

NIES-GOSAT2-SYS-20220701-005-02

Release Note

GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole
Fraction Product

Product version 02.00

October 2023

National Institute for Environmental Studies
GOSAT-2 Project

Revision History

Version	Revised on	Page	Description
00	Jul. 2022	-	-
01	Aug. 2022	p.2	Fix date version of time-dependent radiance correction coefficient
		p.3	Added that released to General users
02	Oct. 2023	p.3, p.4	Added important information
		p.4	Added References

1 Introduction

The purpose of this document is to provide considerations for 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”).

Table 1-1 shows the product and its version described in this document.

Table 1-1 Product and version explained in the document

Product name	Product version
GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product	02.00

2 Difference from the previous version

Difference between the previous version (01.07) and this version (02.00) is shown below.

2.1 Change of algorithm

The change of processing algorithm is shown below.

- (1) A zero-level offset and an ILS stretch factor for each sub-band are introduced to the state vector.
- (2) With the changes in Section 2.1(1) and 2.2, the coefficient of empirical noise is reevaluated.
- (3) With the changes in Section 2.1(1) and (2), and 2.2, some of the post-screening criteria are changed.

2.2 Change of input data

The change of input data is shown below.

- (1) TANSO-FTS-2 L1B Product as the input product was updated. For more information, refer to the release note of TANSO-FTS-2 L1B Product (GST-210008).
- (2) The TSIS-1 Hybrid Solar Reference Spectrum is used for the solar irradiance data used in the retrieval processing.
- (3) Fix the bug that the wavenumber grid of the FTS-2 Band1 O₂ absorption cross section look-up-table used in the retrieval processing was off by one point (0.01 cm⁻¹).
- (4) The SEOM Improved Atmospheric Spectroscopy Databases is used as the line parameter of the FTS-2 Band3 CH₄ to calculate the absorption cross section look-up-table used in the retrieval processing.

2.3 Change of product format

The change of product format is shown below.

- (1) Newly added the following datasets.
 - RetrievalResult/zero_level_offset_subband01
 - RetrievalResult/zero_level_offset_subband01_apriori
 - RetrievalResult/zero_level_offset_subband01_uncert
 - RetrievalResult/zero_level_offset_subband02
 - RetrievalResult/zero_level_offset_subband02_apriori
 - RetrievalResult/zero_level_offset_subband02_uncert

- RetrievalResult/zero_level_offset_subband03
- RetrievalResult/zero_level_offset_subband03_apriori
- RetrievalResult/zero_level_offset_subband03_uncert
- RetrievalResult/zero_level_offset_subband04
- RetrievalResult/zero_level_offset_subband04_apriori
- RetrievalResult/zero_level_offset_subband04_uncert
- RetrievalResult/zero_level_offset_subband05
- RetrievalResult/zero_level_offset_subband05_apriori
- RetrievalResult/zero_level_offset_subband05_uncert
- RetrievalResult/ils_stretch_factor_subband01
- RetrievalResult/ils_stretch_factor_subband01_apriori
- RetrievalResult/ils_stretch_factor_subband01_uncert
- RetrievalResult/ils_stretch_factor_subband02
- RetrievalResult/ils_stretch_factor_subband02_apriori
- RetrievalResult/ils_stretch_factor_subband02_uncert
- RetrievalResult/ils_stretch_factor_subband03
- RetrievalResult/ils_stretch_factor_subband03_apriori
- RetrievalResult/ils_stretch_factor_subband03_uncert
- RetrievalResult/ils_stretch_factor_subband04
- RetrievalResult/ils_stretch_factor_subband04_apriori
- RetrievalResult/ils_stretch_factor_subband04_uncert
- RetrievalResult/ils_stretch_factor_subband05
- RetrievalResult/ils_stretch_factor_subband05_apriori
- RetrievalResult/ils_stretch_factor_subband05_uncert

3 Important information

The important information for this product version is shown below.

- (1) The L1 product version corresponding to this product version is shown below.
 - TANSO-FTS-2 L1B Product: 210.210

Note: The spectra before sensitivity correction stored under SoundingData/RawSpectrum is used in the retrieval processing of this product. The instrument characteristic information used in retrieval processing of products of this version is the same those used for the conversion of the sensitivity-corrected spectra stored under SoundingData/Radiance of TANSO-FTS-2 L1B V210.210.
- (2) The wavenumber range of TANSO-FTS-2 SWIR observed spectral radiance, used for retrieval processing of products of this version, consists of 12950-13200 cm^{-1} (Band 1), 6180-6380 cm^{-1} (Band 2), 5900-6150 cm^{-1} (Band 2), 4800-4900 cm^{-1} (Band 3), and 4200-4300 cm^{-1} (Band 3), which correspond to the sub bands 1, 2, 3, 4 and 5 respectively.
- (3) In this version, in retrieval processing, the following TANSO-FTS-2 Instrument characteristic information was used.
 - Instrument line shape function (ILSF) date version: May 25, 2020
 - radiance conversion coefficient (Rad_CNV) date version: Jan. 11, 2022
 - time-dependent radiance correction coefficient (RAD_Time_Wave_Deg) date version: May 25, 2020
 - complex refractive index of the scanner mirror (SCANNER_REFRACTION) date version: Oct. 10, 2018
- (4) The following datasets store invalid value.
 - CloudInformation/FTS-2_TIR
 - RetrievalResult/wind_speed

- RetrievalResult/wind_speed_apriori
 - RetrievalResult/wind_speed_uncert
- (5) Only each data of “Good” quality flag should be used, although xco2_quality_flag, xch4_quality_flag, xco_quality_flag, and xh2o_quality_flag under RetrievalResult store four-level quality flags: “Good”, “Fair”, “Poor”, and “NG”.
- (6) Retrieved column-averaged dry-air mole fraction of atmospheric gases have biases and standard deviations which have following features. The cause is under investigation. Please apply the bias correction shown in (8) as necessary.
- XCO₂ has obvious positive bias and its standard deviation is about 0.5%.
 - XCH₄ has no obvious bias and its standard deviation is about 0.5%.
 - XCO has obvious positive bias.
- (7) In FTS-2 L2 Pre-processing, the calculation method of the surface pressure at the center of FTS-2 IFOV was changed to extrapolate the pressure profile to the mean altitude within the IFOV. This value is used as an a priori value of surface pressure in the retrieval processing.
- (8) The empirical bias correction formula and correction coefficient based on multiple regression analysis, which were evaluated by considering TCCON data (version GGG2014) as the true value, are as follows (Yoshida et al. 2023). The correction coefficients A_i , B_i , C_i ($i = 0\sim3$) are shown in Table 3-1, and the correspondence between each symbol and dataset is shown in Table 3-2. All column-averaged dry-air mole fractions are in [ppm].

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$$XCO_2^{Bias-Corrected} = XCO_2 + A_0 + A_1 \cdot \Delta P_S + A_2 \cdot AOT + A_3 \cdot fILS_{SB2} \quad (3-1)$$

$$XCH_4^{Bias-Corrected} = XCH_4 + B_0 + B_1 \cdot \Delta P_S + B_2 \cdot AOT + B_3 \cdot fILS_{SB5} \quad (3-2)$$

$$XCO^{Bias-Corrected} = XCO + C_0 + C_1 \cdot \Delta P_S + C_2 \cdot AOT + C_3 \cdot fILS_{SB5} \quad (3-3)$$

$$\Delta P_S = P_S - P_S^{a\ priori} \quad (3-4)$$

$$AOT = \sum_{i=1}^{15} AOT_i^{type1} + \sum_{i=1}^{15} AOT_i^{type2} \quad (3-5)$$

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Table 3-1 Correction coefficient used for the bias correction

A_0	-8.98630E-1	B_0	5.29805E-1	C_0	-1.24502E+0
A_1	2.36607E-1	B_1	1.13007E-3	C_1	-4.57477E-6
A_2	-1.64121E+2	B_2	-3.20115E-1	C_2	-3.54139E-1
A_3	-1.53897E+0	B_3	-5.25923E-1	C_3	1.23322E+0

Table 3-2 Dataset used for the bias correction

Symbol	Dataset
XCO_2	RetrievalResult/xco2
XCH_4	RetrievalResult/xch4
XCO	RetrievalResult/xco
P_S	RetrievalResult/surface_pressure
$P_S^{a\ priori}$	RetrievalResult/surface_pressure_apriori
AOT^{type1}	RetrievalResult/aerosol_profile_type1
AOT^{type2}	RetrievalResult/aerosol_profile_type2
$fILS_{SB2}$	RetrievalResult/ils_stretch_factor_subband02
$fILS_{SB5}$	RetrievalResult/ils_stretch_factor_subband05

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4 Version-upgrade history

Table 4-1 shows the version-upgrade history of this product.

Table 4-1 Version-upgrade history

Product version	Date	Remarks
01.01	Nov. 2019	Released to RA users
01.04	Oct. 2020	Changed algorithm Changed input data Changed important information Released to RA users
	Nov. 2020	Released to General users
01.07	Oct. 2021	Changed input data Changed important information Released to RA users
	Dec. 2021	Released to General users
02.00	Jul. 2022	Changed algorithm Changed input data Changed product format Changed important information Released to RA users
	Aug. 2022	Released to General users
	Oct. 2023	Added important information

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References)

Yoshida, Y., Y. Someya, H. Ohyama, I. Morino, T. Matsunaga, N.M. Deutscher, D.W.T. Griffith, F. Hase, L.T. Iraci, R. Kivi, J. Notholt, D.F. Pollard, Y. Té, V.A. Velazco, and D. Wunch (2023): Quality Evaluation of the Column-Averaged Dry Air Mole Fractions of Carbon Dioxide and Methane Observed by GOSAT and GOSAT-2. SOLA, 19, 173-184, doi:10.2151/sola.2023-023.

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