

NIES-GOSAT2-SYS-20190129-056-08

NIES
GOSAT-2 Product File Format Descriptions
(Product edition)

Vol.1
GOSAT-2 TANSO-CAI-2 L1B Product

May 2022

National Institute for Environmental Studies
GOSAT-2 Project

Revision History

| Version | Revised on | Page | Description |
|---------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00 | Feb. 2019 | - | - |
| 01 | Mar. 2019 | p.1, p.2 | Fixed the description of product versions |
| 02 | May 2019 | p.1 | Added product version |
| 03 | Aug. 2019 | p.1 | Added product version |
| 04 | Sep. 2019 | p.1 | Added product version |
| | | p.2 | Fixed the file naming convention |
| 05 | Dec. 2019 | p.1 | Added product version |
| | | p.1, p.3, p.5 | Fixed the product name |
| | | p.1 | Fixed a part of 2 (1) |
| | | p.2 | Fixed a part of 2 (6) |
| 06 | Aug. 2020 | p.1 | Added product version |
| | | p.7 | Changed "Group / Dataset" of the following datasets <ul style="list-style-type: none"> - LineAttribute/preAmpTempQuality_FWD - LineAttribute/preAmpTempQuality_BWD |
| 07 | Apr. 2021 | p.1 | Fixed product version |
| 08 | May 2022 | p.1 | Added product version |

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1 Introduction

1.1 Purpose

The purpose of this document is to define the file format of the GOSAT-2 TANSO-CAI-2 L1B Product which is one of the Greenhouse gases Observing SATellite-2 (hereinafter referred to as “GOSAT-2”) products generated by the National Institute for Environmental Studies, Japan (hereinafter referred to as “NIES”).

1.2 Data product and version

The product and its version described in this document are listed below (Table 1-1).

Table 1-1 Product and version explained in the document

| Product name | Product version |
|---------------------------------|-----------------|
| GOSAT-2 TANSO-CAI-2 L1B Product | 03.12 |
| | 03.13 |

08

2 GOSAT-2 TANSO-CAI-2 L1B Product

(1) Description of GOSAT-2 TANSO-CAI-2 L1B Product

GOSAT-2 TANSO-CAI-2 L1B Product contains spectral radiance data per pixel converted from sensor outputs stored as digital values in TANSO-CAI-2 L1A Product. Band-to-band registration of each forward- and backward-viewing band is applied to this product. In addition, ortho-correction is performed to observation location data based on an earth ellipsoid model, which are decimated and stored in TANSO-CAI-2 L1A Product, using digital elevation model data to put information of observation location with regard to elevation to all pixels.

(2) Major dataset

Spectral radiance

(3) Category

Standard

(4) Unit

CAI-2 frame*

*Forward viewing bands (Band 1-5) data and backward viewing bands (Band 6-10) data are stored in the same file.

(5) File format

HDF5

(6) File naming convention

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 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 |
| G | O | S | A | T | 2 | T | C | A | I | 2 | Y | Y | Y | M | M | D | D | H | H | m | m | P | P | P | F | F | F | _ | 1 | B | C | C | L | 1 | B | V | M | M | N | N | R | R | o | o | o | . | h | 5 | | |

GOSAT2: Satellite name (Fixed)

TCAI2: Sensor name (Fixed)

YYYYMMDDHHmm: Start date of observation* (UTC)

*In principle, it is observation time of the first line without margin in forward viewing frame.

If there is no forward viewing frame, it is observation time of the first line without margin in backward viewing frame.

PPP: Path number (001-089)

FFF: Frame number (001-036)

1B: Processing level (Fixed)

C: Band (Fixed)

CL1B: Product code (Fixed)

V: Processing identifier (V: Steady, T: Test), added as necessary

MMNN: Product version (MM: Major version, NN: Minor version)

RR: Revision

oooo: Input data version

h5: Extension

(7) File size

Approx. 641MB

3 Product Format

3.1 Dataset structure

Table 3-1 shows the dataset structure of GOSAT-2 TANSO-CAI-2 L1B Product.

Table 3-1 Dataset structure of GOSAT-2 TANSO-CAI-2 L1B Product

| No. | Group | Outline |
|-----|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Metadata | The following items are mainly included to describe overview of the product. <ul style="list-style-type: none"> - Processing date - Start/End date - Sensor name - Processing level - Algorithm researcher |
| 2 | FrameAttribute | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Number of bands - Number of lines - Number of pixels - Frame edge latitude/longitude - Missing pixels rate |
| 3 | LineAttribute | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Observation time - Sensor gain - Missing flag - Quality flag |
| 4 | ImageData_FWD | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Calibrated radiance of Bands 1-5 - Saturation flag |
| 5 | ImageData_BWD | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Calibrated radiance of Bands 6-10 - Saturation flag |
| 6 | ImageGeometry | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Sunlint angle - Geodetic latitude/longitude/height - Satellite zenith/azimuth angle - Solar zenith/azimuth angle |
| 7 | ForwardBackwardCollocation | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Pixel/Line number index (BWD) - Pixel/Line number index (FWD) |
| 8 | SatelliteGeometry | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Satellite position/velocity/attitude |
| 9 | SolarGeometry | The following items are mainly included to provide information related to the observation. <ul style="list-style-type: none"> - Solar position/velocity |

The special mention about “Group” above is shown below.

- **FrameAttribute**

There is an overlap with the adjacent frames as margin, which has a certain number of lines. Therefore, it is necessary to consider these overlaps when handling several continuous frames. These overlaps can be avoided by using `frameLineMargin_FWD` or `frameLineMargin_BWD` under `FrameAttribute`. In addition, the number of contained lines between forward and backward viewing bands are different.

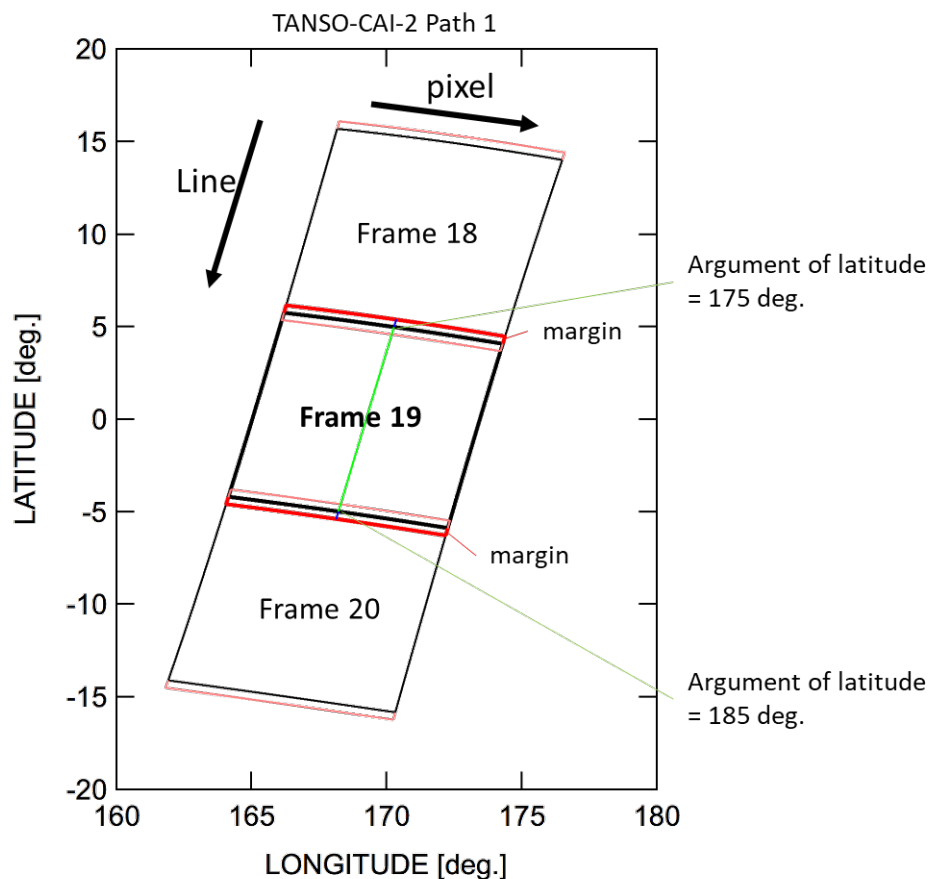


Figure 3-1 Image of margin between adjacent frames

- **LineAttribute**

Since frame division and margin provision are processed according to observation data of TANSO-CAI-2 L1A Product, overlaps between adjacent frames can be avoided by using `index_L1A_FWD` or `index_L1A_BWD` under `LineAttribute` when handling several continuous frames. In addition, the observation time between forward and backward viewing bands are different since each frame is divided according to the argument of latitude at an observation point.

- **ForwardBackwardCollocation**

Since the frames are divided according to the argument of latitude at the center pixel of each line, several locations of observation points at corners of each line are different (blue circle in Figure 3-2) between forward viewing bands (shown as red frame in Figure 3-2) and backward viewing bands (shown as black frame in Figure 3-2). Each pixel between forward and backward viewing bands can be corresponded by using datasets under `ForwardBackwardCollocation`. The pixel/line number of each pixel in backward viewing bands which corresponds to a pixel in forward viewing bands is stored in

index_BWD_pixel/index_BWD_line, and the pixel/line number of forward viewing bands which corresponds to a pixel in backward viewing bands is stored in index_FWD_pixel/index_FWD_line.

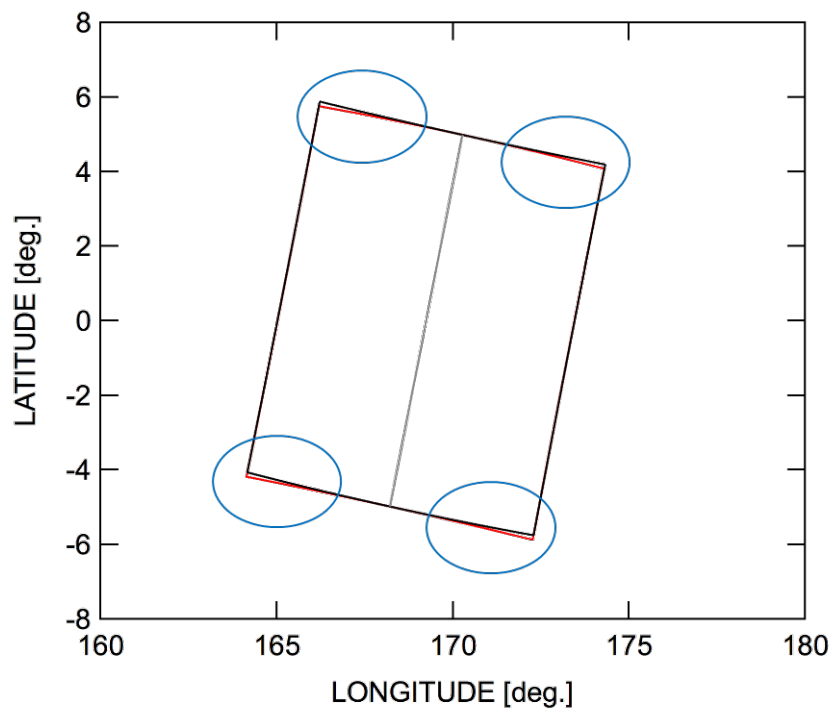


Figure 3-2 Image of observation points for forward and backward viewing bands

3.2 File format details

Table 3-2 shows the file format details of the GOSAT-2 TANSO-CAI-2 L1B Product.

Table 3-2 GOSAT-2 TANSO-CAI-2 L1B Product Format (1/4)

| Group | Group / Dataset | Dataspace | | Datatype | Dataset name | attribute | | | |
|-------|------------------------|-----------|-------------|----------------|------------------------------|-----------|---------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | Rank | Size | | | unit | validRange | invalidValue | description |
| G | Metadata | | | | | | | | |
| | fileID | 1 | 1 | H5T_STRING | File identifier | (none) | (none) | (none) | file identifier of the product |
| | operationMode | 1 | 1 | H5T_STRING | Operation mode | (none) | (none) | (none) | operation mode: "OBSM"-Observation Mode (day) |
| | processingDate | 1 | 1 | H5T_STRING | Processing date | UTC | (none) | (none) | date of product creation (UTC): Time format is "YYYY-MM-DDThh:mm:ss.ffffffZ". |
| | startDate_FWD | 1 | 1 | H5T_STRING | Start date (FWD) | UTC | (none) | "_" | start date of frame of forward viewing band(UTC): Time format is "YYYY-MM-DDThh:mm:ss.ffffffZ". |
| | startDate_BWD | 1 | 1 | H5T_STRING | Start date (BWD) | UTC | (none) | "_" | start date of frame of backward viewing band(UTC): Time format is "YYYY-MM-DDThh:mm:ss.ffffffZ". |
| | endDate_FWD | 1 | 1 | H5T_STRING | End date (FWD) | UTC | (none) | "_" | end date of frame of forward viewing band(UTC): Time format is "YYYY-MM-DDThh:mm:ss.ffffffZ". |
| | endDate_BWD | 1 | 1 | H5T_STRING | End date (BWD) | UTC | (none) | "_" | end date of frame of backward viewing band(UTC): Time format is "YYYY-MM-DDThh:mm:ss.ffffffZ". |
| | geodeticDatum | 1 | 1 | H5T_STRING | Geodetic datum | (none) | (none) | (none) | reference ellipsoid model/frame of reference: "WGS84/WGS84"(Fixed) |
| | satelliteName | 1 | 1 | H5T_STRING | Satellite name | (none) | (none) | (none) | satellite name: "GOSAT-2" - Greenhouse gases Observing SATellite-2 (Fixed) |
| | sensorName | 1 | 1 | H5T_STRING | Sensor name | (none) | (none) | (none) | sensor name: "TANSO-CAI-2" - Cloud and Aerosol Imager-2 (Fixed) |
| | processingLevel | 1 | 1 | H5T_STRING | Processing level | (none) | (none) | (none) | processing level: "L1B" - Level 1B (Fixed) |
| | algorithmName | 1 | 1 | H5T_STRING | Algorithm name | (none) | (none) | (none) | algorithm name: "TANSO-CAI-2 L1B" (Fixed) |
| | algorithmVersion | 1 | 1 | H5T_STRING | Algorithm version | (none) | (none) | (none) | algorithm version is stored |
| | productVersion | 1 | 1 | H5T_STRING | Product version | (none) | (none) | (none) | product version is stored |
| | inputDataVersion | 1 | 1 | H5T_STRING | Input data version | (none) | (none) | (none) | version of input data list is stored |
| | processingFacility | 1 | 1 | H5T_STRING | Processing facility | (none) | (none) | (none) | processing facility name: "G2DPS" - GOSAT-2 Data Processing System (Fixed) |
| | contact_01 | 1 | 1 | H5T_STRING | Organization name 01 | (none) | (none) | (none) | organization name: "Japan Aerospace Exploration Agency (JAXA)" (Fixed) |
| | contact_02 | 1 | 1 | H5T_STRING | Organization name 02 | (none) | (none) | (none) | organization name: "National Institute for Environmental Studies (NIES)" (Fixed) |
| | contact_03 | 1 | 1 | H5T_STRING | Algorithm researcher | (none) | (none) | (none) | researcher |
| | e-mail | 1 | 1 | H5T_STRING | E-mail address | (none) | (none) | (none) | e-mail address |
| G | FrameAttribute | | | | | | | | |
| | numBand_FWD | 1 | 1 | H5T_STD_I32LE | Number of bands (FWD) | (none) | (none) | (none) | number of forward viewing bands "5"(Fixed) |
| | numBand_BWD | 1 | 1 | H5T_STD_I32LE | Number of bands (BWD) | (none) | (none) | (none) | number of backward viewing bands "5"(Fixed) |
| | numLine_FWD | 1 | 1 | H5T_STD_I32LE | Number of lines (FWD) * | (none) | (none) | (none) | number of lines of forward viewing band |
| | numLine_BWD | 1 | 1 | H5T_STD_I32LE | Number of lines (BWD) * | (none) | (none) | (none) | number of lines of backward viewing band |
| | numPixel_FWD | 1 | 1 | H5T_STD_I32LE | Number of pixels (FWD) | (none) | (none) | (none) | number of pixels per line of forward viewing band "2048"(Fixed) |
| | numPixel_BWD | 1 | 1 | H5T_STD_I32LE | Number of pixels (BWD) | (none) | (none) | (none) | number of pixels per line of backward viewing band "2048"(Fixed) |
| | frameEdgeLatitude_FWD | 1 | 4 | H5T_IEEE_F32LE | Frame edge latitude (FWD) | deg | -90.0, 90.0 | -9999.0 | geodetic latitude of four corners of the frame of forward viewing band starting at the upper left and proceeding clockwise: -90 <= frameEdgeLatitude_FWD <= 90 |
| | frameEdgeLatitude_BWD | 1 | 4 | H5T_IEEE_F32LE | Frame edge latitude (BWD) | deg | -90.0, 90.0 | -9999.0 | geodetic latitude of four corners of the frame of backward viewing band starting at the upper left and proceeding clockwise: -90 <= frameEdgeLatitude_BWD <= 90 |
| | frameEdgeLongitude_FWD | 1 | 4 | H5T_IEEE_F32LE | Frame edge longitude (FWD) | deg | -180.0, 180.0 | -9999.0 | geodetic longitude of four corners of the frame of forward viewing band starting at the upper left and proceeding clockwise: -180 < frameEdgeLongitude_FWD <= 180 |
| | frameEdgeLongitude_BWD | 1 | 4 | H5T_IEEE_F32LE | Frame edge longitude (BWD) | deg | -180.0, 180.0 | -9999.0 | geodetic longitude of four corners of the frame of backward viewing band starting at the upper left and proceeding clockwise: -180 < frameEdgeLongitude_BWD <= 180 |
| | missingPixelRate_FWD | 1 | numBand_FWD | H5T_IEEE_F32LE | Missing pixels rate (FWD) | (none) | 0.0, 1.0 | -9999.0 | ratio of missing pixels to all pixels in one frame of forward viewing band |
| | missingPixelRate_BWD | 1 | numBand_BWD | H5T_IEEE_F32LE | Missing pixels rate (BWD) | (none) | 0.0, 1.0 | -9999.0 | ratio of missing pixels to all pixels in one frame of backward viewing band |
| | frameLineMargin_FWD | 1 | 2 | H5T_STD_I32LE | Number of margin lines (FWD) | (none) | (none) | (none) | number of margin lines of forward viewing band: overlapped with the prior-frame and the post-frame in order |
| | frameLineMargin_BWD | 1 | 2 | H5T_STD_I32LE | Number of margin lines (BWD) | (none) | (none) | (none) | number of margin lines of backward viewing band: overlapped with the prior-frame and the post-frame in order |
| G | LineAttribute | | | | | | | | |
| | observationTime_FWD | 1 | numLine_FWD | H5T_STRING | Observation time (FWD) | UTC | (none) | (none) | observation time UTC for each line at the center of integration time of the reference band of forward viewing band(YYYY-MM-DDThh:mm:ss.ffffffZ) |
| | observationTime_BWD | 1 | numLine_BWD | H5T_STRING | Observation time (BWD) | UTC | (none) | (none) | observation time UTC for each line at the center of integration time of the reference band of backward viewing band(YYYY-MM-DDThh:mm:ss.ffffffZ) |

Table 3-2 GOSAT-2 TANSO-CAI-2 L1B Product Format (2/4)

| Group | Group / Dataset | Dataspace | | Datatype | Dataset name | attribute | | | |
|-------|------------------------------------|-----------|------------------------------|----------------|--------------------------------------------------------|-----------------------------|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | Rank | Size | | | unit | validRange | invalidValue | description |
| | sensorGain_FWD | 2 | numLine_FWD, numBand_FWD | H5T_STD_I8LE | Sensor gain (FWD) | (none) | (none) | (none) | sensor gain of pre-amplifier for the center pixel of each line and each forward viewing band |
| | sensorGain_BWD | 2 | numLine_BWD, numBand_BWD | H5T_STD_I8LE | Sensor gain (BWD) | (none) | (none) | (none) | sensor gain of pre-amplifier for the center pixel of each line and each backward viewing band |
| | integrationNum_FWD | 2 | numLine_FWD, numBand_FWD | H5T_STD_I32LE | Integration number (FWD) | (none) | (none) | (none) | integration number (0 to 31) denoting integration time for the center pixel of each line and each forward viewing band |
| | integrationNum_BWD | 2 | numLine_BWD, numBand_BWD | H5T_STD_I32LE | Integration number (BWD) | (none) | (none) | (none) | integration number (0 to 31) denoting integration time for the center pixel of each line and each backward viewing band |
| | missingFlag_FWD | 2 | numLine_FWD, numBand_FWD | H5T_STD_I8LE | Missing flag (FWD) | (none) | 0, 1 | 2 | missing data in line of forward viewing band: 0 - No missing pixels, 1 - Missing pixel exists |
| | missingFlag_BWD | 2 | numLine_BWD, numBand_BWD | H5T_STD_I8LE | Missing flag (BWD) | (none) | 0, 1 | 2 | missing data in line of backward viewing band: 0 - No missing pixels, 1 - Missing pixel exists |
| | sensorTempQuality_FWD | 2 | numLine_FWD, numBand_FWD | H5T_STD_I8LE | Quality flag of sensor temperature (FWD) | (none) | 0, 1 | 2 | quality flag of sensor temperature for the center pixel of each line and each forward viewing band: 0 - Good, 1 - No good (invalid range) |
| | sensorTempQuality_BWD | 2 | numLine_BWD, numBand_BWD | H5T_STD_I8LE | Quality flag of sensor temperature (BWD) | (none) | 0, 1 | 2 | quality flag of sensor temperature for the center pixel of each line and each backward viewing band: 0 - Good, 1 - No good (invalid range) |
| | preAmpTempQuality_FWD | 2 | numLine_FWD, numBand_FWD | H5T_STD_I8LE | Quality flag of pre-amplifier temperature (FWD) | (none) | 0, 1 | 2 | quality flag of pre-amplifier temperature for the center pixel of each line and each forward viewing band: 0 - Good, 1 - No good (invalid range) |
| | preAmpTempQuality_BWD | 2 | numLine_BWD, numBand_BWD | H5T_STD_I8LE | Quality flag of pre-amplifier temperature (BWD) | (none) | 0, 1 | 2 | quality flag of pre-amplifier temperature for the center pixel of each line and each backward viewing band: 0 - Good, 1 - No good (invalid range) |
| | AmpTempQuality_FWD | 2 | numLine_FWD, numBand_FWD | H5T_STD_I8LE | Quality flag of output amplifier temperature (FWD) | (none) | 0, 1 | 2 | quality flag of output amplifier temperature for the center pixel of each line and each forward viewing band: 0 - Good, 1 - No good (invalid range) |
| | AmpTempQuality_BWD | 2 | numLine_BWD, numBand_BWD | H5T_STD_I8LE | Quality flag of output amplifier temperature (BWD) | (none) | 0, 1 | 2 | quality flag of output amplifier temperature for the center pixel of each line and each backward viewing band: 0 - Good, 1 - No good (invalid range) |
| | yawSteeringOperation_FWD | 1 | numLine_FWD | H5T_STD_I8LE | Yaw steering operation (FWD) | (none) | 0, 1 | 2 | yaw steering operation of the satellite for each line of forward viewing band: 0 - Yaw steering Off, 1 - Yaw steering On |
| | yawSteeringOperation_BWD | 1 | numLine_BWD | H5T_STD_I8LE | Yaw steering operation (BWD) | (none) | 0, 1 | 2 | yaw steering operation of the satellite for each line of backward viewing band: 0 - Yaw steering Off, 1 - Yaw steering On |
| | satAttInterpolationQualityFlag_FWD | 1 | numLine_FWD | H5T_STD_I8LE | Quality flag of satellite attitude interpolation (FWD) | (none) | 0, 1 | 2 | quality flag of satellite attitude interpolation for each line of forward viewing band: 0 - Good (Interval of source data is fine resolution.), 1 - Poor (Interval of source data is coarse resolution.) |
| | satAttInterpolationQualityFlag_BWD | 1 | numLine_BWD | H5T_STD_I8LE | Quality flag of satellite attitude interpolation (BWD) | (none) | 0, 1 | 2 | quality flag of satellite attitude interpolation for each line of backward viewing band: 0 - Good (Interval of source data is fine resolution.), 1 - Poor (Interval of source data is coarse resolution.) |
| | argumentLatitudeLOS_FWD | 1 | numLine_FWD | H5T_IEEE_F32LE | Argument of latitude at the observation point (FWD) | deg | 0.0, 360.0 | -9999.0 | argument of latitude at the observation point for the center pixel of each line of forward viewing band by the projection of line of sight onto the Earth |
| | argumentLatitudeLOS_BWD | 1 | numLine_BWD | H5T_IEEE_F32LE | Argument of latitude at the observation point (BWD) | deg | 0.0, 360.0 | -9999.0 | argument of latitude at the observation point for the center pixel of each line of backward viewing band by the projection of line of sight onto the Earth |
| | argumentLatitudeSubSat_FWD | 1 | numLine_FWD | H5T_IEEE_F32LE | Argument of latitude at the sub-satellite point (FWD) | deg | 0.0, 360.0 | -9999.0 | argument of latitude at the sub-satellite point for each line of forward viewing band |
| | argumentLatitudeSubSat_BWD | 1 | numLine_BWD | H5T_IEEE_F32LE | Argument of latitude at the sub-satellite point (BWD) | deg | 0.0, 360.0 | -9999.0 | argument of latitude at the sub-satellite point for each line of backward viewing band |
| | index_L1A_FWD | 1 | numLine_FWD | H5T_STD_I32LE | Index L1A (FWD) | (none) | (none) | -999 | line number in the CAI-2 L1A file (hemispherical strip) corresponding to this L1B file (frame) for the reference of forward viewing band |
| | index_L1A_BWD | 1 | numLine_BWD | H5T_STD_I32LE | Index L1A (BWD) | (none) | (none) | -999 | line number in the CAI-2 L1A file (hemispherical strip) corresponding to this L1B file (frame) for the reference of backward viewing band |
| G | ImageData_FWD | | | | | | | | |
| | band01 | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Calibrated radiance of Band 1 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 1 after registration to the reference band by the nearest neighbor method |
| | band02 | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Calibrated radiance of Band 2 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 2 after registration to the reference band by the nearest neighbor method |
| | band03 | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Calibrated radiance of Band 3 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 3 after registration to the reference band by the nearest neighbor method |
| | band04 | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Calibrated radiance of Band 4 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 4 after registration to the reference band by the nearest neighbor method |
| | band05 | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Calibrated radiance of Band 5 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 5 after registration to the reference band by the nearest neighbor method |

Table 3-2 GOSAT-2 TANSO-CAI-2 L1B Product Format (3/4)

| Group | Group / Dataset | Dataspace | | Datatype | Dataset name | attribute | | | |
|-------|----------------------|-----------|------------------------------|----------------|--------------------------------|-----------------------------|----------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | Rank | Size | | | unit | validRange | invalidValue | description |
| | saturationFlag_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_STD_U8LE | Saturation flag (FWD) | (none) | (none) | (none) | bit flags indicating the saturation in each forward viewing band: Bit7 = Band 1, Bit6 = Band 2, Bit5 = Band 3, Bit4 = Band 4, and Bit3 = Band 5 (Bit2 to Bit0 are not used). |
| G | ImageData_BWD | | | | | | | | |
| | band06 | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Calibrated radiance of Band 6 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 6 after registration to the reference band by the nearest neighbor method |
| | band07 | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Calibrated radiance of Band 7 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 7 after registration to the reference band by the nearest neighbor method |
| | band08 | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Calibrated radiance of Band 8 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 8 after registration to the reference band by the nearest neighbor method |
| | band09 | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Calibrated radiance of Band 9 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 9 after registration to the reference band by the nearest neighbor method |
| | band10 | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Calibrated radiance of Band 10 | W/m ² /micron/sr | 0.0 or more | less than 0.0 | calibrated radiance of Band 10 after registration to the reference band by the nearest neighbor method |
| | saturationFlag_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_STD_U8LE | Saturation flag (BWD) | (none) | (none) | (none) | bit flags indicating the saturation in each backward viewing band: Bit7 = Band 6, Bit6 = Band 7, Bit5 = Band 8, Bit4 = Band 9, and Bit3 = Band 10 (Bit2 to Bit0 are not used). |
| G | ImageGeometry | | | | | | | | |
| | glintAngle_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Sun glint angle (FWD) | deg | 0.0, 180.0 | -9999.0 | the angle of forward viewing band between specular solar reflection vector and satellite vector at the observation footprint: 0 ≤ glintAngle_FWD ≤ 180 |
| | glintAngle_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Sun glint angle (BWD) | deg | 0.0, 180.0 | -9999.0 | the angle of backward viewing band between specular solar reflection vector and satellite vector at the observation footprint: 0 ≤ glintAngle_BWD ≤ 180 |
| | latitude_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Geodetic latitude (FWD) | deg | -90.0, 90.0 | -9999.0 | geodetic latitude of forward viewing band based on topography at the observation footprint: -90 ≤ latitude_FWD ≤ 90 |
| | latitude_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Geodetic latitude (BWD) | deg | -90.0, 90.0 | -9999.0 | geodetic latitude of backward viewing band based on topography at the observation footprint: -90 ≤ latitude_BWD ≤ 90 |
| | longitude_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Geodetic longitude (FWD) | deg | -180.0, 180.0 | -9999.0 | geodetic longitude of forward viewing band based on topography at the observation footprint: -180 < longitude_FWD ≤ 180 |
| | longitude_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Geodetic longitude (BWD) | deg | -180.0, 180.0 | -9999.0 | geodetic longitude of backward viewing band based on topography at the observation footprint: -180 < longitude_BWD ≤ 180 |
| | height_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Topographic height (FWD) | m | -443.0, 8648.0 | -9999.0 | topographic height of forward viewing band above the WGS84 Earth geoid model at the observation footprint |
| | height_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Topographic height (BWD) | m | -443.0, 8648.0 | -9999.0 | topographic height of backward viewing band above the WGS84 Earth geoid model at the observation footprint |
| | landWaterMask_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_STD_I8LE | Land/Water mask (FWD) | (none) | 0, 1 | -128 | Land/Water mask of forward viewing band at the observation footprint: 0 - Land, 1 - Water surface |
| | landWaterMask_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_STD_I8LE | Land/Water mask (BWD) | (none) | 0, 1 | -128 | Land/Water mask of backward viewing band at the observation footprint: 0 - Land, 1 - Water surface |
| | satelliteZenith_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Satellite zenith angle (FWD) | deg | 0.0, 180.0 | -9999.0 | angle of forward viewing band between the normal to the Earth geoid and the satellite view vector at the observation footprint based on topography: 0 ≤ satelliteZenith_FWD ≤ 180 |
| | satelliteZenith_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Satellite zenith angle (BWD) | deg | 0.0, 180.0 | -9999.0 | angle of backward viewing band between the normal to the Earth geoid and the satellite view vector at the observation footprint based on topography: 0 ≤ satelliteZenith_BWD ≤ 180 |
| | satelliteAzimuth_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Satellite azimuth angle (FWD) | deg | 0.0, 360.0 | -9999.0 | angle of forward viewing band between local North and the projection of the satellite view vector onto the Earth at the observation footprint based on topography: 0 ≤ satelliteAzimuth_FWD < 360 |
| | satelliteAzimuth_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Satellite azimuth angle (BWD) | deg | 0.0, 360.0 | -9999.0 | angle of backward viewing band between local North and the projection of the satellite view vector onto the Earth at the observation footprint based on topography: 0 ≤ satelliteAzimuth_BWD < 360 |
| | solarZenith_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Solar zenith angle (FWD) | deg | 0.0, 180.0 | -9999.0 | angle of forward viewing band between the normal to the Earth geoid and the solar direction at the observation footprint based on topography: 0 ≤ solarZenith_FWD ≤ 180 |
| | solarZenith_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Solar zenith angle (BWD) | deg | 0.0, 180.0 | -9999.0 | angle of backward viewing band between the normal to the Earth geoid and the solar direction at the observation footprint based on topography: 0 ≤ solarZenith_BWD ≤ 180 |

Table 3-2 GOSAT-2 TANSO-CAI-2 L1B Product Format (4/4)

| Group | Group / Dataset | Dataspace | | Datatype | Dataset name | attribute | | | |
|-------|----------------------------|-----------|------------------------------|----------------|---------------------------------|-----------|------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | Rank | Size | | | unit | validRange | invalidValue | description |
| | solarAzimuth_FWD | 2 | numLine_FWD, numPixel_FWD | H5T_IEEE_F32LE | Solar azimuth angle (FWD) | deg | 0.0, 360.0 | -9999.0 | angle of forward viewing band between local North and the projection of the solar direction onto the Earth at the observation footprint based on topography: $0 \leq \text{satelliteAzimuth_FWD} < 360$ |
| | solarAzimuth_BWD | 2 | numLine_BWD, numPixel_BWD | H5T_IEEE_F32LE | Solar azimuth angle (BWD) | deg | 0.0, 360.0 | -9999.0 | angle of backward viewing band between local North and the projection of the solar direction onto the Earth at the observation footprint based on topography: $0 \leq \text{satelliteAzimuth_BWD} < 360$ |
| | solarDistance_FWD | 1 | numLine_FWD | H5T_IEEE_F32LE | Solar distance (FWD) | AU | (none) | -9999.0 | distance of forward viewing band from sun to the observation footprint for the center pixel in each line (astronomical unit) |
| | solarDistance_BWD | 1 | numLine_BWD | H5T_IEEE_F32LE | Solar distance (BWD) | AU | (none) | -9999.0 | distance of backward viewing band from sun to the observation footprint for the center pixel in each line (astronomical unit) |
| G | ForwardBackwardCollocation | | | | | | | | |
| | index_BWD_pixel | 2 | numLine_FWD, numPixel_FWD | H5T_STD_I32LE | Pixel number index (BWD) | (none) | (none) | -999 | pixel number index of backward viewing band corresponding to forward viewing band for each line and each pixel |
| | index_BWD_line | 2 | numLine_FWD, numPixel_FWD | H5T_STD_I32LE | Line number index (BWD) | (none) | (none) | -999 | line number index of backward viewing band corresponding to forward viewing band for each line and each pixel |
| | index_FWD_pixel | 2 | numLine_BWD, numPixel_BWD | H5T_STD_I32LE | Pixel number index (FWD) | (none) | (none) | -999 | pixel number index of forward viewing band corresponding to backward viewing band for each line and each pixel |
| | index_FWD_line | 2 | numLine_BWD, numPixel_BWD | H5T_STD_I32LE | Line number index (FWD) | (none) | (none) | -999 | line number index of forward viewing band corresponding to backward viewing band for each line and each pixel |
| G | SatelliteGeometry | | | | | | | | |
| | satPos_ECR_FWD | 2 | numLine_FWD, 3 | H5T_IEEE_F64LE | Satellite position in ECR (FWD) | km | (none) | (0, 0, 0) | satellite position in ECR(WGS84) for each line of forward viewing band |
| | satPos_ECR_BWD | 2 | numLine_BWD, 3 | H5T_IEEE_F64LE | Satellite position in ECR (BWD) | km | (none) | (0, 0, 0) | satellite position in ECR(WGS84) for each line of backward viewing band |
| | satVel_ECR_FWD | 2 | numLine_FWD, 3 | H5T_IEEE_F64LE | Satellite velocity in ECR (FWD) | km/s | (none) | (0, 0, 0) | satellite velocity in ECR(WGS84) for each line of forward viewing band |
| | satVel_ECR_BWD | 2 | numLine_BWD, 3 | H5T_IEEE_F64LE | Satellite velocity in ECR (BWD) | km/s | (none) | (0, 0, 0) | satellite velocity in ECR(WGS84) for each line of backward viewing band |
| | satAtt_FWD | 2 | numLine_FWD, 4 | H5T_IEEE_F64LE | Satellite attitude (FWD) | (none) | (none) | (0, 0, 0, 0) | satellite attitude as quaternion in ECI(J2000) for each line of forward viewing band : scalar and vector parts in order |
| | satAtt_BWD | 2 | numLine_BWD, 4 | H5T_IEEE_F64LE | Satellite attitude (BWD) | (none) | (none) | (0, 0, 0, 0) | satellite attitude as quaternion in ECI(J2000) for each line of backward viewing band : scalar and vector parts in order |
| G | SolarGeometry | | | | | | | | |
| | solarPos_ECR_FWD | 2 | numLine_FWD, 3 | H5T_IEEE_F64LE | Solar position in ECR (FWD) | km | (none) | (0, 0, 0) | apparent solar position in ECR(WGS84) for each line of forward viewing band |
| | solarPos_ECR_BWD | 2 | numLine_BWD, 3 | H5T_IEEE_F64LE | Solar position in ECR (BWD) | km | (none) | (0, 0, 0) | apparent solar position in ECR(WGS84) for each line of backward viewing band |
| | solarVel_ECR_FWD | 2 | numLine_FWD, 3 | H5T_IEEE_F64LE | Solar velocity in ECR (FWD) | km/s | (none) | (0, 0, 0) | apparent solar velocity in ECR(WGS84) for each line of forward viewing band |
| | solarVel_ECR_BWD | 2 | numLine_BWD, 3 | H5T_IEEE_F64LE | Solar velocity in ECR (BWD) | km/s | (none) | (0, 0, 0) | apparent solar velocity in ECR(WGS84) for each line of backward viewing band |

* If numLine_FWD or numLine_BWD is 0, corresponding datasets under the following groups are not stored.

LineAttribute, ImageData_FWD, ImageData_BWD, ImageGeometry, ForwardBackwardCollocation, SatelliteGeometry, SolarGeometry