IWGGMS 15

Toward 20-year GHG Monitoring from Space by GOSAT: Operation, Calibration, Level 1 Dataset, Research Product, and Analytical Tools

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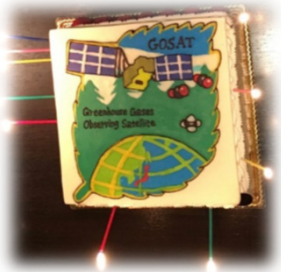
June 3, 2019 Sapporo

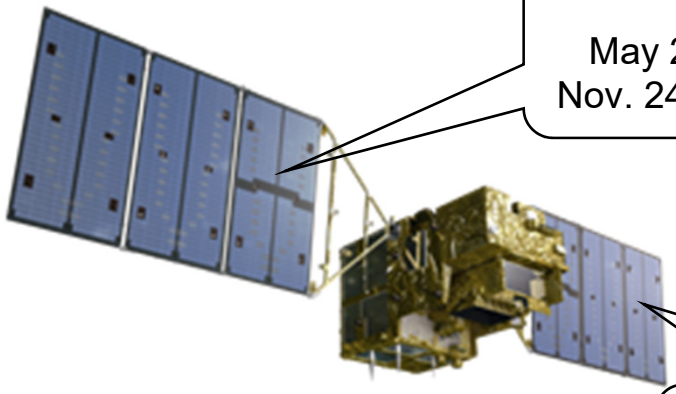
A decade long GOSAT Operation

2018 Operation Summary and present status

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Milestone	* Launch					* * Solar paddle incident Unstable Pointing	* * Switching Pointing mechanism Cryocooler suspend			* CDMS incident * Solar Paddle incident	
FTS Nominal Pointing Pattern	5p-CT		3p-CT			1, 3 p-CT	3p-CT				
FTS Pointing Mechanism	Primary						Secondary				
FTS interferogram	No bias					800 fringes bias	650	1100		1860	830
FTS Operation	SWIR (S) and TIR (T)						S	S & T			
FTS L1B V161.161	Re-processing (no geometry correction)		Old version								
FTSL1B V201.202	Re-processing (pointing error, biased interferogram corrected)						Older version				Operational
FTSL1B V210.210	Re-processing (completed)										Operational
FTSL1B V220.220	Sample products now available. Official release will be in July.										
CAI L1A V130.131	Latest version										Operational



Four major anomalies that affected TIR in Orbit



Solar Array Paddle-1
May 24, 2014 Rotation stopped at -70 deg
Nov. 24, 2018 rotated and stopped at 133 deg

Image over the North Pole
before 2014.5

Solar Array Paddle-2
Nov. 29, 2018 Rotation stopped
viewing zenith

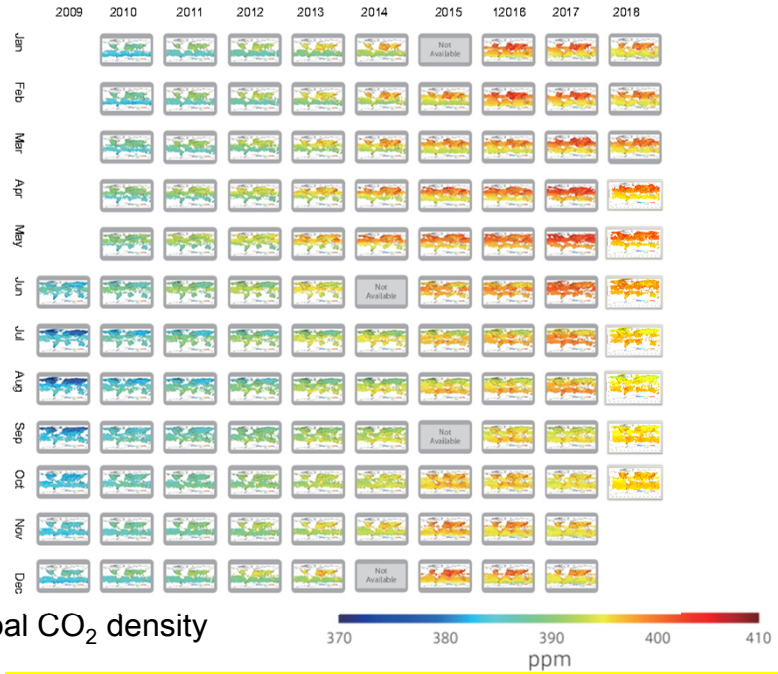
1. May, 2014, Rotation of one of the two solar paddles stopped

2. Aug. 2015, the cryocooler (pulse tube cooler) restarted the detector cooling.

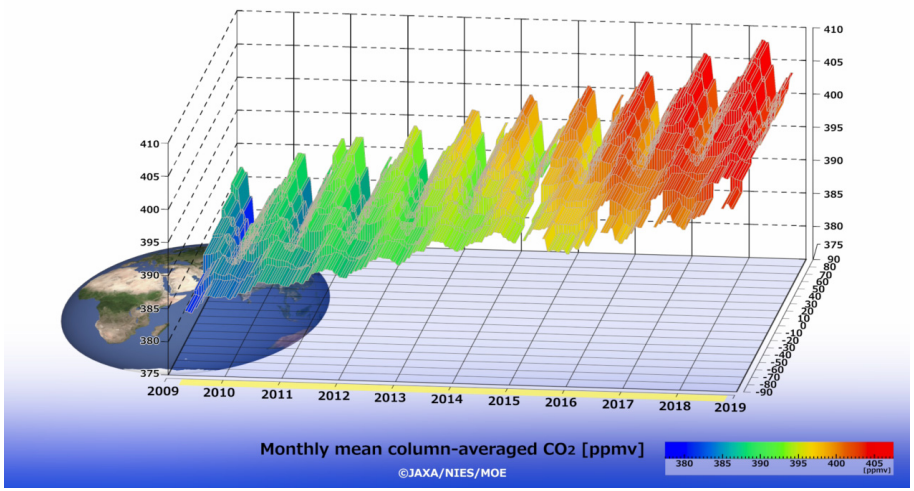
3. May, 2018, the Command and Data Management System (CDMS) incident. Similar phenomenon on TANSO with May 2014 event but smaller effect.

4. Nov. 2018: the solar-paddle-rotation incident, rotation of both solar paddles stopped. TANSO operation was suspended for a month. Well decontaminated.

Decade-long Observation by GOSAT
10th anniversary on Jan. 23, 2018



Global CO_2 density



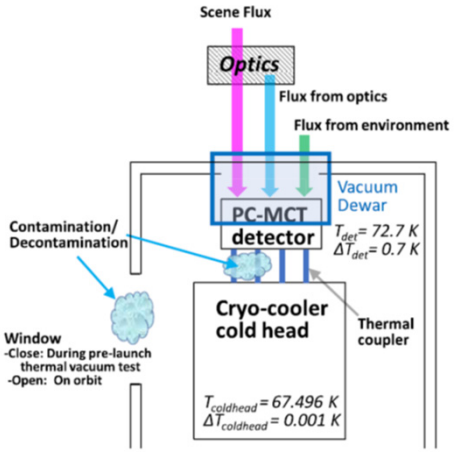
https://data2.gosat.nies.go.jp/gallery/fts_l3_swir_co2_gallery_en.html

Toward 20-year operation

- July-Aug, 2018 3rd Inclination Maneuvering control,
- enough fuel for another decade operation
- no significant degradation in classic four NiCd batteries.
- Radiance degradation and TIR correction tables for 20-year operation are ready in new Level V220.

TANSO-FTS Level 1 products (V220.220 release next month)

Every time TIR, thermal environment has changed. Output of PC-MCT detector offset level must be accurately estimated.



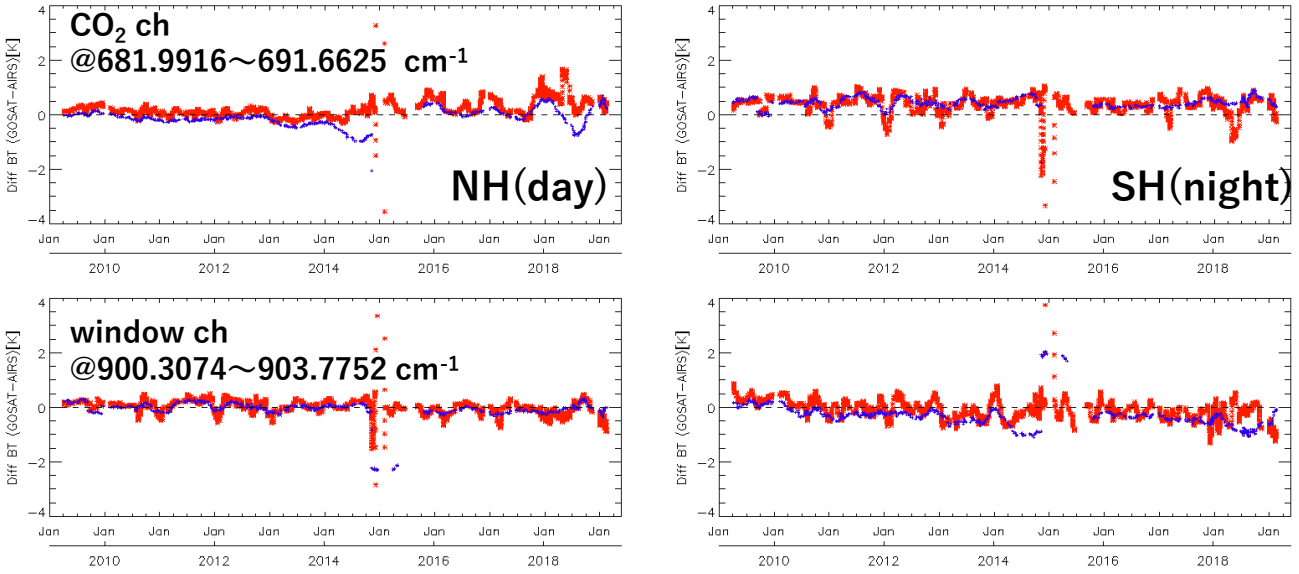
Kataoka et al, TGRS (2019), Published a week ago

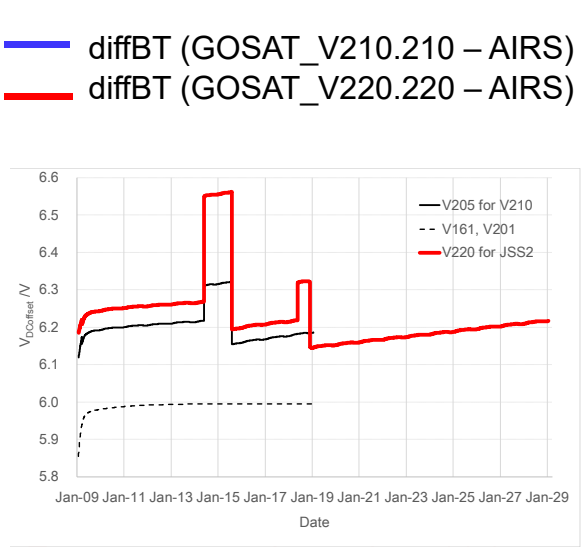
TIR non-linearity correction

$$V_{Pamp} = -\left((V_{DC} - V_{DCoffset}(t)) / g_{DC} \right) - V_{AC} / g_{AC}$$

$$V_{NLcorrected} = V_{Pamp} + a_{nlc} V_{Pamp}^2$$

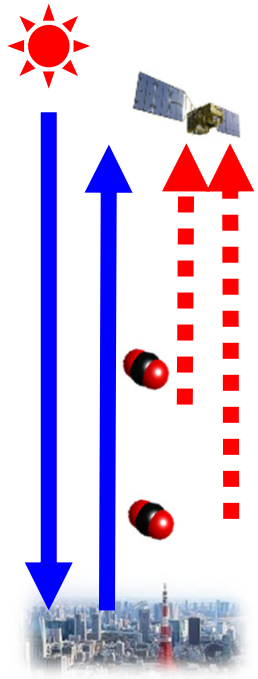
V_{pamp} : output of the pre-amplifier as
V_{AC} : analogue circuit AC output: 38168 samples per interferogram
V_{DC} : analogue circuit DC output: 38 samples per interferogram
g_{AC} , g_{DC} : gain factors of the circuit
a_{ncl}: the quadratic non-linearity correction coefficient



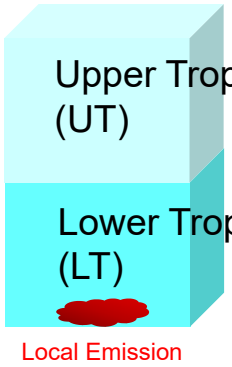


To remove step change in 2014.4, 2015.9, 2018.5, 2018.12

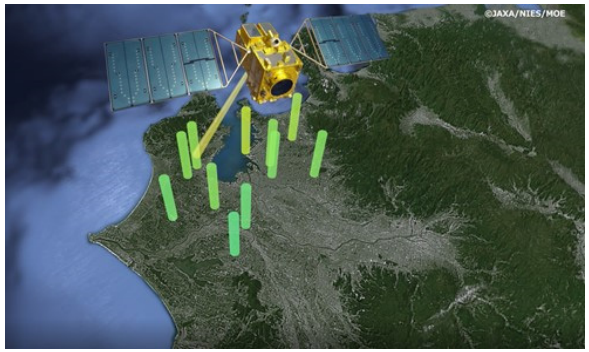
A decade long dataset and new research products

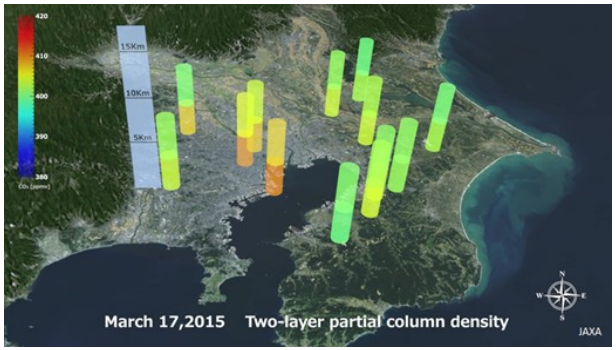


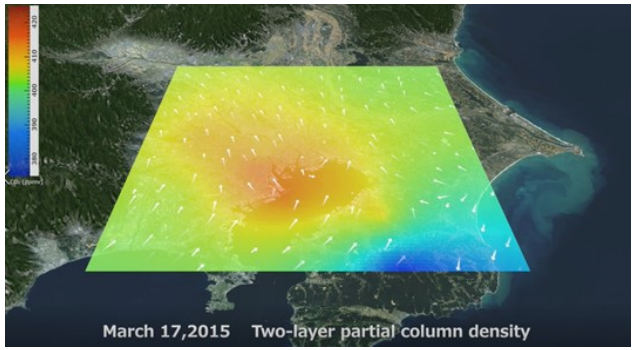
GOSAT measures both solar reflected light from the Earth's surface (SWIR) and thermal emission from the Earth's atmosphere (TIR) providing CO_2 partial-column densities of UT and LT.



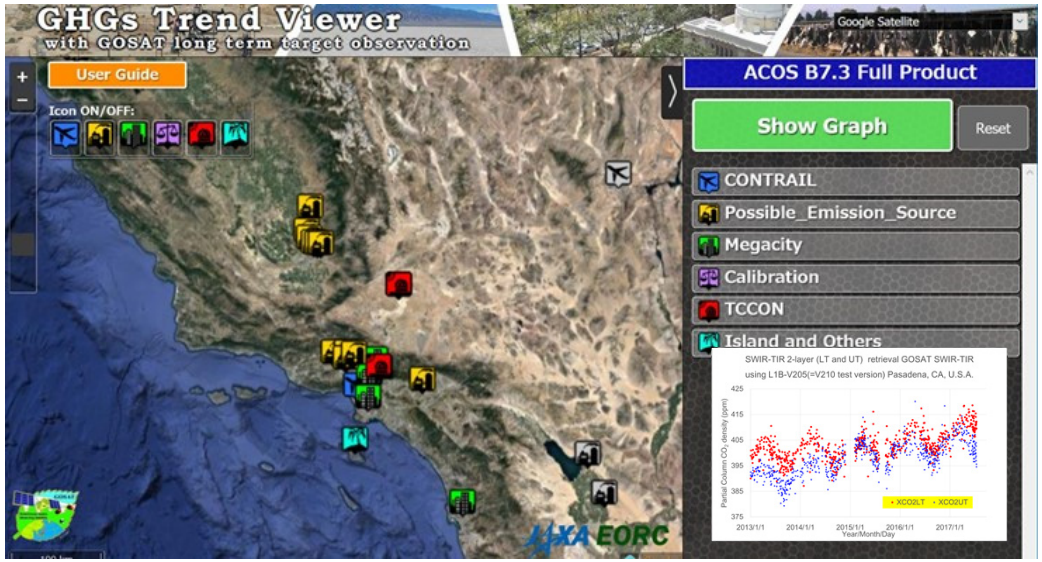
- Entire TIR band to add only one more parameter
- Retrieve XCO_2 (LT), XCO_2 (UT), XCH_4 (LT), and XCH_4 (UT)
- Constraining accurate total column density of XCO_2 and XCH_4.
- 5 layers: 2 Trop. 3 Strat. 1 -0.6 P_{surf} / 0.6 -0.2 P_{surf}





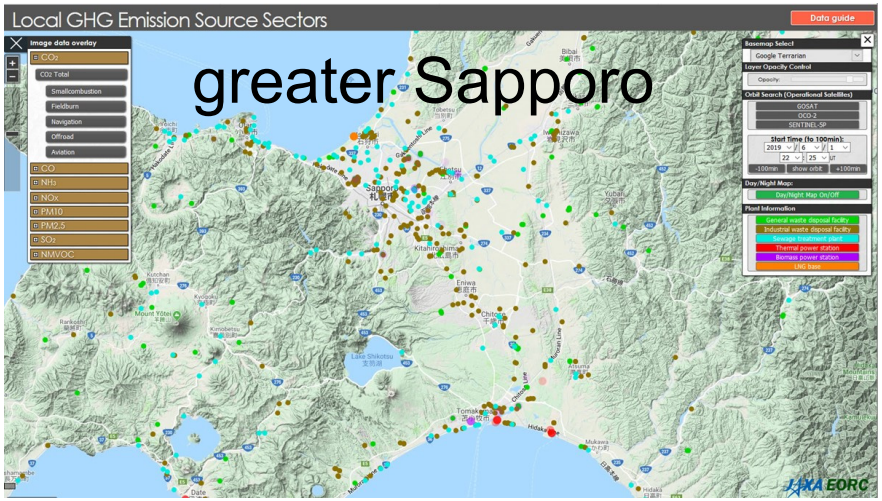


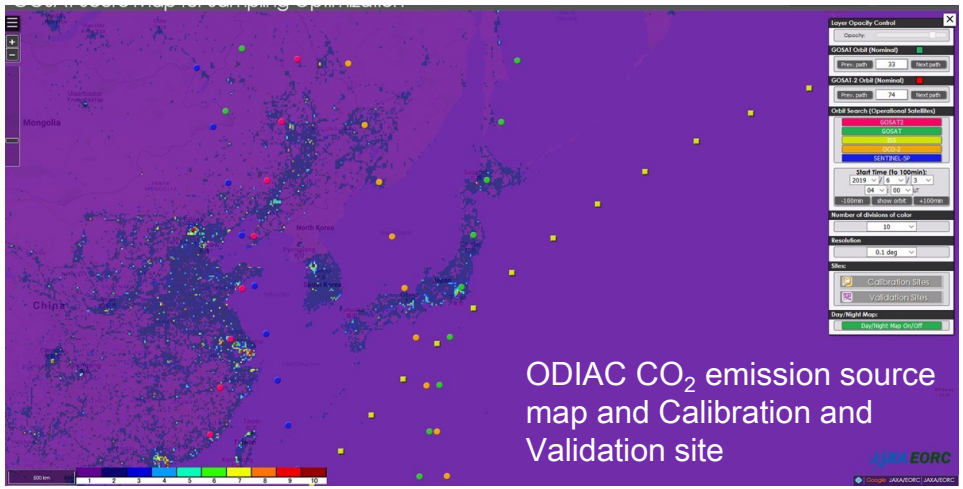
Tools for analysis
Visit EORC GOSAT Sites



long-term trend data of the selected targets, including the large point sources of methane (CH_4) and intensive observations of selected mega cites.
[Two layer products of mega cities are now available as research produces .](http://www.eorc.jaxa.jp/GOSAT/product.html#trendviewer)
http://www.eorc.jaxa.jp/GOSAT/product.html#trendviewer

GOSAT, GOSAT-2, Sentinel 5, OCO-2, TanSat, OCO-3





Different GHG source sector location
CO_2: Power plant, traffic, industry
CH_4: Waste, Gas production

https://www.eorc.jaxa.jp/GOSAT/GOSAT_Optimization/index.html

Upcoming Events

<1> V220 release

10-year reprocessed data set are available at JSS2 super computer. TIR data became consistent.

After the review by NIES, JAXA, STM, V220 will become the operational version.

Correction Tables for 20-year data are now available.

<2> 11th Joint campaign at Railroad Valley between June 30-July 5

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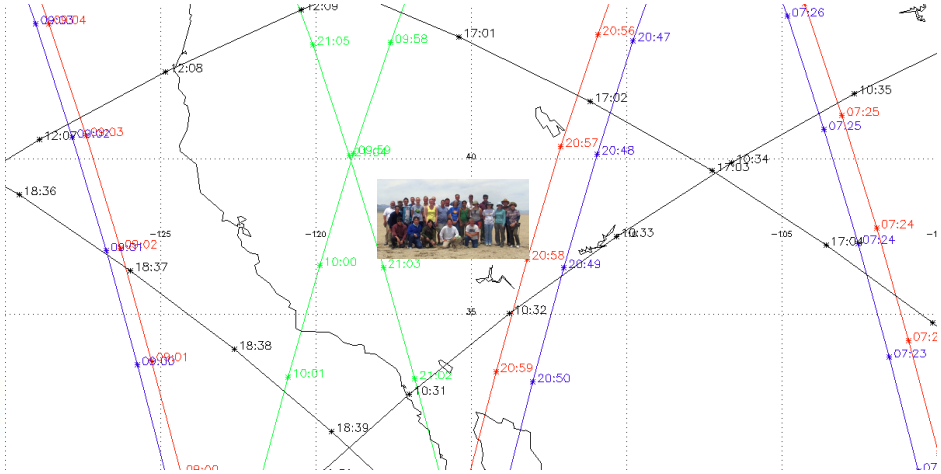

OCO-2, OCO-3, GOSAT, GOSAT-2