Calibration for GOSAT and GOSAT-2

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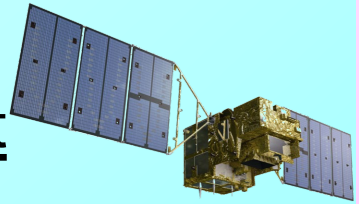
and GOSAT team

CEOS AC-VC-22/WGCV-ACSG Joint Meeting, SRON, Leiden, the Netherlands / Remote Hybrid, June 4, 2026

GOSAT and GOSAT-2 status

Long term (17-year Jan. 2026) calibrated and validated dataset



Satellite Condition

Enough fuel to operate for at least another several years
All four batteries are healthy

Since Jan. 2024, the monthly-used back-side solar diffuser has not been available due to rotation anomaly, but the front-side is in normal operation every orbit.

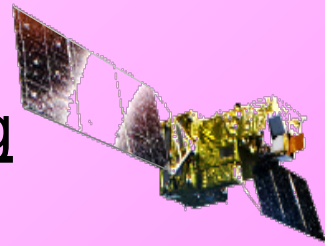
Level 1 V300.300 (released in March 2023)

Best-estimate SWIR radiance spectra using TSIS-HSRS and long-term vicarious-calibration data.

Level 1 V300.301 (released in March 2026)

Only TIR update reprocessing data starting from April 2025, Revise the DC offset change of the FTS restart

Long term (7-year Oct. 2025) Intense target observations using flexible and wide angle pointing



Oct30,2023, 5-year operation review.

The operation has been extended.

Feb. 2021, anomaly occurred in the solar diffuser plate mechanism. The solar irradiance calibration has been suspended since then, Lunar calibration is normal.

Level 1 V240.240 (released in March 2026)

SWIR O2A band radiance have recovered since just before 2023 because of the over correction than expected.

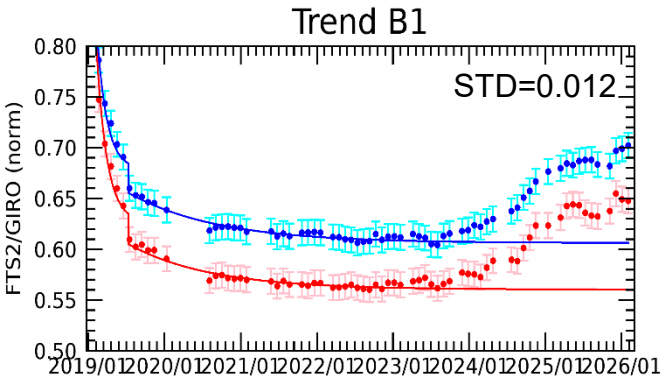
Calibration strategy

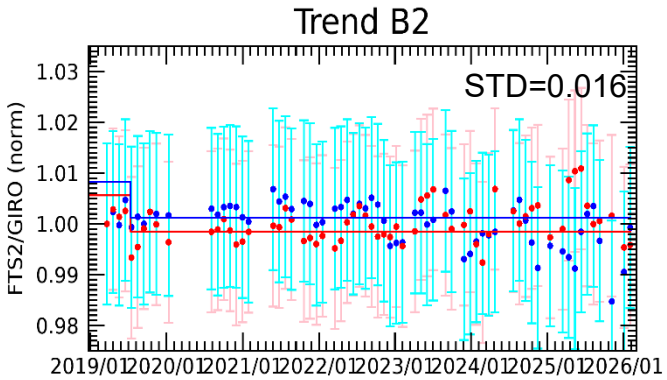
	GOSAT (2009~)	GOSAT-2 (2018~)
Relative radiance degradation		
Solar diffuser	Backside diffuser is only exposed Once per month (2009-2023) Suspended due to the rotation trouble Frontside diffuser operation Once per orbit	Diffuser is only exposed a few minutes Once per orbit (2018-Feb2021) Suspended due to the shutter trouble
Lunar calibration	1-2 times per year (2009-2014) Suspended due to the solar paddles rotation stop	2 times per month Both before and after full moon
Sahara desert	Monitor per 3-day revisit	Monitor per 6-day revisit
Absolute radiance		
Vicarious Calibration	Field campaign at Railroad Valley (RRV) playa, Nevada conducted annually every summer with OCO team	
Inter-comparison		
Simultaneous observation with other GHG sensors	Simultaneous observations - At RRV target on the same day - At orbit crossing (SO with BRDF correction)	

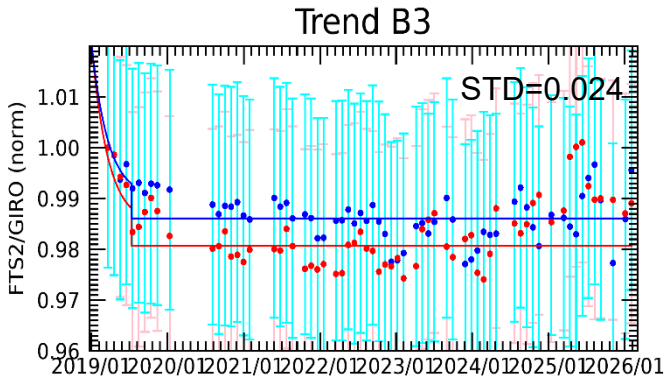
GOSAT/FTS-2 radiometric degradation from lunar calibration

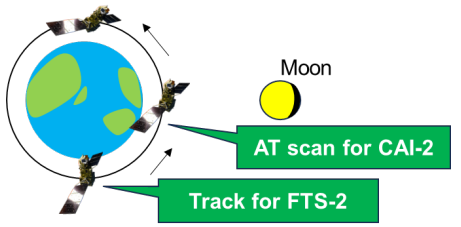
FTS-2 RadConvCoef/GIRO

● LCAL P-band
-- RDF2024 S-band

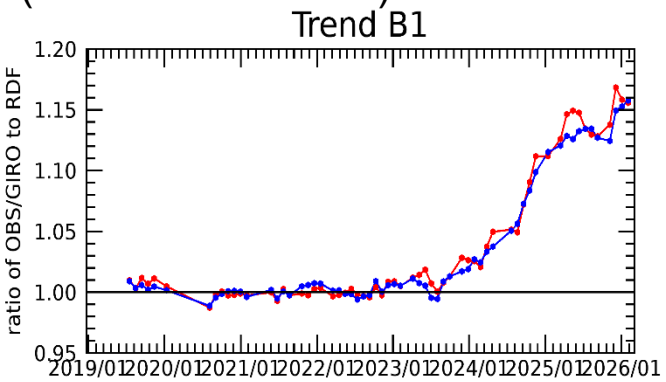


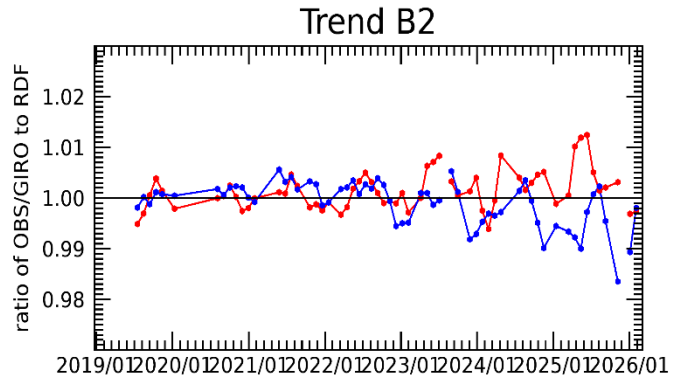


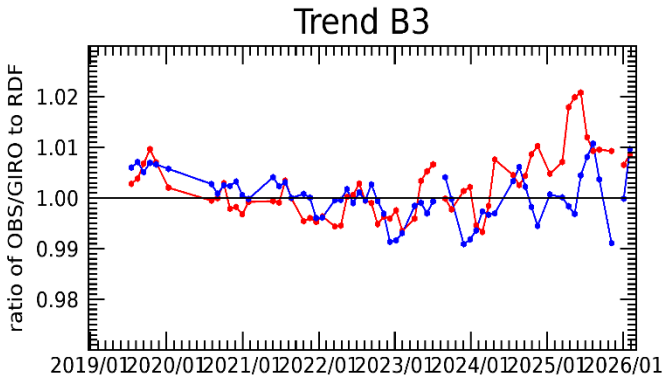


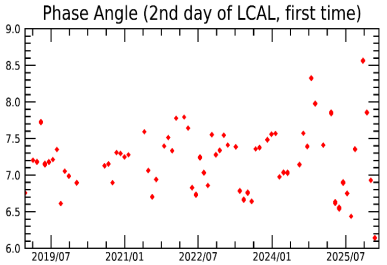


(FTS-2 RCC/GIRO) /RDF2024



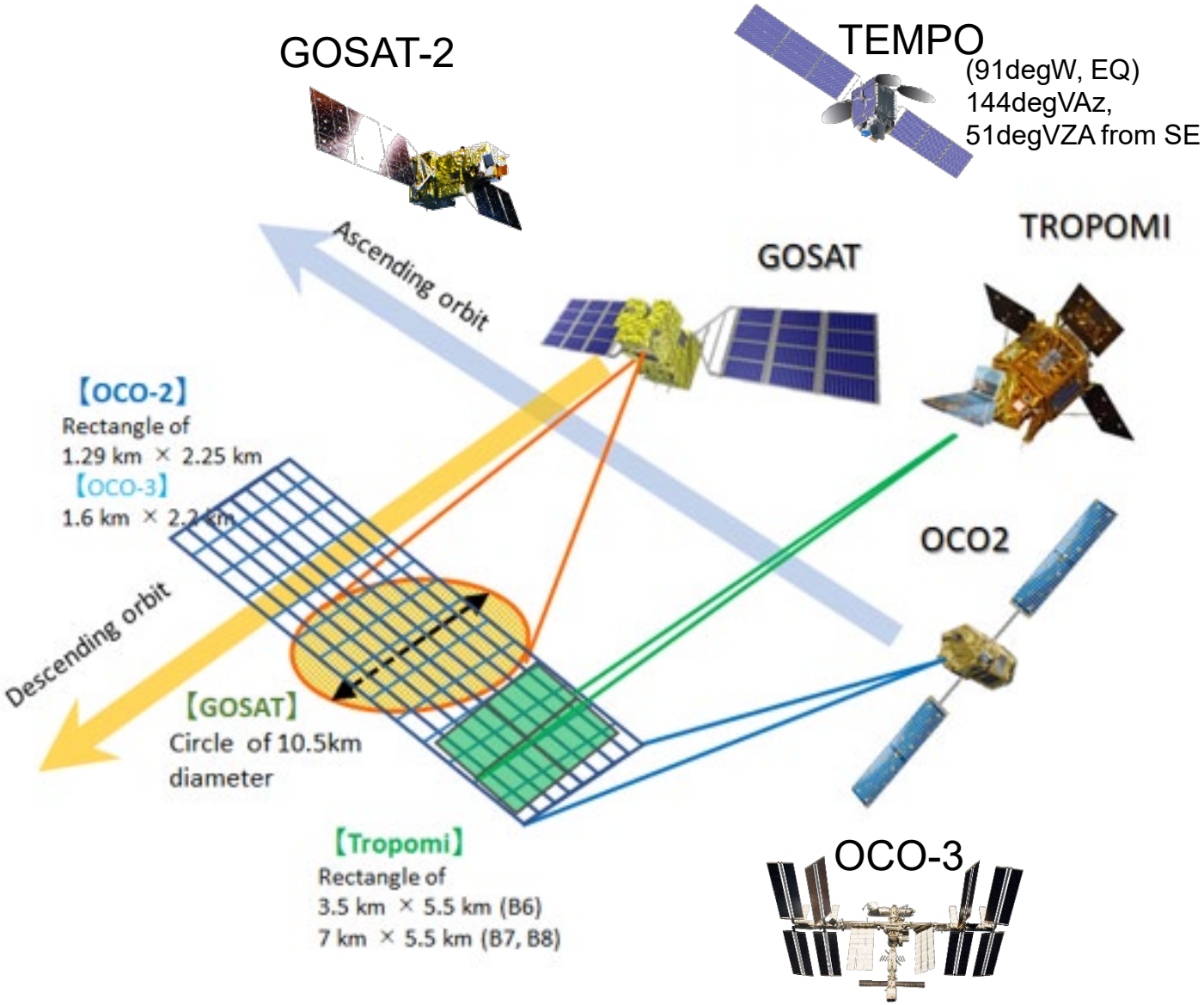






- The GOSAT-2 radiance degradation curve was estimated from solar diffuser calibration before. (RDF2021)
- Radiance degradation curve was estimated from 5-year lunar calibration and scaled to the Railroad Valley vicarious calibration results.(RDF2024)
- After that, the B1(O2A) radiometric response has recovered up to 15 % as shown by lunar calibration.

Railroad Valley target by multiple GHG & AQ sensors



RRV 2024 Summer Campaign Schedule

Date	DoW	OCO-2 path	GOSAT path	GOSAT-2 path	TROPOMI InstZA [deg]	
12-Jun-24	Wed			74	28.0	RRV
13-Jun-24	Thu		36		53.6	RRV
14-Jun-24	Fri	138	37		8.1	RRV
15-Jun-24	Sat				6.9	RRV
16-Jun-24	Sun	136	36	72	46.3	RRV
17-Jun-24	Mon		37	73	31.7	RRV
18-Jun-24	Tue			74	46.6	RRV

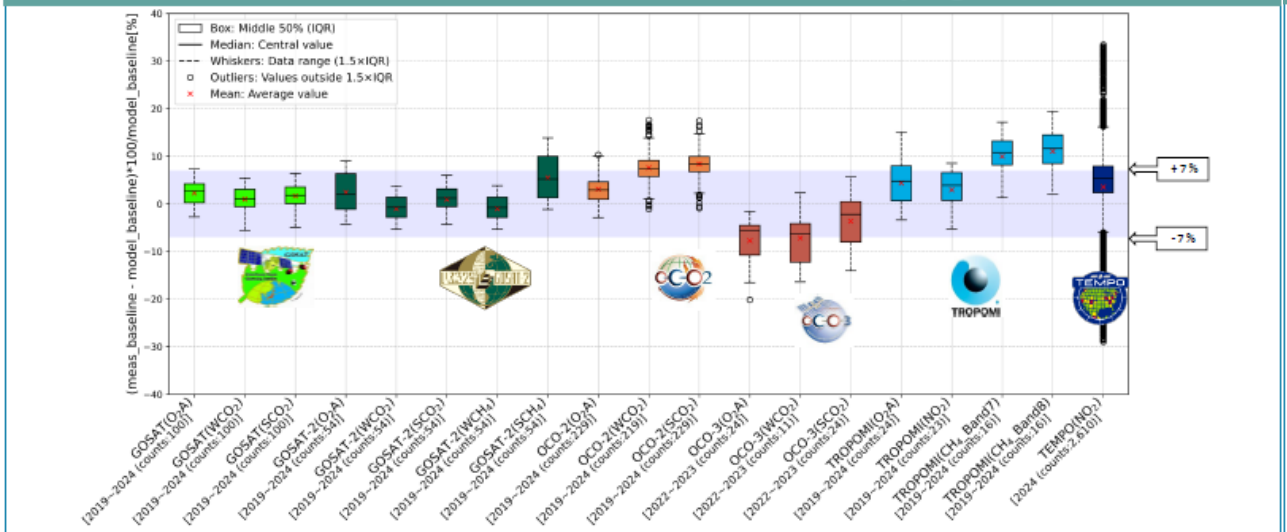
Good conditions for all sensors come every 48 days.

	Nadir footprint size
GOSAT	Circle of 10.5km diameter
GOSAT-2	Circle of 9.6km diameter
OCO-2	Rectangle of 1.3 km * 2.3 km
OCO-3	Rectangle of 1.6 km * 2.2 km
TROPOMI	Rectangle of 3.5 km * 5.5 km (B6) 7 km * 5.5 km (B7, B8)

Multiple sensors VCAL results for RRV2025 and averaged all RRV campaigns

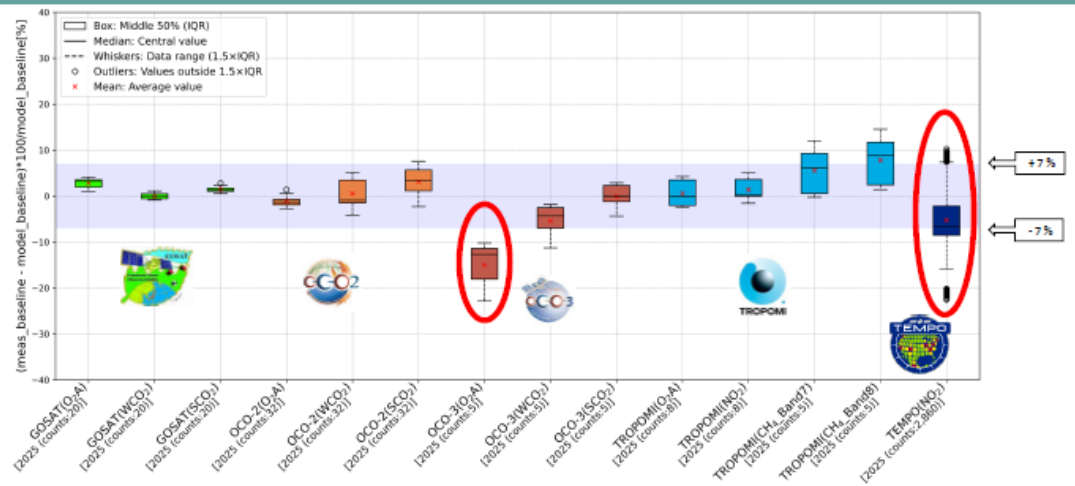
- All sensors are in good agreement within 5-7 % through the long-term campaign.
- OCO-3 late afternoon observation is affected by large BRDF correction uncertainty in RRV2025.
- TEMPO outliers decrease by using L1 ver.4 data in RRV2025.

Chart 1. Result for RRV 2019-2024 campaigns



GOSAT, **GOSAT-2**, and **OCO-2** show good agreement with median residuals within **about±5%. OCO-3** has a wider spread and **more outliers (values outside 1.5×IQR)**, reflecting the variability of ISS viewing geometry. **TROPOMI** is generally stable, with a slight positive bias where observed radiance exceeds the model. **TEMPO's** geostationary sampling results in far more observations, making outliers more noticeable, although most values remain within roughly −5% to +15%.

Chart 3. Result for RRV 2025 fall campaign

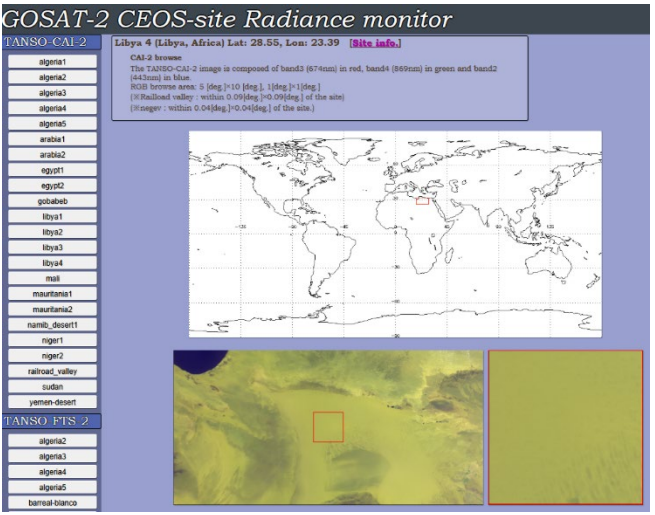


The **September 2025** update to **TEMPO's Level-1 processing (Version 4) significantly reduced the number of outliers**, indicating improved radiometric stability. However, sensitivity differences between **detector elements (or viewing sectors) still appear to remain**; further details will be discussed later. **GOSAT-2** is not included here because its overpass during this period was **cloud-contaminated**. In addition, **OCO-3's late-afternoon observations** resulted in **larger solar zenith angles**, which may increase BRDF and/or radiative-transfer uncertainties.

Ishida et al., AGU25

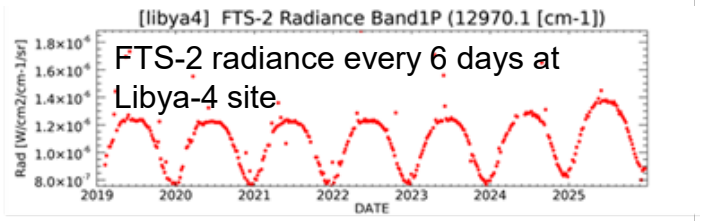
GOSAT-2/FTS-2 radiometric degradation from Sahara desert site monitoring

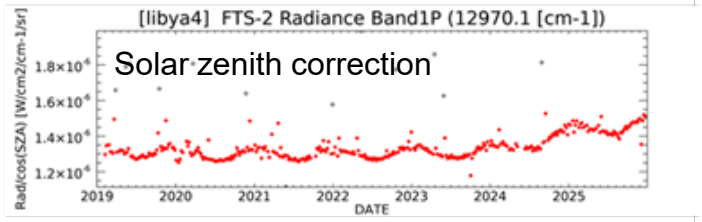
GOSAT-2 CEOS-site monitor

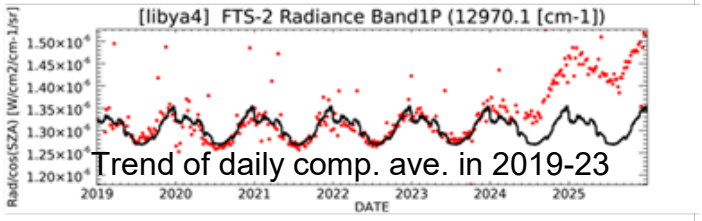


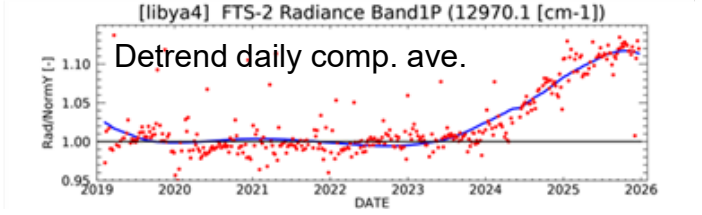
CEOS PICS

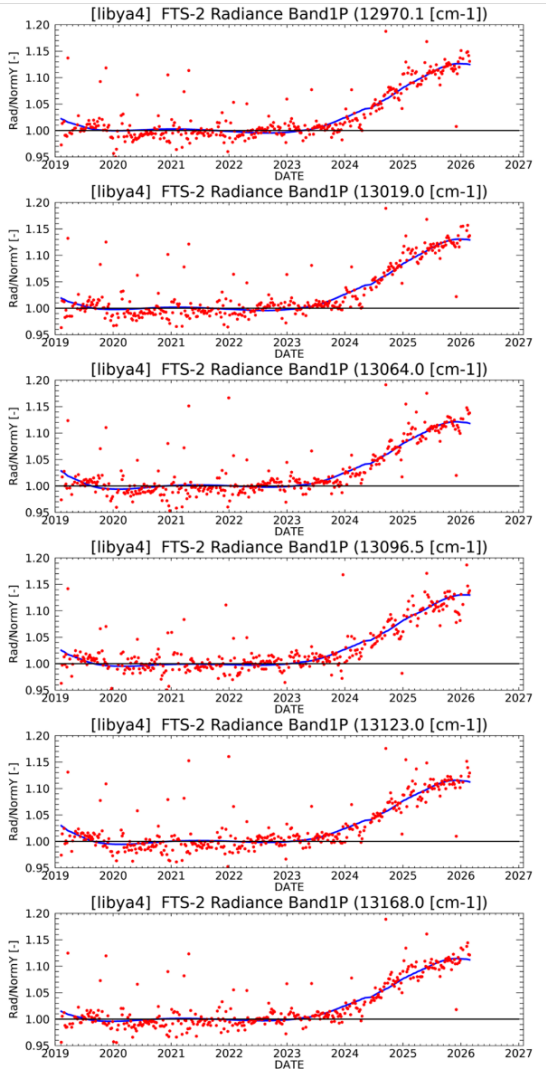
Period : 2019/2/8—2026/2/27
Site : Libya4 Sensor: FTS-2 B1

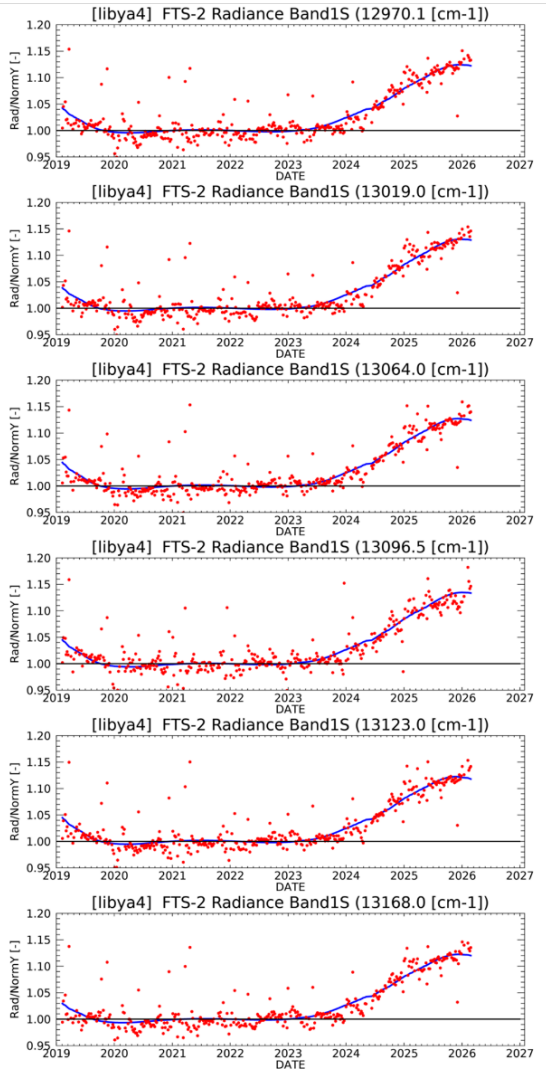












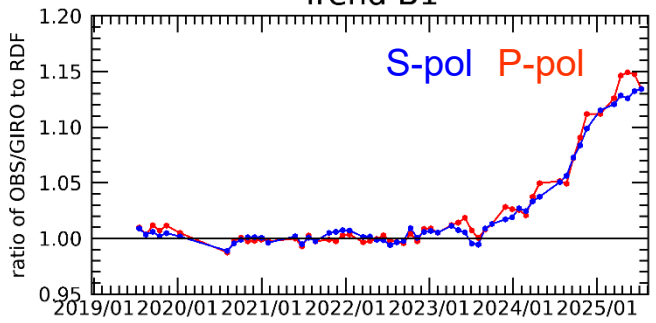
Sahara desert site monitoring supported the other calibration method results.

GOSAT-2/FTS-2 radiometric response change evaluated with 3 methods

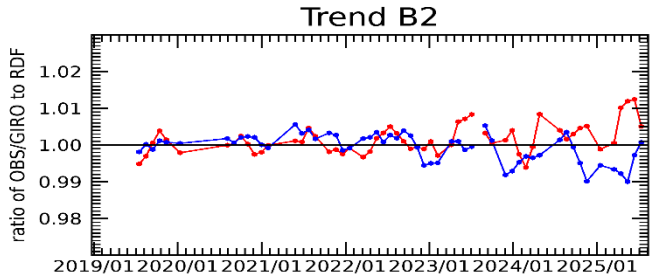
LunarCAL

monthly

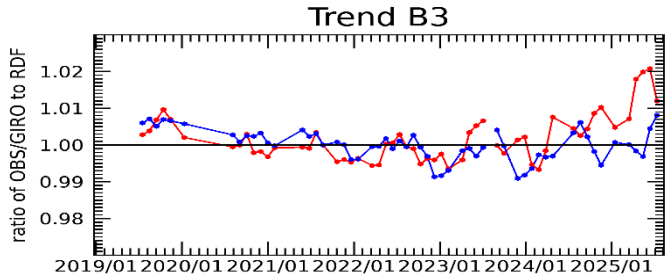
Trend B1



Trend B2

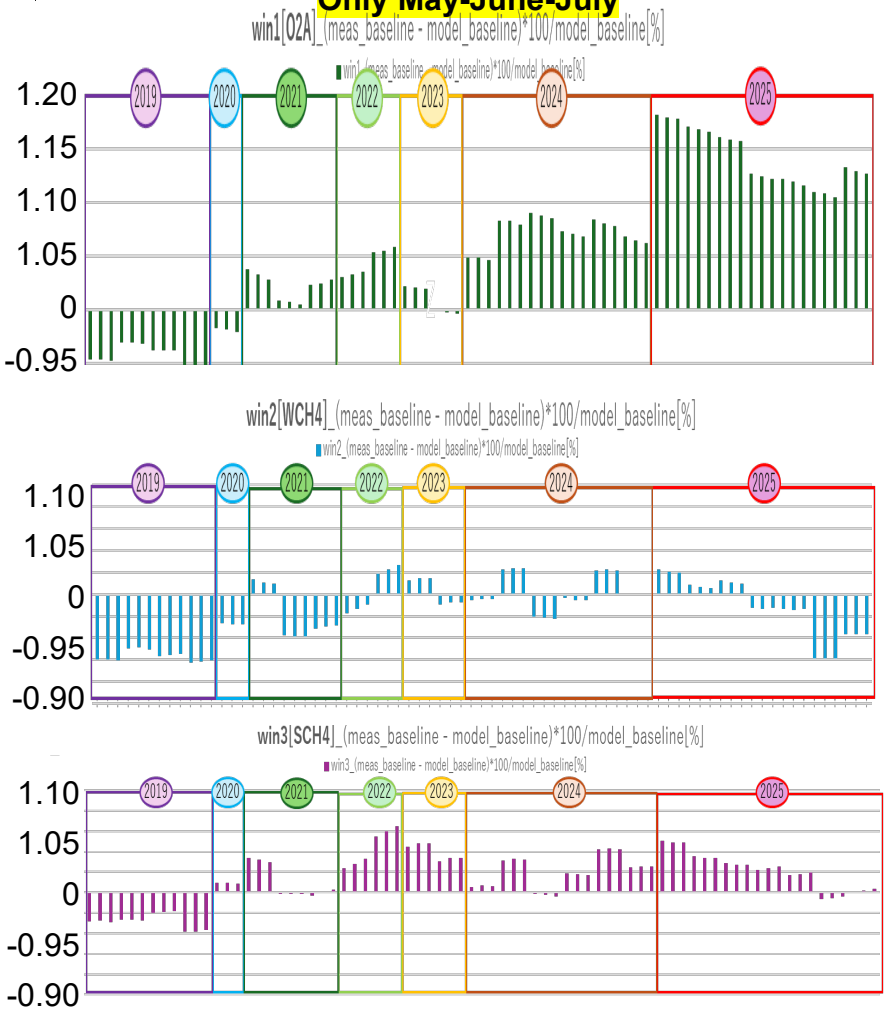


Trend B3



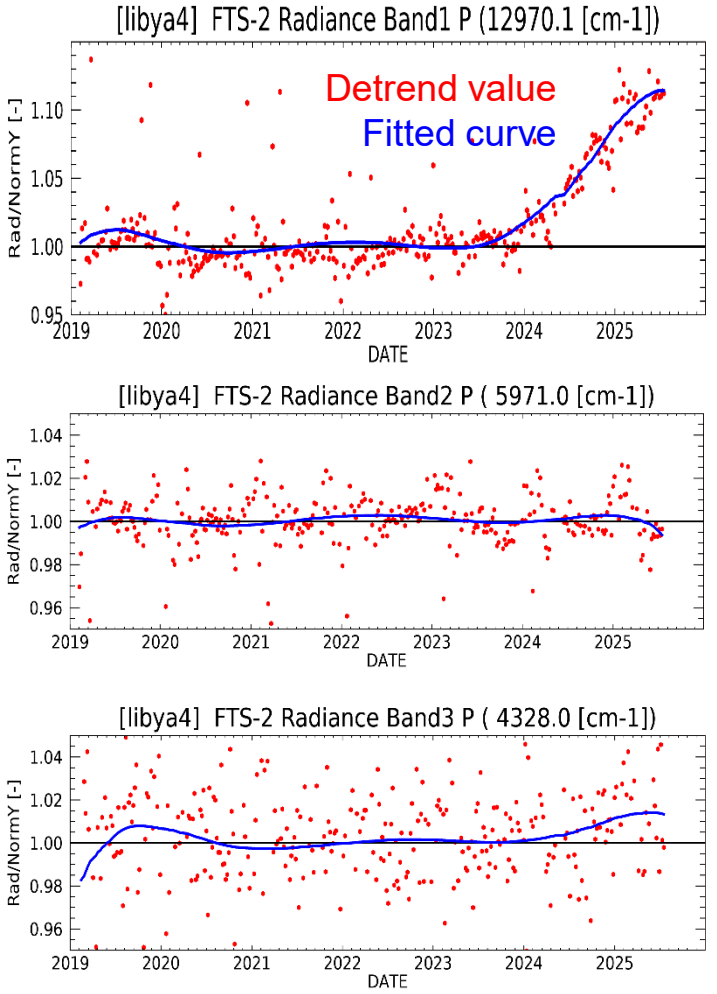
RRV ViCAL

Only May-June-July



Sahara desert

After detrend



Radiometric response change ratios to the former L1B RDF between 3 methods almost agree.

Inter-comparison of GOSAT-2/GOSAT/OCO-2 global simultaneous observation for update confirmation

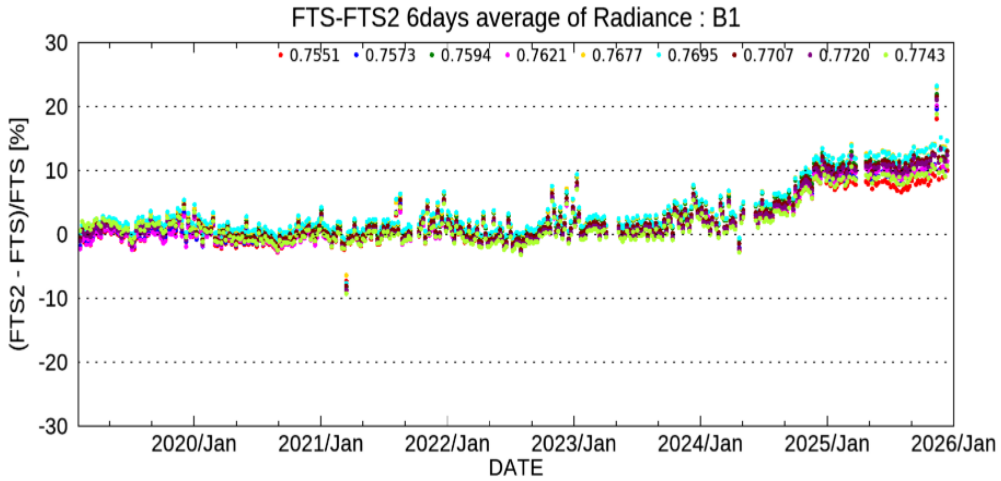
GOSAT-2 L1B applied new RDF is compared with GOSAT and OCO-2 for radiometric validation by using simultaneous observations applied BRDF correction.

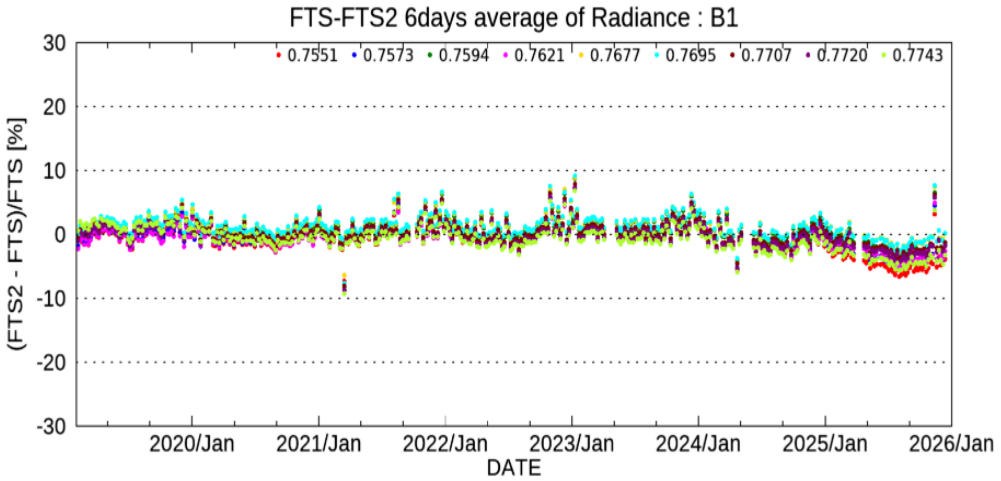
V230.230 (old RDF)

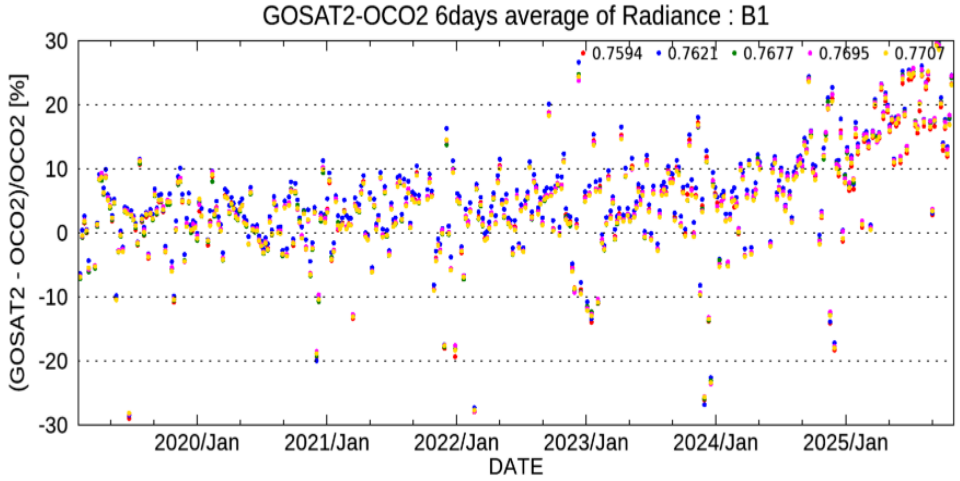
V240.240 (new RDF from Nov2022)

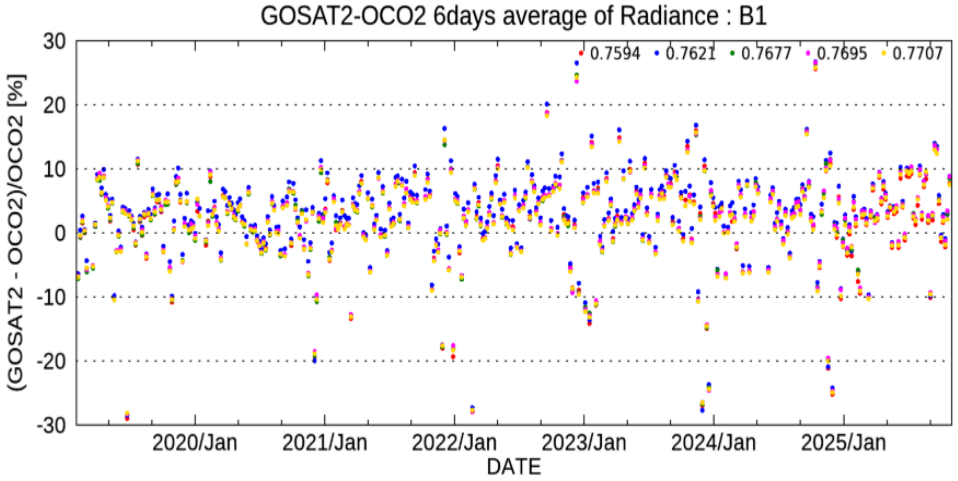
minus

minus









Summary

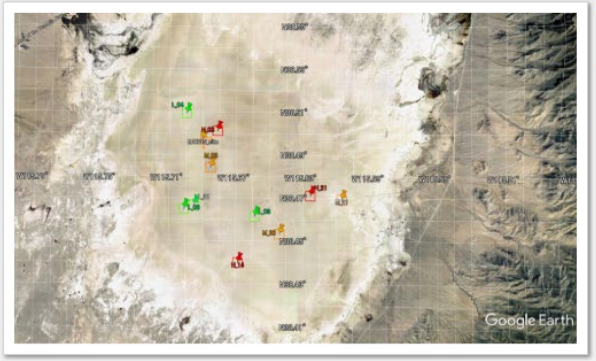
Vicarious Calibration Portal for Space-borne GHGs Sensors

Campaign Data Surface reflectance (in-situ)

- Surface nadir reflectance data measured with an ASD FieldSpec and a Spectralon panel, collected by the JPL and JAXA teams.
- Data analyzed by Carol Bruegge (JPL, V0: 2009 - 2022) and JAXA (V1: 2009 - present, data through Fall 2025)
- Descriptions of the V0 and V1 products:
  - The reflectance calculation method is described in Bruegge et al. (2019, 2021).
  - The outlier filtering for the V0 product was based on the fractional difference of each sample from the overall mean computed over the entire observation period. The V1 product filter is based on the deviation from a moving average calculated over a specific time interval.
  - The V0 and V1 products are comparable, with a mean difference of less than 0.1% across all wavelengths on clear days.

Data Link (V0) | Data Link (V1) Newly released!

【ASD Site】



Site	centerLon[deg.]	centerLat[deg.]
H_03	-115.6812	38.5011
H_14	-115.6687	38.4399
M_03	-115.6852	38.4841
M_20	-115.6440	38.4532
L_04	-115.6997	38.5093
L_06	-115.7010	38.4648
L_08	-115.6588	38.4614
MODIS	-115.6902	38.4970

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

Index of /GOSAT/GHGs_Vical/download/Surface_reflectance_V1

- Parent Directory
- 2009/
- 2010/
- 2011/
- 2012/
- 2013/
- 2014/
- 2015/
- 2016/
- 2017/
- 2018/
- 2019/
- 2020/
- 2021/
- 2022/
- 2023/
- 2024/
- 2025/

Summer2025

- 20250413_M03_JPL_report_long.txt
- 20250413_MOD_JPL_report_long.txt
- 20250414_M03_JPL_report_long.txt
- 20250414_MDN_JPL_1600_report_long.txt
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- 20250603_M03_JAXAFS4-1_report_long.txt
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Fall2025

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- 20251010_M20_JAXAFS4-2_report_long.txt

- OCO and GOSAT teams provide the Railroad Valley campaign dataset for common calibration standard.
- GOSAT and GOSAT-2 are both healthy and have been providing the long-term GHG observation dataset continuously since 2009.
- GOSAT-2 SWIR radiometric response were updated by combining the results of Lunar calibration, Railroad vicarious calibration, Sahara desert and then confirmed validity by inter-comparison using GOSAT and OCO-2