JAXA's Greenhouse Gases Monitoring Plan in 2025

Hiroshi Suto

Japan Aerospace Exploration Agency (JAXA)
E-mail: suto.hiroshi@jaxa.jp

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Japan's GHG observatories from space

Project	GOSAT (*Kuze et al, AO, 2009*)	GOSAT-2 (*Suto et al, AMT, 2021,2022*)	GOSAT-GW (*developing*)
Image			
Launch	2009/1/23 (15 years on-orbit)	2018/10/29 (5 years on-orbit)	JFY2024
Local observation time	13:00	13:00	13:30
Revisit time	3 days	6 days	3 days
Observation target	**CO_2, CH_4,** SIF(Solar-induced chlorophyll fluorescence)	**CO_2, CH_4,** CO, (N_2O) SIF(Solar-induced chlorophyll fluorescence)	**CO_2, CH_4,** NO_2 SIF(Solar-induced chlorophyll fluorescence)
Current status	- **Operation is nominal** - **ZPD position is stable** - Suspended the back-side solar diffuser operation.	- **Operation is nominal** - **Approved the extended mission operation (since last Oct.)** - Suspended the solar diffuser operation. - The operation was suspended for orbit- control maneuver during May 10 to the biggening of June.	- **TANSO-3 onboard GOSAT-GW is led by MOE and NIES**

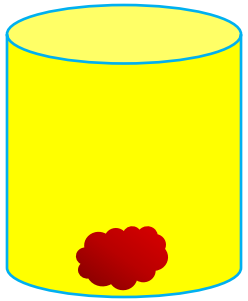
JAXA patrial column GHG product

- Use full observation advantage by GOSAT and GOSAT-2 such as simultaneous ShortWave Infrared (**SWIR**) and Thermal Infrared (**TIR**) observation as well as **2-orthogonal polarization information**.
- 2 layers in troposphere and 3 layers in stratosphere are applied for CO_2 and CH_4 vertical* concentration.

*** 6 pressure levels: 0.1 hPa & (0.05, 0.1, 0.2, 0.6, 1)*Psurf**

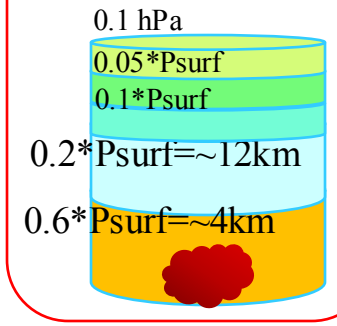
Conventional Method

Use only solar reflected light

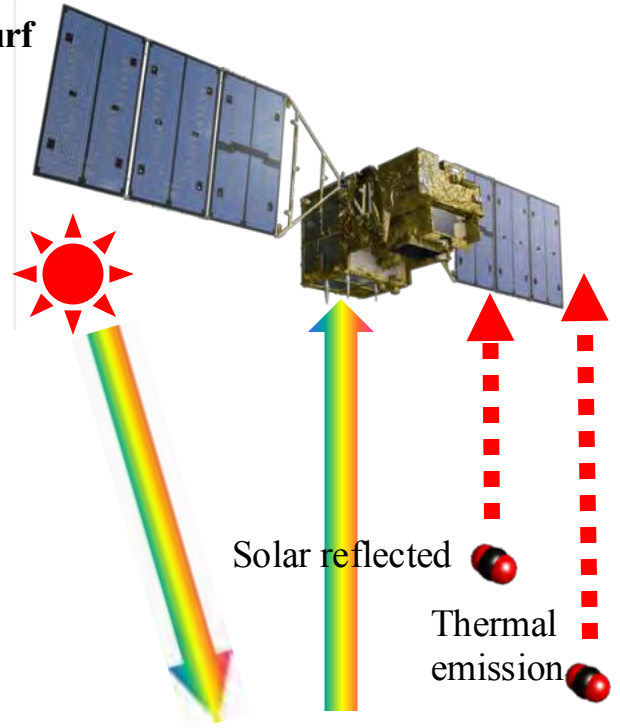


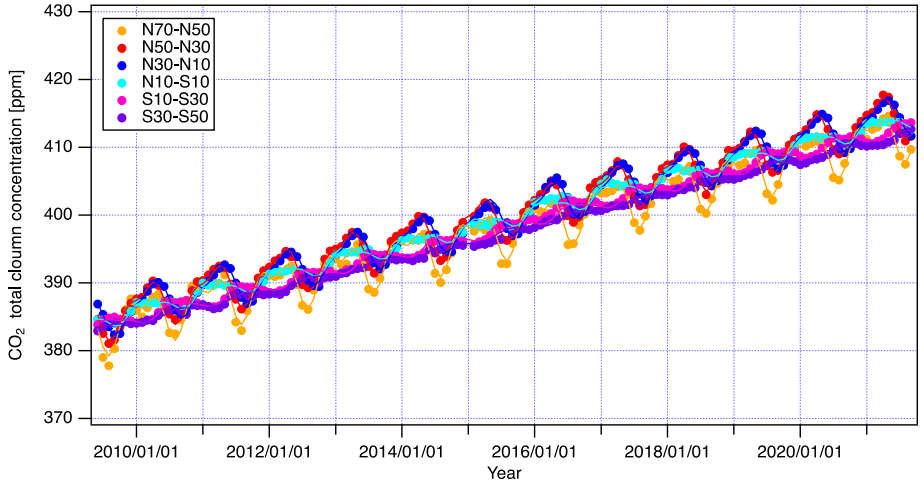
JAXA/EORC new Method

Use both solar reflected light & thermal

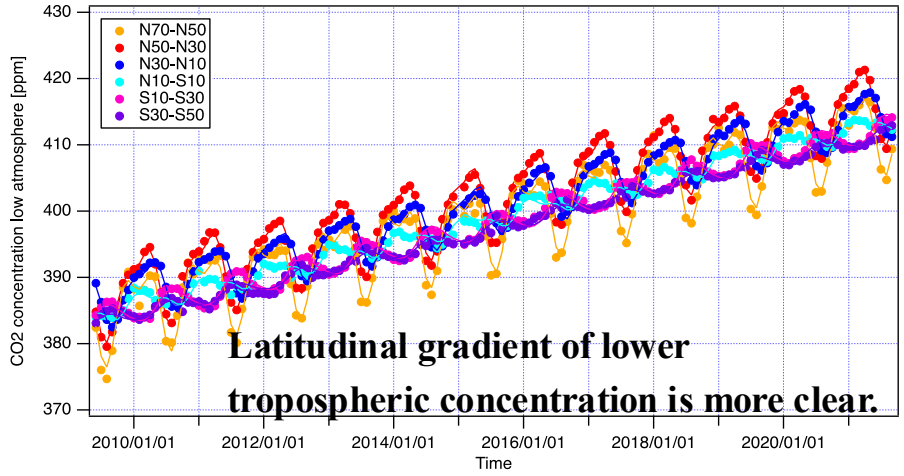


CO_2 & CH_4 emission and enhanced density of the lower troposphere





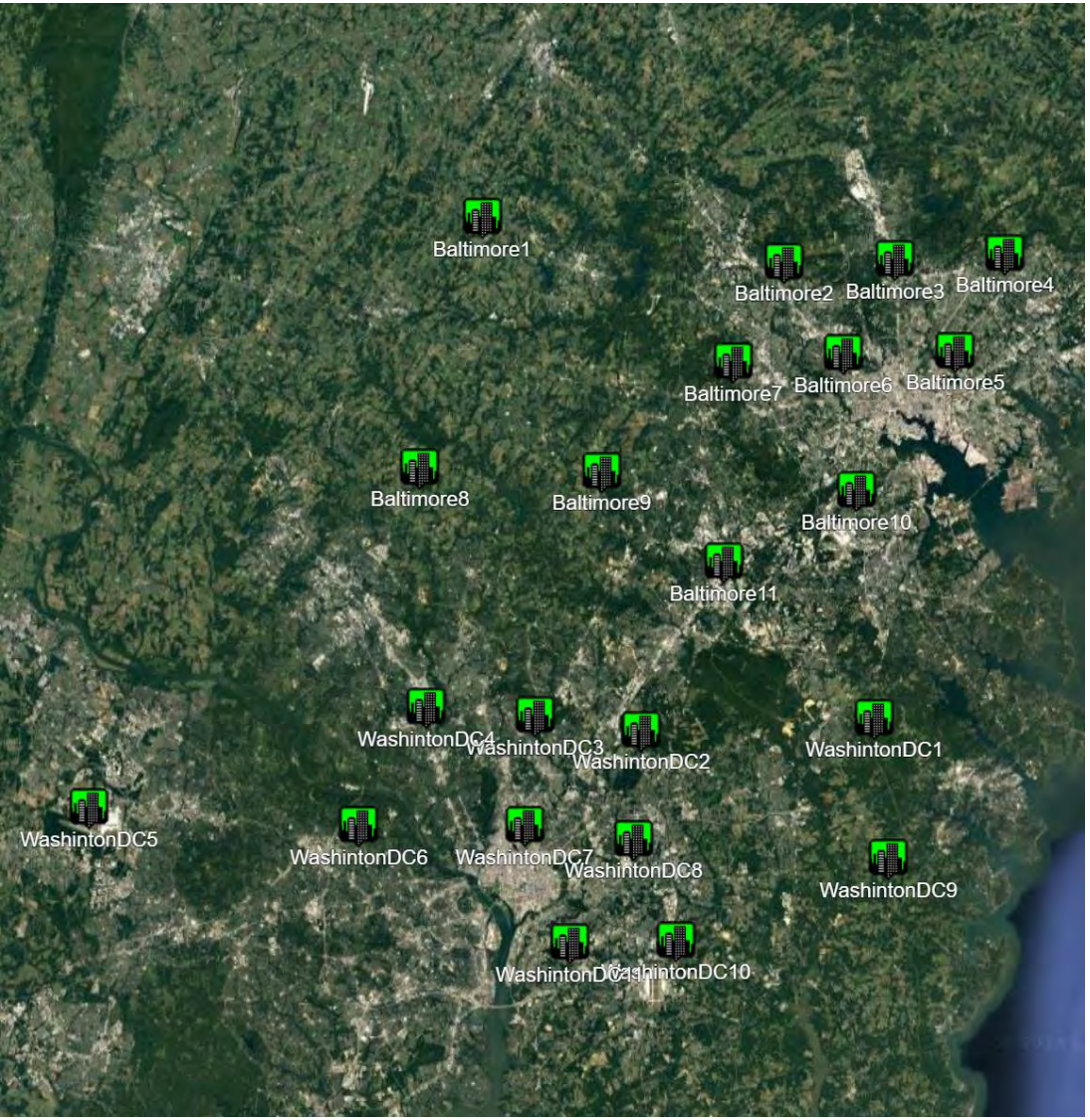
Total column concentration



Lower tropospheric concentration

Suto et al, in prep.

Current observations over Washington D.C & Baltimore

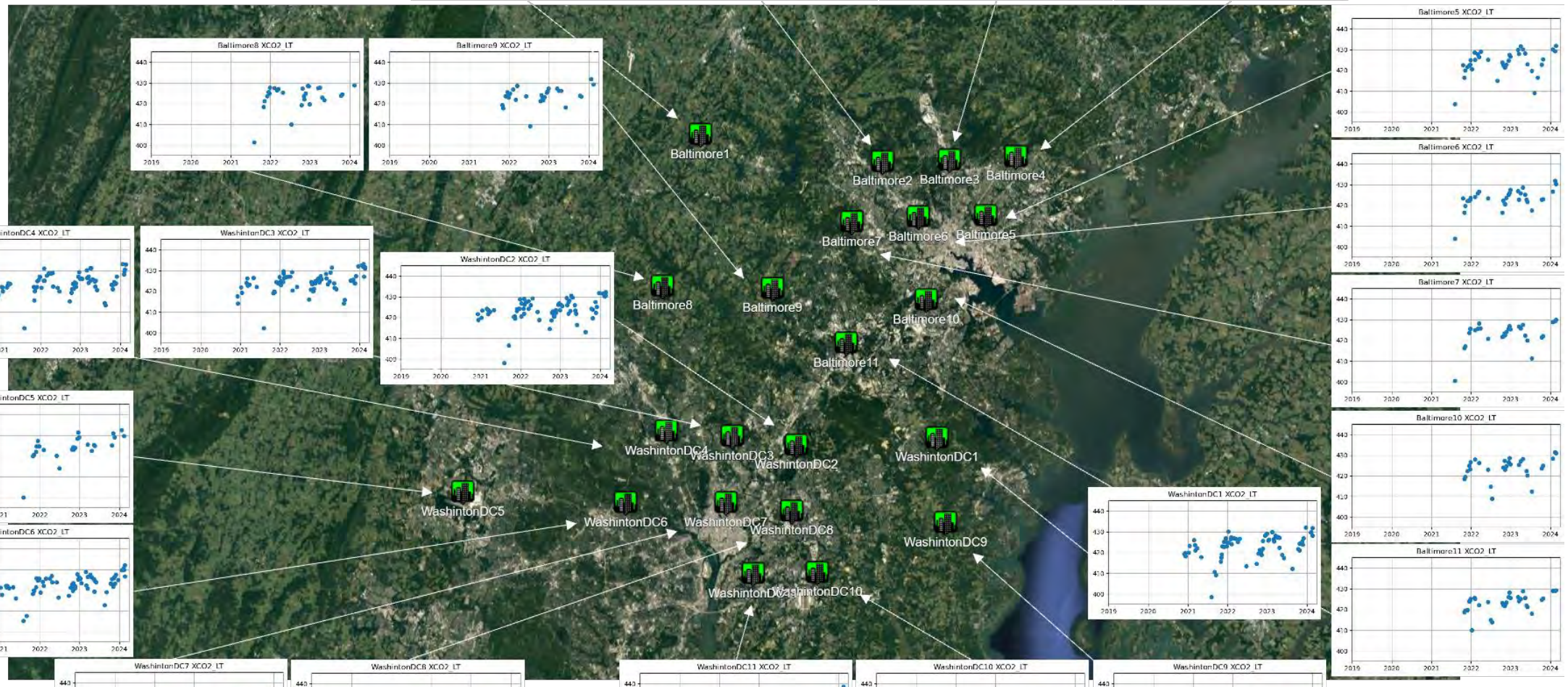


Location	Latitude	Longitude
Baltimore1	39.426934	-77.051090
Baltimore2	39.389877	-76.730250
Baltimore3	39.391758	-76.612397
Baltimore4	39.396669	-76.495549
Baltimore5	39.316539	-76.548639
Baltimore6	39.314397	-76.667755
Baltimore7	39.307253	-76.784843
Baltimore8	39.220152	-77.117826
Baltimore9	39.217039	-76.925011
Baltimore10	39.200972	-76.654231
Baltimore11	39.141862	-76.795303
WashintonDC1	39.012809	-76.635444
WashintonDC2	39.003499	-76.883405
WashintonDC3	39.015557	-76.996366
WashintonDC4	39.022604	-77.111313
WashintonDC5	38.938478	-77.470663
WashintonDC6	38.924186	-77.183799
WashintonDC7	38.924299	-77.007765
WashintonDC8	38.913368	-76.891792
WashintonDC9	38.896527	-76.621396
WashintonDC10	38.829079	-76.847237
WashintonDC11	38.827210	-76.960154

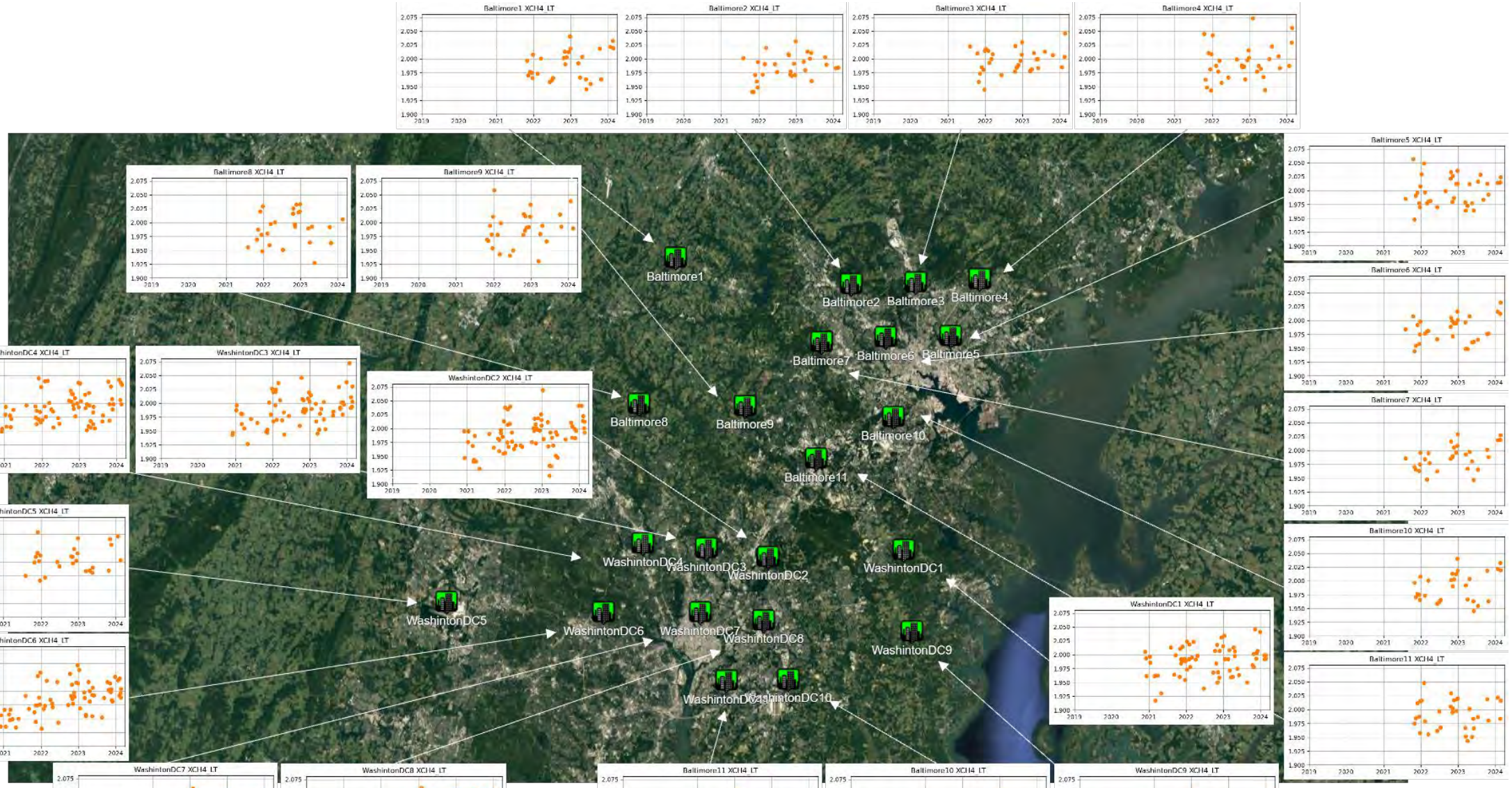
- Continuously observing GHG' by GOSAT-2 since 2021.
- JAXA can allocate the target position, if the modification will be required.
- Both total and partial column products are freely available from our website.
- Near surface H_2O, SIF and CO are simultaneously retrieved from GOSAT-2.

https://www.eorc.jaxa.jp/GOSAT/CO2_monitor/index_Ver.K.G2.html

Trend of lower tropospheric CO_2 concentration since 2021



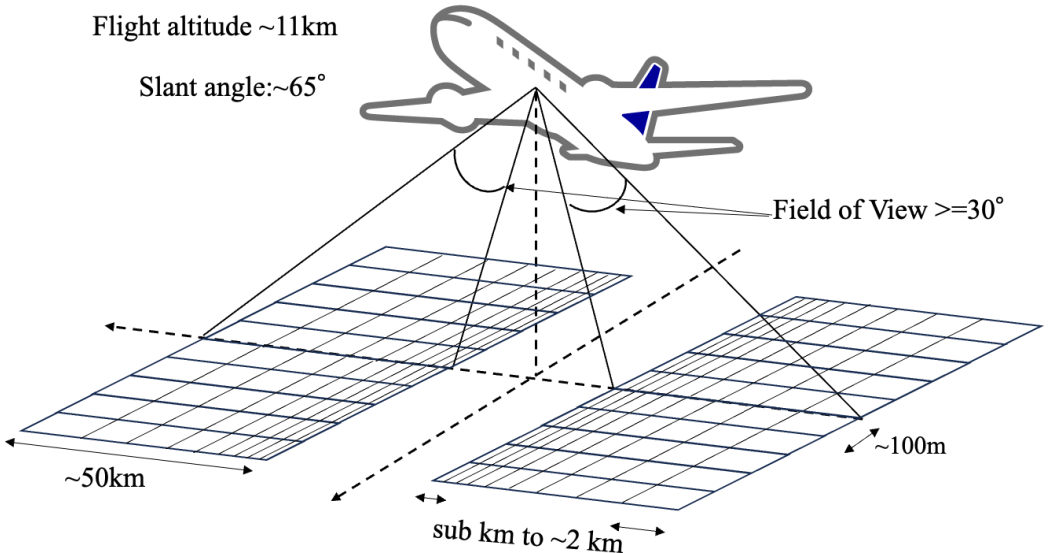
Trend of lower tropospheric CH_4 concentration since 2021



Remote sensing from a commercial airliner

Our concepts:

- NO hardware modification to aircraft*
- Compact instruments on cabin seats
- Observing through cabin window (slant viewing)
- Small power consumption with mobile battery operation
- 3 modules: 450nm, 740nm and 1.6um bands for NO_2, SIF and CO_2 with fiber coupling.

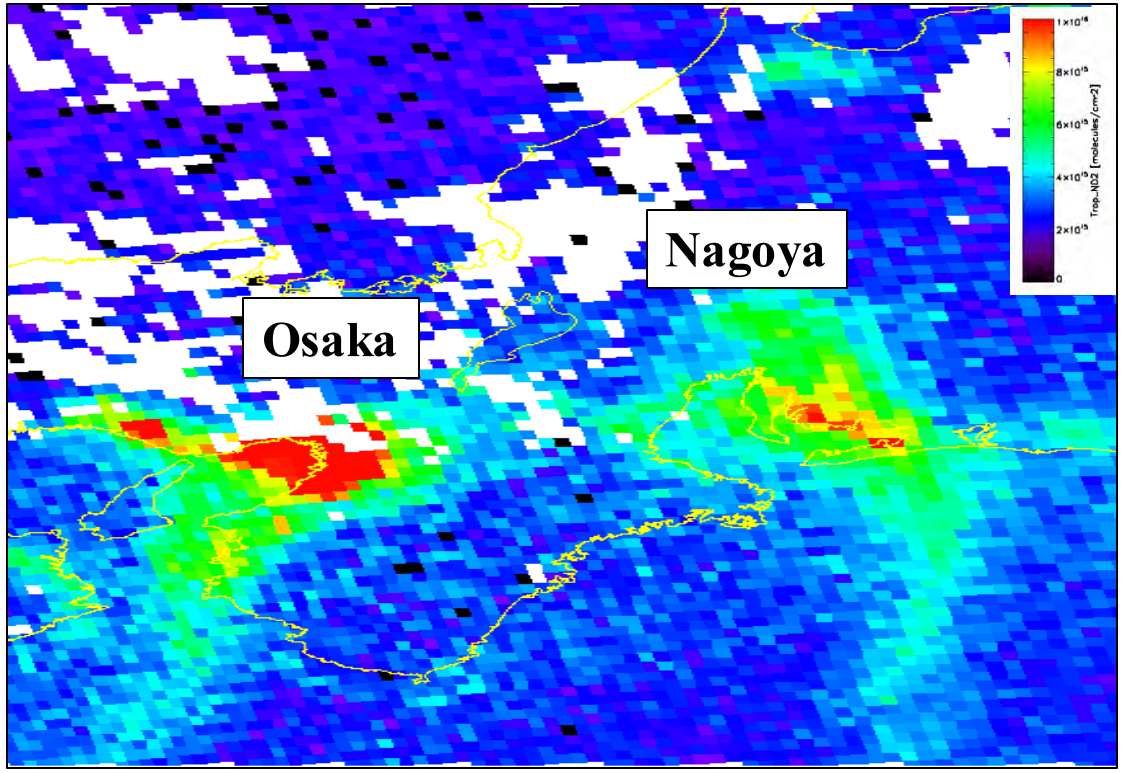


*Limitation of size and wight, the capacity of battery, electronical magnetic conduction from instruments have to be passed the certifications.

We can discuss the installation of our instruments on the campaign aircraft.

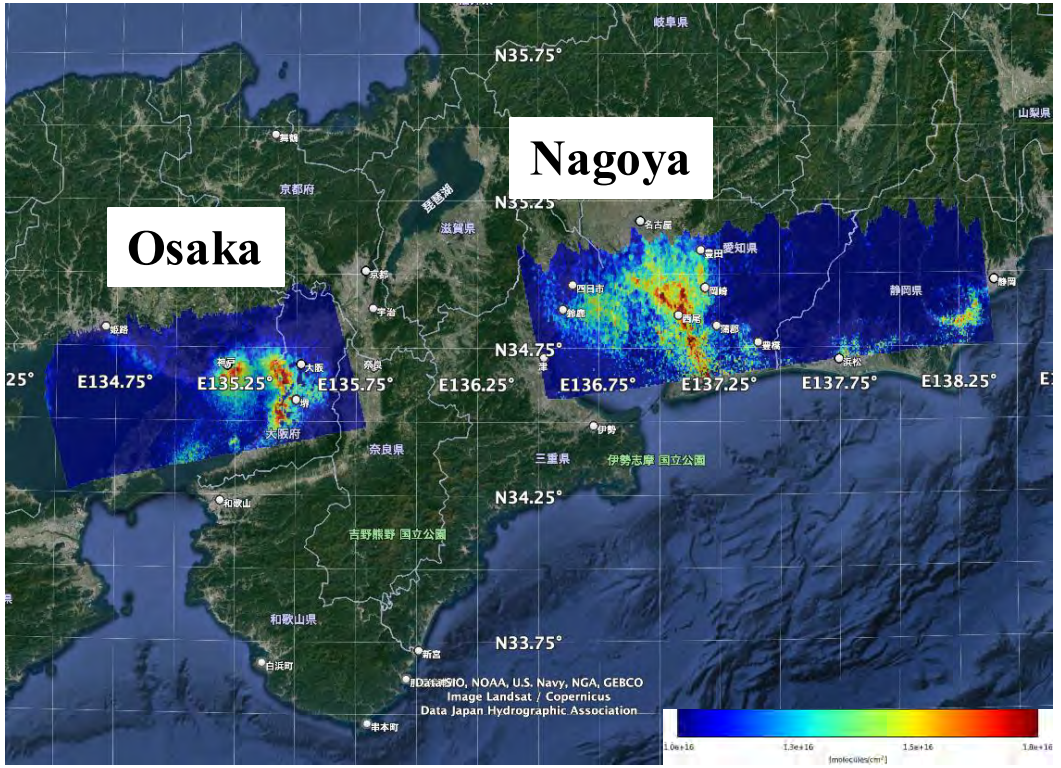
Suto *et al. Carbon Balance and Management* (2024) 19:27
https://doi.org/10.1186/s13021-024-00273-1

Observing NO_2 as a CO_2 emission marker



TROPOMI

Nov. 17, 2023 **13:17** (UTC+9)



GOBLEU:

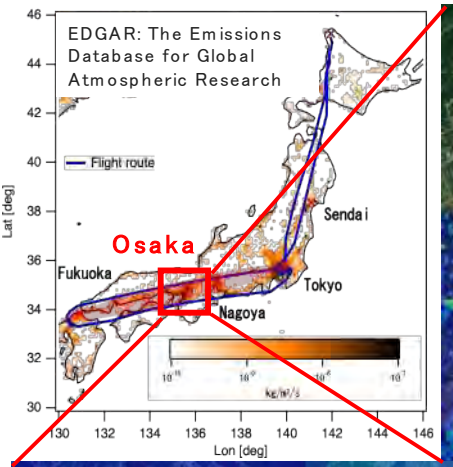
Nov. 17, 2021 **11:25** (UTC+9)

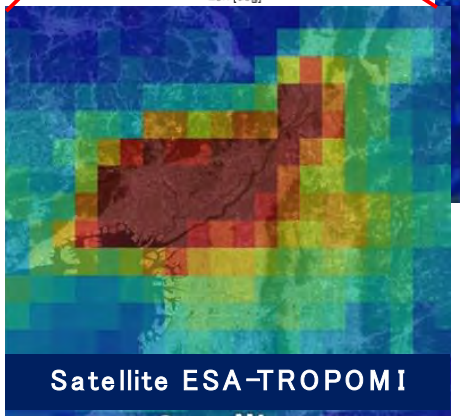
- Wind speed and direction are essential for NO_2 distribution.
- Especially in Nagoya, the emission are flown to out of megacities during winter season.
- In contrast, megacity Osaka, the emission are staying over cities.

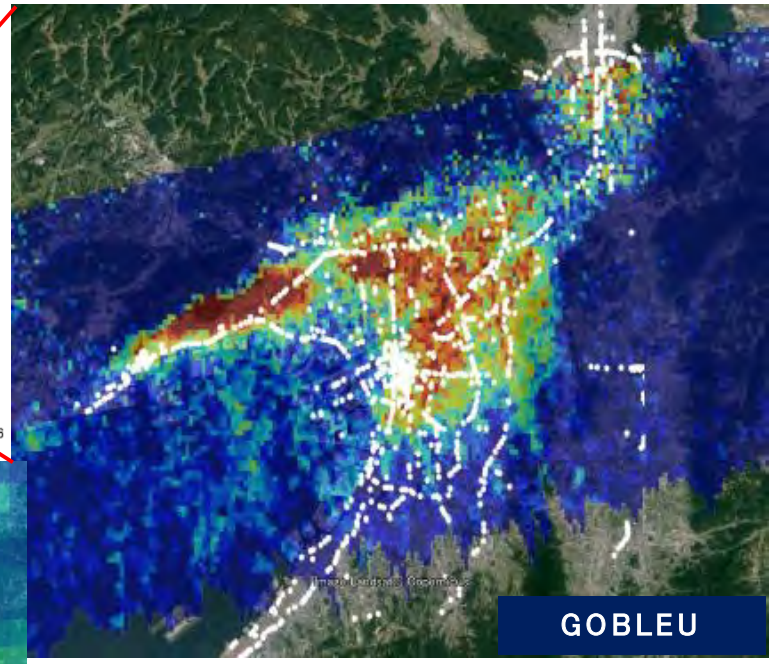
Global to Regional: commercial airborne observation

Observation Data

anthropogenic NO_2 emission proxy

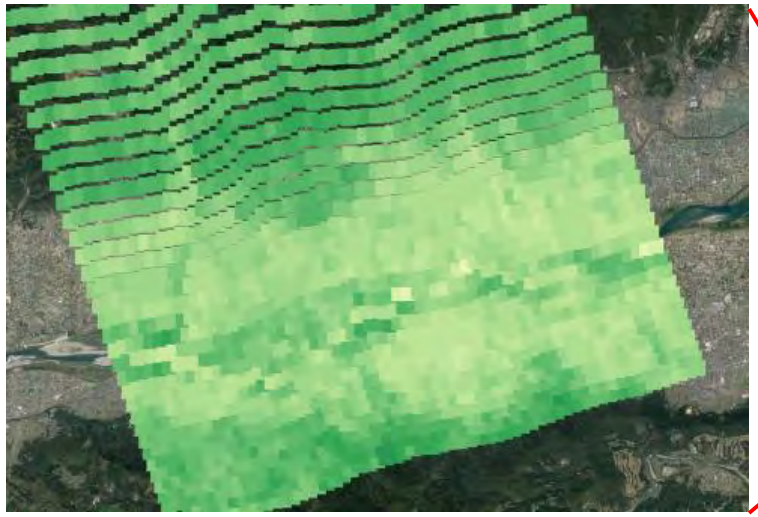






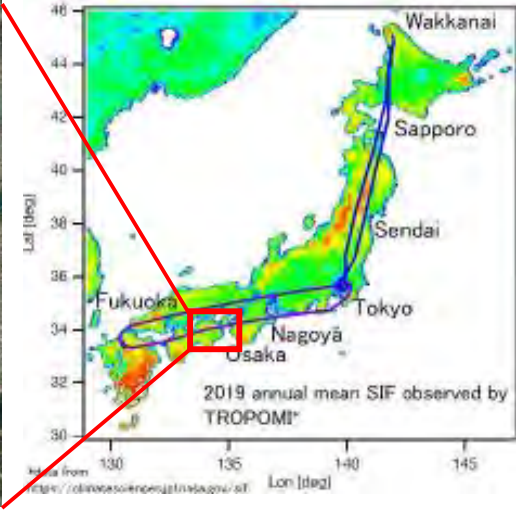
NO_2 2023-5-15
ESA-TROPIMI vs GOBLEU
(Tokyo Haneda – Nagasaki)
Kobe – Osaka
dotted line : Heavy traffic roads

Solar-Induced chlorophyll Fluorescence (SIF)



SIF 2023-5-16
GOBLEU
(Nagasaki – Tokyo)
Yoshino River
Tokushima

CO_2 uptake proxy



Items	GOBLEU
Total Mass	30kg
Altitude	10km ±2km
Measurement Targets	NO_2, CO_2, CH_4, SIF
Observation width	50～100km
Footprint size	100m～

- Airborne remote-sensing observation is one of the powerful tool to understand the emission changes on regional scale.
- JAXA collaborate with commercial sector (airline company: ANAHD) , and conducting the observations over Japan's megacities.

Outlook

- GOSAT-2 is observing GHG over Washington D.C and Baltimore region since 2021.

- We can coordinate the target observation for 2025 campaign.

- In addition, JAXA has an airborne remote-sensing observation instruments. It also have a potential to contribute the local and fine spatial scale observation by mounting our instruments on the campaign aircraft.

Discussion on the target observations by GOSAT and GOSAT-2 are very welcome !.