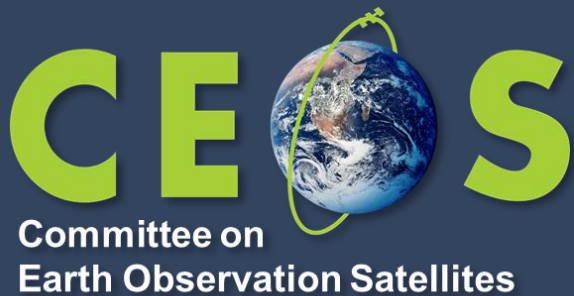


CEOS-AC-VC GHG

GOSAT, GOSAT-2, and GOBLUE:
14-year global grid data and
targeted mega city observations

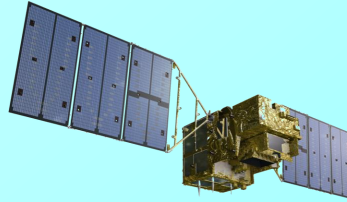


Akihiko KUZE,
Kei SHIOMI,
Hiroshi SUTO,
Nobuhiro KIKUCHI,

JAXA GOSAT team, and
ANA-JAXA GOBLEU team

24th October 2023

Long term (15-year Jan. 2024)
calibrated and validated dataset



Satellite Condition

Enough fuel to operate for at least another 10-year

All four batteries are healthy

Level 1 V300.300 (released in March 2023)

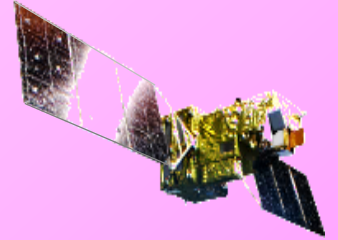
Best-estimate radiance spectra using TSIS-HSRS and long-term vicarious-calibration data.

JAXA Level 2 Partial Column product V3

GOSAT (14-year) and GOSAT-2 (4-year)

Lite (csv format) and HDF with averaging kernels.

Intense target observations
using flexible and
wide angle pointing



Oct. 30 5-year operation review.
The operation will be extended.

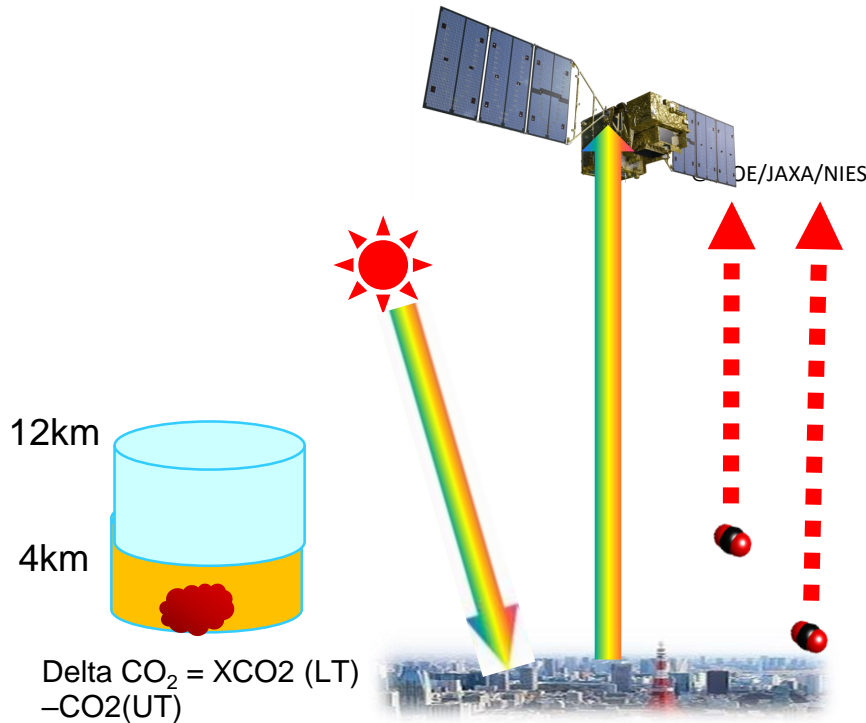
Calibration

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 V220 (released in March 2023)
TIR calibration updated in large-AT angles

JAXA EORC Research Product

Partial Column Density of Upper and Lower Troposphere

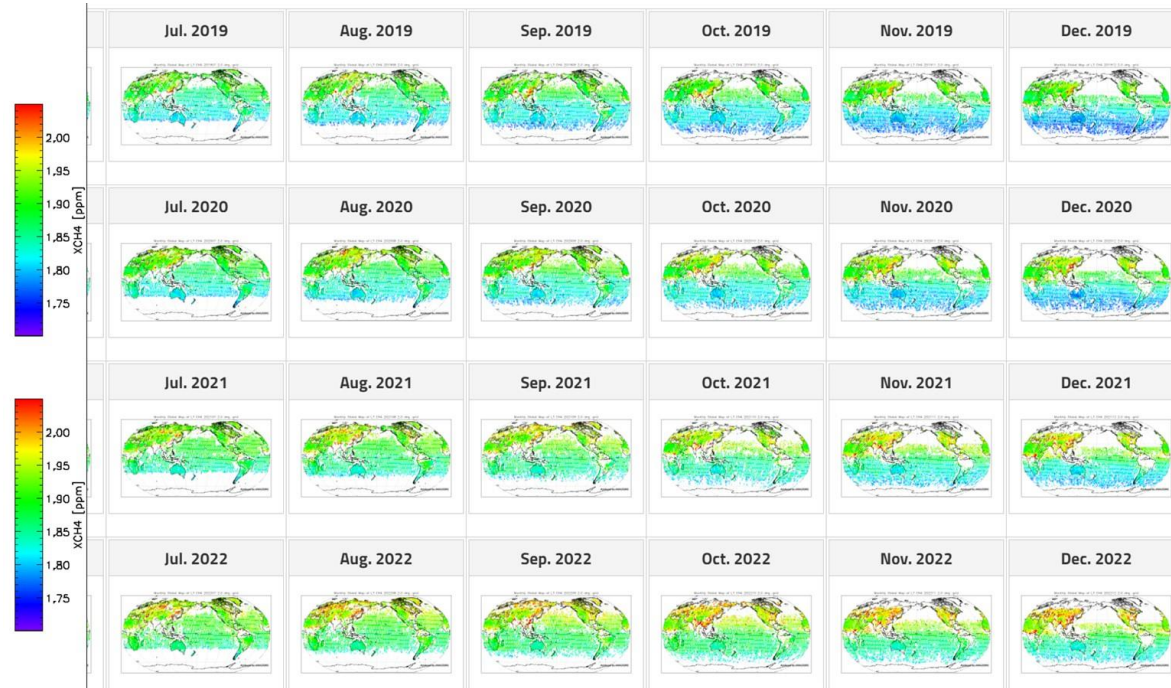


- (1) SWIR constrains column density
- (2) Two orthogonal linear polarization data remove aerosol contamination.
- (3) TIR provides difference in partial column density between lower and upper troposphere.

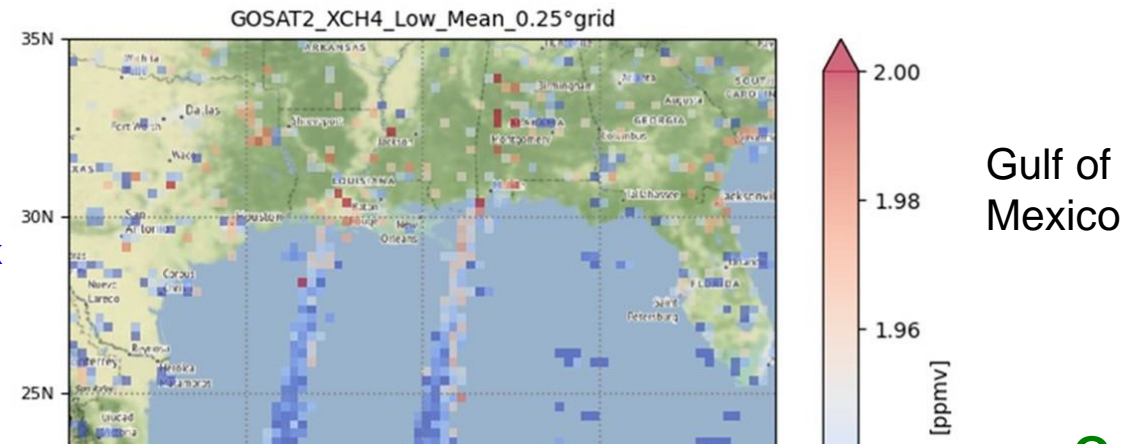
Post screening of cloud contamination using onboard camera

- (1) 14-year GOSAT and 4-year GOSAT-2 products One file per month with clear sky data, CSV format and AK
- (2) Contents XCO₂, XCH₄, XCO₂ (LT, UT), XCH₄ (LT, UT), XCO (GOSAT-2 only), H₂O (11 layers) aerosol optical thickness (AOT), Retrieved surface pressure (P), solar-induced chlorophyll fluorescence (SIF) time, geometry

(3) https://www.eorc.jaxa.jp/GOSAT/GPCG/download_v3/ ID : gosat, PW : ***** (please contact kuze.akhiko@jaxa.jp)



GOSAT-2
XCH₄ (LT)

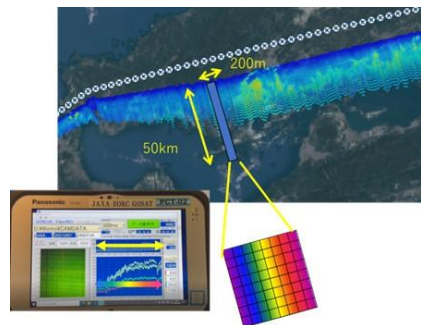


Satellites vs. Passenger Aircrafts

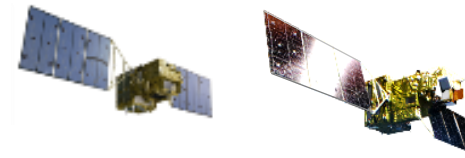
The Greenhouse gas Observations of Biospheric and Local Emissions from the Upper sky (GOBLEU)



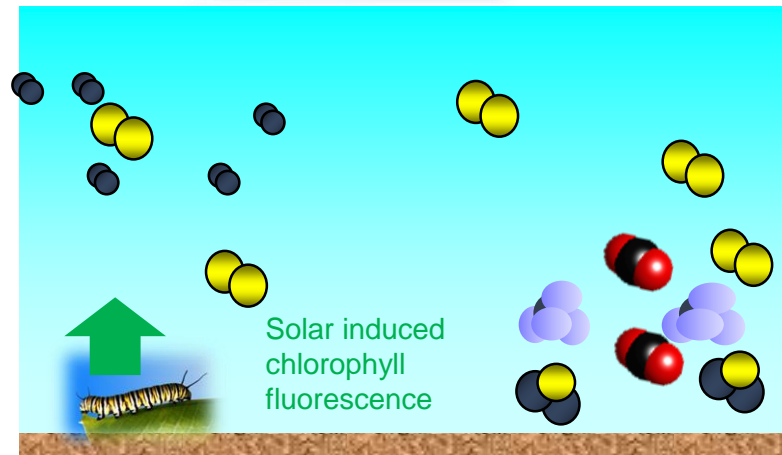
- Satellite move too fast 7 km/sec
- Airplane 850 km/h = 200 m/s
- (2 Hz sampling = 100 m) 1,000 color fax
- For greenhouse gases monitoring, just above the troposphere is the most effective
- Measures NO₂, O₂, CO₂, CH₄ and SIF



666 km



12 km



Stratosphere

Ozone O₃

Troposphere

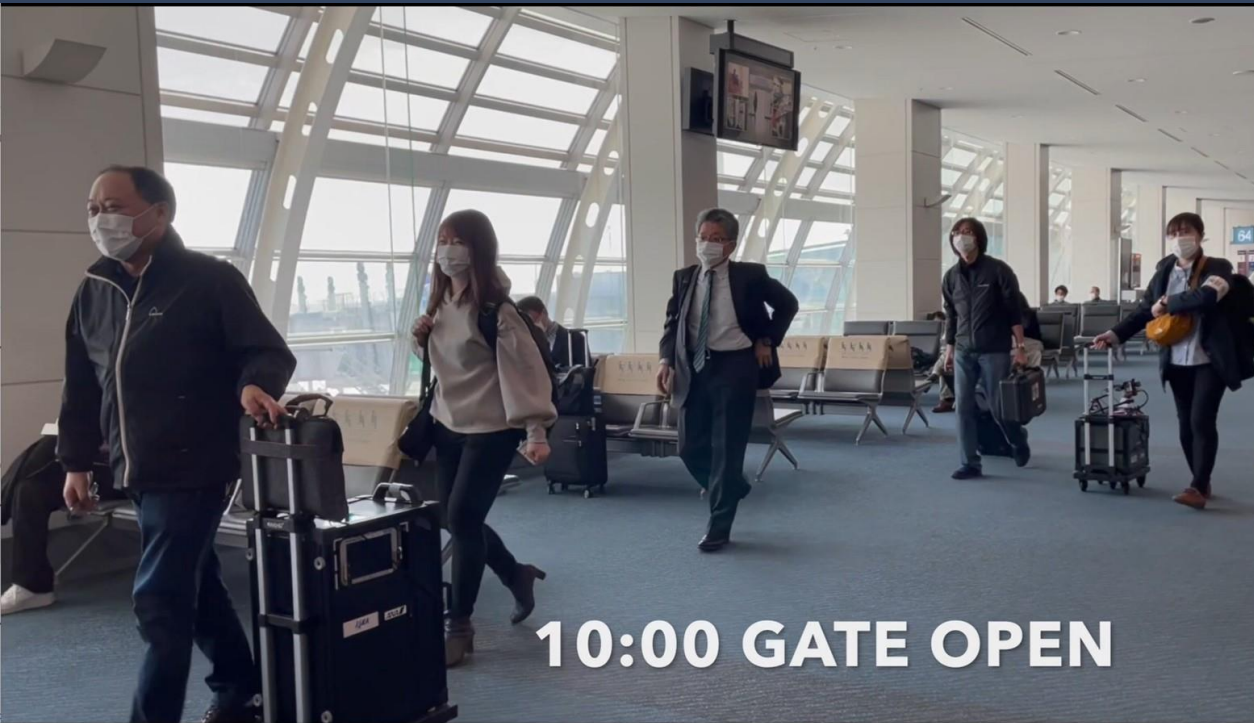
Nitrogen N₂

Oxygen O₂

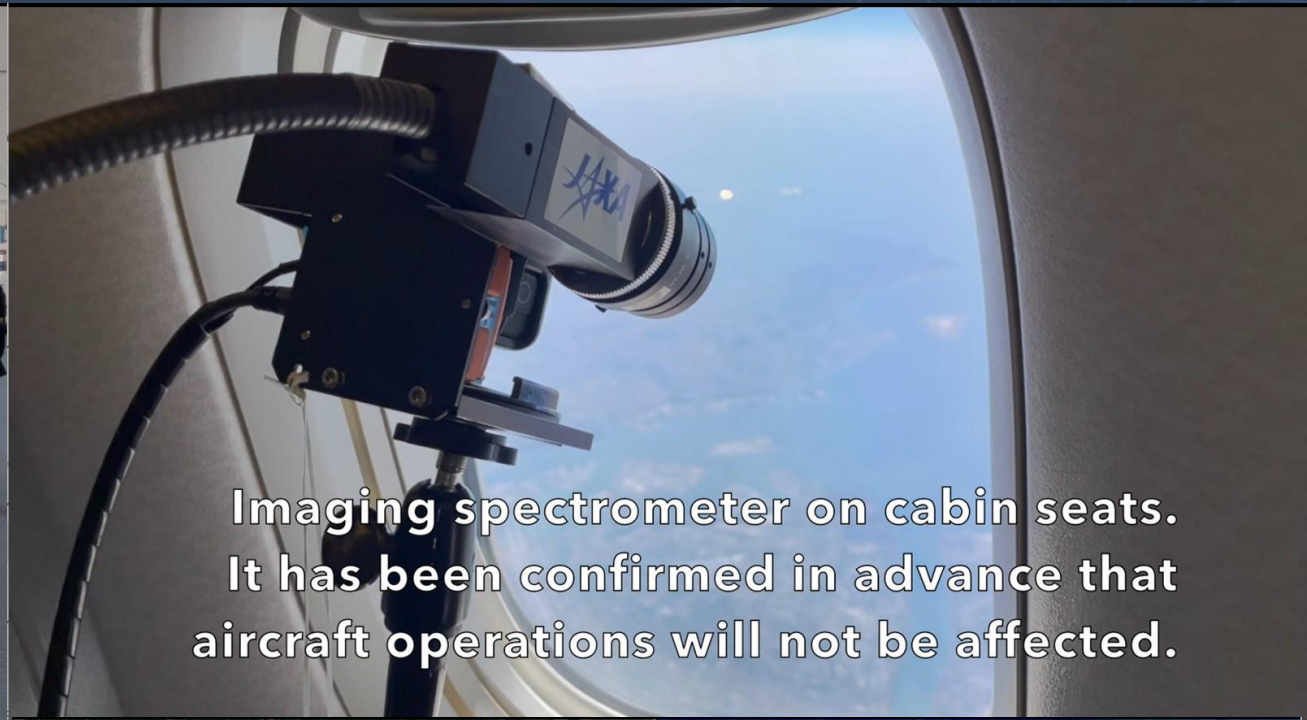
Carbon dioxide CO₂

Methane CH₄

Nitrogen dioxide NO₂



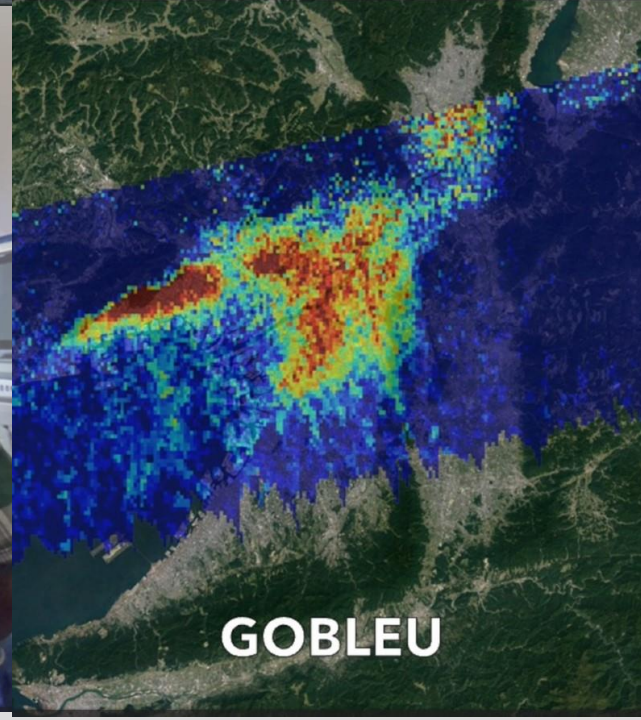
10:00 GATE OPEN



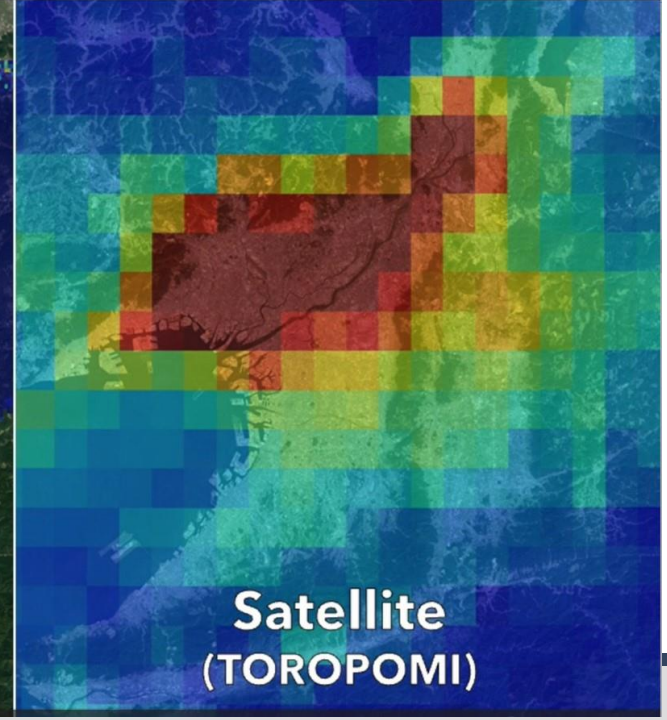
Imaging spectrometer on cabin seats.
It has been confirmed in advance that
aircraft operations will not be affected.



Imaging spectrometer on cabin seats.
It has been confirmed in advance that
aircraft operations will not be affected.



GOBLEU



**Satellite
(TOROPOMI)**

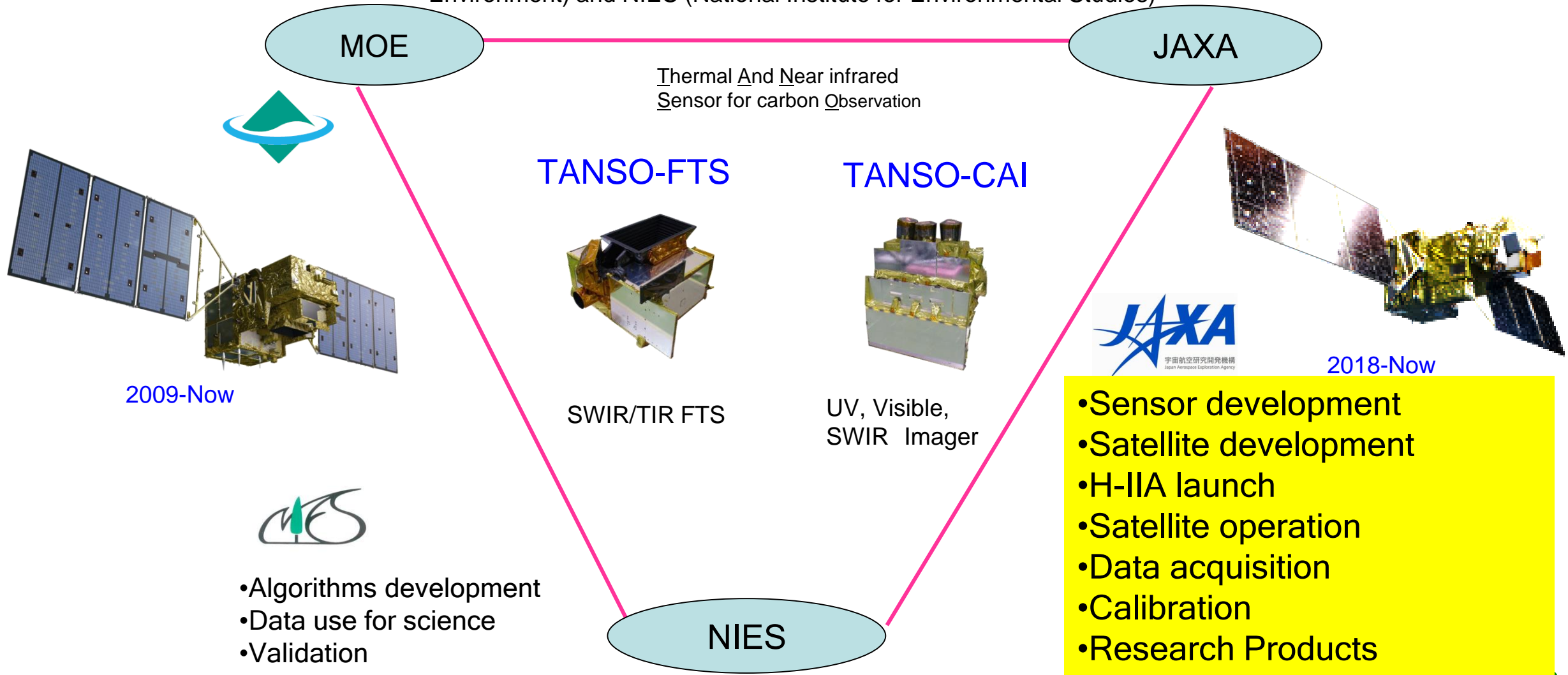
Back up

1. The first GHG-observing satellite GOSAT launched in 2009 has enough fuel to operate for another decade and healthy batteries after 14 years in space. In addition to global grid observation, the satellite has been observing ocean glint and global megacities with an agile pointing system. GOSAT-2, launched in 2018, has an additional $2.3 \mu\text{m}$ band for CO, pointing angles twice as wide as GOSAT, and a higher signal-to-noise ratio (SNR), especially for the TIR CH₄ band. All the observation locations can be customized by uploading all the observation points from the ground daily.
2. JAXA EORC provides research Level 2 products from TANSO-FTS's wide spectral range of solar reflected light with two-orthogonal polarizations and thermal emissions. The products contain partial columns of the upper and lower troposphere (approximately 0-4 km and 4-12 km respectively) CO₂, CH₄, and 11-layer H₂O, a total column of CO₂, CH₄, Solar induced chlorophyll fluorescence (SIF), and averaging kernels.
3. JAXA and ANA Holdings have started the Greenhouse gas Observations of Biospheric and Local Emissions from the Upper sky (GOBLEU) project to estimate local anthropogenic emissions from individual source sectors such as transportation, power plants, and industries. We have developed imaging spectrometer suites for CO₂, CH₄ of GHGs, NO₂ of anthropogenic emission proxies, oxygen (O₂), and SIF from plant photosynthesis. We have flown our instrumentation over urban areas such as Tokyo, Nagoya, and Osaka and industrial zones.

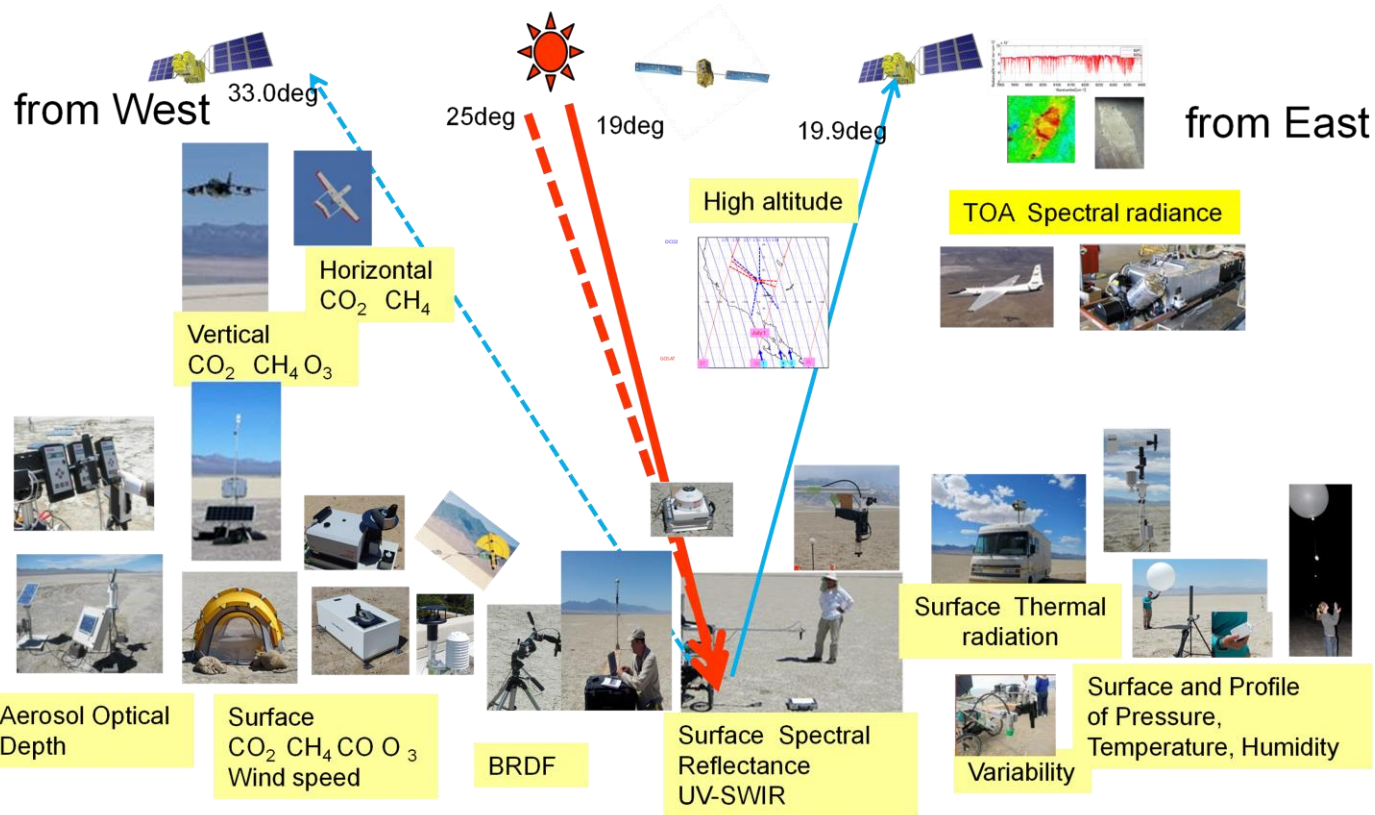
GOSAT & GOSAT-2 Organization



GOSAT and GOSAT-2 are the joint projects of JAXA, MOE (Ministry of the Environment) and NIES (National Institute for Environmental Studies)



Free and Open calibration and validation data for multiple satellites from JAXA and CEOS



Vicarious Calibration Portal for Space-borne GHGs Sensors

HOME Methodology Satellite Orbit Team Meeting Documents Gallery Links

Campaign Data

- Surface reflectance (in-situ)
NASA JPL : Surface reflectance measured by ASD field spectrometer.
Data Link
- Temperature and Humidity profile (radio sonde)
JAXA : Temperature and Humidity profile measured with radio sonde.
Data Link
- Trace gas profile
NASA Ames : Alpha Jet Atmospheric eXperiment (AJAX)
Data Link
- CO2 and CH4 total column density (EM27/SUN)
JAXA : CO2 and CH4 total column density measured with ground-based portable FTS (EM27/SUN)

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JAXA EORC CEOS

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

- Every year in June, 5 US-Europe-Japan sensors target the Railroad Valley (RRV) desert playa, in Nevada.
- RRV2023 campaign (Jun-Jul) added polarization measurements to estimate uncertainties in surface reflectance.
- From next year TEMPO from the geostationary orbit will be added. New Space Sensors are welcome.