Greenhouse gases observation from the space: Japan’s contribution to implementing the Paris Agreement

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Greenhouse Gases Observing Satellite series

Achievement of GOSAT (2009-)

- Contributing to the scientific understanding of climate change by revealing the global increases of GHG concentrations
- Showing the possibility of utilizing satellite data for estimating the emissions from the large-scale sources

Target of GOSAT series

- Continuously observing the global atmospheric GHGs
- Monitoring emissions from the large-scale point sources
- Used for comparison/check of national GHG inventories using the data obtained from satellites

Image courtesy of JAXA and NIES
Global CO₂ Concentrations Estimated Using the GOSAT Data

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The concentration levels range from low (370 ppm) to high (420 ppm).
The 49th Plenary of the IPCC held on 8th-12th May 2019 in Kyoto, Japan


*prepared by the Inventory Task Force (TFI) of IPCC: Japan has been hosting its technical support unit (TSU) since its establishment in 1999.

The 2019 Refinement:

- overall aims to provide an updated and sound scientific basis for supporting the preparation and continuous improvement of national GHG inventories.

- has the first ever reference on the satellite observations of atmospheric GHGs for useful quality assurance of the national GHGs estimates.

- introduces several case studies using the products by GOSAT

- shows expectations to the newly launched GOSAT-2 and other satellites.

representing high expectations towards GOSAT and GOSAT2 for further improvement of national GHGs estimates.
Global Stocktake and GOSAT series contribution

- **Refinement of IPCC GHG inventory guidelines**
- **Paris Agreement**
- **UNFCCC IPCC**
- **Guidebook**
  - Published guidebook on how to utilize satellite GHG concentration data to compare to anthropogenic GHG emission inventories
  - For Users

- **GOSAT**
- **GOSAT-2**
- **GOSAT-GW**
- **MoU with NASA, ESA etc**
- **MoU with Mongolia**
- **Other satellites**
- **Collaborate with other countries**

Timeline:
- 2014-2029 (FY)
- 1st Global Stocktake
- 2nd Global Stocktake
- AR6
- Revise based on results from GOSAT-2 and -3
- Capacity building with the Guidebook
Capacity Building for science-based decision-making

Project on Assessment of Global Climate Change Impacts on Asia-Pacific Environment using Satellite Earth Observations

➢ Generated terrestrial and oceanic low-trophic level organism databases (such as phytoplankton, vegetation, etc.) which can be accessed from the LowTroMAP database website:
  •  https://ebcrpa.jamstec.go.jp/rcgc/e/APN/index.htm

Project on Mapping and Modelling Vulnerability to Dengue in Vietnam and the Philippines using Geospatial and Time-series Approaches

➢ Developed a geospatial database of climate change related to malaria and dengue diseases
➢ Developed a GIS-based website presenting project results: http://apn-climateandhealth.com

Source: Asia Pacific Network for Global Change Research (APN)
Toward sustainable earth observations

1) Top-down Analysis with Inverse Models to Estimate GHG Sources and Sinks
   Anthropogenic and natural GHG sources & sinks
   (Niwa et al., 2017)

2) Flux Upscaling with Oceanic and Terrestrial GHG Flux Monitoring Data
   Natural GHG sources & sinks
   (Ichi et al., 2017)

Evaluation of discrepancies in spatial distribution for accuracy improvement

3) Improvement of the Reliability of GHG Inventory Data
   Estimating emissions based on Earth observations for GHGs has a potential for providing additional sources of information that can complement national inventories.

Anthropogenic sources

Spatial downscaling

Estimating national GHG emissions
以下補足素材
We aim to contribute to enhance transparency of each country's countermeasures against climate change based on the Paris Agreement from detecting the human-induced GHG emissions with the GOSAT-2.
Observing CO\textsubscript{2} emissions from space

High Quality CO\textsubscript{2} emissions estimated from statistics (emission inventory data)

Develop methodology to use satellite data for GHG emission estimations

Comparing

Verifying emission inventory data

Observing CO\textsubscript{2} emissions from space

Relatively low quality inventory data

In Japan:
- Having high-quality inventory data
  - Preparing a guidebook
  - Capacity building

In developing countries having relatively low-quality inventory data

Realizing GHG emission report with high transparency
Guidebook on Use of GHG Observations by Satellites

- Developed by MOEJ and NIES
- The 1\textsuperscript{st} edition, published in March 2018, will be updated soon.
- Includes GHG data analysis methodology and a number of case studies based on published research papers.

[Image of the guidebook cover]

Providing Additional Information to Complement National Inventories

1) Top-down Analysis with Inverse Models to Estimate GHG Sources and Sinks

High-quality atmospheric GHG concentration data observed using various platforms

Inverse analysis to estimate GHG sources and sinks performed to make the difference between observed and modeled atmospheric GHG concentrations minimal

2) Flux Upscaling with Oceanic and Terrestrial GHG Flux Monitoring Data

Terrestrial and oceanic GHG flux (pCO₂) observed at multiple locations

Verification and optimization of process-based models and machine learning systems using observed data
1) Top-down Analysis with Inverse Models to Estimate GHG Sources and Sinks

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(Niwa et al., 2017)

2) Flux Upscaling with Oceanic and Terrestrial GHG Flux Monitoring Data

Natural GHG sources & sinks

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