

**Greenhouse gases Observing SATellite (GOSAT) /
Greenhouse gases Observing SATellite-2 (GOSAT-2) Data Policy**

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National Institute for Environmental Studies
Global Environment Bureau, Ministry of the Environment of Japan

1. Purpose

This document defines the terms and conditions to users related to data obtained by Greenhouse gases Observing SATellite (hereinafter referred to as “GOSAT”) and Greenhouse gases Observing SATellite-2 (hereinafter referred to as “GOSAT-2”) (hereinafter collectively referred to as “GOSAT/GOSAT-2 Data”), in accordance with the agreement concerning the development and utilization of the Greenhouse gases Observing SATellite (GOSAT) sensor (August 1, 2005) and the agreement concerning the development and utilization of the Greenhouse gases Observing SATellite-2 (GOSAT-2) (June 27, 2014).

2. Basic Policies

- (1) The GOSAT/GOSAT-2 Data will be distributed on a “non-discriminatory” basis as provided for in the Principles Relating to Remote Sensing of the Earth from Space issued by the United Nations.
- (2) The GOSAT/GOSAT-2 Data will be processed in a prompt manner with the help from inside and outside Japan and will be provided at large to promote data utilization.
- (3) The GOSAT/GOSAT-2 Data Policy takes into consideration the following missions of Japan Aerospace Exploration Agency (hereinafter referred to as “JAXA”), National Institute for Environmental Studies of Japan (hereinafter referred to as “NIES”), and Ministry of the Environment of Japan (hereinafter referred to as “MOE”) (hereinafter collectively referred to as the “Three Parties”), to the maximum extent possible.
 - ① JAXA contributes to improvement of satellite data through calibration of GOSAT/GOSAT-2 sensors, data processing for Level 1, and development and verification of infrared algorithms, and promotes data utilization inside and outside of Japan through data distribution.
 - ② NIES contributes to deepening of scientific understanding of the global carbon cycle and spatial distribution of related materials, and improving of future climate prediction through high level processing of the GOSAT/GOSAT-2 Data and validation, distribution and utilization research of the processing results, as well as the measures concerning global

warming by MOE through technical development for verification of inventories for greenhouse gas and particulate matter (GOSAT-2 only) in each country using satellites and emission reduction activities.

- ③ MOE will utilize the GOSAT/GOSAT-2 Data in its environmental administration through the data use for research and development to monitor and verify emission of greenhouse gases and the contribution to the measures for global warming in each country, while maintaining the balance between international cooperation and national interests.

3. Definitions of GOSAT/GOSAT-2 Data Products Types and Categories

The attached Table 1 lists the types of GOSAT products distributed by JAXA or NIES. The attached Table 2 lists the types of GOSAT-2 products distributed by JAXA or NIES. There are several “Levels” of GOSAT/GOSAT-2 products in accordance with the data processing steps: Level 1 products are data representing physical quantities converted from the voltage and current values measured by the sensor; Level 2 products are processed from Level 1 products and show column abundances of greenhouse gases; Level 3 products are data on the global distribution of column abundances obtained by applying a statistical processing to Level 2 products taken over a certain period of time; and Level 4 products provide greenhouse gas fluxes and three-dimensional concentrations calculated based on Level 2 products. All GOSAT/GOSAT-2 products at these different levels are classified into three product categories: standard, research and internal products. Each category is described and defined as follows:

(1) Standard products

Standard products are Level 1 products or high-level products (*1) which are generated constantly and are available generally, and whose document related to algorithms, formats and results of accuracy assessment (*2) will be released to the public.

(*1) Definitions of the calibration stages for levels of standard products in GOSAT Data Policy are abolished.

(*2) Results of accuracy assessment indicate calibration results or verification results that are assessed the accuracy of specific physical quantity stored in GOSAT-2 product using data obtained by stand-alone observation instruments with a higher accuracy, or comparison results using data obtained by stand-alone and observation instruments/models with a similar accuracy.

(2) Research products

Research products are to be distributed to a limited community of users for research on calibration, validation, data processing algorithms and data utilization, and other scientific researches. The Three Parties are not required to carry out validation or comparison and not to release results of accuracy assessment of these products. The term and scope for generating this product may be limited.

(3) Internal products

Internal products are to be available within the Three Parties only. However, Internal products may be provided to limited research investigators and research organizations with respect to

calibration or research on Level 1 processing algorithms of observation sensors, solely for the purpose of carrying out such activities.

4. User Categories

List 3 shows the user categories of the GOSAT/GOSAT-2 Data.

5. Release of the GOSAT/GOSAT-2 Data

(1) Policies on release of the GOSAT/GOSAT-2 Data

- ① The data distribution of standard products to all users will start immediately after the completion of the calibration and validation. However, the data will be provided with priority to users other than general users defined in Article 4 earlier than general users in cases where such data distribution contributes to the development of the GOSAT/GOSAT-2 sensors, calibration and validation or data utilization researches.
- ② The GOSAT/GOSAT-2 Data other than standard product are not distributed in principle. However, the processed products in appropriate scope may be distributed at the appropriate timing to users other than general users defined in Article 4.

(2) Timing of the start of the GOSAT-2 Data

① Standard products

- (i) As for Level 1 products, products after the calibration of its sensor(s) and its validation are scheduled to be released 9 (nine) months after the launch. However, Level 1 products before the calibration may be distributed for the propose of a good influence on calibration works prior to 9 (nine) months after the launch to users other than general users defined in Article 4 at the discretion of the Three Parties.
- (ii) As for Level 2 products, products after the validation are scheduled to be released 12 (twelve) months after the launch. However, Level 2 products before the validation may be distributed prior to 12 (twelve) months after the launch to users other than general users defined in Article 4 at the discretion of the Three Parties. As for products after above-mentioned distribution, the release timing of each product will be discussed by the Three Parties when products are updated.
- (iii) As for Level 3 and 4 products, products will be released by the procedures similar to Level 1 and 2 as soon as it is ready.

② Research products

Research products are not distributed in principle. However, the processed product in appropriate scope may be distributed at the appropriate timing to users other than general users defined in Article 4.

③ Internal products

Internal products are not distributed in principle. However, the processed product in

appropriate scope may be distributed at the appropriate timing to users other than general users defined in Article 4.

6. Method for distribution of the GOSAT/GOSAT-2 Data

The GOSAT/GOSAT-2 Data shall be distributed online in principle after making an arrangement between a distributed party and JAXA or NIES in the form of agreement, contract or online agreement on the promise of abiding by terms and conditions concerning the utilization of the GOSAT/GOSAT-2 Data in Article 9.

7. Expenses for distribution of the GOSAT/GOSAT-2 Data

The data shall be distributed free of charge. In the case of occurring any other expenses for distribution, the actual cost may be collected from the users.

8. Rights to the GOSAT/GOSAT-2 Data

- (1) The Three Parties shall own all intellectual property rights including but not limited to copyrights in relation to all the data they provide, except intellectual property rights possessed by a third party.
- (2) When a user has generated high-level, value-added products (*3), the Three Parties shall not exercise their copyrights, i.e., rights as the copyright holders of the original data, to the derivative data and the user may use the value-added data based on his/her own copyrights as the developer of the data.

(*3) High-level, value-added products are, of modified products, those that have been modified by applying high-level data processing and which are irreversible to the original data. High-level data processing here includes data analyses or a combination of satellite data acquired by different missions, image processing based on external information other than the original data, conversion to physical quantities, and so forth.

9. Terms and conditions concerning the utilization of the GOSAT/GOSAT-2 Data

- (1) The use of the data for any purpose in opposition to peaceful use is prohibited.
- (2) Any publication of outcomes obtained in consequence of the use of the data must be accompanied by any one of the following indications.

JAXA/NIES/MOE

Japan Aerospace Exploration Agency / National Institute for Environmental Studies /
Ministry of the Environment

The user is also required to indicate that the original data are provided by JAXA/NIES/MOE, if he or she has generated high-level, value-added data and provides a third party with such data (including publications). When each indication required above is difficult, as in the case of each indication on an academic paper or the documents based on the Paris Agreement, it is to be shown

at the end of the paper or anywhere appropriate.

- (3) Users are allowed to redistribute standard products to a third party (limited to products which the Three Parties release to the public). In the preceding case, a distributing party shall ensure that a distributed party complies with this Data Policy. Users are prohibited to use other products than standard products for any purpose other than the purpose the Three Parties and the user agreed and, to redistribute the data to a third party.
- (4) The Three Parties shall not be liable for any missing data, degradation of data quality, delay in data delivery, or any other situation in which the data cannot be provided, as a result of problems that occur to the spacecraft or the ground facilities.

10. Others

This Data Policy supersede and terminate the GOSAT Data Policy (November 11, 2008). The terms and conditions in Article 8 “Rights to the GOSAT/GOSAT-2 Data” and Article 9 “Terms and conditions concerning the utilization of the GOSAT/GOSAT-2 Data” retroactively apply to GOSAT data which were distributed prior to the establishment of this Data Policy.

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Table 1 List of GOSAT products

Processing Level	Sensor	Product Name	Main Contents	Category	Stored File	Unit	Format
L1A	CAI	CAI L1A data	Uncorrected digital value	Internal	CAI scene	Daily	HDF5
		CAI L1A calibration data					
		CAI L1A lunar calibration data					
	FTS	FTS L1A data	Interferogram		FTS scene		
		FTS L1A calibration data					
		FTS L1A lunar calibration data					
L1B	CAI	CAI L1B data	Radiance including parameters of band-to-band correction and geometric correction	Standard	CAI frame	Path	
	FTS	FTS L1B data	Radiance spectrum	Standard	FTS scene	Daily	
		FTS L1B calibration data		Internal			
		FTS L1B lunar calibration data					
L1B+	CAI	CAI L1B+ data	Radiance after band-to-band correction, geometric correction, and mapping	Standard	CAI frame	Path	
L2	CAI	L2 cloud flag	Clear-sky confidence level and result of cloud discrimination	Standard	CAI frame	Path	
		L2 cloud property	Cloud optical thickness	Research			
		L2 aerosol property	Aerosol optical thickness				
	FTS SWIR	L2 CO ₂ column amount (SWIR)	SWIR CO ₂ column amount	Standard	Daily	Monthly	
		L2 CH ₄ column amount (SWIR)	SWIR CH ₄ column amount				
		L2 H ₂ O column amount (SWIR)	SWIR H ₂ O column amount				
	FTS TIR	L2 CO ₂ profile (TIR)	TIR CO ₂ concentration profile	Standard	Daily	Monthly	
		L2 CH ₄ profile (TIR)	TIR CH ₄ concentration profile				
		L2 H ₂ O column amount (TIR)	TIR H ₂ O column amount	Research			

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Table 1 List of GOSAT products (Continued)

Processing Level	Sensor	Product Name	Main Contents	Category	Stored File	Unit	Format
L3	CAI	L3 global radiance distribution	Global radiance distribution	Standard	Daily	Monthly	HDF5
		L3 global reflectance distribution	Global reflectance distribution		Every 3 days		
		L3 NDVI	Global NDVI				
	FTS SWIR	L3 global CO ₂ distribution (SWIR)	Global distribution of CO ₂ concentration (SWIR)	Standard	Monthly	Monthly	
		L3 global CH ₄ distribution (SWIR)	Global distribution of CH ₄ concentration (SWIR)				
L4A	/	L4A global CO ₂ flux	Regional CO ₂ flux	Standard	Annually	Annually	Text or NetCDF
		L4A global CH ₄ flux	Regional CH ₄ flux				
L4B	/	L4B global CO ₂ distribution	3D global distribution of CO ₂ concentration	Standard	Monthly	Annually	NetCDF
		L4B global CH ₄ distribution	3D global distribution of CH ₄ concentration				

Table 2 List of GOSAT-2 products

Processing Level	Sensor	Product Name	Main Contents	Category	Stored File		Unit	Format	
L1A	CAI-2	TANSO-CAI-2 L1A Product	Uncorrected digital value	Internal	Common		CAI-2 scene	HDF5	
					Forward viewing				
					Backward viewing				
		TANSO-CAI-2 CAL L1A Product	Uncorrected digital value of calibration data	Internal	Nighttime	Common			Path
						Forward viewing			
						Backward viewing			
	Lunar				Common				
					Forward viewing				
					Backward viewing				
	FTS-2	TANSO-FTS-2 L1A Product	Interferogram	Internal	Common		FTS-2 scene		
					SWIR				
					TIR				
		TANSO-FTS-2 CAL L1A Product	Interferogram	Internal	Solar irradiance	Common			Path
						SWIR			
					Blackbody	Common			
						SWIR			
						TIR			
					Deep space	Common			
						SWIR			
						TIR			
Instrument function					Common				
					SWIR				
Nighttime					Common				
	SWIR								
Lunar	Common								
	SWIR								

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Table 2 List of GOSAT-2 products (Continued)

Processing Level	Sensor	Product Name	Main Contents	Category	Stored File		Unit	Format
L1B	CAI-2	GOSAT-2 TANSO-CAI-2 L1B Product	Radiance	Standard	CAI-2 frame		CAI-2 frame	HDF5
	FTS-2	TANSO-FTS-2 L1B Product	SWIR/TIR common information and FOV monitor camera image	Internal	Common		FTS-2 scene	
			SWIR spectra before radiance conversion (V/cm^{-1}) SWIR spectra after radiance conversion ($W/cm^2/str/cm^{-1}$)	Standard	SWIR			
			TIR spectra after radiance conversion ($W/cm^2/str/cm^{-1}$) TIR spectra after radiance conversion and finite IFOV correction ($W/cm^2/str/cm^{-1}$)		TIR			
	FTS-2	TANSO-FTS-2 CAL L1B Product	Spectra of calibration data (same as above)	Internal	Solar irradiance	Common	Path	
						SWIR		
					Blackbody	Common		
						SWIR		
						TIR		
					Deep space	Common		
SWIR								
TIR								
Instrument function	Common							
	SWIR							
Nighttime	Common							
	SWIR							
Lunar	Common							
	SWIR							

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Table 2 List of GOSAT-2 products (Continued)

Processing Level	Sensor	Product Name	Main Contents	Category	Stored File	Unit	Format		
L2	CAI-2	GOSAT-2 TANSO-CAI-2 L2 Cloud Discrimination Product	Integrated clear-sky confidence level, cloud status bit data	Standard	CAI-2 frame	CAI-2 frame	HDF5		
		GOSAT-2 TANSO-CAI-2 L2 Aerosol Property Product	Aerosol optical thickness, soot volume fraction, Ångström exponent, PM2.5						
	FTS-2 SWIR	GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product	Solar induced chlorophyll fluorescence, XCH ₄ [*] , XCO [*] [*] By proxy method	Standard	Daily	Daily			
		GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product	XCO ₂ ^{**} , XCH ₄ ^{**} , XCO ^{**} , XH ₂ O ^{**} ^{**} By full-physics method						
	FTS-2 TIR	GOSAT-2 TANSO-FTS-2 TIR L2 Cloud and Aerosol Property Product	Cloud flags (by each method), optical thickness, cloud particle type	Standard	Daily	Daily			
		GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Product	Vertical profiles of temperature, CO ₂ , CH ₄ , and H ₂ O						
		GOSAT-2 TANSO-FTS-2 TIR L2 Temperature and Gas Profile Research Product	Vertical profiles of temperature, CO ₂ , CH ₄ , H ₂ O, O ₃ , and N ₂ O	Research					
	L4A	/	GOSAT-2 L4A Global CO ₂ Flux Product	CO ₂ surface flux	Standard	Annually		Annually	NetCDF
			GOSAT-2 L4A Global CH ₄ Flux Product	CH ₄ surface flux					
L4B	/	GOSAT-2 L4B Global CO ₂ Distribution Product	Vertical profile of CO ₂ concentrations	Standard	Annually	Annually			
		GOSAT-2 L4B Global CH ₄ Distribution Product	Vertical profile of CH ₄ concentrations						

The details of L3 products are TBD.

Table 3 User Category

User Category ^{*1}	Description
Project Staff (PS)	Researchers, scientists, and staff members who belong to the GOSAT and GOSAT-2 Project implementation body (Three Parties) and engage in the GOSAT or GOSAT-2 Project, or those who belong to other organizations but engage in the GOSAT or GOSAT-2 Project as contractors to any of the Three Parties.
RA Investigator (RA) ^{*2}	PI and Co-I ^{*3} approved and registered by the Three Parties.
Science Team Member (ST)	A member of the GOSAT or GOSAT-2 Science Team organized by the Three Parties, or a designated researcher by the member for the purpose of the Science Team.
Alliance Organization (sensor development, calibration and validation, research, data processing, provision of necessary data, data distribution) (AO) ^{*4}	An organization which has been approved by the Three Parties and signed a cooperative agreement with any of the Three Parties, in order to collaborate in the aspect of sensor development, calibration and validation, research, or data processing, to provide data necessary for the GOSAT or GOSAT-2 data processing, or to cooperate the GOSAT-2 data distribution. Note that a researcher ^{*5} who contracted with an AO solely for the purpose of carrying out the above-mentioned activities and who is recognized by the Three Parties is regarded as a member of the AO.
General User (GU)	All data users other than the above-defined users.

(*1) The meanings of abbreviations in the user category are as follows:

PS: Project Staff, RA: Research Announcement, ST: Science Team, AO: Alliance Organization, GU: General User

(*2) The User Category "RA" in the GOSAT Data Policy is abolished.

(*3) PI stands for Principal Investigator representing a research theme approved by the Three Parties as a result of the RA selection.

Co-I stands for Co Investigator participating in the research theme.

(*4) The User Category "AO" in the GOSAT Data Policy is abolished.

(*5) A researcher here may be a user of higher-level data processed by an AO.