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

June 2020

National Institute for Environmental Studies
GOSAT-2 Project

Revision History

| Version | Revised on | Page | Description |
|---------|-----------|------|-------------|
| 00 | Feb. 2019 | - | - |
| 01 | Mar. 2019 | p.1 | Updated references |
| | | p.5, p.9 | Fixed the description of product versions |
| 02 | Sep. 2019 | p.2 | Updated JAXA product (Remove electric calibration product) |
| | | p.5 | Fixed the file naming convention |
| 03 | Jun. 2020 | p.1, p.3, p.5, p.9, p.10 | Added about L4 products |

Table of Contents

Separate Volume
- Vol.1: GOSAT-2 TANSO-CAI-2 L1B Product
- Vol.2: GOSAT-2 TANSO-CAI-2 L2 Cloud Discrimination Product
- Vol.3: GOSAT-2 TANSO-CAI-2 L2 Aerosol Property Product
- Vol.4: GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product
- Vol.5: GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product
- Vol.6: GOSAT-2 TANSO-FTS-2 TIR L2 Cloud and Aerosol Property Product
- Vol.7: GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Product
- Vol.8: GOSAT-2 L4A Global $CO_2$ Flux Product
- Vol.9: GOSAT-2 L4A Global $CH_4$ Flux Product
- Vol.10: GOSAT-2 L4B Global $CO_2$ Distribution Product
- Vol.11: GOSAT-2 L4B Global $CH_4$ Distribution Product

# 1 Introduction

## 1.1 Purpose

The purpose of this document is to define the file format of the Greenhouse gases Observing Satellite-2 (hereinafter referred to as "GOSAT-2") product generated by the National Institute for Environmental Studies (hereinafter referred to as "NIES").

## 1.2 References

(1) NIES GOSAT-2 Product Definition Document (NIES-GOSAT2-SYS-20160513-006-02)
(2) GOSAT-2 JAXA Product Definition Document (GST-180002)

# 2 Number of the Product Format Descriptions

This document summarizes common information for all GOSAT-2 products generated by NIES. Individual information of each product is handled as a separate volume and consists of the following numbers.

- Vol.1: GOSAT-2 TANSO-CAI-2 L1B Product
- Vol.2: GOSAT-2 TANSO-CAI-2 L2 Cloud Discrimination Product
- Vol.3: GOSAT-2 TANSO-CAI-2 L2 Aerosol Property Product
- Vol.4: GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product
- Vol.5: GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product
- Vol.6: GOSAT-2 TANSO-FTS-2 TIR L2 Cloud and Aerosol Property Product
- Vol.7: GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Product
- Vol.8: GOSAT-2 L4A Global $CO_2$ Flux Product
- Vol.9: GOSAT-2 L4A Global $CH_4$ Flux Product
- Vol.10: GOSAT-2 L4B Global $CO_2$ Distribution Product
- Vol.11: GOSAT-2 L4B Global $CH_4$ Distribution Product

    \* Vol.3 and after will be provided by the start of each product release.

03

## 3  Product list

### 3.1  JAXA product

Products generated by JAXA (hereinafter referred to as "JAXA products") and their descriptions are listed below (Table 3-1). A few JAXA products, TANSO-CAI-2 L1A Product and TANSO-FTS-2 L1B Product, are used as input data to generate NIES products. Detailed descriptions of JAXA products are found in "GOSAT-2 JAXA Product Definition Document".

Table 3-1　List of JAXA products

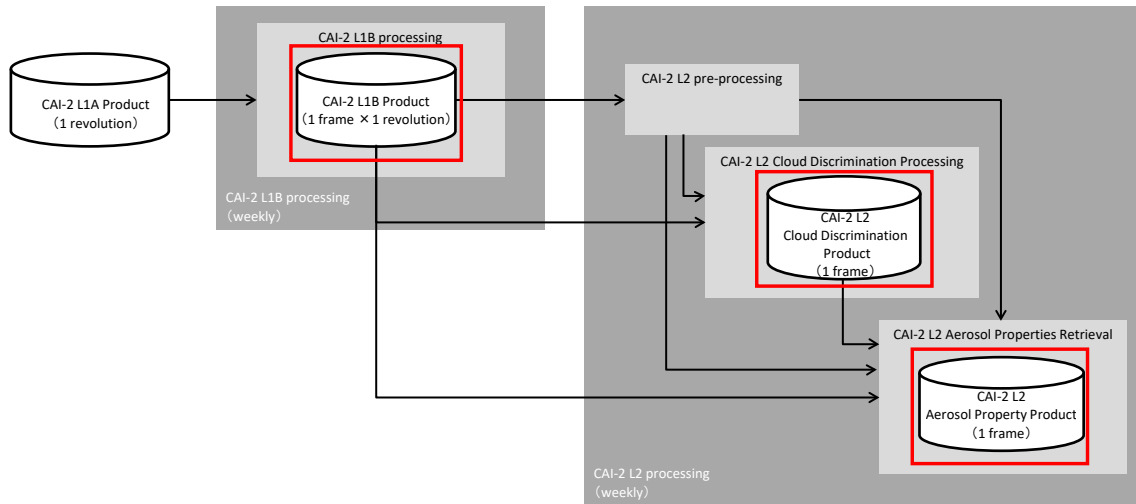| Sensor | Product name | Category | Stored file | | Unit |
|---|---|---|---|---|---|
| CAI-2 | TANSO-CAI-2 L1A Product | Internal | Common / Forward viewing / Backward viewing | | CAI-2 scene |
| | TANSO-CAI-2 CAL L1A Product | Internal | Nighttime | Common / Forward viewing / Backward viewing | Path |
| | | | Lunar | Common / Forward viewing / Backward viewing | Path |
| FTS-2 | TANSO-FTS-2 L1A Product | Internal | Common / SWIR / TIR | | FTS-2 scene |
| | TANSO-FTS-2 CAL L1A Product | Internal | Solar irradiance | Common / SWIR | Path |
| | | | Blackbody | Common / SWIR / TIR | Path |
| | | | Deep-space | Common / SWIR / TIR | Path |
| | | | Instrument function | Common / SWIR | Path |
| | | | Nighttime | Common / SWIR | Path |
| | | | Lunar | Common / SWIR | Path |
| | TANSO-FTS-2 L1B Product | Internal | Common | | FTS-2 scene |
| | | Standard | SWIR / TIR | | |
| | TANSO-FTS-2 CAL L1B Product | Internal | Solar irradiance | Common / SWIR | Path |
| | | | Blackbody | Common / SWIR / TIR | Path |
| | | | Deep-space | Common / SWIR / TIR | Path |
| | | | Instrument function | Common / SWIR | Path |
| | | | Nighttime | Common / SWIR | Path |
| | | | Lunar | Common / SWIR | Path |

### 3.2 NIES product

Products generated by NIES (hereinafter referred to as "NIES products") and their descriptions are listed below (Table 3-2). The data processing flows of TANSO-CAI-2 and TANSO-FTS-2 are shown in Figure 3-1 and Figure 3-2, respectively. Detailed descriptions of NIES products are found in each number of Product Format Description.
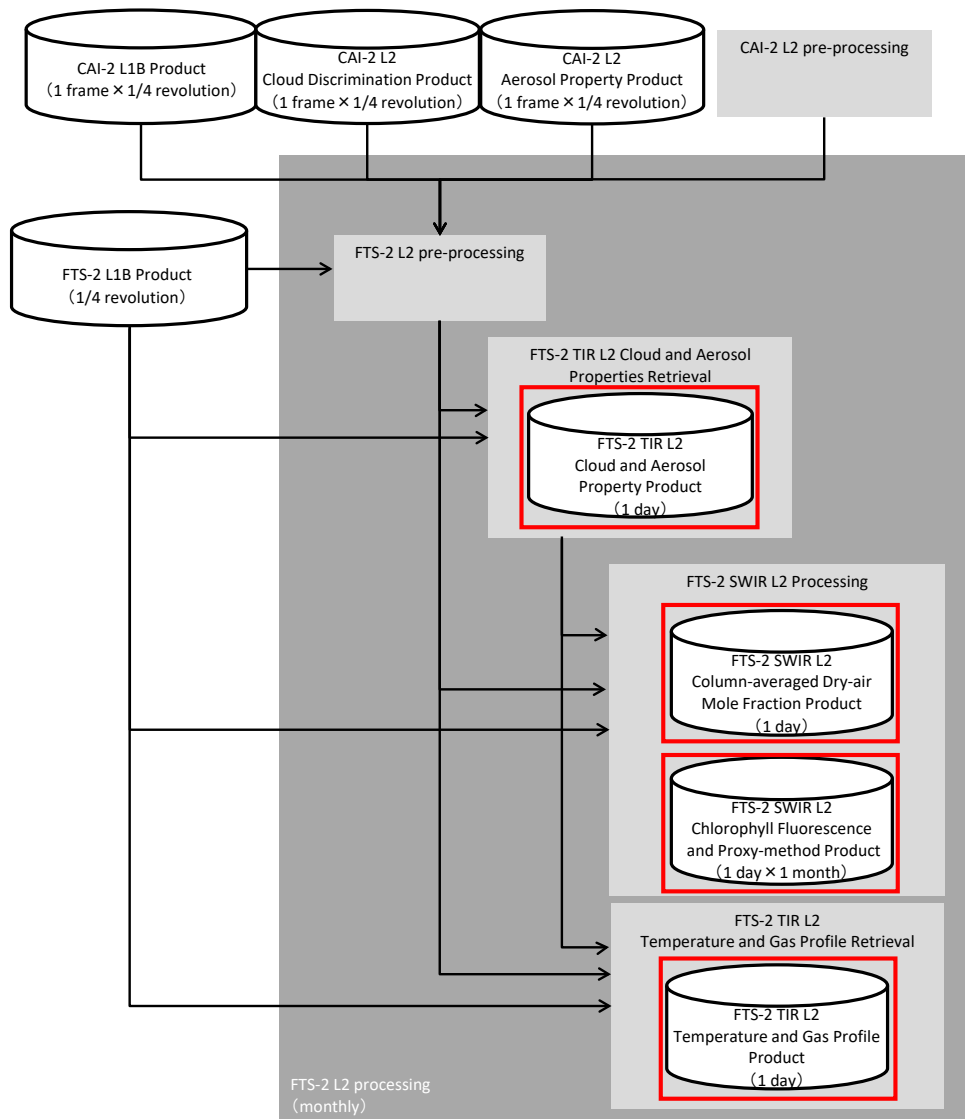
Table 3-2    List of NIES products

| Sensor | Product name | Category | Stored file | Unit |
|---|---|---|---|---|
| CAI-2 | GOSAT-2 TANSO-CAI-2 L1B Product | Standard | CAI-2 frame | CAI-2 frame |
| | GOSAT-2 TANSO-CAI-2 L2 Cloud Discrimination Product | Standard | CAI-2 frame | CAI-2 frame |
| | GOSAT-2 TANSO-CAI-2 L2 Aerosol Property Product | Standard | CAI-2 frame | CAI-2 frame |
| FTS-2 SWIR | GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product | Standard | Daily | Daily |
| | GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product | Standard | Daily | Daily |
| FTS-2 TIR | GOSAT-2 TANSO-FTS-2 TIR L2 Cloud and Aerosol Property Product | Standard | Daily | Daily |
| | GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Product | Standard | Daily | Daily |
| | GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Research Product | Research | Daily | Daily |
| - | GOSAT-2 L4A Global $CO_2$ Flux Product | Standard | Annually | Annually |
| | GOSAT-2 L4A Global $CH_4$ Flux Product | Standard | Annually | Annually |
| | GOSAT-2 L4B Global $CO_2$ Distribution Product | Standard | Annually | Annually |
| | GOSAT-2 L4B Global $CH_4$ Distribution Product | Standard | Annually | Annually |

03

**Figure 3-1**

CAI-2 L1B processing

CAI-2 L1A Product
（1 revolution）

CAI-2 L1B Product
（1 frame ×1 revolution）

CAI-2 L1B processing
（weekly）

CAI-2 L2 pre-processing

CAI-2 L2 Cloud Discrimination Processing

CAI-2 L2
Cloud Discrimination
Product
（1 frame）

CAI-2 L2 Aerosol Properties Retrieval

CAI-2 L2
Aerosol Property Product
（1 frame）

CAI-2 L2 processing
（weekly）

NIES products shown in Table 3-2

Figure 3-1 Data processing flow of TANSO-CAI-2

**Figure 3-2**

CAI-2 L1B Product
（1 frame ×1/4 revolution）

CAI-2 L2
Cloud Discrimination Product
（1 frame ×1/4 revolution）

CAI-2 L2
Aerosol Property Product
（1 frame ×1/4 revolution）

CAI-2 L2 pre-processing

FTS-2 L1B Product
（1/4 revolution）

FTS-2 L2 pre-processing

FTS-2 TIR L2 Cloud and Aerosol Properties Retrieval

FTS-2 TIR L2
Cloud and Aerosol
Property Product
（1 day）

FTS-2 SWIR L2 Processing

FTS-2 SWIR L2
Column-averaged Dry-air
Mole Fraction Product
（1 day）

FTS-2 SWIR L2
Chlorophyll Fluorescence
and Proxy-method Product
（1 day ×1 month）

FTS-2 TIR L2
Temperature and Gas Profile Retrieval

FTS-2 TIR L2
Temperature and Gas Profile
Product
（1 day）

FTS-2 L2 processing
（monthly）

NIES products shown in Table 3-2

Figure 3-2　Data processing flow of TANSO-FTS-2

# 4    List of NIES products and file naming convention

The NIES products and file naming convention for each product are listed below (Table 4-1).

Table 4-1    NIES products and file naming convention for each product

| Product name | Unit | Product code | File name |
|---|---|---|---|
| GOSAT-2 TANSO-CAI-2 L1B Product | CAI-2 frame | CL1B | GOSAT2TCAI2YYYYMMDDHHmmPPPFFF_1BCCL1BVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-CAI-2 L2 Cloud Discrimination Product | CAI-2 frame | CLDD | GOSAT2TCAI2YYYYMMDDHHmmPPPFFF_02CCLDDVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-CAI-2 L2 Aerosol Property Product | CAI-2 frame | AERP | GOSAT2TCAI2YYYYMMDDHHmmPPPFFF_02CAERPVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product | Daily | SWPR | GOSAT2TFTS2YYYYMMDD_02SWPRVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product | Daily | SWFP | GOSAT2TFTS2YYYYMMDD_02SWFPVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-FTS-2 TIR L2 Cloud and Aerosol Property Product | Daily | TCAP | GOSAT2TFTS2YYYYMMDD_02TCAPVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Product | Daily | TTGP | GOSAT2TFTS2YYYYMMDD_02TTGPVMMNNRRoooo.h5 |
| GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Research Product | Daily | TTGP | GOSAT2TFTS2YYYYMMDD_R2TTGPVMMNNRRoooo.h5 |
| GOSAT-2 L4A Global $CO_2$ Flux Product | Annually | CO2F | GOSAT2YYYYMMyyyymm_4ACO2FVMMNNRRoooo.nc |
| GOSAT-2 L4A Global $CH_4$ Flux Product | Annually | CH4F | GOSAT2YYYYMMyyyymm_4ACH4FVMMNNRRoooo.nc |
| GOSAT-2 L4B Global $CO_2$ Distribution Product | Annually | CO2C | GOSAT2YYYYMMyyyymm_4BCO2CVMMNNRRoooo.nc |
| GOSAT-2 L4B Global $CH_4$ Distribution Product | Annually | CH4C | GOSAT2YYYYMMyyyymm_4BCH4CVMMNNRRoooo.nc |

| Character strings | Description |
|---|---|
| Y Y Y Y M M D D H H m m | Start time of observation (year, month, day, hour, minute) [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.) |
| Y Y Y Y M M D D | Observation date (year, month, day) [UTC] |
| Y Y Y Y M M | Start month of target period (year, month) [UTC] |
| y y y y m m | End month of target period (year, month) [UTC] |
| P P P | Path No. (001 - 089) |
| F F F | Frame No. (001 - 036) |
| V | Processing identifier (V: Steady, T: Test), add as necessary |
| M M N N | Product version (MM: Major, NN: Minor) |
| R R | Revision |
| o o o o | Input data version |

# 5    File unit of products
Products are provided to users by a file unit, which has a different definition per each sensor. The outline of file unit is shown below.

## 5.1    File unit definitions
This section describes file units of products.

(1)  Scene
The definition of scene depends on sensor (TANSO-FTS-2 or TANSO-CAI-2).
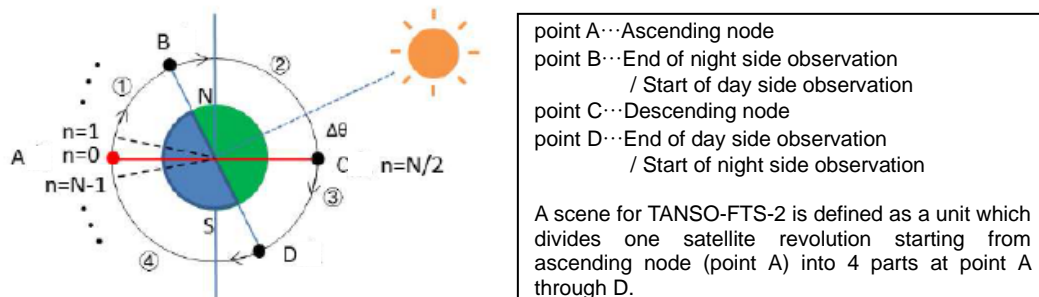The definition of scene for TANSO-FTS-2 is shown in Figure 5-1.



point A···Ascending node
point B···End of night side observation
/ Start of day side observation
point C···Descending node
point D···End of day side observation
/ Start of night side observation

A scene for TANSO-FTS-2 is defined as a unit which divides one satellite revolution starting from ascending node (point A) into 4 parts at point A through D.

Figure 5-1    Definition of scene for TANSO-FTS-2

A scene for TANSO-CAI-2 is defined as a data of one satellite revolution starting from ascending node. The image of scene for TANSO-CAI-2 is shown in Figure 5-2. The image of all scenes (all paths) for GOSAT-2 is shown in Figure 5-3 (descending node) and Figure 5-4 (ascending node). Numbers in the figure show path number.
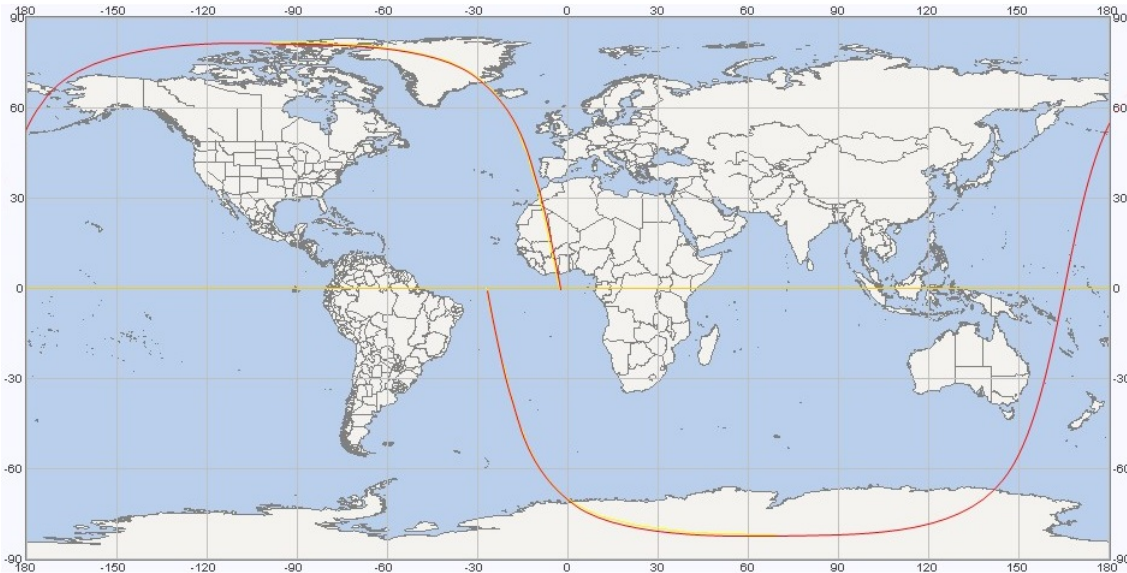


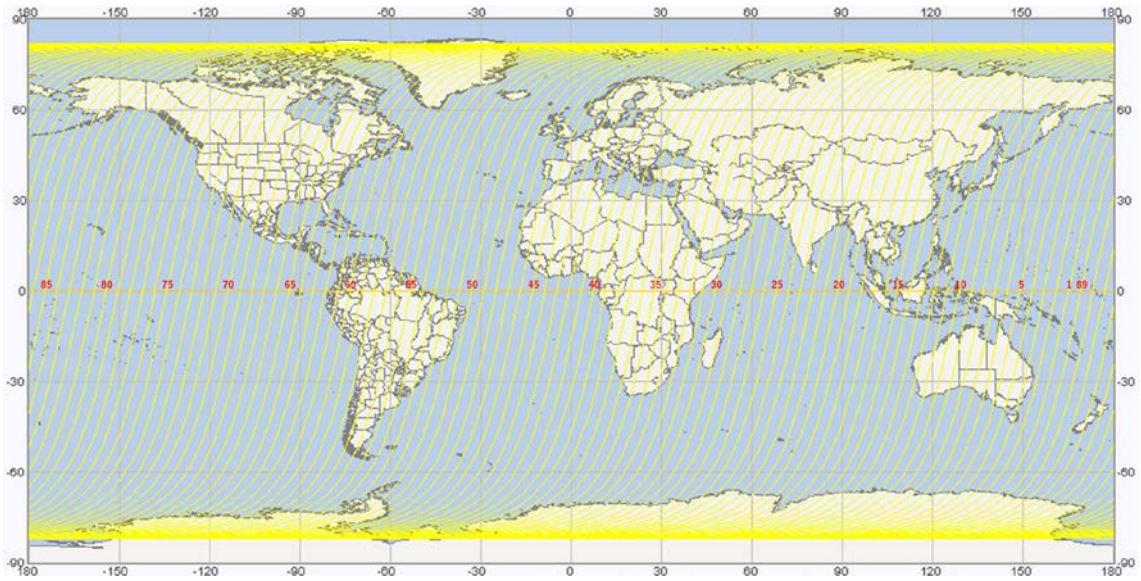Figure 5-2    Image of scene for TANSO-CAI-2 (Path number: 1)

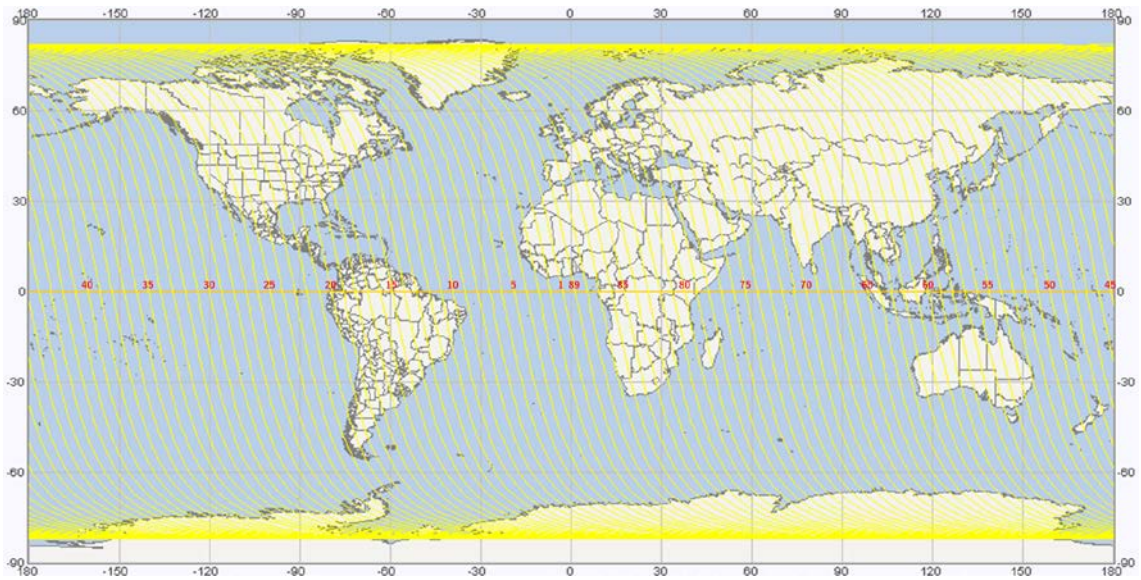Figure 5-3    Image of all paths for GOSAT-2 (descending node)


Figure 5-4    Image of all paths for GOSAT-2 (ascending node)

(2) Frame
A frame of TANSO-CAI-2 is defined as a unit which divides one scene into 36 equal parts by the argument of latitude at observation point of central pixel. The image of frames for TANSO-CAI-2 is shown in Figure 5-5.
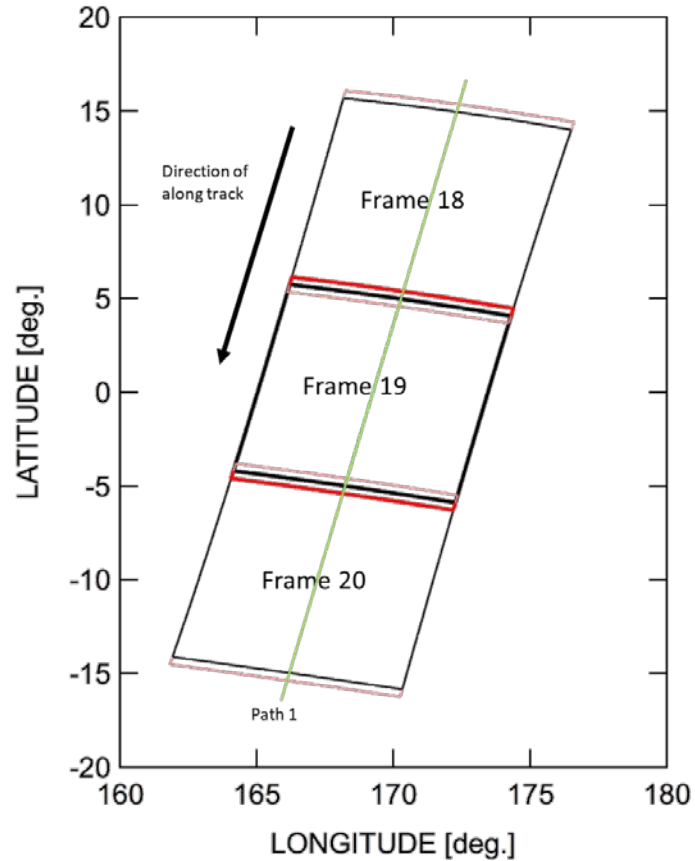


Figure 5-5    Image of frames for TANSO-CAI-2 (Path number: 1)

## 5.2    File unit of TANSO-FTS-2
A file unit of TANSO-FTS-2 archives the data of one observational day (00:00–23:59 UTC).

## 5.3    File unit of TANSO-CAI-2
A file unit of TANSO-CAI-2 archives the data of one frame. Since the scene for TANSO-CAI-2 archives the data of only day side, 18 files are generated from one satellite revolution.

## 6 Description of versions
### 6.1 Versions of TANSO-FTS-2 product and TANSO-CAI-2 product

(1) Product version

The product version consists of Major version and Minor version, and each one is expressed by a zero-padded two-digit integer. It is assigned as [MMNN] in Table 4-1. The increment policy of Major version and Minor version is described as follows.

· Major version is incremented if the impact to updated product is large.

· Minor version is incremented if the impact to updated product is small.

(2) Revision

The revision is expressed by a zero-padded two-digit integer. It is assigned as [RR] in Table 4-1. The revision is incremented if there is no impact on updated product with some changes.

(3) Input data version

The input data version, which is given to a set of input data and reference data used for data processing, is expressed by a zero-padded four-digit integer. If any version of an input data or a reference data is changed, the input data version is incremented. It is assigned as [oooo] in Table 4-1.

The image of version increment is shown in Table 6-1.

Table 6-1　Image of version increment

| Date | Changed contents | Product version (*) | Revision | Input data version |
|---|---|---|---|---|
| Jan. 1, 2016 | Initial release | 01.00 | 00 | 0001 |
| Feb. 1, 2016 | Correction of log contents (There is no impact on a product.) | 01.00 | 01 | 0001 |
| Mar. 1, 2016 | Version change of reference data (There is a small impact on a product.) | 01.01 | 00 | 0002 |
| Apr. 1, 2016 | Change of algorithms and processing parameters (There is a large impact on a product.) | 02.00 | 00 | 0003 |

*As a general notation, there is a dot between Major version and Minor version.

### 6.2 Versions of L4 product

(1) Product version

The product version consists of Major version and Minor version, and each one is expressed by a zero-padded two-digit integer. It is assigned as [MMNN] in Table 4-1. The increment policy of Major version and Minor version is described as follows.

- ・ Major version is incremented if major version of model is incremented.
- ・ Minor version is incremented if minor version of model is incremented, or version of *a priori* information, and so on used to model is incremented.

(2) Revision

The revision is expressed by a zero-padded two-digit integer. It is assigned as [RR] in Table 4-1. The revision is incremented if model or *a priori* information, and so on is fixed.

(3) Input data version

The input data version, which is given to a set of observation data of atmospheric concentration (TANSO-FTS-2 L2 product and ground observation data) used for model processing, is expressed by a zero-padded four-digit integer. If any version of an observation data of atmospheric concentration is changed, the input data version is incremented. It is assigned as [oooo] in Table 4-1.

# 7    Sensor information
## 7.1    TANSO-FTS-2
·    Intelligent pointing

TANSO-FTS-2 has a function of Intelligent pointing, which automatically identifies clouds and changes the observation direction to avoid clouds within the imaging range of its camera by itself in case that there are some clouds. The purpose of this function is to increase the number of usable cloud-free observations.

## 7.2    TANSO-CAI-2
·    Forward and backward viewing bands

TANSO-CAI-2 observes areas in two directions, forward direction of along track at a 20-degree angle (forward viewing bands) and backward direction of along track at a 20-degree angle (backward viewing bands). The purpose of the forward and backward viewing bands is to avoid sunglint in either direction and improve the performance of cloud discrimination by observing the same point from different angles.
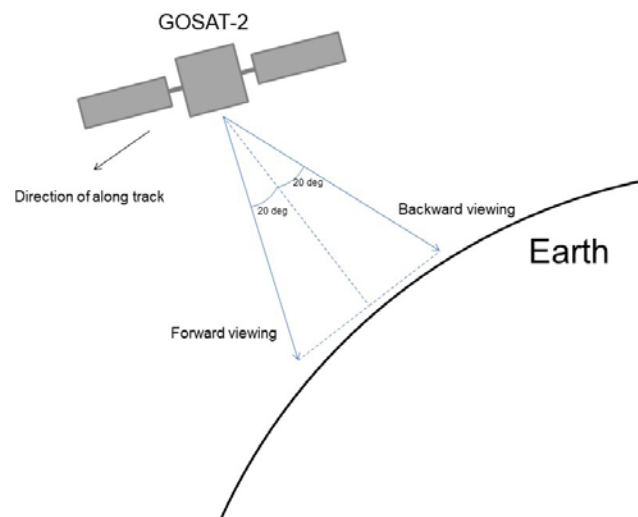
Figure 7-1    Image of forward and backward viewing bands for TANSO-CAI-2