction and e is the eccentricity; they are computed from the Earth's flattening f and equatorial radius R_e as follows.

$$e = 2f - f^2$$

Eq. 3-52

$$N = \frac{R_e}{\sqrt{1 - e^2 \times \sin^2\phi_i}}$$

Eq. 3-53

3.2.6. Group related to the observation data for Band 1, Band 2, and Band 3

The Band1, Band2, and Band3 groups store the band-specific observation data along with the corresponding position information. The following section describes the subgroups of the Band1, Band2, and Band3 groups.

3.2.6.1. SoundingData Group (for the Level 1A case)

In Level 1A, the SoundingData group stores observation data as DN (digital number) values. The observation data for a band are stored into three separate dataset: the usable data area, dark pixel 1, and dark pixel 2. Each dataset is stored as a three-dimensional array frames×spatial×wavelength. The accumulated frame number and the scale_factor are stored as attributes of the usable data area.

3.2.6.2. SoundingData Group (for the Level 1B case)

In Level 1B, the SoundingData group stores spectral radiance data (W/m²/sr/µm) and wavelength information. The observation data for each band are stored in the usable data area. Each dataset is organized as a three-dimensional array frames×spatial×wavelength.

Wavelength information stores the reference wavelength for a single frame. Section 2.5.3 defines the formula for wavelength adjustment using the reference wavelength and temperatures of a frame.

3.2.6.3. PixelAttribute Group

The PixelAttribute group stores, the number of pixels per bin, the valid spatial and wavelength ranges and the number of defective pixels. Each of them is defined for the usable data area and stored for each band.

The valid spatial and wavelength ranges represent the region within the usable data area where performance is guaranteed for a single frame.

Defective pixels store the number of unusable pixels in each bin due to malfunctions or other issues.

For Band 3, the coefficient of variation within each segment, $CV = CV(m, n)$, is stored as a statistical indicator representing the variation of DN values within the observation data segment. Additionally, the value of m used to calculate $CV(m, n)$ is stored in cvWavelengthIndex as the wavelength index for computing the in-segment coefficient of variation. The method for calculating the wavelength coefficient of variation $CV(m,n)$ is given in Eq. 3-54. Note that in the case of non-binning, $CV(m,n)$ will be zero.

$$\text{Coefficient of variation } CV \text{ for segment}(m,n) = \frac{\sqrt{\frac{1}{N_{bin}}\sum_{i=1}^{N_{bin}}(PV_i - \overline{PV})^2}}{\overline{PV}}$$

Eq. 3-54

Here,

PV_i : Pixel values within segment(m,n) $(i = 1 \ldots N_{bin})$, excluding saturated pixels, defects, and missing data

N_{bin}: Number of pixels within segment (m,n), excluding saturated pixels, defects, and missing data.

$\overline{PV}$: The average value of pixel data within segment(m,n), excluding saturated pixels, defects, and missing data.

3.3. Data Structure of the Processing Result File (XML Format)

Table 3.3-1 provides an overview of the data stored in the processing result files. For detailed information on each stored data, please refer to Chapter 4.

Table 3.3-1 Data structure of the TANSO-3 Level 1 processing result file

Storage Location		Stored Data
L1Result		Store the L1 processing results.
	Metadata	The following catalog information is mainly stored to describe the product type, contents, and related details. ・Granule ID ・Satellite Name ・Sensor Name ・Processing Date and Time ・Processing Level ・Observation Start/End Times ・Product Quality ・Band 1–3 Processing Enabled/Disabled
	Observation	The following information is mainly stored as a summary for each observation ID. ・Observation ID ・Observation Start/End Time according to the observation plan ・Actual Observation Start/End Time ・Quality for each Observation ID ・Number of frames/Missing frames/Missing rate per band ・Observation area on the map In the Solar Calibration Mode, the Solar Diffuser Calibration Mode, and the Lunar Calibration Mode, observation area is not stored.

3.3.1. Metadata

The Metadata group stores catalog information such as the product file type, observation time, and overall product quality information. For details on product quality, please refer to section 2.5.4.3.

3.3.2. Observation

The Observation group stores information for each Observation ID. For details on the quality at the Observation ID level, please refer to section 2.5.4.2.

4. Format Details

Table 4-1 presents the global attributes of the Level 1 product file (HDF5 format).

Tables 4-2 through 4-25 present detail of the datasets within the Level 1 product file (HDF5 format).

Table 4-26 presents the details of the Level 1 processing result file (XML format).

Table 4-1 Level 1 Product Global Attributes (1/3)

No.	Attribute Name	Data Type	Name	Description
1	Conventions	H5T_STRING	Convention	Stores the versions of CF Convention and ACDD. "CF-1.7, ACDD-1.3" (fixed)
2	title	H5T_STRING	Product Name	Stores the product name with the following values. "GOSAT-GW/TANSO-3 L1A": for Level 1A "GOSAT-GW/TANSO-3 L1B": for Level 1B
3	institution	H5T_STRING	Organization Name	Sets the name of the organization that created the product. "Japan Aerospace Exploration Agency (JAXA)" (fixed)
4	project	H5T_STRING	Project Name	Describes the name of the project that created the product. "GOSAT-GW Project" (fixed)
5	summary	H5T_STRING	Summary	Describes the summary of the file. "Processing of TANSO-3 level 1 is defined as follows: Level 1A processing : Level 1A products are observation digital number (DN) with geometric information. Level 1B processing : Level 1B products are spectral radiance data applied radiometric correction, with geometric and spectral information." (fixed)
6	license	H5T_STRING	Data Rights	Stores data rights, usage conditions, or URL of the website listing them. "https://www.nies.go.jp/soc/en/documents/datapolicy/" (fixed)
7	creator_name	H5T_STRING	Product Creator Organization	Records the name of the entity that created the product. "Japan Aerospace Exploration Agency (JAXA) "(fixed)
8	creator_type	H5T_STRING	Organization Type	Stores the type of entity that created the product. "institution" (fixed)
9	creator_email	H5T_STRING	Creator Contact Email	Stores the contact email of the entity that created the product. "z-tanso-3_mo_sys@ml.jaxa.jp" (fixed)
10	creator_url	H5T_STRING	Creator Website URL	Stores the URL of the website providing information about the entity that created the product. "https://global.jaxa.jp/projects/sat/gosat-gw" (fixed)
11	keywords	H5T_STRING	Keywords	Stores keywords describing the file content, separated by commas. "GOSAT-GW, TANSO-3" (fixed)
12	standard_names_vocabulary	H5T_STRING	Vocabulary Referenced by standard_name	Stores the name and version of the vocabulary referenced by standard_name. "CF Standard Name Table (v49, 12 February 2018)" (fixed)
13	id	H5T_STRING	Product ID	Stores the granule ID.
14	observation_request_id	H5T_STRING	Observation Request ID	Stores the Observation Request ID.
15	naming_authority	H5T_STRING	Organization Name	Stores the name of the organization providing the product in reversed DNS format. "jp.go.nies" (fixed)
16	source	H5T_STRING	Data Generation Method	Stores the version of the Algorithm Theoretical Basis Document used to generate the data. "NA" (fixed)
17	processing_level	H5T_STRING	Processing Level	Stores the processing level in the following format. "Level1A": for Level 1A "Level1B": for Level 1B
18	comment	H5T_STRING	Comment	Stores comments not included in other attributes.

Table 4-1 Level 1 Product Global Attributes (2/3)

No.	Attribute Name	Data Type	Name	Description
19	date_created	H5T_STRING	Data Creation Date and Time	Stores the file creation date and time (UTC) in the format YYYY-MM-DDThh:mm:ss.uuuZ. YYYY: year MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) uuu: 000-999 (millisecond)
20	time_coverage_start	H5T_STRING	Observation Start Date and Time	Stores the observation start date and time of the first data record in the format YYYY-MM-DDThh:mm:ss.uuuZ. YYYY: year MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) uuu: 000-999 (millisecond)
21	time_coverage_end	H5T_STRING	Observation End Date and Time	Stores the observation end date and time of the first data record in the format YYYY-MM-DDThh:mm:ss.uuuZ. YYYY: year MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) uuu: 000-999 (millisecond)
22	geospatial_lat_min	H5T_IEEE_F32LE	Southernmost Latitude of Observation Range	Stores the southernmost latitude of the data in the range -90.0 to 90.0. Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
23	geospatial_lat_max	H5T_IEEE_F32LE	Northernmost Latitude of Observation Range	Stores the northernmost latitude of the data in the range -90.0 to 90.0. Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
24	geospatial_lon_min	H5T_IEEE_F32LE	Westernmost Longitude of Observation Range	Stores the westernmost longitude of the data in the range -180.0 to 180.0. Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
25	geospatial_lon_max	H5T_IEEE_F32LE	Easternmost Longitude of Observation Range	Stores the easternmost longitude of the data in the range -180.0 to 180.0. Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
26	geospatial_vertical_min	H5T_IEEE_F32LE	Minimum Altitude of Observation Range	Stores the minimum altitude of the data in the range 0 to 6000. Fixed at 0 for this product. Only stored for Normal Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
27	geospatial_vertical_max	H5T_IEEE_F32LE	Maximum Altitude of Observation Range	Stores the maximum altitude of the data in the range 0 to 6000. Fixed at 0 for this product. Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.

Table 4-1 Level 1 Product Global Attributes (3/3)

No.	Attribute Name	Data Type	Name	Description
28	geospatial_vertical_positive	H5T_STRING	Interpretation of Vertical Values, Altitude/Depth Identification	Stores the identification of altitude/depth. "up" (fixed) Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
29	geospatial_bounds	H5T_STRING	Spatial Extent	Stores the latitude and longitude range in OGC Well-Known Text (WKT) Geometry format. Example: POLYGON ((152.28 83.71,91.82 73.23,-10.34 34.10,-24.72 -25.31,-39.30 -84.97,-105.73 -73.60,-40.70 -23.13,-27.99 36.52)) Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
30	geospatial_bounds_crs	H5T_STRING	Coordinate Reference System (CRS) of geospatial_bounds attribute	Stores the Coordinate Reference System (CRS). "EPSG:4326" (fixed) Only stored for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. Not stored for other products.
31	language	H5T_STRING	Language Used	Describes the language used. "en" (fixed)
32	topicCategory	H5T_STRING	Topic Category Code	Stores the most appropriate topic categories from ISO-19115 subject code list (see section 8.8), separated by commas. "004,014" (Meteorology, Ocean: fixed)
33	Role	H5T_STRING	Role Code	Stores the ISO-19115 role code. "003" (Information Owner: fixed)
34	history	H5T_STRING	File Modification History	Stores the record of file modification history line by line.
35	characterSet	H5T_STRING	Character Encoding	Stores the code from ISO-19115 character encoding list. "004" (UTF-8: fixed)
36	acknowledgement	H5T_STRING	Project Supplementary Information	Stores supplementary information about the project. "TANSO-3 mission is aimed at continuing and advancing GOSAT/GOSAT-2 mission and continuously providing useful information that contributes to environmental decision making for global warming and is led by the Ministry of the Environment (MOE) and the National Institute for Environmental Studies (NIES). Japan Aerospace Exploration Agency (JAXA) implements Level 1 processing of TANSO-3 data. The Level 1 products based on the observation data of TANSO-3 is processed in the TANSO-3 Mission Operations System." (fixed)
37	publisher_name	H5T_STRING	Responsible Person Name	Stores the name of the person responsible for data publication. "National Institute for Environmental Studies (NIES)/Ministry of the Environment (MOE) "(fixed)
38	publisher_email	H5T_STRING	Responsible Person Email Address	Stores the contact email address of the person responsible for data publication. "g3pa_desk@nies.go.jp" (fixed)
39	publisher_url	H5T_STRING	Responsible Person Website URL	Stores the URL of the website of the person responsible for data publication. "https://product.gosat-gw.nies.go.jp" (fixed)
40	_NCProperties	H5T_STRING	File Format Information	Stores NetCDF-compatible format information.

Table 4-2 Level 1 Product Metadata Group Details (1/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Metadata	–	–	Metadata	Catalog information.	–
2	granuleID	H5T_STRING	scalar	Granule ID	ID that uniquely identifies the observation.	long_name:File identifier (granule ID)
3	satelliteName	H5T_STRING	scalar	Satellite Name	Satellite name. "GOSAT-GW" (fixed)	long_name:Satellite name
4	sensorName	H5T_STRING	scalar	Sensor Name	Sensor name. "TANSO-3" (fixed)	long_name:Sensor name
5	operationMode	H5T_STRING	scalar	Operating Mode	Operation mode. Format: "xxyyz" xx: Observation/Calibration Mode yy: Imaging Mode/resolution z: Wavelength binning state	long_name:Operation mode
6	productionDateTime	H5T_STRING	scalar	Product Creation Date/Time (UTC)	Product creation date and time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Production date and time
7	processingLevel	H5T_STRING	scalar	Processing Level	Processing level. Level1A: for Level 1A; Level1B: for Level 1B	long_name:Processing level flag_values:["Level1A", "Level1B"] flag_meanings:"Level1A Level1B"
8	algorithmVersion	H5T_STRING	scalar	Processing Algorithm Version	Algorithm version. 000-999	long_name:Algorithm version
9	parameterVersion	H5T_STRING	scalar	Parameter Version	Parameter version. 000-999	long_name:Parameter version

Table 4-2 Level 1 Product Metadata Group Details (2/2)

No.		Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
10		observationStartDateTime	H5T_STRING	scalar	Observation Data Start Date/Time (UTC)	Observation start date and time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds) The observation start time is the earliest observation time (excluding fixed delay time and integration time) among bands 1-3.	long_name:Observation start date and time
11		observationEndDateTime	H5T_STRING	scalar	Observation Data End Date/Time (UTC)	Observation end date and time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds) The observation end time is the latest observation time(excluding fixed delay time and integration time) among bands 1-3.	long_name:Observation end date and time
12		geodeticDatum	H5T_STRING	scalar	Geodetic Datum	Reference Geodetic coordinate system. "WGS84/WGS84" (fixed)	long_name:Geodetic datum
13		productQualityFlag	H5T_STRING	scalar	Overall Product Quality	Overall product quality. One of: Good, Fair, Poor, NG, determined by the conditions of individual quality items.	long_name:Product quality flag flag_values:["Good", "Fair", "Poor", "NG"] flag_meanings:"Good Fair Poor NG"
14		yawSteeringFlag	H5T_STD_U8LE	scalar	Product Yaw-Steering Flag	Yaw-steering state. Values: 0: OFF; 1: ON; 2: indeterminate (e.g., no applicable data). If yaw-steering is active in even one frame, the state is ON.	long_name: Yaw Steering Flag flag_values:[0,1,2] flag_meanings:"OFF ON NA"

Table 4-3 Level 1 Product OnboardOrbitData Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	OnboardOrbitData	–	–	Satellite Orbit Information	–	–
3	timeUTC	H5T_STRING	OnboardOrbitData	Orbit Data Time (UTC)	Orbit data time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of onboard orbit data (UTC)
4	time	H5T_IEEE_F64LE	OnboardOrbitData	Orbit Data Time (Cumulative Seconds)	Orbit data time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of onboard orbit data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	posECR	H5T_IEEE_F64LE	OnboardOrbitData, CoordinatesXYZ	Satellite Position (ECR)	Satellite position [km] in the ECR (WGS84) coordinate system.	long_name:Satellite position vector(ECR) units:km
6	velECR	H5T_IEEE_F64LE	OnboardOrbitData, CoordinatesXYZ	Satellite Velocity (ECR)	Satellite velocity [km/s] in the ECR (WGS84) coordinate system.	long_name:Satellite velocity vector(ECR) units:km/s
7	posECI	H5T_IEEE_F64LE	OnboardOrbitData, CoordinatesXYZ	Satellite Position (ECI)	Satellite position [km] in the ECI (TOD) coordinate system.	long_name:Satellite position vector(ECI) units:km
8	velECI	H5T_IEEE_F64LE	OnboardOrbitData, CoordinatesXYZ	Satellite Velocity (ECI)	Satellite velocity [km/s] in the ECI (TOD) coordinate system.	long_name:Satellite velocity vector(ECI) units:km/s

Table 4-4 Level 1 Product AttitudeData Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	AttitudeData	–	–	Satellite Attitude Information	–	–
3	timeUTC	H5T_STRING	AttitudeData	Attitude Data Time (UTC)	Attitude data acquisition time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of attitude data (UTC)
4	time	H5T_IEEE_F64LE	AttitudeData	Attitude Data Time (Cumulative Seconds)	Attitude data acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of attitude data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	quaternion	H5T_IEEE_F64LE	AttitudeData, Quaternion	Satellite Attitude	Satellite attitude as a quaternion in the ECI (J2000) frame. q0: the scalar component; q1, q2, q3: i, j, and k respectively.	long_name:Satellite attitude data (J2000 quaternion)

Table 4-5 Level 1 Product AOCEStatus Group Details (1/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	AOCEStatus	–	–	AOCE Status	–	–
3	timeUTC	H5T_STRING	AOCEStatus	AOCE Status Time (UTC)	AOCE status acquisition time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of AOCE status (UTC)
5	time	H5T_IEEE_F64LE	AOCEStatus	AOCE Status Time (Cumulative Seconds)	AOCE status acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of AOCE status (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
6	calStatus	H5T_STD_I8LE	AOCEStatus	CAL Status	Calibration status. Values: 110b: Lunar pointing 111b: Diffuser panel operation 010b: Deep space calibration	long_name:Calibration status flag_values:[6,7,2] flag_meanings:"moon diffuser deepspace"
7	yawSteeringFlag	H5T_STD_U8LE	AOCEStatus	Yaw-Steering Flag	Yaw-steering state. Values: 0: OFF 1: ON	long_name: Yaw steering flag flag_values:[0,1] flag_meanings:"OFF ON"
8	AOCEStatus	H5T_STD_I8LE	AOCEStatus	AOCE Status	AOCE state. Values: 10b: FNM (excluding attitude maneuver) 11b: CAL 01b: OCM sequence (+Δa)	long_name:AOCE status flag_values:[2,3,1] flag_meanings:"FNM CAL OCM"
9	AOCEStatusQuality	H5T_STD_I8LE	AOCEStatus	AOCE Status Quality	Quality result of AOCE status. Values: 0: OK 1: NG	long_name:AOCEStatusQuality flag_values:[0,1] flag_meanings:"OK NG"
10	attitudeStatus	H5T_STD_I8LE	AOCEStatus	Attitude Determination Status	Attitude determination state. Values: 100b: Not converged 101b: Attitude-only converged 110b: Attitude and rate converged 111b: Gyro-integrated basis (no STT update)	long_name:Attitude status flag_values:[4,5,6,7] flag_meanings:"Unstable Att Att_and_Rate Gyro_base"

Table 4-5 Level 1 Product AOCEStatus Group Details (2/2)

No.	Group Path/Dataset Name			Data Type	Dimension	Name	Description	Attribute
11			orbitStatus	H5T_STD_I8LE	AOCEStatus	Orbit Determination Status	Orbit determination state. Values: 00b: AOCE internal propagation 10b: GPS orbit determination (Kalman filter converged) 11b: GPS orbit determination (AG Kalman filter converged)	long_name:Orbit status flag_values:[0,2,3] flag_meanings:"AOCE_Internal GPS(Kalman_filter) GPS(AG_and_Kalman_filter)"
12			autoTrackingFlag	H5T_STRING	AOCEStatus	Auto-Tracking Confirmation Flag	Automatic tracking fixed flag. Values: "Good" "NG"	long_name:Product auto tracking flag flag_values:["Good","NG"] flag_meanings:"Good NG"
13			timeSystem	H5T_STD_I8LE	AOCEStatus	Time System Status	Time-system status. Values: 00b: AOCE internal clock; 01b: GPS align; 10b: CDMS align	long_name:Time system flag_values:[0,1,2] flag_meanings:"AOCE_Internal GPS CDMS"
14			timeSystemFlag	H5T_STRING	AOCEStatus	Time Information Flag	Time information flag. Values: "Good" "NG"	long_name:Time system flag flag_values:["Good","NG"] flag_meanings:"Good NG"

Table 4-6 Level 1 Product PointingData Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	−	−	−	−	−
2	PointingData	−	−	Pointing Information	−	−
3	timeUTC	H5T_STRING	PointingData	Pointing Data Reference Time (UTC)	Pointing data acquisition time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds).	long_name:Date and time of pointing data (UTC)
4	time	H5T_IEEE_F64LE	PointingData	Pointing Data Time (Cumulative Seconds)	Pointing data acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of pointing data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	directionControlAngleAT	H5T_IEEE_F64LE	PointingData	Pointing Control Angle (AT)	AT (Along-Track) pointing control angle ω [rad].	long_name:Direction control angle AT units:radians
6	directionControlAngleATQualityFlag	H5T_STD_I8LE	PointingData	Pointing Control Angle (AT) Quality Flag	Quality flag for the AT pointing control angle. Values: 0: OK 1: Error	long_name:Direction control angle AT quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
7	directionControlAngleCT	H5T_IEEE_F64LE	PointingData	Pointing Control Angle (CT)	CT (Cross-Track) pointing control angle θ [rad].	long_name:Direction control angle CT units:radians
8	directionControlAngleCTQualityFlag	H5T_STD_I8LE	PointingData	Pointing Control Angle (CT) Quality Flag	Quality flag for the CT pointing control angle. Values: 0: OK 1: Error	long_name:Direction control angle CT quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
9	opticalPathSwitchingMotorAngle	H5T_IEEE_F64LE	PointingData	Optical Path Switching Motor Drive Angle	Motor drive angle for optical-path switching [rad].	long_name:Optical path switching motor angle units:radians
10	opticalPathSwitchingMotorAngleQualityFlag	H5T_STD_I8LE	PointingData	Optical Path Switching Motor Drive Angle Quality Flag	Quality flag for the optical-path switching motor drive angle. Values: 0: OK; 1: Error.	long_name:Optical path switching motor angle quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-7 Level 1 Product SpacecraftTimeError Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	SpacecraftTimeError	–	–	Satellite Time Error	–	–
3	startDate	H5T_STRING	SpacecraftTimeErrorInfo	Data Validity Period Start Time (UTC)	Data validity period start time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Start date of Time Difference Information (UTC)
4	endDate	H5T_STRING	SpacecraftTimeErrorInfo	Data Validity Period End Time (UTC)	Data validity period end time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:End date of Time Difference Information (UTC)
5	groundTime	H5T_STRING	SpacecraftTimeErrorInfo	Reference Ground Time (UTC)	Reference ground time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Ground Reference time (UTC)
6	refCount	H5T_STD_I32LE	SpacecraftTimeErrorInfo	Reference Satellite Time	Reference satellite time (elapsed seconds) used to calculate the satellite counter period for the visible pass.	long_name:Satellite Reference time (seconds) units:seconds
7	periodCount	H5T_IEEE_F64LE	SpacecraftTimeErrorInfo	Calculated Satellite Counter Cycle	Calculated satellite counter period per counter during the data validity period.	long_name:Satellite counter period units:seconds

Table 4-8 Level 1 Product SiderealTimeInfo Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	SiderealTimeInfo	–	–	Sidereal Time Information	–	–
3	timeUTC	H5T_STRING	SiderealTimeDataInfo	Reference Time t0 (UTC)	Reference time t0 (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Reference time t0 (UTC)
4	time	H5T_IEEE_F64LE	SiderealTimeDataInfo	Reference Time t0 (Cumulative Seconds)	Reference time t0 as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Reference time t0 (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	thetaG0	H5T_IEEE_F64LE	SiderealTimeDataInfo	Greenwich Sidereal Time θg0	Greenwich Sidereal Time θg0 [degrees] at the reference time. The valid range of θg0 is 0 ≤ θg0 < 360.	units:degrees long_name:theta_g0 valid_min:0 valid_max:360
6	thetaGDot	H5T_IEEE_F64LE	SiderealTimeDataInfo	Rate of Change of Greenwich Sidereal Time θg0_dot	Greenwich Mean Sidereal Time rate of change (θg_dot) [degrees/second].	units:degrees/second long_name:theta_g0_dot

Table 4-9 Level 1 Product TransCoordMatrix Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	TransCoordMatrix	–	–	Coordinate Transformation Information	–	–
3	timeUTC	H5T_STRING	TransCoordMatrixInfo	PN, XY Matrix Calculation Time (UTC)	PN, XY matrix calculation time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of PN and XY matrix (UTC)
4	time	H5T_IEEE_F64LE	TransCoordMatrixInfo	PN, XY Matrix Calculation Time (Cumulative Seconds)	PN, XY matrix calculation time (elapsed seconds) as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of PN and XY matrix (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	pnMatrix	H5T_IEEE_F64LE	TransCoordMatrixInfo, TransCoordMatrix	PN Matrix	PN matrix in row-major order. Rows: (PN00, PN01, PN02), (PN10, PN11, PN12), (PN20, PN21, PN22) The PN matrix is the coordinate transformation matrix for precession and nutation from ECI (J2000) to ECI (TOD).	long_name:PN Matrix
6	xyMatrix	H5T_IEEE_F64LE	TransCoordMatrixInfo, TransCoordMatrix	XY Matrix	XY matrix in row-major order. Rows: (XY00, XY01, XY02), (XY10, XY11, XY12), (XY20, XY21, XY22) The XY matrix is the polar motion coordinate transformation from the pseudo-Earth-fixed coordinate system (without polar motion) to ECR (WGS84).	long_name:XY Matrix

Table 4-10 Level 1 Product KinematicOrbitDataPredicted Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	KinematicOrbitDataPredicted	–	–	Predicted Orbit Calendar	–	–
3	timeUTC	H5T_STRING	PredictedOrbitData	Orbit Data Time (UTC)	Orbit data time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of predicted kinematic orbit data (UTC)
4	time	H5T_IEEE_F64LE	PredictedOrbitData	Orbit Data Time (Cumulative Seconds)	Orbit data time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of predicted kinematic orbit data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	posECR	H5T_IEEE_F64LE	PredictedOrbitData, CoordinatesXYZ	Satellite Position (ECR)	Satellite position [km] in the ECR (WGS84) coordinate system.	long_name:Satellite position vector(ECR) units:km
6	posECI	H5T_IEEE_F64LE	PredictedOrbitData, CoordinatesXYZ	Satellite Position (ECI)	Satellite position [km] in the ECI (TOD) coordinate system.	long_name:Satellite position vector(ECI) units:km

Table 4-11 Level 1 Product KinematicOrbitDataDetermined Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	−	−	−	−	−
2	KinematicOrbitDataDetermined	−	−	Confirmed Orbit Calendar	−	−
3	timeUTC	H5T_STRING	DeterminedOrbitData	Orbit Data Time (UTC)	Orbit data time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of determined kinematic orbit data(UTC)
4	time	H5T_IEEE_F64LE	DeterminedOrbitData	Orbit Data Time (Cumulative Seconds)	Orbit data time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of determined kinematic orbit data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	posECR	H5T_IEEE_F64LE	DeterminedOrbitData, CoordinatesXYZ	Satellite Position (ECR)	Satellite position [km] in the ECR (WGS84) coordinate system.	long_name:Satellite position (ECR) units:km
6	posECI	H5T_IEEE_F64LE	DeterminedOrbitData, CoordinatesXYZ	Satellite Position (ECI)	Satellite position [km] in the ECI (TOD) coordinate system.	long_name:Satellite position (ECI) units:km

Table 4-12 Level 1 Product SolarEphemeris Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	SolarEphemeris	–	–	Celestial Calendar (Sun)	–	–
3	timeUTC	H5T_STRING	SolarOrbitData	Orbit Data Time (UTC)	Orbit data time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of solar ephemeris data (UTC)
4	time	H5T_IEEE_F64LE	SolarOrbitData	Orbit Data Time (Cumulative Seconds)	Orbit data time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of solar ephemeris data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	posECI	H5T_IEEE_F64LE	SolarOrbitData, CoordinatesXYZ	Sun Position (ECI)	Sun position [km] in the ECI (TOD) coordinate system.	long_name:Solar position (ECI) units:km

Table 4-13 Level 1 Product LunarEphemeris Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	LunarEphemeris	–	–	Celestial Calendar (Moon)	–	–
3	timeUTC	H5T_STRING	LunarOrbitData	Orbit Data Time (UTC)	Orbit data time (UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of lunar ephemeris data(UTC)
4	time	H5T_IEEE_F64LE	LunarOrbitData	Orbit Data Time (Cumulative Seconds)	Orbit data time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of lunar ephemeris data (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	posECI	H5T_IEEE_F64LE	LunarOrbitData, CoordinatesXYZ	Moon Position (ECI)	Moon position [km] in the ECI (TOD) coordinate system.	long_name:Lunar position (ECI) units:km

Table 4-14 Level 1 Product HKData Group Details (1/9)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common	–	–	–	–	–
2	HKData	–	–	HK Data	–	–
3	AD3_IP_TEMP_timeUTC	H5T_STRING	AD3_IP_TEMP	AD3_IP_TEMP Acquisition Time (UTC)	AD3_IP_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of AD3_IP_TEMP (UTC)
4	AD3_IP_TEMP_time	H5T_IEEE_F64LE	AD3_IP_TEMP	AD3_IP_TEMP Acquisition Time (Cumulative Seconds)	AD3_IP_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of AD3_IP_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	AD3_IP_TEMP_Temperature	H5T_IEEE_F64LE	AD3_IP_TEMP	AD3_IP_TEMP Temperature	AD3_IP_TEMP temperature [℃].	long_name: AD3_IP_TEMP temperature units:degree_Celsius
6	AD3_IP_TEMP_QualityFlag	H5T_STD_I8LE	AD3_IP_TEMP	AD3_IP_TEMP Quality Flag	AD3_IP_TEMP quality assessment result. Values: 0: Normal 1: Abnormal	long_name: AD3_IP_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
7	AD3_AMP_TEMP_timeUTC	H5T_STRING	AD3_AMP_TEMP	AD3_AMP_TEMP Acquisition Time (UTC)	AD3_AMP_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of AD3_AMP_TEMP (UTC)
8	AD3_AMP_TEMP_time	H5T_IEEE_F64LE	AD3_AMP_TEMP	AD3_AMP_TEMP Acquisition Time (Cumulative Seconds)	AD3_AMP_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59 as 0.	long_name:Date and time of AD3_AMP_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
9	AD3_AMP_TEMP_Temperature	H5T_IEEE_F64LE	AD3_AMP_TEMP	AD3_AMP_TEMP Temperature	AD3_AMP_TEMP temperature [℃].	long_name: AD3_AMP_TEMP temperature units:degree_Celsius
10	AD3_AMP_TEMP_QualityFlag	H5T_STD_I8LE	AD3_AMP_TEMP	AD3_AMP_TEMP Quality Flag	AD3_AMP_TEMP quality assessment result. Values: 0: Normal 1: Abnormal	long_name: AD3_AMP_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (2/9)

No.			Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
11			B1_DET_TEMP_A_timeUTC	H5T_STRING	B1_DET_TEMP_A	B1_DET_TEMP_A Acquisition Time (UTC)	B1_DET_TEMP_A acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of B1_DET_TEMP_A (UTC)
12			B1_DET_TEMP_A_time	H5T_IEEE_F64LE	B1_DET_TEMP_A	B1_DET_TEMP_A Acquisition Time (Cumulative Seconds)	B1_DET_TEMP_A acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of B1_DET_TEMP_A (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
13			B1_DET_TEMP_A_Temperature	H5T_IEEE_F64LE	B1_DET_TEMP_A	B1_DET_TEMP_A Temperature	B1_DET_TEMP_A temperature [℃].	long_name: B1_DET_TEMP_A temperature units:degree_Celsius
14			B1_DET_TEMP_A_QualityFlag	H5T_STD_I8LE	B1_DET_TEMP_A	B1_DET_TEMP_A Quality Flag	B1_DET_TEMP_A quality assessment result. Values: 0: Normal 1: Abnormal	long_name: B1_DET_TEMP_A quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
15			PCA_DET1_TEMP_B_timeUTC	H5T_STRING	PCA_DET1_TEMP_B	PCA_DET1_TEMP_B Acquisition Time (UTC)	PCA_DET1_TEMP_B acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of PCA_DET1_TEMP_B (UTC)
16			PCA_DET1_TEMP_B_time	H5T_IEEE_F64LE	PCA_DET1_TEMP_B	PCA_DET1_TEMP_B Acquisition Time (Cumulative Seconds)	PCA_DET1_TEMP_B acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of PCA_DET1_TEMP_B (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
17			PCA_DET1_TEMP_B_Temperature	H5T_IEEE_F64LE	PCA_DET1_TEMP_B	PCA_DET1_TEMP_B Temperature	PCA_DET1_TEMP_B temperature [℃].	long_name: PCA_DET1_TEMP_B temperature units:degree_Celsius
18			PCA_DET1_TEMP_B_QualityFlag	H5T_STD_I8LE	PCA_DET1_TEMP_B	PCA_DET1_TEMP_B Quality Flag	PCA_DET1_TEMP_B quality assessment result. Values: 0: Normal 1: Abnormal	long_name: PCA_DET1_TEMP_B quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (3/9)

No.	Group Path/Dataset Name			Data Type	Dimension	Name	Description	Attribute
19			B2_DET_TEMP_A_timeUTC	H5T_STRING	B2_DET_TEMP_A	B2_DET_TEMP_A Acquisition Time (UTC)	B2_DET_TEMP_A acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of B2_DET_TEMP_A (UTC)
20			B2_DET_TEMP_A_time	H5T_IEEE_F64LE	B2_DET_TEMP_A	B2_DET_TEMP_A Acquisition Time (Cumulative Seconds)	B2_DET_TEMP_A acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of B2_DET_TEMP_A (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
21			B2_DET_TEMP_A_Temperature	H5T_IEEE_F64LE	B2_DET_TEMP_A	B2_DET_TEMP_A Temperature	B2_DET_TEMP_A temperature [℃].	long_name: B2_DET_TEMP_A temperature units:degree_Celsius
22			B2_DET_TEMP_A_QualityFlag	H5T_STD_I8LE	B2_DET_TEMP_A	B2_DET_TEMP_A Quality Flag	Stores the B2_DET_TEMP_A quality assessment result. Values: 0: Normal 1: Abnormal	long_name: B2_DET_TEMP_A quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
23			B2_DET_TEMP_B_timeUTC	H5T_STRING	B2_DET_TEMP_B	B2_DET_TEMP_B Acquisition Time (UTC)	B2_DET_TEMP_B acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of B2_DET_TEMP_B (UTC)
24			B2_DET_TEMP_B_time	H5T_IEEE_F64LE	B2_DET_TEMP_B	B2_DET_TEMP_B Acquisition Time (Cumulative Seconds)	B2_DET_TEMP_B acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of B2_DET_TEMP_B (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
25			B2_DET_TEMP_B_Temperature	H5T_IEEE_F64LE	B2_DET_TEMP_B	B2_DET_TEMP_B Temperature	B2_DET_TEMP_B temperature [℃].	long_name: B2_DET_TEMP_B temperature units:degree_Celsius
26			B2_DET_TEMP_B_QualityFlag	H5T_STD_I8LE	B2_DET_TEMP_B	B2_DET_TEMP_B Quality Flag	B2_DET_TEMP_B quality assessment result. Values: 0: Normal 1: Abnormal	long_name: B2_DET_TEMP_B quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (4/9)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
27	B3_DET_TEMP_A_timeUTC	H5T_STRING	B3_DET_TEMP_A	B3_DET_TEMP_A Acquisition Time (UTC)	Stores the B3_DET_TEMP_A acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of B3_DET_TEMP_A (UTC)
28	B3_DET_TEMP_A_time	H5T_IEEE_F64LE	B3_DET_TEMP_A	B3_DET_TEMP_A Acquisition Time (Cumulative Seconds)	B3_DET_TEMP_A acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of B3_DET_TEMP_A (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
29	B3_DET_TEMP_A_Temperature	H5T_IEEE_F64LE	B3_DET_TEMP_A	B3_DET_TEMP_A Temperature	B3_DET_TEMP_A temperature [℃].	long_name: B3_DET_TEMP_A temperature units:degree_Celsius
30	B3_DET_TEMP_A_QualityFlag	H5T_STD_I8LE	B3_DET_TEMP_A	B3_DET_TEMP_A Quality Flag	B3_DET_TEMP_A quality assessment result. Values: 0: Normal 1: Abnormal	long_name: B3_DET_TEMP_A quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
31	B3_DET_TEMP_B_timeUTC	H5T_STRING	B3_DET_TEMP_B	B3_DET_TEMP_B Acquisition Time (UTC)	Stores the B3_DET_TEMP_B acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of B3_DET_TEMP_B (UTC)
32	B3_DET_TEMP_B_time	H5T_IEEE_F64LE	B3_DET_TEMP_B	B3_DET_TEMP_B Acquisition Time (Cumulative Seconds)	B3_DET_TEMP_B acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of B3_DET_TEMP_B (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
33	B3_DET_TEMP_B_Temperature	H5T_IEEE_F64LE	B3_DET_TEMP_B	B3_DET_TEMP_B Temperature	B3_DET_TEMP_B temperature [℃].	long_name: B3_DET_TEMP_B temperature units:degree_Celsius
34	B3_DET_TEMP_B_QualityFlag	H5T_STD_I8LE	B3_DET_TEMP_B	B3_DET_TEMP_B Quality Flag	B3_DET_TEMP_B quality assessment result. Values: 0: Normal 1: Abnormal	long_name: B3_DET_TEMP_B quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (5/9)

No.	Group Path/Dataset Name			Data Type	Dimension	Name	Description	Attribute
35			OC_IF_timeUTC	H5T_STRING	OC_IF	A System/B System Determination Flag Acquisition Time (UTC)	OC interface flag acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of OC Interface Flags (UTC)
36			OC_IF_time	H5T_IEEE_F64LE	OC_IF	A System/B System Determination Flag Acquisition Time (Cumulative Seconds)	OC interface flag acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of OC Interface Flags (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
37			OC_IF	H5T_STD_I8LE	OC_IF	A System/B System Determination Flag	Flag to determine system A or system B. Values: 0: System A 1: System B	long_name:OC Interface Flags flag_values:[0,1] flag_meanings:"A B"
38			TS3_OPSS1_1_TEMP_timeUTC	H5T_STRING	TS3_OPSS1_1_TEMP	TS3_OPSS1_1_TEMP Acquisition Time (UTC)	TS3_OPSS1_1_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS1_1_TEMP (UTC)
39			TS3_OPSS1_1_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS1_1_TEMP	TS3_OPSS1_1_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS1_1_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS1_1_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
40			TS3_OPSS1_1_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS1_1_TEMP	TS3_OPSS1_1_TEMP Temperature	TS3_OPSS1_1_TEMP temperature [℃].	long_name: TS3_OPSS1_1_TEMP temperature units:degree_Celsius
41			TS3_OPSS1_1_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS1_1_TEMP	TS3_OPSS1_1_TEMP Quality Flag	TS3_OPSS1_1_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS1_1_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (6/9)

No.			Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
42			TS3_OPSS1_2_TEMP_timeUTC	H5T_STRING	TS3_OPSS1_2_TEMP	TS3_OPSS1_2_TEMP Acquisition Time (UTC)	Stores the TS3_OPSS1_2_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS1_2_TEMP (UTC)
43			TS3_OPSS1_2_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS1_2_TEMP	TS3_OPSS1_2_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS1_2_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS1_2_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
44			TS3_OPSS1_2_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS1_2_TEMP	TS3_OPSS1_2_TEMP Temperature	TS3_OPSS1_2_TEMP temperature [℃].	long_name: TS3_OPSS1_2_TEMP temperature units:degree_Celsius
45			TS3_OPSS1_2_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS1_2_TEMP	TS3_OPSS1_2_TEMP Quality Flag	TS3_OPSS1_2_TEMP quality: Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS1_2_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
46			TS3_OPSS1_3_TEMP_timeUTC	H5T_STRING	TS3_OPSS1_3_TEMP	TS3_OPSS1_3_TEMP Acquisition Time (UTC)	TS3_OPSS1_3_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS1_3_TEMP (UTC)
47			TS3_OPSS1_3_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS1_3_TEMP	TS3_OPSS1_3_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS1_3_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS1_3_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
48			TS3_OPSS1_3_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS1_3_TEMP	TS3_OPSS1_3_TEMP Temperature	TS3_OPSS1_3_TEMP temperature [℃].	long_name: TS3_OPSS1_3_TEMP temperature units:degree_Celsius
49			TS3_OPSS1_3_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS1_3_TEMP	TS3_OPSS1_3_TEMP Quality Flag	TS3_OPSS1_3_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS1_3_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (7/9)

No.			Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
50			TS3_OPSS2_1_TEMP_timeUTC	H5T_STRING	TS3_OPSS2_1_TEMP	TS3_OPSS2_1_TEMP Acquisition Time (UTC)	Stores the TS3_OPSS2_1_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS2_1_TEMP (UTC)
51			TS3_OPSS2_1_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS2_1_TEMP	TS3_OPSS2_1_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS2_1_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS2_1_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
52			TS3_OPSS2_1_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS2_1_TEMP	TS3_OPSS2_1_TEMP Temperature	TS3_OPSS2_1_TEMP temperature [℃].	long_name: TS3_OPSS2_1_TEMP temperature units:degree_Celsius
53			TS3_OPSS2_1_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS2_1_TEMP	TS3_OPSS2_1_TEMP Quality Flag	TS3_OPSS2_1_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS2_1_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
54			TS3_OPSS2_2_TEMP_timeUTC	H5T_STRING	TS3_OPSS2_2_TEMP	TS3_OPSS2_2_TEMP Acquisition Time (UTC)	TS3_OPSS2_2_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS2_2_TEMP (UTC)
55			TS3_OPSS2_2_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS2_2_TEMP	TS3_OPSS2_2_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS2_2_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS2_2_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
56			TS3_OPSS2_2_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS2_2_TEMP	TS3_OPSS2_2_TEMP Temperature	TS3_OPSS2_2_TEMP temperature [℃].	long_name: TS3_OPSS2_2_TEMP temperature units:degree_Celsius
57			TS3_OPSS2_2_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS2_2_TEMP	TS3_OPSS2_2_TEMP Quality Flag	TS3_OPSS2_2_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS2_2_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (8/9)

No.			Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
58			TS3_OPSS2_3_TEMP_timeUTC	H5T_STRING	TS3_OPSS2_3_TEMP	TS3_OPSS2_3_TEMP Acquisition Time (UTC)	TS3_OPSS2_3_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS2_3_TEMP (UTC)
59			TS3_OPSS2_3_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS2_3_TEMP	TS3_OPSS2_3_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS2_3_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS2_3_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
60			TS3_OPSS2_3_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS2_3_TEMP	TS3_OPSS2_3_TEMP Temperature	TS3_OPSS2_3_TEMP temperature [℃].	long_name: TS3_OPSS2_3_TEMP temperature units:degree_Celsius
61			TS3_OPSS2_3_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS2_3_TEMP	TS3_OPSS2_3_TEMP Quality Flag	TS3_OPSS2_3_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS2_3_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
62			TS3_OPSS3_1_TEMP_timeUTC	H5T_STRING	TS3_OPSS3_1_TEMP	TS3_OPSS3_1_TEMP Acquisition Time (UTC)	TS3_OPSS3_1_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS3_1_TEMP (UTC)
63			TS3_OPSS3_1_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS3_1_TEMP	TS3_OPSS3_1_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS3_1_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS3_1_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
64			TS3_OPSS3_1_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS3_1_TEMP	TS3_OPSS3_1_TEMP Temperature	TS3_OPSS3_1_TEMP temperature [℃].	long_name: TS3_OPSS3_1_TEMP temperature units:degree_Celsius
65			TS3_OPSS3_1_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS3_1_TEMP	TS3_OPSS3_1_TEMP Quality Flag	TS3_OPSS3_1_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS3_1_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-14 Level 1 Product HKData Group Details (9/9)

No.			Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
66			TS3_OPSS3_2_TEMP_timeUTC	H5T_STRING	TS3_OPSS3_2_TEMP	TS3_OPSS3_2_TEMP Acquisition Time (UTC)	TS3_OPSS3_2_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS3_2_TEMP (UTC)
67			TS3_OPSS3_2_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS3_2_TEMP	TS3_OPSS3_2_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS3_2_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS3_2_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
68			TS3_OPSS3_2_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS3_2_TEMP	TS3_OPSS3_2_TEMP Temperature	TS3_OPSS3_2_TEMP temperature [℃].	long_name: TS3_OPSS3_2_TEMP temperature units:degree_Celsius
69			TS3_OPSS3_2_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS3_2_TEMP	TS3_OPSS3_2_TEMP Quality Flag	TS3_OPSS3_2_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS3_2_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
70			TS3_OPSS3_3_TEMP_timeUTC	H5T_STRING	TS3_OPSS3_3_TEMP	TS3_OPSS3_3_TEMP Acquisition Time (UTC)	TS3_OPSS3_3_TEMP acquisition time(UTC). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds)	long_name:Date and time of TS3_OPSS3_3_TEMP (UTC)
71			TS3_OPSS3_3_TEMP_time	H5T_IEEE_F64LE	TS3_OPSS3_3_TEMP	TS3_OPSS3_3_TEMP Acquisition Time (Cumulative Seconds)	TS3_OPSS3_3_TEMP acquisition time as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Date and time of TS3_OPSS3_3_TEMP (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
72			TS3_OPSS3_3_TEMP_Temperature	H5T_IEEE_F64LE	TS3_OPSS3_3_TEMP	TS3_OPSS3_3_TEMP Temperature	TS3_OPSS3_3_TEMP temperature [℃].	long_name: TS3_OPSS3_3_TEMP temperature units:degree_Celsius
73			TS3_OPSS3_3_TEMP_QualityFlag	H5T_STD_I8LE	TS3_OPSS3_3_TEMP	TS3_OPSS3_3_TEMP Quality Flag	TS3_OPSS3_3_TEMP quality. Values: 0: Normal 1: Abnormal	long_name: TS3_OPSS3_3_TEMP quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-15 Level 1 Product SceneInfo Group Details (1/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/SceneInfo	–	–	Scene Information	Scene information for each observation ID.	–
2	obsID	H5T_STD_U16LE	Sounding	Observation ID	Observation ID.	long_name:Observation ID
3	planStartDateTime	H5T_STRING	Sounding	Observation Start Time in Observation Plan (UTC)	Observation start time (UTC) for the observation plan's Observation ID. Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds) If a single Observation ID spans multiple files, the processing result of the first file containing that Observation ID stores the planned start time, and the second and subsequent files store "*".	long_name:Observation plan start time (UTC)
4	planEndDateTime	H5T_STRING	Sounding	Observation End Time in Observation Plan (UTC)	Observation end time (UTC) for the observation plan's Observation ID. Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds) If a single Observation ID spans multiple files, the processing result of the last file containing that Observation ID stores the planned end time, and the preceding files store "*".	long_name:Observation plan end time (UTC)
5	obsFrameNum	H5T_STD_U16LE	Sounding,Band	Number of Frames	Number of frames for each Observation ID.	long_name:Obs frame num valid_min:0
6	obsMissingFrameNum	H5T_STD_I16LE	Sounding,Band	Number of Missing Frames	Number of missing frames per Observation ID. For unprocessed bands, store -1.	long_name:Number of obs missing frames valid_min:0 _FillValue:-1
7	obsMissingFrameRatio	H5T_IEEE_F64LE	Sounding,Band	Missing Frame Rate	Missing rate per Observation ID (0-100%). The missing rate is calculated as obsMissingFrameNum / obsFrameNum × 100 [%]. If there is no missing data, it is 0 [%]. If obsFrameNum is 0 or for unprocessed bands, store NaN.	long_name:Obs missing frame ratio units:percent valid_min:0 valid_max:100 _FillValue:NaN

Table 4-15 Level 1 Product SceneInfo Group Details (2/2)

No.		Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
8		obsQualityFlag	H5T_STD_STRING	Sounding	Overall Quality Flag per Observation ID	Stores the overall quality per observation ID. Values: "Good", "Fair", "Poor", "NG".	long_name:Obs quality flag flag_values:["Good", "Fair", "Poor", "NG"] flag_meanings:"Good Fair Poor NG"
9		geospatial_bounds	H5T_STD_STRING	Sounding	Observation Area on Map	Latitude and longitude range calculated based on the reference band as a polygon represented in the OGC Well-Known Text (WKT) Geometry format. Geometry format example: POLYGON ((152.28 83.71,91.82 73.23,-10.34 34.10,-24.72 -25.31,-39.30 -84.97,-105.73 -73.60,-40.70 -23.13,-27.99 36.52)). The latitude and longitude values are stored without leading zeros and with two decimal places. This is stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. For all other products, this dataset is not stored.	long_name:geospatial_bounds _FillValue:"-"

Table 4-16 Level 1 Product FrameInfo Group Details (1/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common or /Band1 or /Band2 or /Band3	-	-	-	-	-
2	FrameInfo	-	-	Frame Information	-	-
3	frameTimeUTC	H5T_STRING	Frame	Observation Time per Frame (Uncorrected) (UTC)	Observation time (UTC) of per frame (excluding delay time and integration time). Format: "YYYY-MM-DDThh:mm:ss.ffffffZ" YYYY: year(AD) MM: 01-12 (month) DD: 01-31 (day) hh: 00-23 (hour) mm: 00-59 (minute) ss: 00-60 (second) ffffff: 000000-999999 (microseconds) This time is the same value for each group of /Band1, /Band2, /Band3.	long_name:Frame common time (UTC)
4	frameTime	H5T_IEEE_F64LE	Frame	Observation Time per Frame (Uncorrected) (Cumulative Seconds)	Observation time of per frame (excluding delay time and integration time) as elapsed seconds (sec) since 2012-12-31 23:59:59. This time is the same value for each group of /Band1, /Band2, /Band3.	long_name:Frame common time (seconds) standard_name:time units:seconds since 2012-12-31T23:59:59Z
5	obsID	H5T_STD_U16LE	Frame	Observation ID per Frame	Observation ID for each frame. The observation ID ranges from 0 to 65535. obsID is the same value for each group of /Band1, /Band2, /Band3.	long_name:Observation ID valid_min:0 valid_max:65535
6	missingFlag	H5T_STD_U8LE	Frame	Missing Flag per Frame	Missing flag for each frame. Values: 0: Normal 1: Missing If even a single pixel is missing within a frame, the flag is 1. or the common band, if any band has a missing flag is set to 'Missing', the flag is 1.	long_name:Missing Flag flag_values:[0,1] flag_meanings:"Normal Missing"
7	saturationFlag	H5T_STD_U8LE	Frame	Saturation Flag per Frame	Saturation flag for each frame. Values: 0: Normal 1: Saturated 2: Indeterminate (e.g., no applicable data) If even a single pixel is saturated within a frame, the flag is 1. or the common band, if any band has a saturation flag is set to 'Missing', the flag is 1.	long_name:Saturation Flag flag_values:[0,1,2] flag_meanings:"Normal Saturated NA"

Table 4-16 Level 1 Product FrameInfo Group Details (2/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
8	observationTime	H5T_IEEE_F64LE	Frame	Observation Time per Frame (Cumulative Seconds)	Observation time of per frame (considering delay time and integration time) as elapsed seconds (sec) since 2012-12-31 23:59:59.	long_name:Observation time standard_name:time units:seconds since 2012-12-31T23:59:59Z _FillValue:-999.0
9	integrationTime	H5T_IEEE_F64LE	Frame	Integration Time per Frame (Seconds)	Integration time per frame [sec].	long_name: Integration time units:seconds _FillValue:-999.0
10	yawSteeringFlag	H5T_STD_U8LE	Frame	Yaw Steering Flag per Frame	Yaw-steering state for each fram. Values: 0: OFF 1: ON 2: Indeterminate (when determination is not possible due to missing data, etc.) The value is the same value for each group of /Band1, /Band2, /Band3.	long_name: Yaw Steering Flag in frame flag_values:[0,1,2] flag_meanings:"OFF ON NA"
11	temperature	H5T_IEEE_F64LE	Frame, WavelengthTemperatureCorrectionTemperatureNum	Component Temperatures	Temperature of each unit for each frame. For details, refer to WavelengthTemperatureCorrectionTemperatureNum.	long_name: temperatures units:degree_Celsius _FillValue:-999.0
12	sensorTemperatureB1	H5T_IEEE_F64LE	Frame	Band 1 Detector Temperature	Detector temperature of Band 1 at the observation time considering delay time and integration time. This dataset is not output for Common.	long_name: Sensor temperature of band1 units:degree_Celsius _FillValue:-999.0
13	sensorTemperatureB2	H5T_IEEE_F64LE	Frame	Band 2 Detector Temperature	Detector temperature of Band 2 at the observation time considering delay time and integration time. This dataset is not output for Common.	long_name: Sensor temperature of band2 units:degree_Celsius _FillValue:-999.0
14	sensorTemperatureB3	H5T_IEEE_F64LE	Frame	Band 3 Detector Temperature	Detector temperature of Band 3 at the observation time considering delay time and integration time. This dataset is not output for Common.	long_name: Sensor temperature of band3 units:degree_Celsius _FillValue:-999.0
15	preampTemperatureB3	H5T_IEEE_F64LE	Frame	Band 3 Preamplifier Temperature	Preamplifier temperature of Band 3 at the observation time considering delay time and integration time. This dataset is not output for Common.	long_name: Preamp temperature of band3 units:degree_Celsius _FillValue:-999.0
16	ampTemperatureB3	H5T_IEEE_F64LE	Frame	Band 3 Amplifier Temperature	Amplifier temperature of Band 3 at the observation time considering delay time and integration time. This dataset is not output for Common.	long_name: Amp temperature of band3 units:degree_Celsius _FillValue:-999.0

Table 4-17 Level 1 Product SatelliteGeometry Group Details (1/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common or /Band1 or /Band2 or /Band3	–	–	–	–	–
2	SatelliteGeometry	–	–	Satellite Geometry Information	–	–
3	satPos_ECR	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Satellite Position (ECR)	Satellite position [km] in the ECR (WGS84) coordinate system at the observation time, taking into account the delay time and integration time. If valid orbital data does not exist, an invalid value is stored.	long_name:Satellite position (ECR) units:km _FillValue:NaN
4	satVel_ECR	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Satellite Velocity (ECR)	Satellite velocity [km/s] at the observation time in the ECR (WGS84) coordinate system, taking into account the delay time and integration time. If valid orbital data does not exist, an invalid value is stored.	long_name:Satellite velocity (ECR) units:km/s _FillValue:NaN
5	satPos_ECI	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Satellite Position (ECI)	Satellite position [km] at the observation time in the ECI (TOD) coordinate system, taking into account the delay time and integration time. If valid orbital data does not exist, an invalid value is stored.	long_name:Satellite position (ECI) units:km _FillValue:NaN
6	satVel_ECI	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Satellite Velocity (ECI)	Satellite velocity [km/s] at the observation time in the ECI (TOD) coordinate system, taking into account the delay time and integration time. If valid orbital data does not exist, an invalid value is stored.	long_name:Satellite velocity (ECI) units:km/s _FillValue:NaN
7	satRPY	H5T_IEEE_F64LE	Frame, AttitudeRPY	Attitude Angles (Roll, Pitch, Yaw)	Satellite attitude in the order of roll, pitch, yaw at the observation time, taking into account the delay time and integration time. Roll, pitch, and yaw ranges are: $-180 < \text{satRPY[frameNum][b]} \leq 180$. If valid attitude data does not exist, an invalid value is stored.	long_name:Satellite Attitude Roll/Pitch/Yaw units:degrees valid_min:-180 valid_max:180 _FillValue:NaN
8	satRPYQualityFlag	H5T_STD_I8LE	Frame, AttitudeRPY	Attitude Angles Quality Flag	Attitude quality flag in the order of roll, pitch, yaw. Values: 0: Normal 1: Abnormal	long_name: Satellite Attitude Roll/Pitch/Yaw quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"
9	satRPYAngularVelocity	H5T_IEEE_F64LE	Frame, AttitudeRPY	Attitude Angles (Roll, Pitch, Yaw)	Angular rate of the satellite attitude in the order of roll, pitch, yaw at the observation time, taking into account the delay time and integration time. If valid attitude data does not exist, an invalid value is stored.	long_name:Satellite Attitude Roll/Pitch/Yaw angular velocity units:degrees/s _FillValue:NaN
10	satRPYAngularVelocityQualityFlag	H5T_STD_I8LE	Frame, AttitudeRPY	Attitude Angular Velocity (Roll, Pitch, Yaw) Quality Flag	Attitude angular-rate quality flag in the order of roll, pitch, yaw with the following values: 0: normal, 1: abnormal	long_name: Satellite Attitude Roll/Pitch/Yaw angular velocity quality flag flag_values:[0,1] flag_meanings:"Normal Abnormal"

Table 4-17 Level 1 Product SatelliteGeometry Group Details (2/2)

No.	Group Path/Dataset Name			Data Type	Dimension	Name	Description	Attribute
11			satAtt	H5T_IEEE_F64LE	Frame,Quaternion	Attitude Quaternion (J2000)	Satellite attitude as a quaternion in the ECI (J2000) system. q0 is the scalar component, q1, q2, q3 are the i, j, k components. If valid attitude data does not exist, an invalid value is stored.	long_name:Satellite attitude (ECI(J2000)) in pseudo satellite-fixed coordinate _FillValue:NaN
12			satToECR_Matrix	H5T_IEEE_F64LE	Frame,TransCoordMatrix	Transformation Matrix from Satellite Coordinate System to ECR Coordinate System	Coordinate transformation matrix from the satellite coordinate system to the ECR (WGS84) coordinate system in row-major order. Rows: (0,1,2) (3,4,5) (6,7,8) If valid attitude data does not exist, an invalid value is stored.	long_name:Coordinate transformation matrix from satellite-fixed to ECR(WGS84) _FillValue:NaN
13			satOrbitPrecision	H5T_STRING	scalar	Orbit Type in Use	satPos_ECR/ECI and satVel_ECR/ECI trajectory type. Values: O: onboard, P: predicted orbit calendar, D: determined orbit calendar. If valid orbit data does not exist, default "O"	long_name:Precision of satellite orbit flag_values:["O", "P", "D"] flag_meanings:"Onboard Predicted Determined" _FillValue:"O"

Table 4-18 Level 1 Product SolarGeometry Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common or /Band1 or /Band2 or /Band3	–	–	–	–	–
2	SolarGeometry	–	–	Sun Geometry Information	–	–
3	solarPos_ECR	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Sun Position (ECR)	Apparent Sun's position [km] at the observation time, taking into account delay time and integration time, in the ECR (WGS84) coordinate system. If the Sun's position cannot be calculated, an invalid value is stored.	units:km long_name:Apparent solar position at the frame exposure point (ECR) _FillValue:NaN
4	solarVel_ECR	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Sun Velocity (ECR)	Apparent Sun's velocity [km/s] at the observation time, taking into account delay time and integration time, in the ECR (WGS84) coordinate system. If the Sun's velocity cannot be calculated, an invalid value is stored.	units:km/s long_name:Apparent solar velocity at the frame exposure point(ECR) _FillValue:NaN
5	solarPos_ECI	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Sun Position (ECI)	Apparent Sun's position [km] at the observation time, taking into account delay time and integration time, in the ECI (TOD) coordinate system. If the Sun's position cannot be calculated, an invalid value is stored.	units:km long_name:Apparent solar position at the frame exposure point(ECI) _FillValue:NaN
6	solarVel_ECI	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Sun Velocity (ECI)	Apparent Sun's velocity [km/s] at the imaging time of each frame on the reference band image in the ECI (TOD) coordinate system. If the Sun's position cannot be calculated, an invalid value is stored.	units:km/s long_name:Apparent solar velocity at the frame exposure point (ECI) _FillValue:NaN

Table 4-19 Level 1 Product LunarGeometry Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common or /Band1 or /Band2 or /Band3	－	－	－	－	－
2	LunarGeometry	－	－	Moon Geometry Information	－	－
3	lunarPos_ECR	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Moon Position (ECR)	Moon's position [km] at the observation time, taking into account delay time and integration time, in the ECR (WGS84) coordinate system. If the Moon's position cannot be calculated, an invalid value is stored.	units:km long_name:Lunar position at the frame exposure point (ECR) _FillValue:NaN
4	lunarVel_ECR	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Moon Velocity (ECR)	Moon's velocity [km/s] at the observation time, taking into account delay time and integration time, in the ECR (WGS84) coordinate system. If the Moon's velocity cannot be calculated, an invalid value is stored.	units:km/s long_name:Lunar velocity at the frame exposure point(ECR) _FillValue:NaN
5	lunarPos_ECI	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Moon Position (ECI)	Moon's position [km] at the observation time, taking into account delay time and integration time, in the ECI (TOD) coordinate system. If the Moon's position cannot be calculated, an invalid value is stored.	units:km long_name:Lunar position at the frame exposure point(ECI) _FillValue:NaN
6	lunarVel_ECI	H5T_IEEE_F64LE	Frame, CoordinatesXYZ	Moon Velocity (ECI)	Moon's velocity [km/s] at the observation time, taking into account delay time and integration time, in the ECI (TOD) coordinate system. If the Moon's velocity cannot be calculated, an invalid value is stored.	units:km/s long_name:Lunar velocity at the frame exposure point (ECI) _FillValue:NaN

Table 4-20 Level 1 Product Instrument Group Details (1/2)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common or /Band1 or /Band2 or /Band3	–	–	–	–	–
2	Instrument	–	–	Instrument Information	–	–
3	viewVectorOptics	H5T_IEEE_F64LE	</Common case> No dataset </Band1 case> SpatialPixelB1,WavelengthPixelB1, CoordinatesXYZ </Band2 case> SpatialPixelB2,WavelengthPixelB2, CoordinatesXYZ </Band3 case> SpatialPixelB3,WavelengthPixelB3, CoordinatesXYZ	Line-of-Sight Vector a in Optical Unit Coordinate System	The line-of-sight vector in the Optical Unit coordinate system.	long_name:View vector optics coordinate
4	opticsToTANSO3Matrix	H5T_IEEE_F64LE	TransCoordMatrix	Transformation Matrix P1 from Optical Unit Coordinate System to TANSO-3 Coordinate System	Transformation matrix from the Optical Unit coordinate system to the TANSO-3 coordinate system. Bands 1 to 3 contain the same value.	long_name:Coordinate transform matrix optics to TANSO3
5	pointingToTANSO3Matrix	H5T_IEEE_F64LE	TransCoordMatrix	Transformation Matrix P2 from Pointing Control Unit Coordinate System to TANSO-3 Coordinate System	Transformation matrix from the Pointing Control Unit coordinates to the TANSO-3 coordinates. Bands 1 to 3 contain the same value.	long_name:Coordinate transform matrix pointing to TANSO3
6	xpo0	H5T_IEEE_F64LE	CoordinatesXYZ	AT Direction Pointing Axis Vector of Pointing Control Unit at Initial Position (Pointing Control Unit Coordinate System)	Mirror normal vector of the Pointing Control Unit. Bands 1 to 3 contain the same value.	long_name:AT axis vector
7	ypo0	H5T_IEEE_F64LE	CoordinatesXYZ	CT Direction Pointing Axis Vector of Pointing Control Unit at Initial Position (Pointing Control Unit Coordinate System)	Mirror normal vector of the Pointing Control Unit. Bands 1 to 3 contain the same value.	long_name:CT axis vector
8	na	H5T_IEEE_F64LE	CoordinatesXYZ	Mirror Normal Vector of Pointing Control Unit at Initial Position (Pointing Control Unit Coordinate System)	Mirror normal vector of the Pointing Control Unit. Bands 1 to 3 contain the same value.	long_name:Mirror normal vector
9	TANSO3toSatMatrix	H5T_IEEE_F64LE	TransCoordMatrix	Transformation Matrix P3 from TANSO-3 Coordinate System to Satellite Coordinate System	Transformation matrix from the TANSO-3 coordinate system to the satellite coordinate system. Bands 1 to 3 contain the same value.	long_name:Coordinate transform matrix optics to TANSO3

Table 4-20 Level 1 Product Instrument Group Details (2/2)

No.			Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
10			wavelengthCorrTableP2	H5T_IEEE_F64LE	Only Level 1B shall be stored. </Common case> No dataset </Band1 case> SpatialPixelB1, WavelengthPixelB1, WavelengthTemperatureCorrectionTemperatureNum, WavelengthTemperatureCorrectionPolynomialFunctionOrder </Band2 case> SpatialPixelB2, WavelengthPixelB2, WavelengthTemperatureCorrectionTemperatureNum, WavelengthTemperatureCorrectionPolynomialFunctionOrder </Band3 case> SpatialPixelB3, WavelengthPixelB3, WavelengthTemperatureCorrectionTemperatureNum, WavelengthTemperatureCorrectionPolynomialFunctionOrder	Table for Temperature Correction of Wavelength	The coefficients for correcting the wavelength of observation data using temperature.	long_name:Wavelength-temperature correction table
11			nominal_temperature	H5T_IEEE_F64LE	Only Level 1B shall be stored. </Common case> No dataset </Band1 case> WavelengthTemperatureCorrectionTemperatureNum </Band2 case> WavelengthTemperatureCorrectionTemperatureNum </Band3 case> WavelengthTemperatureCorrectionTemperatureNum	Nominal Temperature Values of Each Component [℃]	Nominal values of each unit's temperature.	long_name: nominal temperature units:degree_Celsius
12			mcm_correction_coefficient	H5T_IEEE_F64LE	</Common case> No dataset </Band1 case> SpatialPixelB1,WavelengthPixelB1,CoordinatesXYZ </Band2 case> SpatialPixelB2,WavelengthPixelB2,CoordinatesXYZ </Band3 case> SpatialPixelB3,WavelengthPixelB3,CoordinatesXYZ	Coefficient for Correction Amount of Optical Path Switching Motor Drive Angle	Coefficients for correcting the motor drive angle for optical path switching, for the Imaging Mode of the product.	long_name: mcm correction coefficient
13			mcm_nominal_angle	H5T_IEEE_F64LE	scalar	Nominal Value of Optical Path Switching Motor Drive Angle [rad]	Nominal values of the motor drive angle for optical path switching, for the Imaging Mode of the product.	long_name: mcm nominal angle units:radians

Table 4-21 Level 1 Product SoundingGeometry Group Details (1/3)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Common or /Band1 or /Band2 or /Band3	-	-	-	-	-
2	SoundingGeometry	-	-	Image Position Information	-	-
3	directionControlAngleAT	H5T_IEEE_F64LE	Frame	AT Direction Pointing Control Angle	AT-direction pointing control angle ω [rad] at the observation time, taking into account delay time and integration time. The valid range of ω is $-0.3508 < \omega < 0.3509$ [rad] ($-20.1 < \omega < 20.1$ [deg]). If no valid pointing control angle exists, an invalid value is stored.	long_name:Direction Control Angle AT units:radians valid_min: -0.3508 valid_max: 0.3509 _FillValue:NaN
4	directionControlAngleCT	H5T_IEEE_F64LE	Frame	CT Direction Pointing Control Angle	CT-direction pointing control angle θ [rad] at the observation time, taking into account delay time and integration time. The valid range of θ for normal observation is $-0.6999 < \theta < 0.7000$ [rad] ($-40.1 < \theta < 40.1$ [deg]). For sunlight calibration, the valid range is $-3.1434 < \theta < -3.1397$ [rad] ($-180.1 < \theta < -179.9$ [deg]). This field stores the value for normal observation. If no valid pointing control angle exists, an invalid value is stored.	long_name:Direction Control Angle CT units:radians valid_min: -0.6999 valid_max: 0.7000 _FillValue:NaN
5	opticalPathSwitchingMotorAngle	H5T_IEEE_F64LE	Frame	Optical Path Switching Motor Drive Angle	Motor drive angle for optical path switching [rad] at the observation time, taking into account delay time and integration time. If no valid motor drive angle exists, an invalid value is stored.	long_name:Optical path switching motor angle units:radians _FillValue:NaN
6	viewVectorECR	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel,CoordinatesXYZ </Band1 case> Frame,SpatialPixelB1,CoordinatesXYZ </Band2 case> Frame,SpatialPixelB2,CoordinatesXYZ </Band3 case> Frame,SpatialPixelB3,CoordinatesXYZ	Line-of-Sight Vector per Section (ECR) (Binned Pixel Center)	The line-of-sight vector of the center of the binned pixel at the observation time, taking into account delay time and integration time, in the ECR (WGS84) coordinate system. The line-of-sight vector is a unit vector. If no valid line-of-sight vector can be obtained, an invalid value is stored.	long_name:View vector (ECR) pixel center _FillValue:NaN
7	viewVectorPixelBoundsECR	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel,NCorner,CoordinatesXYZ </Band1 case> Frame,SpatialPixelB1,NCorner,CoordinatesXYZ </Band2 case> Frame,SpatialPixelB2,NCorner,CoordinatesXYZ </Band3 case> Frame,SpatialPixelB3,NCorner,CoordinatesXYZ	Line-of-Sight Vector per Section (ECR) (Binned Pixel Corners)	The line-of-sight vectors of the four corners of the binned pixel at the observation time, taking into account delay time and integration time, in the ECR (WGS84) coordinate system. The line-of-sight vectors are unit vectors. If no valid line-of-sight vectors can be obtained, an invalid value is stored. For each segment, the data are stored in the order: forward in the AT direction, then clockwise from the CT- direction.	long_name:View vector (ECR) pixel bounds _FillValue:NaN

Table 4-21 Level 1 Product SoundingGeometry Group Details (2/3)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
8	latitude	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Latitude per Section (Binned Pixel Center)	Observation position (geodetic latitude) [deg] of the center of the binned pixel. The latitude range is as follows: −90 ≤ latitude ≤ 90. If latitude/longitude cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	long_name:Latitude pixel center units:degrees_north standard_name: latitude valid_min:−90 valid_max:90 _FillValue:NaN
9	latitudePixelBounds	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel,NCorner </Band1 case> Frame,SpatialPixelB1,NCorner </Band2 case> Frame,SpatialPixelB2,NCorner </Band3 case> Frame,SpatialPixelB3,NCorner	Latitude per Section (Binned Pixel Corners)	Observation positions (geodetic latitude) [deg] of the four corners of the binned pixel. The latitudePixelBounds range is as follows: −90 ≤ latitudePixelBounds ≤ 90. If latitude/longitude cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. For each segment, the data are stored in the order: forward in the AT direction, then clockwise from the CT− direction.	long_name:Latitude pixel bounds units:degrees_north standard_name: latitude valid_min:−90 valid_max:90 _FillValue:NaN
10	longitude	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Longitude per Section (Binned Pixel Center)	Observation position (geodetic longitude) [deg] of the center of the binned pixel. The longitude range is as follows: −180 < longitude ≤ 180. If latitude/longitude cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	long_name:Longitude pixel center units:degrees_east standard_name: longitude valid_min:−180 valid_max:180 _FillValue:NaN
11	longitudePixelBounds	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel,NCorner </Band1 case> Frame,SpatialPixelB1,NCorner </Band2 case> Frame,SpatialPixelB2,NCorner </Band3 case> Frame,SpatialPixelB3,NCorner	Longitude per Section (Binned Pixel Corners)	Observation positions (geodetic longitude) [deg] of the four corners of the binned pixel. The longitudePixelBounds range is as follows: −180 < longitudePixelBounds ≤ 180. If latitude/longitude cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. For each segment, the data are stored in the order: forward in the AT direction, then clockwise from the CT− direction.	long_name:Longitude pixel bounds units:degrees_east standard_name: longitude valid_min:−180 valid_max:180 _FillValue:NaN

Table 4-21 Level 1 Product SoundingGeometry Group Details (3/3)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
12	viewZenith	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Sensor Incidence Angle per binned pixel	Satellite zenith angle [deg] at the observation position of the center of the binned pixel. The viewZenith range is as follows: 0 ≤ viewZenith ≤ 90. If the sensor incidence angle cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	long_name:View zenith pixel center units:degrees valid_min:0 valid_max:90 _FillValue:NaN
13	viewAzimuth	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Sensor Azimuth Angle per binned pixel	Satellite azimuth angle [deg] at the observation position of the center of the binned pixel. The viewAzimuth range is as follows: 0 ≤ viewAzimuth < 360. If the sensor azimuth angle cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	units:degrees long_name:View azimuth pixel center valid_min: 0 valid_max:360 _FillValue:NaN
14	solarZenith	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Solar Incidence Angle per binned pixel	Solar zenith angle [deg] at the observation position of the center of the binned pixel. The solarZenith range is as follows: 0 ≤ solarZenith ≤ 180. If the solar incidence angle cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	long_name:Solar Zenith pixel center units:degrees valid_min:0 valid_max:180 _FillValue:NaN
15	solarAzimuth	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Solar Azimuth Angle per binned pixel	Solar azimuth angle [deg] at the observation position of the center of the binned pixel. The solarAzimuth range is as follows: 0 ≤ solarAzimuth < 360. If the solar azimuth angle cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	long_name:Solar Azimuth pixel center units:degrees valid_min: 0 valid_max:360 _FillValue:NaN
16	solarDistance	H5T_IEEE_F64LE	</Common case> Frame,SpatialPixel </Band1 case> Frame,SpatialPixelB1 </Band2 case> Frame,SpatialPixelB2 </Band3 case> Frame,SpatialPixelB3	Distance Between Sun and Observation Point	The distance between the Sun and the observation point [A.U] at the observation position of the center of the binned pixel. If the Sun-observation point distance cannot be calculated, an invalid value is stored. Stored only for Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode.	long_name:Solar Distance pixel center units:au _FillValue:NaN

Table 4-22 Level 1 Product SoundingData Group (Level 1A) Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Band1 or /Band2 or /Band3	－	－	－	－	－
2	SoundingData	－	－	Observation Data	－	－
3	raw	H5T_STD_I16LE	</Band1 case> Frame,SpatialPixelB1,WavelengthPixelB1 </Band2 case> Frame,SpatialPixelB2,WavelengthPixelB2 </Band3 case> Frame,SpatialPixelB3,WavelengthPixelB3	Observation Data (DN Values)	Observation data (DN values). If binned pixels are missing, saturated, or defective, the following special values are stored. Missing: -9999, Saturated: -9998, Defective: -9997	long_name: Observation data (DN) valid_min:0 valid_max:32767 _FillValue:-9999 N_add_frames: Number of observation frames accumulated and stored in one product frame. Either 2 or 1. scale_factor: Coefficient used to average the accumulated frames (=1/N_add_frames). Either 0.5 or 1. <In the case of '/Band1' for wide-area and precise observations> coordinates:"/Band1/SoundingGeometry/longitude /Band1/SoundingGeometry/latitude" <In the case of '/Band2' for wide-area and precise observations> coordinates:"/Band2/SoundingGeometry/longitude /Band2/SoundingGeometry/latitude" <In the case of '/Band3' for wide-area and precise observations>
4	rawDark1	H5T_STD_I16LE	</Band1 case> Frame,Dark1PixelB1,WavelengthPixelB1 </Band2 case> Frame,Dark1PixelB2,WavelengthPixelB2 </Band3 case> Frame,Dark1PixelB3,WavelengthPixelB3	Dark 1 Data (DN Values)	Dark data (dark1) (DN values). If binned pixels are missing, saturated, or defective, the following special values are stored. Missing: -9999, Saturated: -9998, Defective: -9997	long_name: Dark1 data (DN) valid_min:0 valid_max:32767 _FillValue:-9999
5	rawDark2	H5T_STD_I16LE	</Band1 case> Frame,Dark2PixelB1,WavelengthPixelB1 </Band2 case> Frame,Dark2PixelB2,WavelengthPixelB2 </Band3 case> Frame,Dark2PixelB3,WavelengthPixelB3	Dark 2 Data (DN Values)	Dark data (dark2) (DN values). If binned pixels are missing, saturated, or defective, the following special values are stored. Missing: -9999, Saturated: -9998, Defective: -9997	long_name: Dark2 data (DN) valid_min:0 valid_max:32767 _FillValue:-9999

Table 4-23 Level 1 Product SoundingData Group (Level 1B) Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Band1 or /Band2 or /Band3	–	–	–	–	–
2	SoundingData	–	–	Observation Data	–	–
3	radiance	H5T_IEEE_F32LE	</Band1 case> Frame,SpatialPixelB1,WavelengthPixelB1 </Band2 case> Frame,SpatialPixelB2,WavelengthPixelB2 </Band3 case> Frame,SpatialPixelB3,WavelengthPixelB3	Spectral Radiance (W/m2/sr/μm)	Band1 radiometrically corrected spectral radiance. If binned pixels are missing, saturated, or defective, the following special values are stored. Missing: -9.99e+30, Saturated: -9.99e+20, Defective: -9.99e+10	long_name:Radiance units:W.m-2.sr-1.um-1 _FillValue:-9.99e+30 <In the case of '/Band1' for wide-area and precise observations> coordinates:"/Band1/SoundingGeometry/longitude /Band1/SoundingGeometry/latitude" <In the case of '/Band2' for wide-area and precise observations> coordinates:"/Band2/SoundingGeometry/longitude /Band2/SoundingGeometry/latitude" <In the case of '/Band3' for wide-area and precise observations> coordinates:"/Band3/SoundingGeometry/longitude /Band3/SoundingGeometry/latitude"
4	wavelength	H5T_IEEE_F64LE	</Band1 case> SpatialPixelB1,WavelengthPixelB1 </Band2 case> SpatialPixelB2,WavelengthPixelB2 </Band3 case> SpatialPixelB3,WavelengthPixelB3	Wavelength	Reference wavelength for one frame. If wavelength cannot be calculated, an invalid value is stored.	long_name:Wavelength standard_name:wavelength units:nm
5	rawDark1	H5T_STD_I16LE	</Band1 case> Frame,Dark1PixelB1,WavelengthPixelB1 </Band2 case> Frame,Dark1PixelB2,WavelengthPixelB2 </Band3 case> Frame,Dark1PixelB3,WavelengthPixelB3	Dark 1 Data (DN Values)	Dark data (dark1) (DN values). If binned pixels are missing, saturated, or defective, the following special values are stored. Missing: -9999, Saturated: -9998, Defective: -9997	long_name: Dark1 data (DN) valid_min:0 valid_max:32767 _FillValue:-9999
6	rawDark2	H5T_STD_I16LE	</Band1 case> Frame,Dark2PixelB1,WavelengthPixelB1 </Band2 case> Frame,Dark2PixelB2,WavelengthPixelB2 </Band3 case> Frame,Dark2PixelB3,WavelengthPixelB3	Dark 2 Data (DN Values)	Dark data (dark2) (DN values). If binned pixels are missing, saturated, or defective, the following special values are stored. Missing: -9999, Saturated: -9998, Defective: -9997	long_name: Dark2 data (DN) valid_min:0 valid_max:32767 _FillValue:-9999

Table 4-24 Level 1 Product PixelAttribute Group Details (1/1)

No.	Group Path/Dataset Name	Data Type	Dimension	Name	Description	Attribute
1	/Band1 or /Band2 or /Band3	–	–	–	–	–
2	PixelAttribute	–	–	Pixel Attribute Information	–	–
3	binningPixelNum	H5T_STD_I16LE	</Band1 case> SpatialPixelB1,WavelengthPixelB1 </Band2 case> SpatialPixelB2,WavelengthPixelB2 </Band3 case> SpatialPixelB3,WavelengthPixelB3	Binning Pixel Count	Binning pixel count of observation data. It represents the number of non-binned pixels within the binned pixel. For non-binning observations, 1 is stored.	long_name:Binning pixel num
4	validSpatialBlockRange	H5T_STD_I16LE	MinMax	Valid Spatial Direction Section Range	The valid range in the spatial direction of the stored observation data.	long_name:Valid spatial block range
5	validWavelengthBlockRange	H5T_STD_I16LE	MinMax	Valid Wavelength Direction Section Range	The valid range in the wavelength direction of the stored observation data.	long_name:Valid wavelength block range
6	defectPixelNum	H5T_STD_I16LE	</Band1 case> SpatialPixelB1,WavelengthPixelB1 </Band2 case> SpatialPixelB2,WavelengthPixelB2 </Band3 case> SpatialPixelB3,WavelengthPixelB3	Number of Defective Pixels	The number of defective pixels within the binned pixel. If no defective pixels exist, 0 is stored.	long_name:Defect pixel num
7	cv	H5T_IEEE_F32LE	</Band1 case> No dataset </Band2 case> No dataset </Band3 case> Frame,SpatialPixelB3,CVWavelengthIndexNum	Coefficient of variation within a segment	Stores the coefficient of variation of DN values within each segment. If the proportion of missing data, saturated pixels, or defective pixels in a segment exceeds a specified threshold, the following special value is stored. For non-binned data, 0 is stored. Invalid/sentinel value: -9999.	long_name: Coefficient of variation _FillValue:-9999
8	cvWavelengthIndex	H5T_STD_I16LE	</Band1 case> No dataset </Band2 case> No dataset </Band3 case> SpatialPixelB3,CVWavelengthIndexNum	Wavelength index used for calculating the within-segment coefficient of variation	Stores the wavelength indices used to calculate the coefficient of variation of DN values within each segment.	long_name: Wavelength index for coefficient of variation

Table 4-25 Level 1 Product Dimension Details (1/3)

No.	Dimension Name	Name	Array Size	Description
1	AOCEStatus	AOCE Status	Number of Stored AOCE Status Data	Stored in chronological order.
2	AttitudeData	Attitude Data	Number of Stored Onboard Attitude Values Data	Stored in chronological order.
3	AttitudeRPY	Roll, Pitch, Yaw	3 (Fixed)	Attitude angles are stored in the order: roll (around X-axis), pitch (around Y-axis), yaw (around Z-axis).
4	Band	Number of Bands	3 (Fixed)	Stored in the order: Band 1, Band 2, Band 3.
5	CoordinatesXYZ	XYZ Vector	3 (Fixed)	Vectors in the Cartesian coordinate system are stored in the order of their components: (X, Y, Z).
6	Dark1PixelB1	Binned pixels in the spatial direction for Band 1 (dark1)	Number of the binned pixels in the spatial direction for Band 1, dark1	Stored in ascending order of spatial direction index.
7	Dark1PixelB2	Binned pixels in the spatial direction for Band 2 (dark1)	Number of the binned pixels in the spatial direction for Band 2, dark1	Stored in ascending order of spatial direction index.
8	Dark1PixelB3	Binned pixels in the spatial direction for Band 3 (dark1)	Number of the binned pixels in the spatial direction for Band 3, dark1	Stored in ascending order of spatial direction index.
9	Dark2PixelB1	Binned pixels in the spatial direction for Band 1 (dark2)	Number of the binned pixels in the spatial direction for Band 1, dark2	Stored in ascending order of spatial direction index.
10	Dark2PixelB2	Binned pixels in the spatial direction for Band 2 (dark2)	Number of the binned pixels in the spatial direction for Band 2, dark2	Stored in ascending order of spatial direction index.
11	Dark2PixelB3	Binned pixels in the spatial direction for Band 3 (dark2)	Number of the binned pixels in the spatial direction for Band 3, dark2	Stored in ascending order of spatial direction index.
12	DeterminedOrbitData	Determined Orbit Data	Number of records of Determined Orbit Data	Stored in ascending order of spatial direction index.
13	Frame	Frames	Number of frames.	Stored in chronological order.
14	LunarOrbitData	Lunar Ephemeris Data	Number of records of Lunar Ephemeris Data	Stored in chronological order.
15	OnboardOrbitData	Onboard Orbit Data	Number of records of Onboard Orbit Data	Stored in chronological order.
16	PointingData	Pointing Data	Number of records of Pointing Information Data	Stored in chronological order.
17	PredictedOrbitData	Predicted Orbit Data	Number of records of Predicted Orbit Data	Stored in chronological order.
18	Quaternion	Quaternion	4 (Fixed)	Quaternions are stored in the order: (q0, q1, q2, q3). q0 is the scalar component, and q1, q2, q3 correspond to i, j, k respectively.

Table 4-25 Level 1 Product Dimension Details (2/3)

No.	Dimension Name	Name	Array Size	Description
19	SiderealTimeDataInfo	Sidereal Time Data	Number of records of Greenwich Mean Sidereal Time Data	Stored in chronological order.
20	SolarOrbitData	Solar Ephemeris Data	Number of records of Solar Ephemeris Data	Stored in chronological order.
21	Sounding	Observations	Number of Observation ID	Stored in chronological order.
22	SpacecraftTimeErrorInfo	Time Error Information	Number of records of Time Error Information	Stored in chronological order.
23	SpatialPixel	Binned pixels in the spatial direction for Common group	Number of the binned pixels in the spatial direction for Common group	Stored in ascending order of spatial direction index.
24	SpatialPixelB1	Binned pixels in the spatial direction for Band 1	Number of the binned pixels in the spatial direction for Band 1	Stored in ascending order of spatial direction index.
25	SpatialPixelB2	Binned pixels in the spatial direction for Band 2	Number of the binned pixels in the spatial direction for Band 2	Stored in ascending order of spatial direction index.
26	SpatialPixelB3	Binned pixels in the spatial direction for Band 3	Number of the binned pixels in the spatial direction for Band 3	Stored in ascending order of spatial direction index.
27	TransCoordMatrix	Coordinate Transformation Matrix	9 (Fixed)	A 3x3 matrix is stored in the following order: (0, 1, 2), (3, 4, 5), (6, 7, 8).
28	TransCoordMatrixInfo	Coordinate Transformation Matrices	Number of records of Coordinate Transformation Matrices	Stored in chronological order.
29	WavelengthPixelB1	Binned pixels in the wavelength direction for Band 1	Number of the binned pixels in the wavelength direction for Band 1	Stored in ascending order of wavelength direction index.
30	WavelengthPixelB2	Binned pixels in the wavelength direction for Band 2	Number of the binned pixels in the wavelength direction for Band 2	Stored in ascending order of wavelength direction index.
31	WavelengthPixelB3	Binned pixels in the wavelength direction for Band 3	Number of the binned pixels in the wavelength direction for Band 3	Stored in ascending order of wavelength direction index.
32	MinMax	Min and Max Values	2 (Fixed)	Stored in the order of min, max.
33	WavelengthTemperatureCorrectionTemperatureNum	Temperature Measurement Points Used for Wavelength Adjustment	10 (Fixed)	The following temperatures are stored in order: 0: Not used, 5: TS3_OPSS2_2_TEMP, 1: TS3_OPSS1_1_TEMP, 6: TS3_OPSS2_3_TEMP, 2: TS3_OPSS1_2_TEMP, 7: TS3_OPSS3_1_TEMP, 3: TS3_OPSS1_3_TEMP, 8: TS3_OPSS3_2_TEMP, 4: TS3_OPSS2_1_TEMP, 9: TS3_OPSS3_3_TEMP.
34	WavelengthTemperatureCorrectionPolynomialFunctionOrder	Temperature polynomial degrees for Wavelength Adjustment	4 (Fixed)	Coefficients from 0th to 3rd order are stored in order.
35	NCorner	Corner of binned pixel	4 (Fixed)	For each segment, the data are stored in the order: forward in the AT direction, followed by clockwise from the CT− direction.

Table 4-25 Level 1 Product Dimension Details (3/3)

No.	Dimension Name	Name	Array Size	Description
36	AD3_IP_TEMP	AD3_IP_TEMP Samples	Number of records of AD3_IP_TEMP Samples	Stored in chronological order.
37	AD3_AMP_TEMP	AD3_AMP_TEMP Samples	Number of records of AD3_AMP_TEMP Samples	Stored in chronological order.
38	B1_DET_TEMP_A	B1_DET_TEMP_A Samples	Number of records of B1_DET_TEMP_A Samples	Stored in chronological order.
39	PCA_DET1_TEMP_B	PCA_DET1_TEMP_B Samples	Number of records of PCA_DET1_TEMP_B Data	Stored in chronological order.
40	B2_DET_TEMP_A	B2_DET_TEMP_A Samples	Number of records of B2_DET_TEMP_A Data	Stored in chronological order.
41	B2_DET_TEMP_B	B2_DET_TEMP_B Samples	Number of records of B2_DET_TEMP_B Data	Stored in chronological order.
42	B3_DET_TEMP_A	B3_DET_TEMP_A Samples	Number of records of B3_DET_TEMP_A Data	Stored in chronological order.
43	B3_DET_TEMP_B	B3_DET_TEMP_B Samples	Number of records of B3_DET_TEMP_B Data	Stored in chronological order.
44	OC_IF	A/B System Determination Flag Samples	Number of records of A/B Determination Flag Data	Stored in chronological order.
45	TS3_OPSS1_1_TEMP	TS3_OPSS1_1_TEMP Samples	Number of records of TS3_OPSS1_1_TEMP Data	Stored in chronological order.
46	TS3_OPSS1_2_TEMP	TS3_OPSS1_2_TEMP Samples	Number of records of TS3_OPSS1_2_TEMP Data	Stored in chronological order.
47	TS3_OPSS1_3_TEMP	TS3_OPSS1_3_TEMP Samples	Number of records of TS3_OPSS1_3_TEMP Data	Stored in chronological order.
48	TS3_OPSS2_1_TEMP	TS3_OPSS2_1_TEMP Samples	Number of records of TS3_OPSS2_1_TEMP Data	Stored in chronological order.
49	TS3_OPSS2_2_TEMP	TS3_OPSS2_2_TEMP Samples	Number of records of TS3_OPSS2_2_TEMP Data	Stored in chronological order.
50	TS3_OPSS3_3_TEMP	TS3_OPSS3_3_TEMP Samples	Number of records of TS3_OPSS3_3_TEMP Data	Stored in chronological order.
51	TS3_OPSS3_1_TEMP	TS3_OPSS3_1_TEMP Samples	Number of records of TS3_OPSS3_1_TEMP Data	Stored in chronological order.
52	TS3_OPSS3_2_TEMP	TS3_OPSS3_2_TEMP Samples	Number of records of TS3_OPSS3_2_TEMP Data	Stored in chronological order.
53	TS3_OPSS3_3_TEMP	TS3_OPSS3_3_TEMP Samples	Number of records of TS3_OPSS3_3_TEMP Data	Stored in chronological order.
54	CVWavelengthIndexNum	Number of wavelength indices for calculating the coefficient of variation within a segment.	Number of wavelength indices for calculating the coefficient of variation within a segment.	Stored in the order of wavelength direction segment indices.

Table 4-26 Details of the format for Level 1 processing result files (XML format) (1/5)

Tag Name			Element Count	Name	Description
L1Result			1	Level 1 Processing Result	
	MetaData		1	Metadata	
		workOrderID	1	Workorder ID	An ID (Work Order ID) used to identify processing tasks within the mission operation system.
		observationRequestID	1	Observation Request ID	Stores the Observation Request ID.
		processResult	1	Processing Result	Stores the result of Level 1 processing with the following values: "OK": Normal completion "NG": Abnormal termination
		granuleID	1	Granule ID	Stores the granule ID.
		satelliteName	1	Satellite Name	Stores the satellite name. "GOSAT-GW"(Fixed)
		sensorName	1	Sensor Name	Stores the sensor name. "TANSO-3"(Fixed)
		observationStartDateTime	1	Observation Start DateTime	Stores the observation time (UT) of the first frame in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". It records the earliest observation start time (obsStartDateTime) among all Observation IDs mentioned later. If product creation fails and the observation start date and time cannot be determined, an empty string is stored.
		observationEndDateTime	1	Observation End DateTime	Stores the observation time (UT) of the last frame in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". It records the most recent observation end time (obsEndDateTime) among all Observation IDs mentioned later. If product creation fails and the observation end date and time cannot be determined, an empty string is stored.

Table 4-26 Details of the format for Level 1 processing result files (XML format) (2/5)

Tag Name	Element Count	Name	Description
pathNo	1	Path Number	Stores the path number (1 to 44) without leading zeros.
B1	1	Band 1 Output	Stores whether Band 1 processing is enabled or disabled with the following values: "ENA": Band 1 enabled "DIS": Band 1 disabled
B2	1	Band 2 Output	Stores whether Band 2 processing is enabled or disabled with the following values: "ENA": Band 2 enabled "DIS": Band 2 disabled
B3	1	Band 3 Output	Stores whether Band 3 processing is enabled or disabled with one of the following values: "ENA": Band 3 enabled "DIS": Band 3 disabled
productionDateTime	1	Processing DateTime	Stores the processing date and time (UT) in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". If product creation fails and the processing date and time cannot be determined, an empty string is stored.
processingLevel	1	Processing Level	Stores the processing level with the following values: "Level1A": Level 1A "Level1B": Level 1B
productQualityFlag	1	Product Quality Flag	Stores the overall product quality as one of the following: "Good", "Fair", "Poor", or "NG". If product creation fails and the product quality flag cannot be determined, "NG" is stored.

Table 4-26 Details of the format for Level 1 processing result files (XML format) (3/5)

Tag Name		Element Count	Name	Description
Observation		0 or greater		Store the processing results for each observation ID in a quantity equal to the number of observation IDs being processed.
	observationID	1	Observation ID	Stores the Observation ID (00000 to 65535) with leading zeros included.
	planStartDateTime	1	Planned Observation Start Time	Stores the planned observation start time (UT) for each Observation ID in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". If a single Observation ID is split across multiple files, the planned start time is stored in the processing result of the first file containing that ID, and "*" is stored in the subsequent files.
	planEndDateTime	1	Planned Observation End Time	Stores the planned observation end time (UT) for each Observation ID in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". If a single Observation ID is split across multiple files, the planned end time is stored in the processing result of the last file containing that ID, and "*" is stored in the preceding files.
	obsStartDateTime	1	Observation Start Time	Stores the observation time (UT) of the first frame of the Observation ID in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". It records the earliest time among the observation data for bands 1 to 3. Note that the observation time does not include fixed delay time or integration time. If product creation fails and the observation start time cannot be determined, an empty string is stored.
	obsEndDateTime	1	Observation End Time	Stores the observation time (UT) of the last frame of the Observation ID in the format "YYYY-MM-DDThh:mm:ss.ffffffZ". It records the latest time among the observation data for bands 1 to 3. Note that the observation time does not include fixed delay time or integration time. If product creation fails and the observation end time cannot be determined, an empty string is stored.

Table 4-26 Details of the format for Level 1 processing result files (XML format) (4/5)

Tag Name	Element Count	Name	Description
obsQualityFlag	1	Observation Quality Flag	Stores the overall quality for the Observation ID as one of the following: "Good", "Fair", "Poor", or "NG".
B1FrameNum	1	Band 1 Frame Count	Stores the number of frames for Band 1 without leading zeros. If Band 1 is not processed, the value will be 0.
B1FrameLossNum	1	Band 1 Missing Frame Count	Stores the number of missing frames for Band 1 without leading zeros. If Band 1 is not processed, the value will be 0. If Band 1 is processed and B1FrameNum is 0, store −999.
B1DataLossRate	1	Band 1 Missing Frame Rate (%)	Stores the missing frame rate for each Observation ID as a percentage (0.0 to 100.0). The missing frame rate is calculated as the ratio of missing frames to the total number of frames in the target band. If the missing frame count cannot be calculated (e.g., B1FrameNum is 0), store −999.0. The value is stored as a decimal with one digit after the decimal point, without leading zeros.
B2FrameNum	1	Band 2 Frame Count	Stores the number of frames for Band 2 without leading zeros. If Band 2 is not processed, the value will be 0.
B2FrameLossNum	1	Band 2 Missing Frame Count	Stores the number of missing frames for Band 2 without leading zeros. If Band 2 is not processed, the value will be 0. If Band 2 is processed and B2FrameNum is 0, store −999.
B2DataLossRate	1	Band 2 Missing Frame Rate (%)	Stores the missing frame rate for the Observation ID as a percentage (0.0 to 100.0). The missing frame rate is calculated as the ratio of missing frames to the total number of frames in the target band. If the missing frame count cannot be calculated (e.g., B2FrameNum is 0), store −999.0. The value is stored as a decimal with one digit after the decimal point, without leading zeros.

Table 4-26 Details of the format for Level 1 processing result files (XML format) (5/5)

Tag Name			Element Count	Name	Description
		B3FrameNum	1	Band 3 Frame Count	Stores the number of frames for Band 3 without leading zeros. If Band 3 is not processed, the value will be 0.
		B3FrameLossNum	1	Band 3 Missing Frame Count	Stores the number of missing frames for Band 3 without leading zeros. If Band 3 is not processed, the value will be 0. If Band 3 is processed and B3FrameNum is 0, store -999.
		B3DataLossRate	1	Band 3 Missing Frame Rate (%)	Stores the missing frame rate for the Observation ID as a percentage (0.0 to 100.0). The missing frame rate is calculated as the ratio of missing frames to the total number of frames in the target band. If the missing frame count cannot be calculated (e.g., B3FrameNum is 0), store -999.0. The value is stored as a decimal with one digit after the decimal point, without leading zeros.
		geospatial_bounds	1	Observation Area on Map	Stores the latitude and longitude range in OGC Well-Known Text (WKT) Geometry format. Example: POLYGON ((152.28 83.71, 91.82 73.23, -10.34 34.10, -24.72 -25.31, -39.30 -84.97, -105.73 -73.60, -40.70 -23.13, -27.99 36.52)) The latitude and longitude values correspond to the bounding corners of the spatial extent across all frames stored in the product. Latitude and longitude values are stored with two decimal places, without leading zeros. The value is valid only for Normal Observation Mode, Bright Target Calibration Mode, and Dark Calibration Mode. For other products, store an empty value.