GOSAT & GOSAT-2 status

Kei Shiomi

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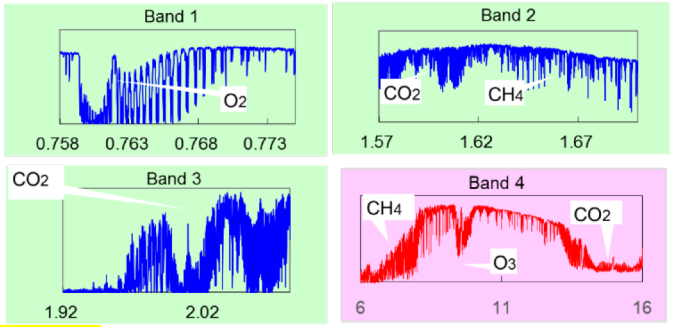
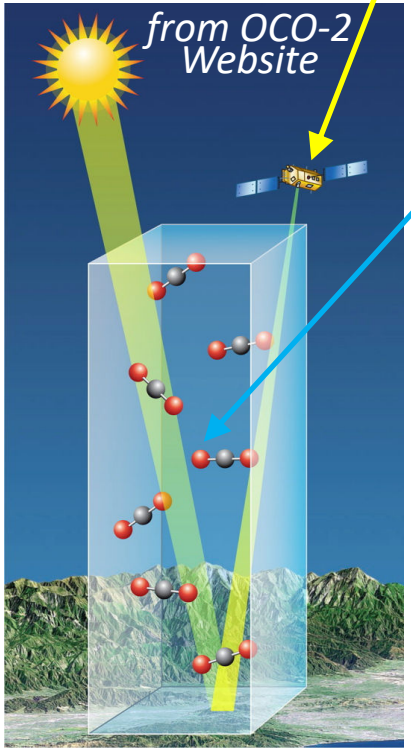
GOSAT on orbit since 2009



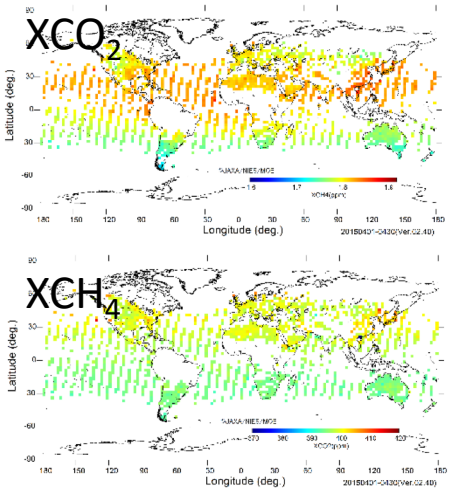
Level 1

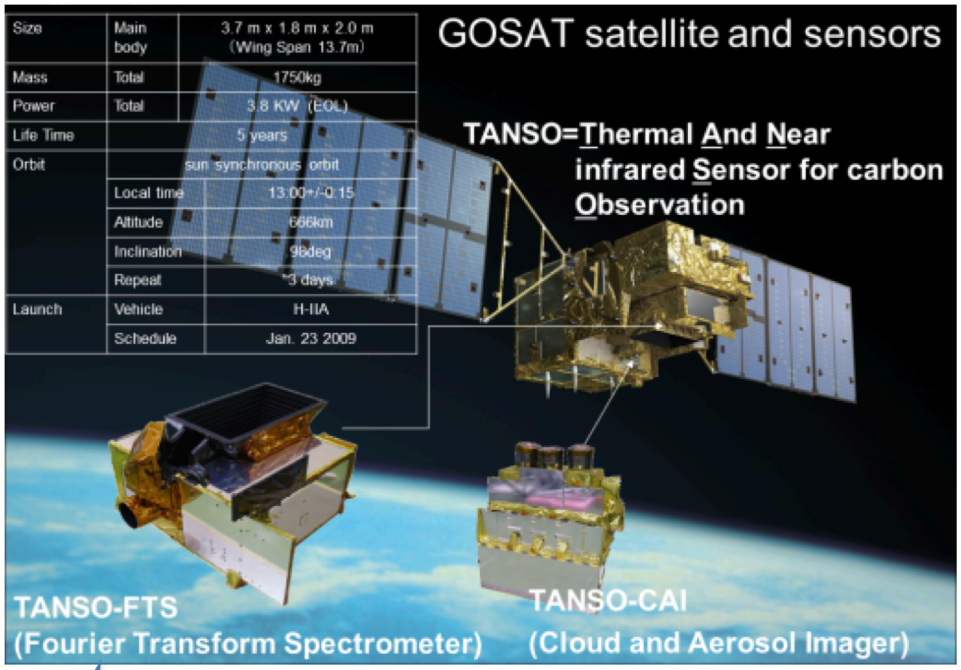
TOA (top of atmosphere) radiance



Level 2

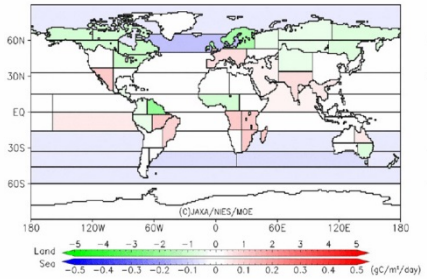
Column-averaged dry air mole fraction of CO_2 and CH_4



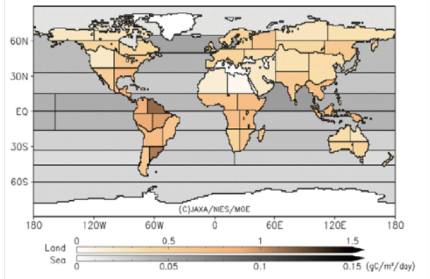


CO_2 and CH_4 emissions and sinks Level 4

CO_2 flux (64 areas)



CH_4 flux (43 areas)

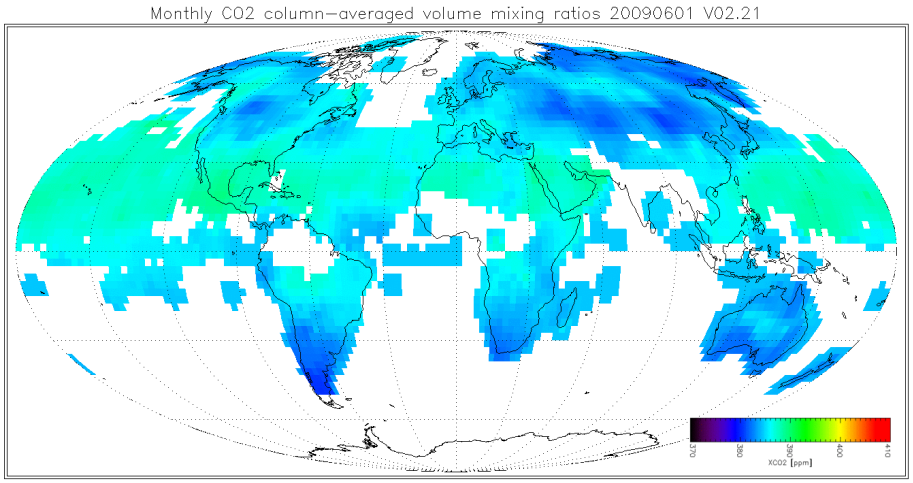


http://www.gosat.nies.go.jp/en/

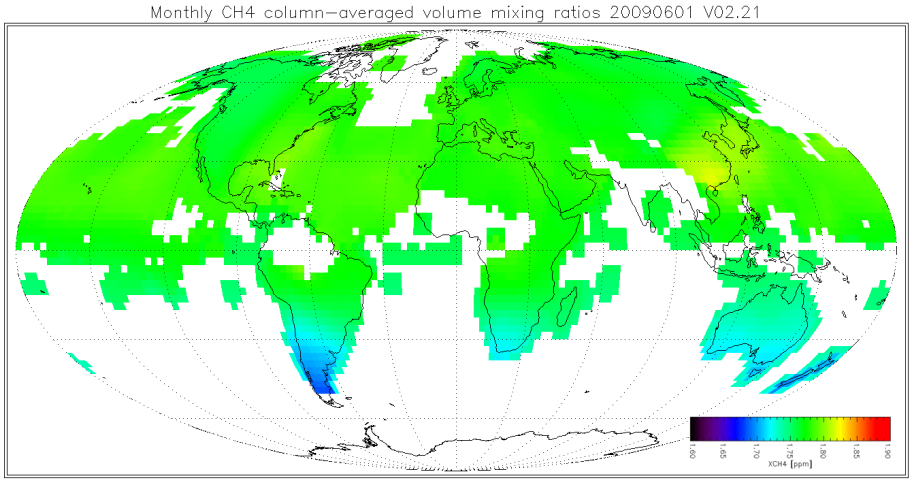
http://www.eorc.jaxa.jp/GOSAT/index.html

GOSAT XCO_2 and XCH_4 over 9 years

Monthly mean global CO_2 and CH_4 since 2009



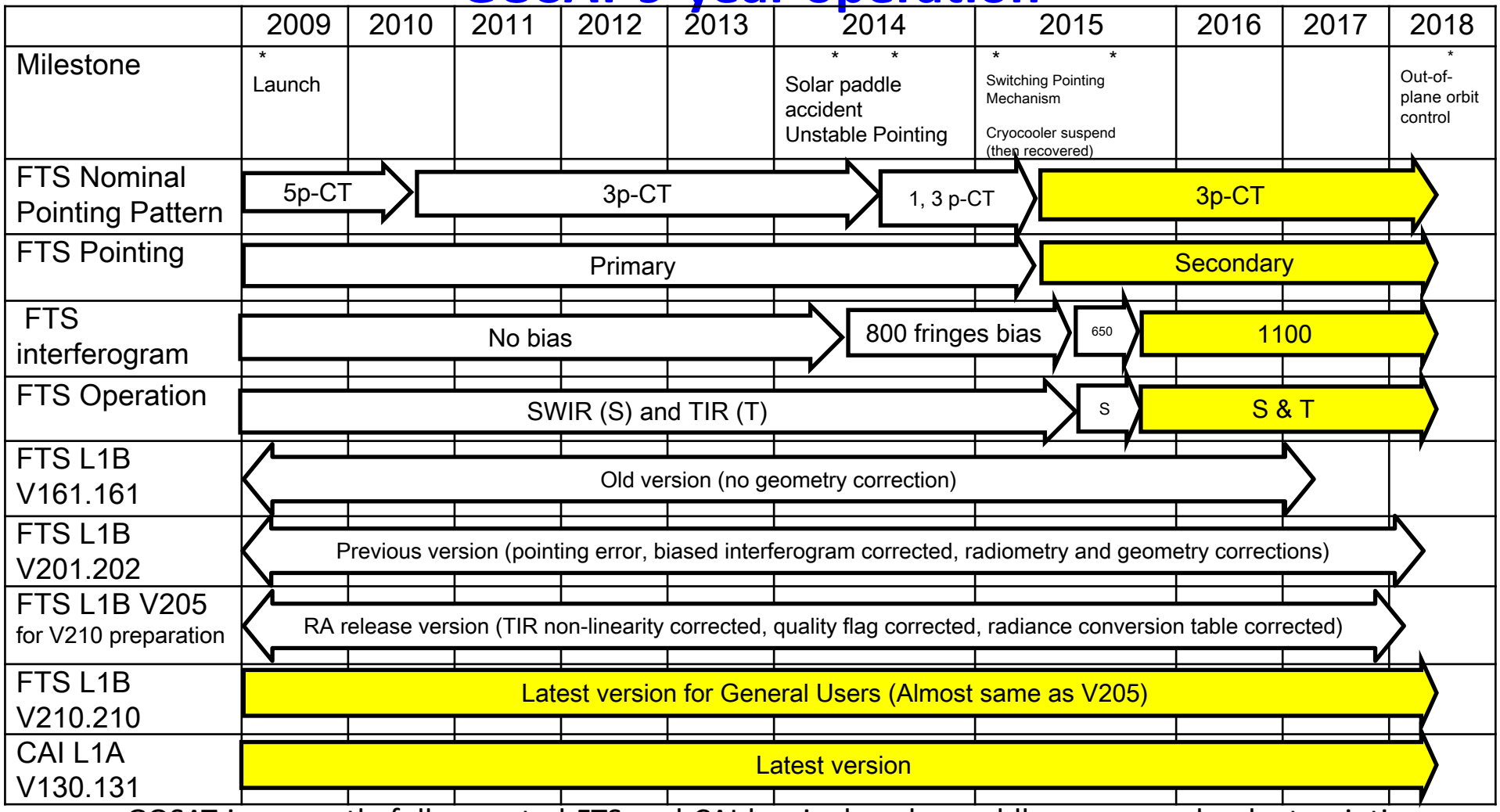
Global XCO_2 L3 map



Global XCH_4 L3 map

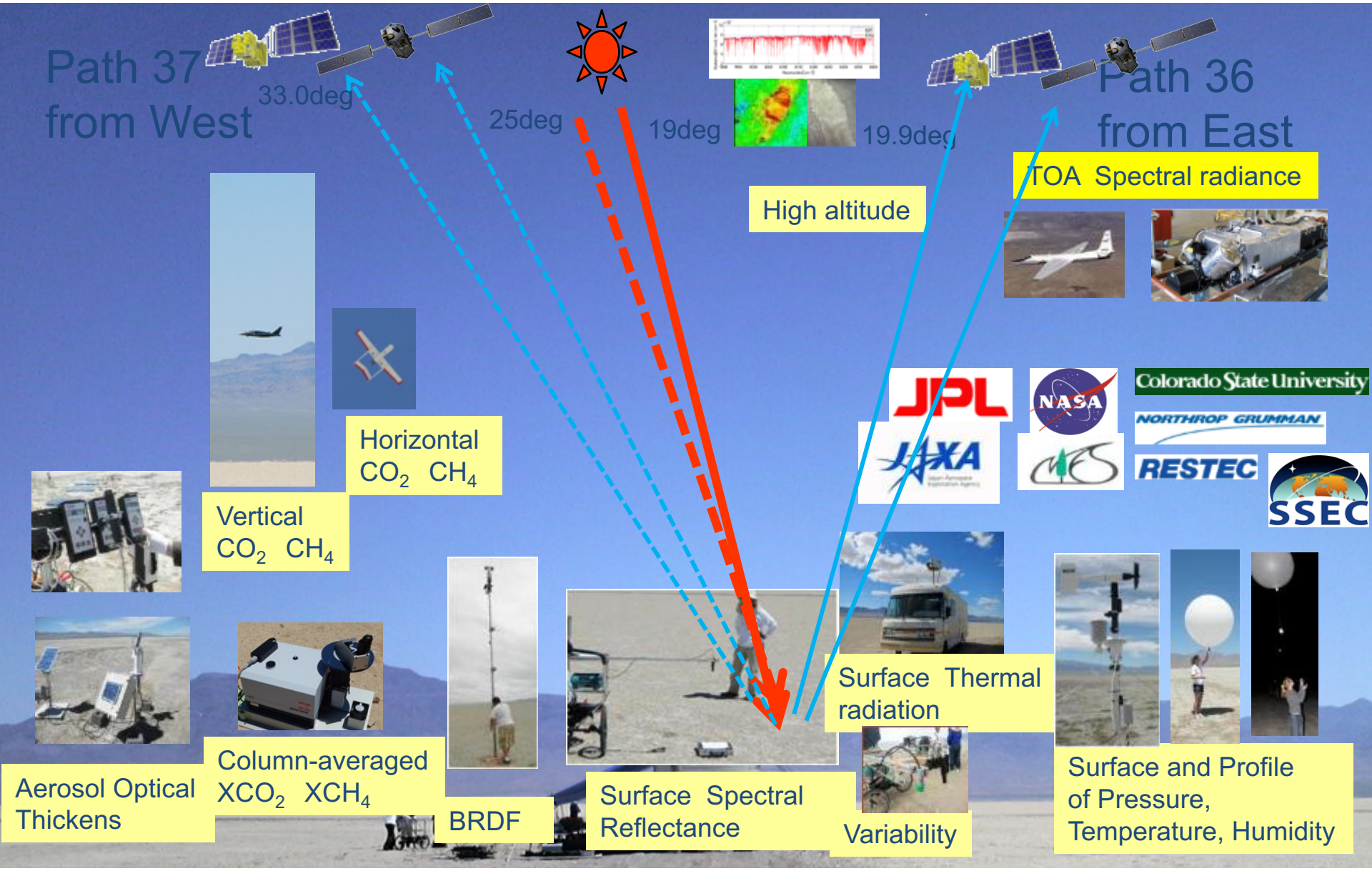
The typical accuracy of retrieved column-averaged dry air mole fractions of CO_2 and CH_4 are 2ppm or 0.5% and 13ppb or 0.7%, respectively.

GOSAT 9-year operation



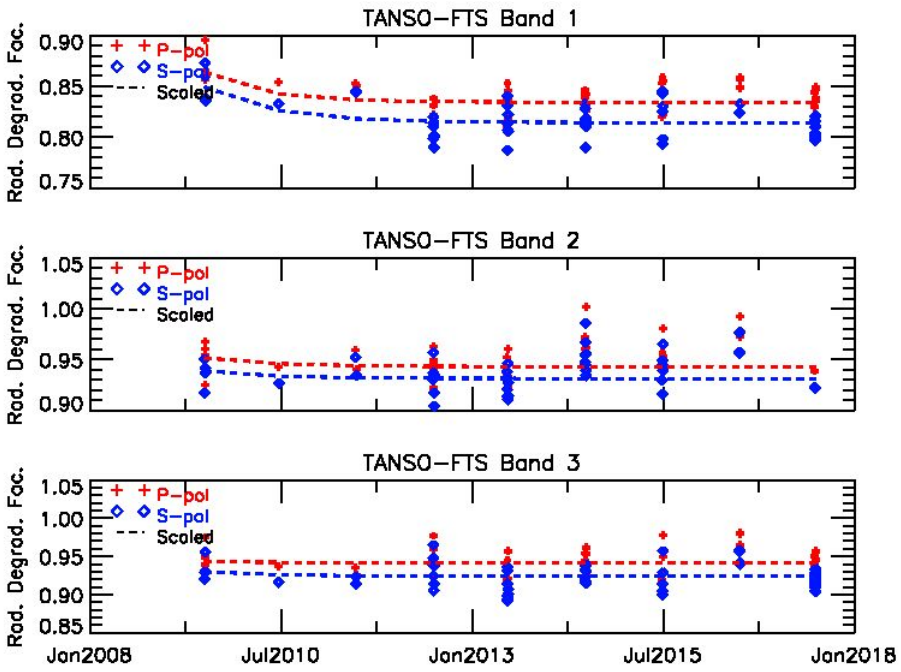
- GOSAT is currently full-operated FTS and CAI by single solar paddle power, redundant pointing mirror, and obtains center-biased double-side interferogram.
- FTS L1 v201.202 processing is improved that weighting function is applied to asymmetrical interferogram to become the same ILS and the same sampling over the whole term data.
- Orbit control in 2016 summer was postponed. Local time is shifting from 12:48 toward 13:00. The next orbit control is scheduled in 2018 summer.

Vicarious calibration campaign at RRV

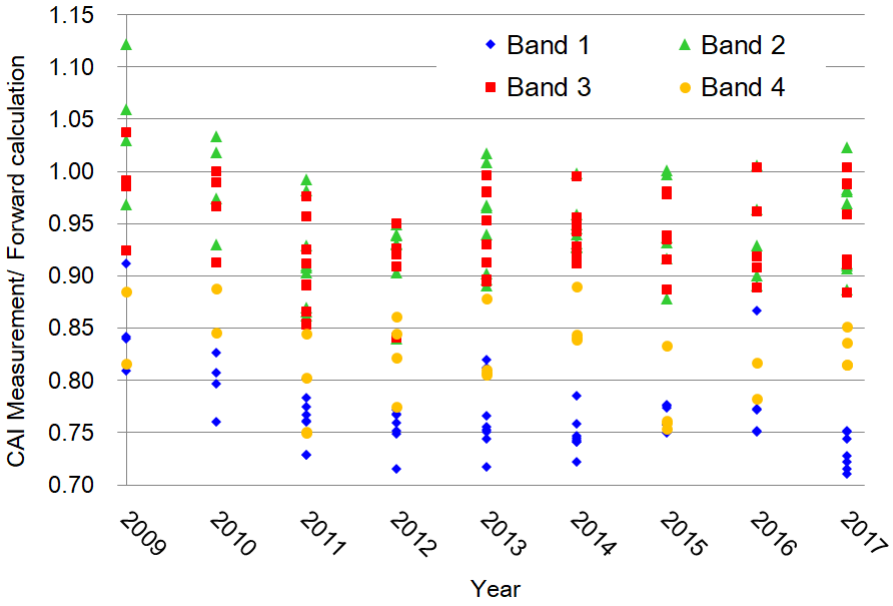


GOSAT radiance degradation

FTS radiance (0.76, 1.6. 2.0 um)



CAI radiance (0.38, 0.67, 0.87, 1.6 um)



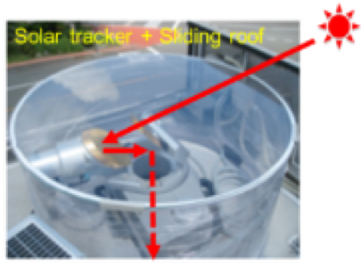
http://www.eorc.jaxa.jp/GOSAT/calibration_1.html

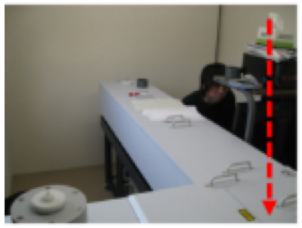
- RDF for 9 years from annual vicarious calibration campaigns. The lines show the model derived from the onboard solar diffuser data.
- The Latest FTS v210.210 records the best estimated radiance after degradation correction.

GOSAT XCO_2 and XCH_4 validation with TCCON stations

from TCCON and TCCON-wiki websites

TCCON sites (https://tccondata.org/)





gbFTS@Saga

Group	Version	XCO_2		XCH_4	
		Bias[ppm]	STD[ppm]	Bias[ppb]	STD[ppb]
NIES-FP	v2.21-v02.60	-0.48	2.27	-3.7	13.7
NIES-PPDF-S	V02.21-v02.40	0.73	1.83	1.4	14.1
ACOS (bias correction)	B3.5	0.1	1.7	-	-
RemoTeC-FP (bias correction)	v2.3.8	0.02	1.91	0.06	14.89
BESD	v1.02	-0.38	2.04		
U-Leicester-Proxy	CH4 v4			4.80	13.44

NIES-FP: Uchino et al., 2017 NIES-PPDF-S: Iwasaki et al.,2017, ACOS : Lindqvist et al., ACP, 2015,
RemoTeC: ESA-CCI SVR RemoTeC, 2016 BESD: Heyman et al., 2015 Univ. Leicester: Parker, AMT, 2015

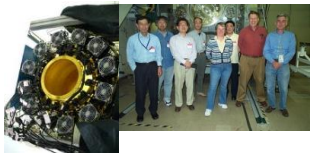
- For long-term consistency, comparison of seasonal and annual trend around TCCON sites is performed in the recent papers. (Lindqvist, ACP, 2015 etc.)

Inter-comparison between GOSAT and OCO-2

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Radiometric calibration

Prelaunch X-CAL



Annual Vicarious Calibration at the desert playa in Nevada

CO_2 & CH_4 profile

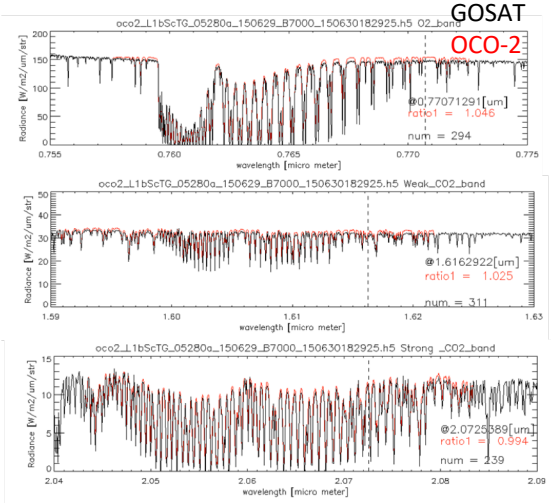
In situ CO_2 and CH_4 on NASA AMES AJAX

XCO_2 & XCH_4

Column with a compact FTS

GOSAT

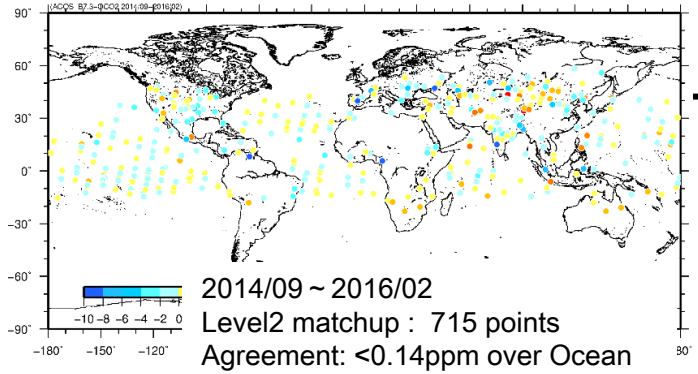
OCO-2



Kataoka et al., 2017

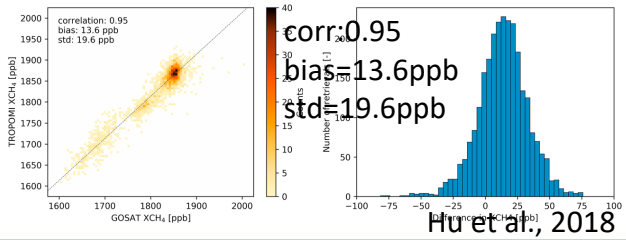
Calibrated GOSAT and OCO-2 radiance spectra agrees within 5% for all bands.

Coincident Target



Retrieved Parameter Comparison over match up points

Inter-comparison with TROPOMI

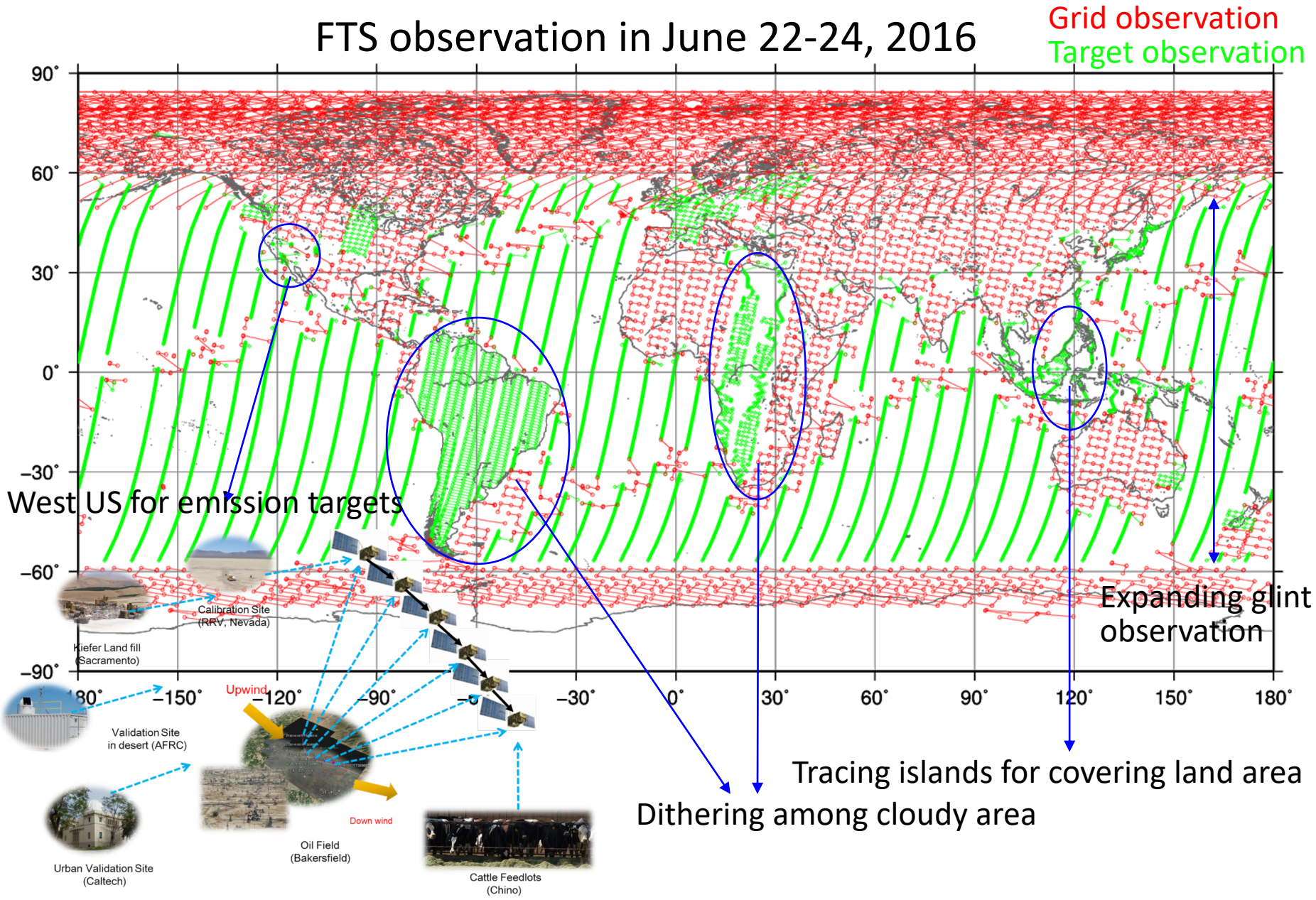


Hu et al., 2018

Next

- Coincident flight with Charm-F
- Inter-comparison with TANSAT

Optimization of GOSAT observation pattern

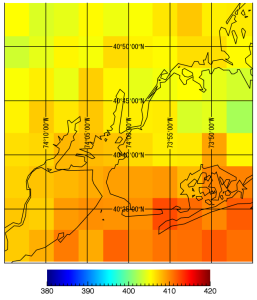


GHG trend viewer & Score map for optimized observation

http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/index_ACOS_B73.html

Long-term trend of ACOS, NIES, RemoTeC
CO_2, CH_4, SIF, AOD

Solar-induced chlorophyll fluorescence
Aerosol optical depth



To be added
City distribution map
Aeronet site
4 Level 2 products intercomparison
OCO-2 match up
Surface wind speed
Ground validation data

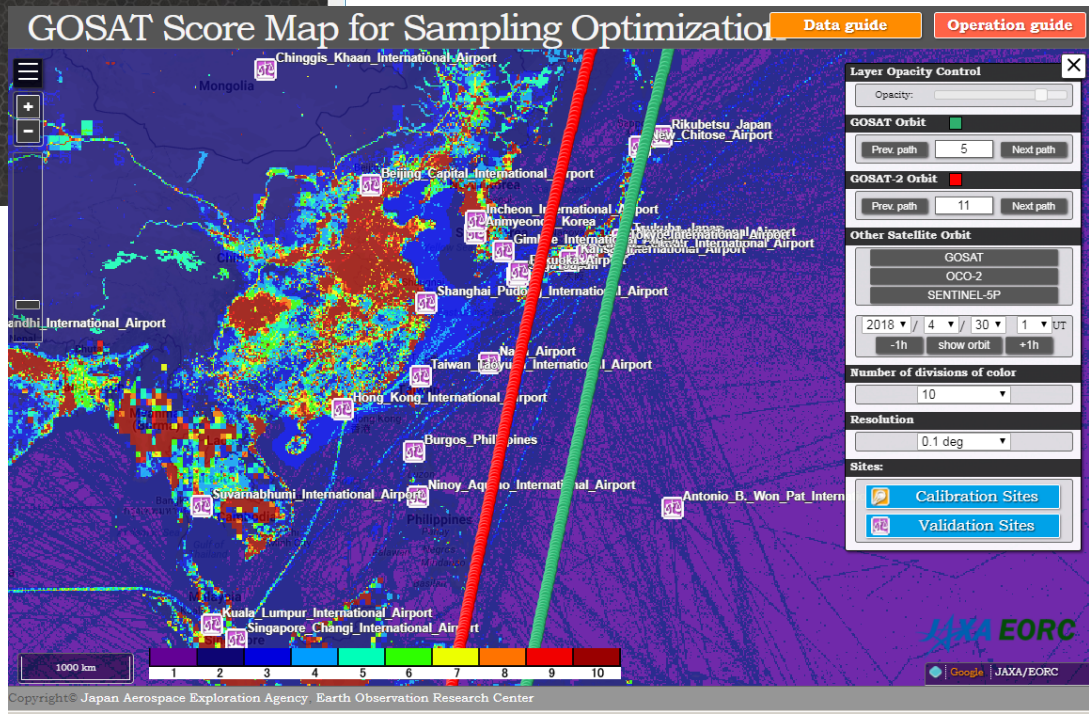
Calculation of weighted score for GHG observation by using database with satellite orbits of GOSAT, others and future GOSAT-2 to optimize sampling pattern

- Emission data of CO_2, CH_4, NO_2, CO

EDGAR, ODIAC, OMI, MOPITT

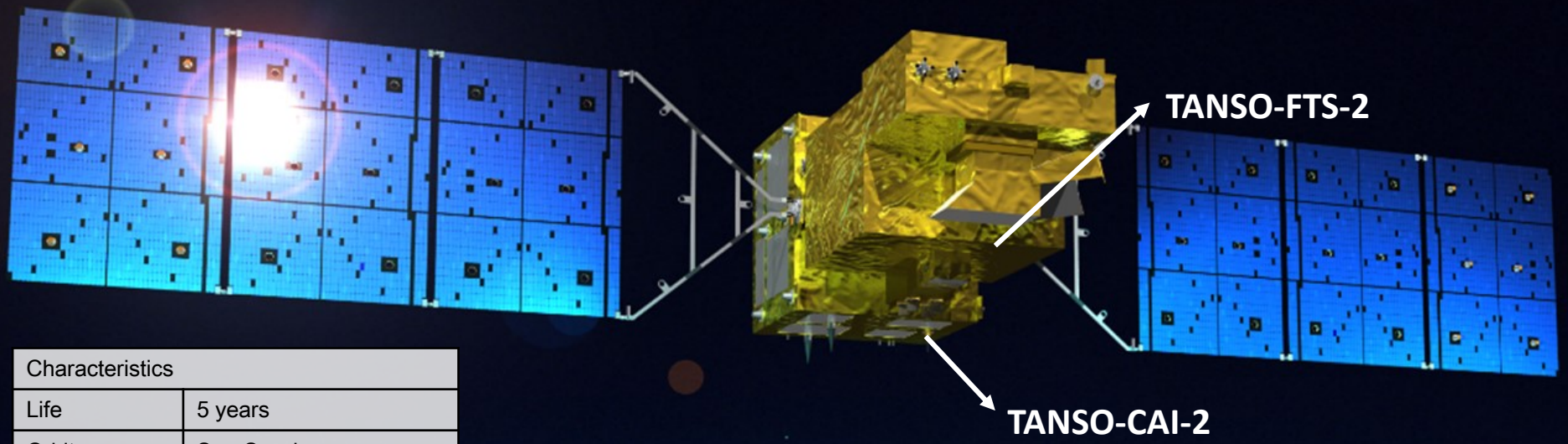
- Observation index from GOSAT, OCO-2, MODIS

Successful retrieval ratio, Reflectance, Clear sky ratio, AOT



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

GOSAT-2 will be launched in late this year



Characteristics	
Life	5 years
Orbit	Sun-Synchronous (628km)
Mass	About 2 t
Launch	FY 2018
Observation Valuables	CO_2, CH_4 and CO Accuracy: 0.5 ppm (CO_2) and 5 ppb (CH_4) at 500-km mesh over earth's surface

1. **Simultaneous CO (carbon monoxide) measurement**
2. **All target mode capability**
3. **Cloud-avoiding pointing with onboard camera**

TANSO-FTS-2

	Band 1	Band 2	Band 3	Band 4	Band 5
Target Gases	O_2	CO_2, H_20	CO_2, CH_4, CO, H_20		
Spectral Coverage (μm)	0.75-0.77	1.56-1.69	1.92-2.33	5.5-8.4	8.4-14.3
Spectral Coverage (cm-1)	12,950 - 13,250	5,900 - 6,400	4,200 - 5,200	1,188 - 1,800	700 - 1,188
Spectral Resolution	0.2 cm^{-1}				
Exposure	4 sec				
IFOV	9.7 km				
Pointing	±40 deg. (Along track), ±35 deg. (Cross track)				
Polarimetry	Yes (P and S channels)			No	

TANSO-CAI-2 (radiometer)

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Spectral Band (nm)	333 - 353	433 - 453	664 - 684	859 - 879	1585 - 1675	370 - 390	540 - 560	664 - 684	859 - 879	1585 - 1675
Tilt	+20 deg. (Forward viewing)					-20 deg. (Backward viewing)				
Spatial Resolution	460 m				920m	460 m				920m
Swath	920 km									

Summary

(1) GOSAT operation
- Successful fully operation of FTS and CAI over 9 years since 2009

(2) GOSAT products
- Latest FTS L1 V210.210 and CAI L1 V130.131 are available in whole observation term.
- NIES L2 XCO2 and XCH4 v02.72 are available for the previous L1 V201.202. L2 processing for L1 V201.202 has just started.
- NIES L3 and L4 are also available corresponding to the latest L2.
- GOSAT L2 are also produced by other organization algorithms (ACOS, RemoTeC, BESD, Leicester, Yonsei etc.)

(3) Calibration, validation and inter-comparison with OCO-2
- Railroad valley campaign collaboration with OCO-2
- XCO2 and XCH4 validation with TCCON data
- Inter-comparison of GOSAT and OCO-2 in spectra and XCO2

(4) Observation points optimized by target observation
- Possible emission targets in western and eastern US, Asia, India, and Europe, where campaign observations are conducted.