Strength in numbers: The benefits of working with multiple platforms to monitor greenhouse gases and other air quality gases

07/11/2023 11:00am to 11:30am
Public GHG observation cases

JAXA’s GOSAT and GOBLEU cases

Osamu Ochiai
Contributing to the GHG observation history from space

GOSAT data presents 14 years of global CO$_2$ concentration and its global changes since 2009.
14 years of spatio-temporal CO₂ distribution from GOSAT

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Data is freely available from website: [https://data2.gosat.nies.go.jp/index_en.html](https://data2.gosat.nies.go.jp/index_en.html)
# Japan’s GHG observatories from space

<table>
<thead>
<tr>
<th>Project</th>
<th>GOSAT (Kuze et al, AO, 2009)</th>
<th>GOSAT-2 (Suto et al, AMT, 2021,2022)</th>
<th>GOSAT-GW (development)</th>
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<td>Image</td>
<td><img src="image1.png" alt="GOSAT" /></td>
<td><img src="image2.png" alt="GOSAT-2" /></td>
<td><img src="image3.png" alt="GOSAT-GW" /></td>
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| Launch   | 2009/1/23 (14 years on-orbit) | 2018/10/29 (4 years on-orbit) | JFY2024 |
| Local observation time | 13:00 | 13:00 | 13:30 |
| Revisit time | 3 days | 6 days | 3 days |

**Observation target**
- **CO₂, CH₄,** SIF(Solar-induced chlorophyll fluorescence)
- **CO₂, CH₄, CO** SIF(Solar-induced chlorophyll fluorescence)
- **CO₂, CH₄, NO₂** SIF(Solar-induced chlorophyll fluorescence)

**Observation image**
- Grid
- Target Glint
- Wide Focus
JAXA partial 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

JAXA/EORC new Method

Use only solar reflected light
& thermal
0.1 hPa
0.05 * Psurf  
0.1 * Psurf
0.2 * Psurf = ~12 km
0.6 * Psurf = ~4 km

CO$_2$ & CH$_4$ emission and enhanced density of the lower troposphere

%MOE/JAXA/NIES

©MOE/JAXA/NIES
# Overview of GHG Satellite Missions – GENERIC

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<th>Satellite</th>
<th>Agency/Origin</th>
<th>CO₂</th>
<th>CH₄</th>
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1. Carbon Mapper is a public/private partnership between California and Carbon Mapper LLC.

- [ ] Launched & nominal
- [ ] Extended or planned
- [ ] Phased deployment
GHG remote sensing from a passenger aircraft

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 weight, the capacity of battery, electronical magnetic conduction from instruments have to be passed the...
The first high resolution NO$_2$ observations from GOBLEU

- 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 GOBLEU(GB) and emission inventory.

*Suto et al., submitted.*
High-Resolution GHG Data

The GHGSat Constellation

Jean-Francois Gauthier
ROUTINE MONITORING OF METHANE EMISSIONS AT INDUSTRIAL SITES – FROM SPACE

GHGSat is the only entity in the world (private or public) with satellites designed to monitor emissions from individual industrial facilities anywhere in the world.
GHGSAT CONSTELLATION - CAPACITY

Every industrial emitter in the world, measured daily, in near real-time
GHGSAT CONSTELLATION – COVERAGE & REVISIT

3M+ facility measurements per year

Up to daily revisits in targeted areas

2023
GHGSAT’S MODEL: COLLABORATION

• GHGSat believes that collaboration is the ultimate force-multiplier when it comes to addressing the emissions challenge head on.

• Academic/Scientific Partnerships
  • Harvard
  • SRON
  • Stanford

• Institutional Partnerships
  • European Space Agency (ESA)
  • Canadian Space Agency (CSA)
  • NASA
  • UNEP IMEO

• Industrial Partnerships
  • Glint mode development/demonstration

• Others
  • S&P Global
  • IEA Methane Tracker Report
COLLABORATIONS
Validation / Combining Public and Private Data

GHGSat Satellite
2023-02-01 / 07h18m

Sentinel-2 / DEMETER
2023-02-01 / 07h21m

PRISMA
27/02/23
07:28 UTC

GHGSat
27/02/23
10:10 UTC
Aircraft monitoring with DATA.AIR

GHGSat airborne sensors are deployed in every major basin in North America, as well as internationally.

- Minimum detection threshold of ~10 kg/hr
- Flight altitude: 10,000 ft above ground level (AGL)
- Spatial resolution (GSD) <1 m (<3 ft), altitude dependent

AV CH₄ measurement

Oil & Gas
Permian Basin, USA
2021-02-03
New free subscription on emissions intelligence platform

Everyone can explore higher temporal resolution of methane concentrations globally with a high-resolution observation gallery of featured emissions around the world.

You can activate your SPECTRA account today for free here: