Multi-species observations from Japanese passenger aircrafts towards the monitoring of the nations’ climate mitigation progress

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Slant column density (SCD) NO₂

EDGAR CO₂

Instrument modules
- NO₂
- CO₂
- SIF in July

Monitoring from cabin

Suto et al., in preparation
Cities are responsible for more than 70 % of the global total GHG emissions.

- 30 % of the Japan’s total CO\textsubscript{2} emissions are emitted between Tokyo and Fukuoka area (shaded in red).

- Towards 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 efforts (e.g. emission reduction and sink enlargement) using high-resolution GHG and AQ measurements.
- Providing an independent assessment to emission estimates reported by inventories.
Remote sensing from a commercial airliner

Our concepts:
- NO hardware modification for aircraft
- Hand-carried instruments on cabin seats
- Observing through cabin window
- Small power consumption with mobile battery operation
- 3 modules: 450nm, 740nm and 1.6um bands for NO₂, SIF and CO₂ with fiber coupling.

Swath width: ~50km with sub to few km spatial resolution

ANA a commercial airliner

A commercial airliner can make repeatable and frequent flights over mega-cities with low cost!

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

Suto et al, in preparation
The first high resolution NO$_2$ observations from GOBLUE (GB)

First flight on Oct. 26, 2020 9:45–11:45 local time (UTC+9)

- During 2 hours, 2 spectral images/sec were acquired with flight attitude information with sub km resolution.
- High NO$_2$ were observed over emission hot spots (cities, point sources, and traffic)
- Large NO$_2$ spatial patterns from GB and TROPOMI are in good agreement, while GB showed some local peaks.
2019 annual mean SIF observed by TROPOMI*

- Instrumental packages are upgraded.
- Ready for flight both NO$_2$, SIF and CO$_2$.
- Expect to start regular observations (more than once per month), after the current COVID-19 restrictions are lifted.
- Plan to observe SIF over forested areas with an additional flight route to Sapporo this summer.

*data from https://climatesciences.jpl.nasa.gov/sif/