The Greenhouse gas Observations of Biospheric and Local Emissions from the Upper sky (GOBLEU): New multi-species observations from passenger aircrafts in support of monitoring of Japan's anthropogenic carbon emissions

Hiroshi Suto[1],

A. Kuze[1], T. Oda[2,3,4], A. Matsumoto[5], S. Mori[6], Y. Nakamura[7], M. Shigetoh[1], C. Hoshino[1], K. Shiomi[1], Y. Miyashita[5], Y. Tsubakihara[5]

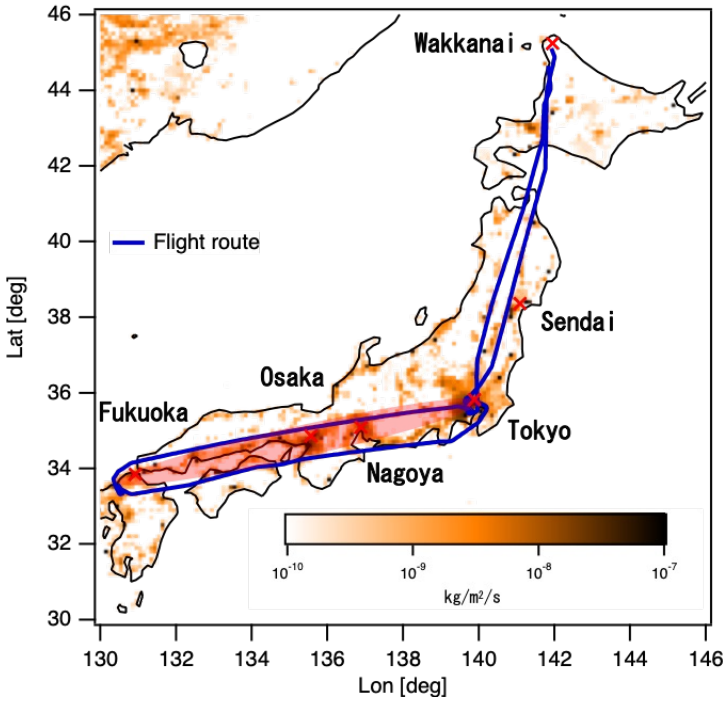
[1]JAXA, [2]USRA, [3]University of Maryland, [4]Osaka University, [5]ANAHD, [6]JASTECS, [7]NEC

E-mail: suto.Hiroshi@jaxa.jp

Suto et al., in prep.

GOBLEU:

Greenhouse gas Observations of Biospheric and Local Emissions from the Upper sky



- Cities are responsible for more than 70 % of the global total GHG emissions.
- 30 % of the Japan's total CO_2 emissions are emitted between Tokyo and Fukuoka area (shaded in red).
- To achieve the net zero goal, the sectoral emissions and their relative magnitude are expected to change drastically over the next decade.

Our objectives:

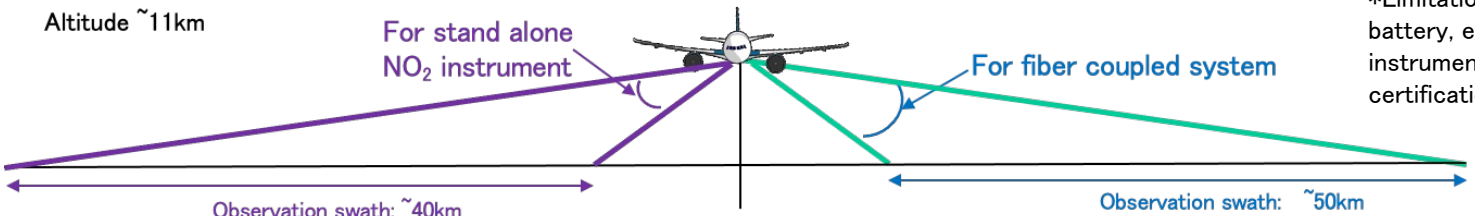
- Monitoring Japan's subnational ~ local climate mitigation progress (e.g. emission reduction and sink enlargement) using high-resolution GHG and AQ measurements.
- Providing an objective evaluation for reported inventory emission estimates.

Remote sensing from a commercial airliner

Our concepts:

- NO hardware modification to aircraft*
- Compact instruments on cabin seats
- Observing through cabin window
- 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.

Commercial airliners can make repeatable and frequent observations over mega-cites with lower cost than research flights!.



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

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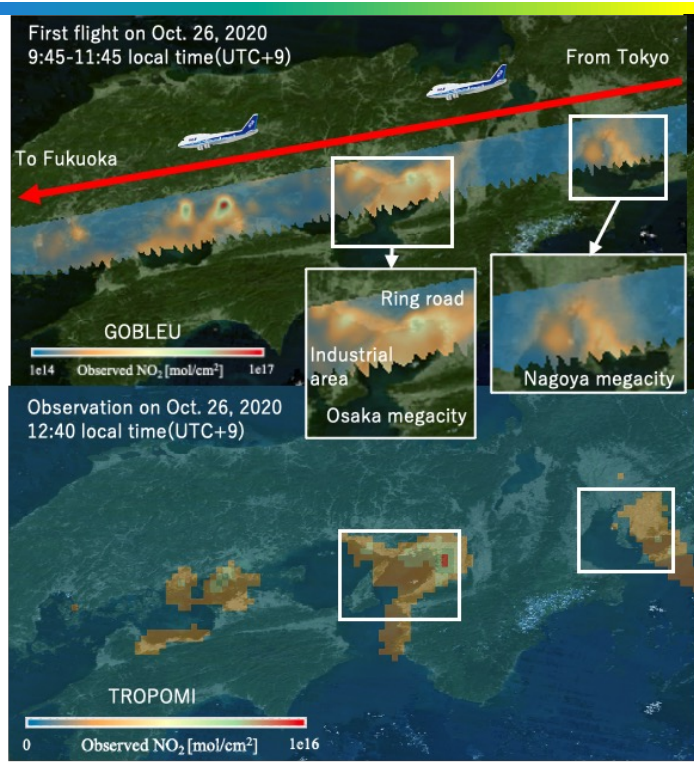
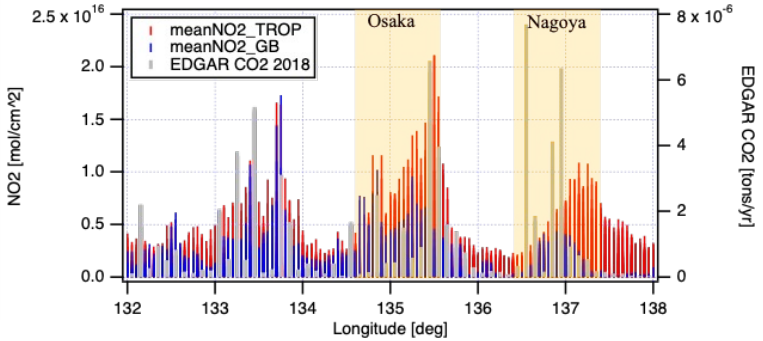
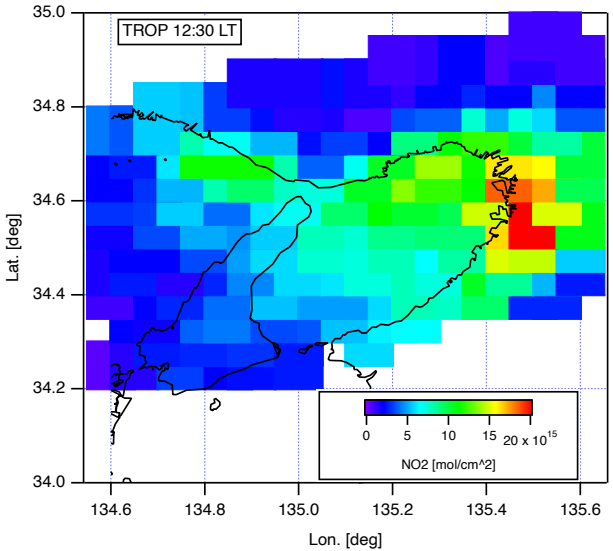
The first high resolution NO_2 observations from GOBLEU (GB)



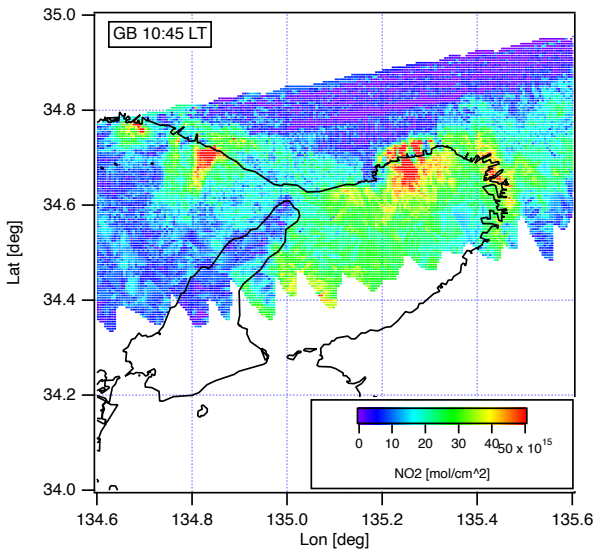


- High NO_2 were observed over emission hot spots (cities, point sources, and traffic)
- In megacity Nagoya, spatial pattern of NO_2 is different from GB and emission inventory.

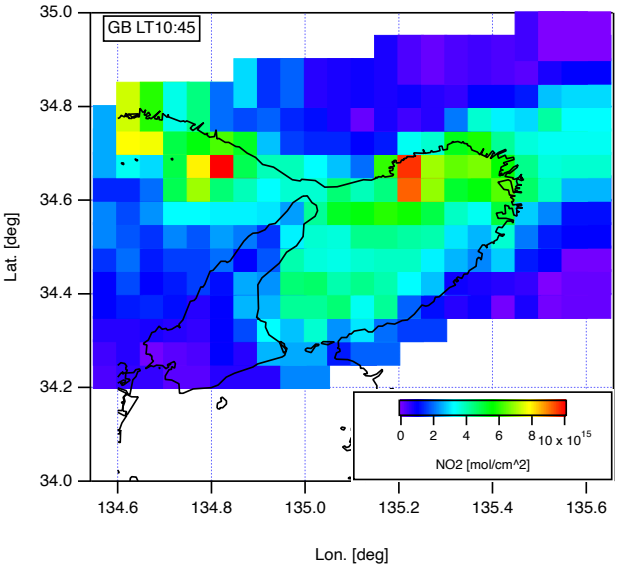
Observing NO_2 as a CO_2 emission marker



TROPOMI: NO_2 observation
0.05° x 0.05° grid
Local time 12:30 (UT+9)



GB: NO_2 observation
0.005° x 0.005° grid
Local time 10:45 (UT+9)



GB: NO_2 observation
0.05° x 0.05° grid
Local time 10:45 (UT+9)
(TROP. grid)

- GB provides fine spatial structures of NO_2 concentration.

Note: observation time of TROPOMI and GB are different.

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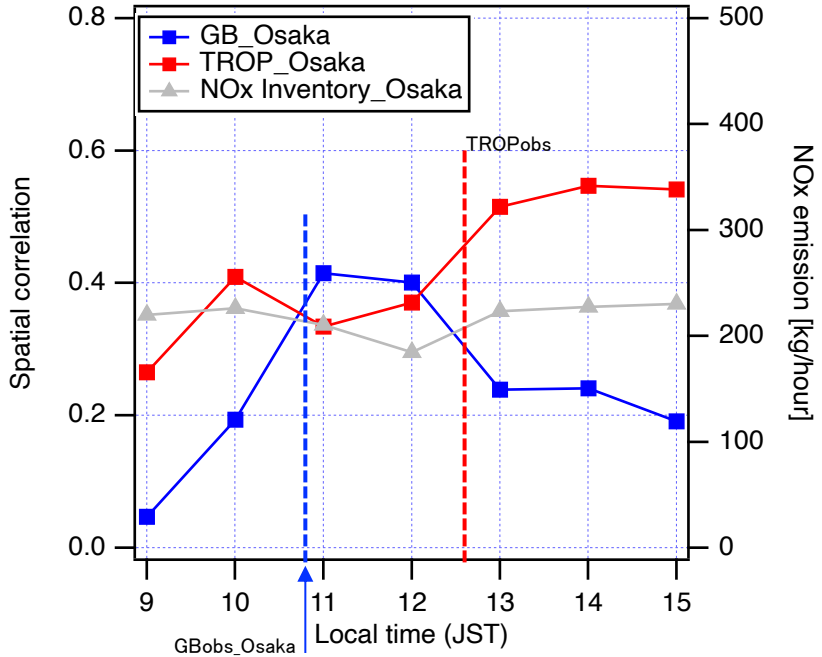
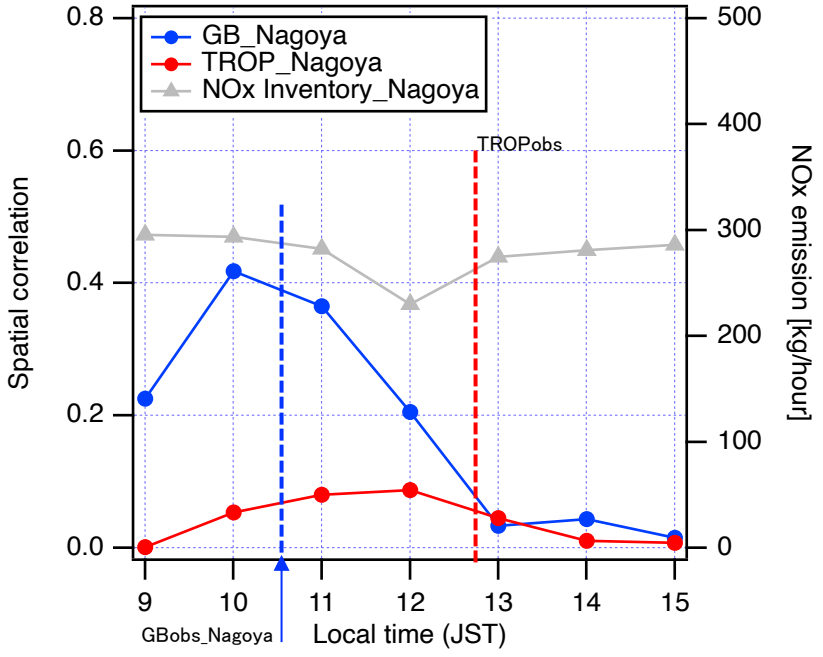
NO_2 Spatial correlation with ground-based observation





- NO2 spatial correlation between GB and ground-based observation are in good agreement.
- Especially in Nagoya, TROP show less agreement with ground-based NO_2 observation.
- The result highlight the significance of the co-located CO_2 and NO_2.

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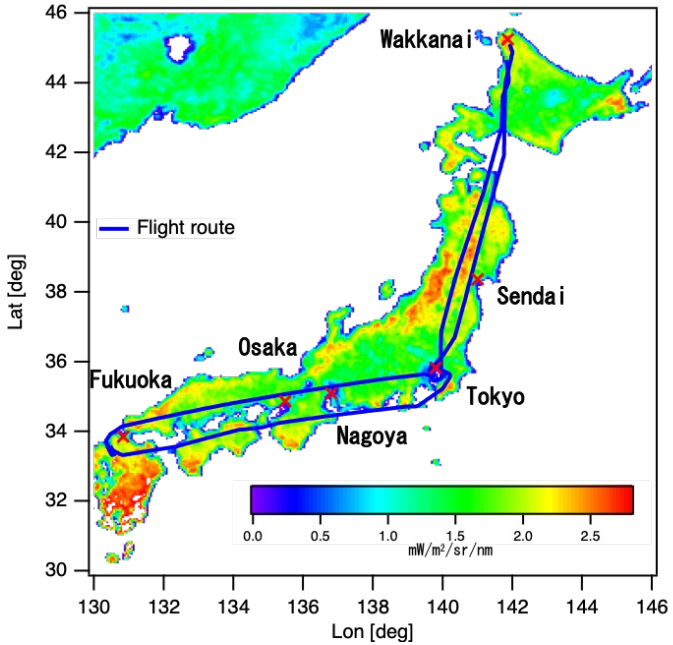
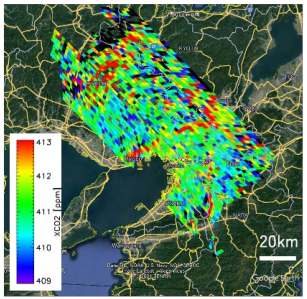
Outlook



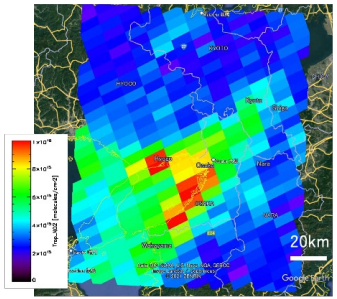
Flight route in 2022.

- Start frequent observations (more than once per month) with full imaging spectrometer suites.
- Start the observation of SIF over forested areas between Tokyo and Wakkanai/Hokkaido since this Summer.
- Process SIF and CO_2 data
- Look for OCO-3 SAM opportunity with GB

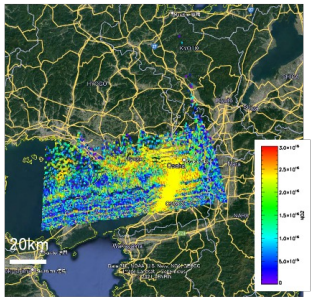
Oct. 27, 2020 over Osaka Japan
Demonstration of coincident observation between OCO-3 and GOBLEU



OCO-3 XCO2,
Local time 11:05 (UTC+9)



TROPOMI NO_2,
Local time 11:11 (UTC+9)
6 min after OCO3



GOBLEU SCD_NO_2,
Local time 13:15 (UTC+9)
2 hours after OCO3