

Greenhouse Gas Analyzing Platform using Ground Sites, Aircraft, Ships, and Satellite-based Data: Japan's Contribution to the Paris Agreement

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Asia, as one of the world's largest greenhouse gas (GHG) emitters, has a responsibility to play an important role to turn the goals of Paris Agreement into reality. Urgent needs in Earth observations for GHGs are to reduce uncertainties in their source and sink estimations and to identify current knowledge gaps and requirement for further international collaboration. Estimating anthropogenic and natural emissions based on observations for GHGs has a great potential for providing additional sources of information that can support estimating the impacts of mitigation actions. Discussions will be focused on current status and challenges from Japan's relevant GHG observation and analysis to improve up-to-date analysis systems and data coverage particularly in Asia-Oceania for better estimation of the distribution of anthropogenic and natural sinks and sources with sufficient accuracy.

Concepts

To provide data and knowledge to stakeholders in time with the Global Stocktake Process under the Paris Agreement

To provide additional sources of information that can support estimating the **impacts of mitigation actions**

Relevant Japanese institutions and agencies for GHG observation and analysis will cooperate to **improve up-to-date analysis systems and data coverage particularly in Asia-Oceania** for better estimation of **the distribution of anthropogenic and natural sinks and sources** with sufficient accuracy

Ground-based Monitoring

Atmospheric concentrations of GHGs at near-ground levels



Observation components: (e.g. Hateruma station): CO₂, CH₄, N₂O, CO, H₂, O₂/N₂, NO_x, SO_x, O₃, CFCs, Rn, aerosol, ¹⁴C, halocarbon, SF₆, POPs

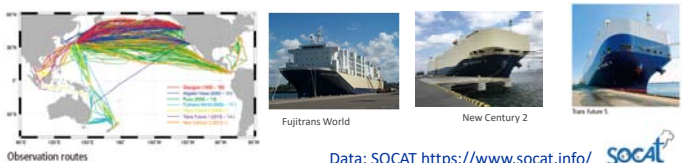
Rikubetsu TCCON site at Rikubetsu Integrated Stratospheric Observation Center, NIES, Rikubetsu, Asyoro, Hokkaido

Atmospheric CO₂, CO, and CH₄ concentrations observed by TCCON

Data: WDCGG/GAW <https://gaw.kishou.go.jp/>
NIES Global Environmental Database <http://db.cger.nies.go.jp/portal/>

Ship-based Monitoring

GHG and ocean surface CO₂ monitoring in the western North Pacific by Volunteer Observing Ships



Data: SOCAT <https://www.socat.info/>



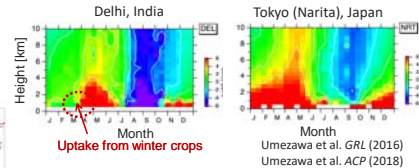
Airborne-based Monitoring

CONTRAIL (Comprehensive Observation Network for TRace gases by AirLiner)



Powerful high-precision data for verifying models and satellite observations

Vertical distribution of CO₂ concentration and its seasonal change

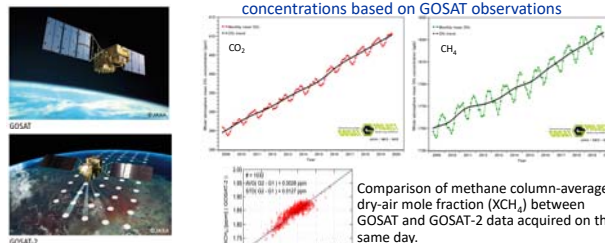


← Flight paths and the number of vertical profile observations of CME

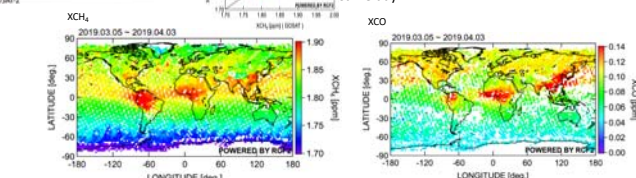
Data: Atmospheric CO₂ mole fraction data of CONTRAIL-CME: <http://www.nies.go.jp/doi/10.17955/20180208.001-e.html>

Satellite-based Monitoring

Whole-atmosphere monthly mean CO₂ and CH₄ concentrations based on GOSAT observations



Comparison of methane column-averaged dry-air mole fraction (XCH₄) between GOSAT and GOSAT-2 data acquired on the same day.

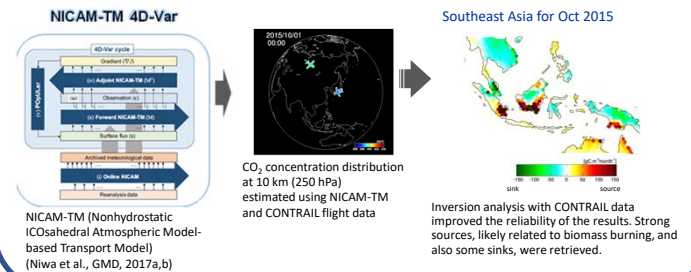


Global distribution of methane column-averaged dry-air mole fraction (XCH₄) retrieved by the proxy-method from FTS-2 data acquired from March 5 to April 3, 2019.

Global distribution of carbon monoxide column-averaged dry-air mole fraction (XCO) retrieved by the proxy method from the FTS-2 data acquired from March 5 to April 3, 2019.

Data: GOSAT Data Archive Service (GDAS) https://data2.gosat.nies.go.jp/index_en.html
GOSAT-2 Product Archive <https://prdct.gosat-2.nies.go.jp/en/index.html>

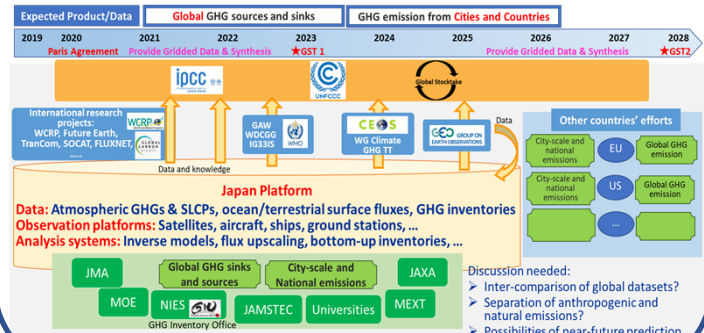
Data Integration and Inverse Model Estimation of GHG Sources and Sinks



NICAM-TM (Nonhydrostatic Icosahedral Atmospheric Model-based Transport Model) (Niwa et al., GMD, 2017a,b)

Inversion analysis with CONTRAIL data improved the reliability of the results. Strong sources, likely related to biomass burning, and also some sinks, were retrieved.

Collaboration Among Japanese Agencies and Institutions to Contribute to the Global Stocktake (tentative)



Summary

- Japanese institutions and agencies for GHG observation and analysis cooperate to **improve up-to-date analysis systems and data coverage globally and in Asia-Oceania** for better estimation of the distribution of **anthropogenic and natural sinks and sources** with sufficient accuracy
- **Urgent international cooperation is needed to improve reliability in the global datasets**
- Technological development is still required for
 - separation of anthropogenic and natural emission
 - near-future prediction of impacts of mitigation actions