Present on
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Design of the retrieval algorithm and level 2 product for greenhouse gases from GOSAT-GW

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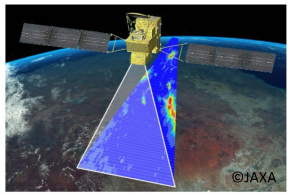
TANSO-3 on GOSAT-GW

GOSAT-GW is a polar orbit satellite with a revisit cycle of three days. The instrument, TANSO-3 onboard GOSAT-GW is an imaging spectrometer with three bands ranging from ultra-violet to short-wave infrared spectral region. TANSO-3 has two observation modes, wide and focus.



Specification of TANSO-3

	Band1	Band2	Band3
Wavelength (nm)	420 – 490	747 – 783	1590 – 1654
Sampling interval (nm)	< 0.5	< 0.05	<0.2
FWHM (nm)	< 0.75	< 0.075	< 0.3
SNR (wide mode)		> 300	
SNR (focus mode)		> 220	
Pixel size (wide mode)		10km	
Pixel size (focus mode)		~3km	
Swath (wide mode)		> 911km	
Swath (focus mode)		> 90km	

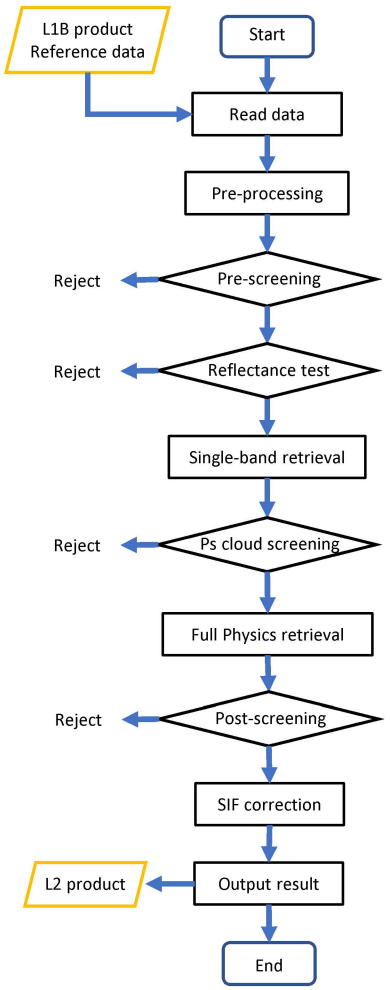
Level 2 GHG product

NIES plans to provide two kinds of level 2 products, greenhouse gases (GHGs) and NO_2. L2 GHG product contains all of the results such as XCO_2, XCH_4, XH_2O, SIF, and the other variables from

- Full Physics retrieval
- Proxy retrieval
- SIF retrieval
- Cloud screening
- Pre/Post-processing
- Pre/Post-screening

in the same file. L2 product is provided by file/day for wide mode and file/scene for focus mode with the HDF5 format from GOSAT-GW TANSO-3 data processing and data distribution system (G3DPS; see the poster presentation, Yashiro et al.).

GOSAT Retrieval Algorithm (GORAL)



Flow of the GORAL processing

GOSAT Retrieval Algorithm (GORAL) consists of several procedures as the flow chart.

Cloud screening

Since GOSAT-GW has no imagers, the pixels contaminated by clouds have to be discriminated by using TANSO-3 spectra itself.

1. Reflectance test

- Land case

Compare the observed reflectance from the UV band with the reference reflectance:

$$R_{UV}^{obs} - R_{UV}^{ref} > C_1.$$

According to the case study using the MODIS surface reflectance product, scenes of 58% are discriminated with the accuracy of 87% against the MODIS cloud product when the threshold value is 0.02.

- Ocean case

In addition to the reflectance, the reflectance ratio is investigated to use wavelength dependency of the refractive index of cloud particle:

$$R_{UV}^{obs} > C_2$$
$$R_{SWIR}^{obs}/R_{UV}^{obs} < C_3$$

2. Ps cloud screening

Surface pressure retrieved from the single-band retrieval using O_2A band is compared:

$$P_s^{ref} - P_s^{obs} > C_4$$

A priori information for the retrievals

A priori values for the state vector in the retrieval processing are obtained from several sources. Japanese reanalysis, JRA-3Q is planned to be used for variables such as pressure, temperature, and water vapor. Non-hydrostatic ICosahedral Atmospheric Model (NICAM) with the extensions for transportation and chemical processes in the atmosphere will be used to provide the profiles of CO_2 and CH_4, the concentrations and optical properties for several types of aerosols.

MAP retrieval module

Maximum a posteriori (MAP) retrieval module is used in single-band retrieval and Full Physics retrieval processing. Variables contained in the state vector are selectable from the control files for each retrieval procedure. This module is based on the MAP retrieval algorithm used to generate the NIES GOSAT-2 SWIR L2 product.

Surface pressure, SIF, and proxy retrieval

Single-band retrievals assuming no scattering particles are performed for:

(1) surface pressure retrieval using O_2A band (Band2)
(2) SIF (radiance@755nm) retrieval using O_2A band (Band2)
(3) XCO_2 retrieval using CO_2 band (Band3)
(4) XCH_4 retrieval using CH_4 band (Band3)

Surface pressure is used for cloud screening. Proxy XCH_4 is estimated from the results from (3) and (4).

Full Physics retrieval

Full Physics retrieval estimates the profiles of CO_2, CH_4, H_2O and ancillary variables simultaneously from Band 2 and 3. The state vector contains the variables as shown below. The aerosol-related parameters to be retrieved are total optical thickness and center heights of the Gaussian profiles for small and large particles. Additionally, the other variables such as radiance offset and wavelength shift can also be retrieved.

Full Physics retrieval setup

state vector	$N_{element}$	a priori	uncertainty
CO_2 profile	15	NICAM	from NICAM
CH_4 profile	15	NICAM	from NICAM
H_2O profile	15	JRA-3Q	from JRA-3Q
aerosol optical thickness	2	NICAM	fixed
aerosol center height	2	NICAM	fixed
surface pressure	1	JRA-3Q	fixed
temperature shift	1	0	fixed
SIF (755nm)	1	0	fixed
SIF slope	1	fixed	fixed
surface albedo (over land)	2, 3 (Band2,3)	from spectra	fixed
surface wind speed (over ocean)	1	JRA-3Q	from JRA-3Q
wavelength stretch	2	0	fixed