

パリ協定への貢献に向けた日本における 温室効果ガス観測及びデータ利活用の現状と課題

国立環境研究所 地球環境研究センター

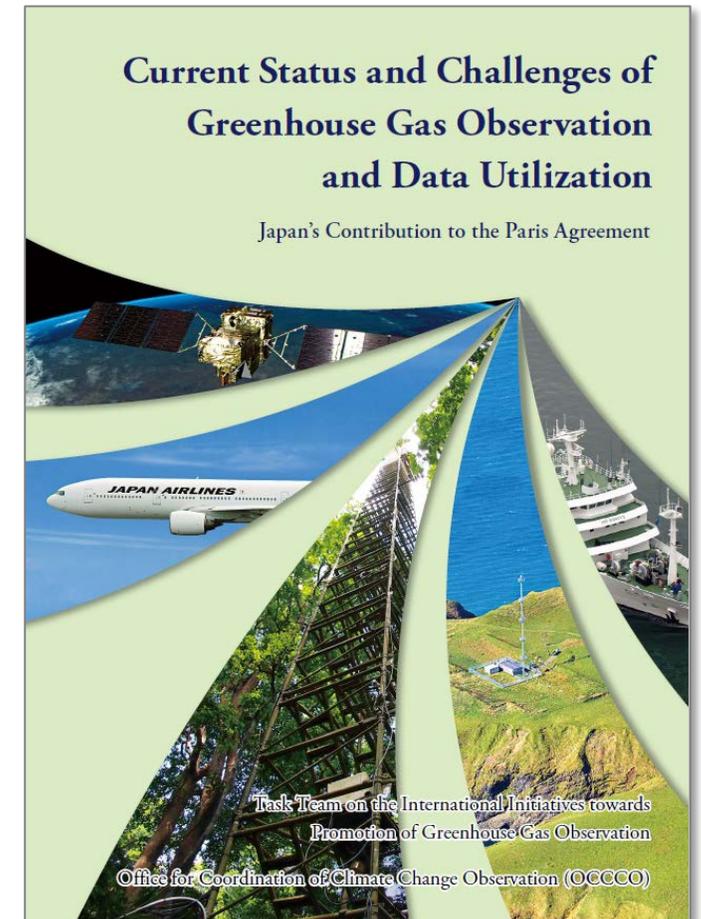
三枝 信子



Office for
Coordination of
Climate
Change
Observation

地球観測連携拠点(温暖化分野)報告

http://occco.nies.go.jp/pdf/inter_initiatives_pamphlet_e2018.pdf



パリ協定の進捗確認: 地球観測で何を監視すべきか

パリ協定の長期目標

- 途上国を含む全ての国が参加し、産業革命前からの気温上昇を2°C未満に抑えること。
- 今世紀後半に**温室効果ガスの実質的な排出をゼロに**。

何が必要か

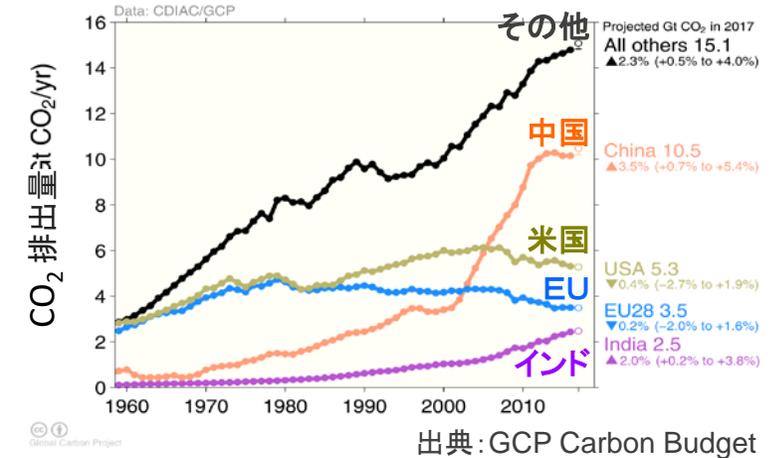
- パリ協定の長期目標に向けた**達成度を確認**すること。
(5年ごとのグローバル・ストックテイクに合わせて、気候変動対策の効果を**確認し、NDC*策定を支援**。)*自国が決定する貢献
- **人為起源排出量の精度向上(特に新興国・途上国等)**。

地球観測(温室効果ガス分野)の強み

- 地球規模で大気中温室効果ガス濃度の監視が可能。
(地球規模で安定化に向かっているか)
- 地球規模で**人為起源・自然起源の排出量・吸収量**の監視が可能: 地球のネットゼロエミッション化を確認。
- **国別インベントリで把握しにくい項目に対応可能**。

地球規模での排出量速報、巨大都市からの排出、農耕地からの間欠的な排出、大規模森林火災による突発的排出、人為吸収源(大規模植林等)の長期的監視、ほか

四大排出国(地域) とその他の国(地域) による温室効果ガス年排出量(CO₂換算)



温室効果ガス分野の地球観測プラットフォームの例



地上ステーション

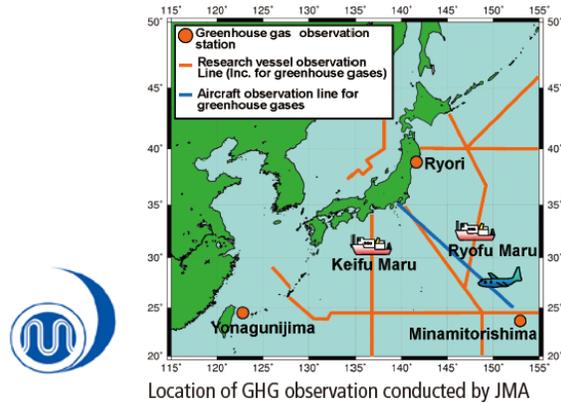
航空機観測

Ground-based Monitoring

地上ステーションによる大気中温室効果ガス濃度観測

Column-averaged concentrations of GHGs

Total Carbon Column Observing Network (TCCON) <http://www.tcon.caltech.edu/>



Japan Meteorological Agency (JMA)



Ryori

Yonagunijima

Minamitorishima

National Institute for Environmental Studies (NIES)



Monitoring station, Cape Ochiishi

Monitoring station, Hateruma

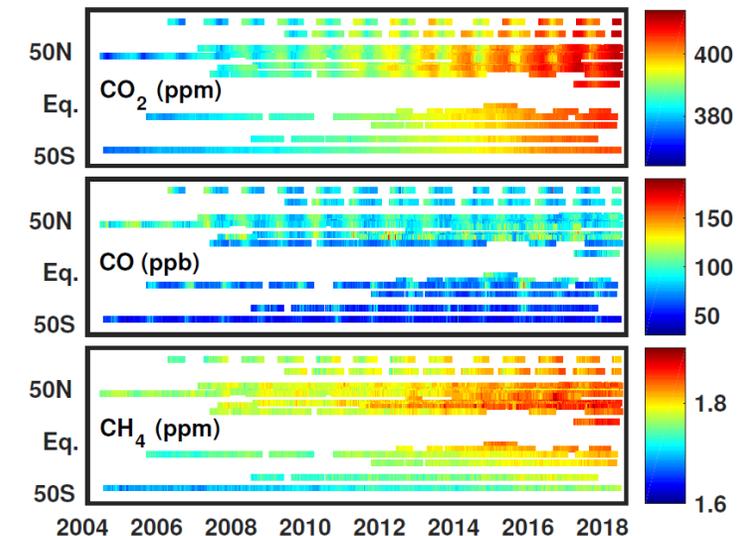
Mt. Fuji automated weather station

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

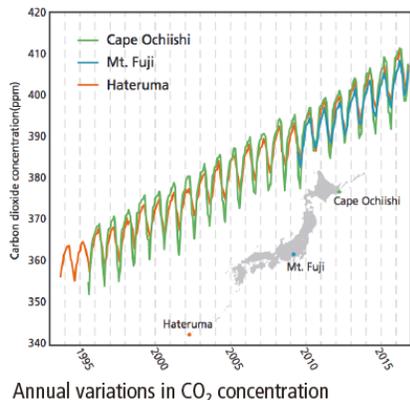
NIES



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



Atmospheric CO₂, CO, and CH₄ concentrations observed by TCCON



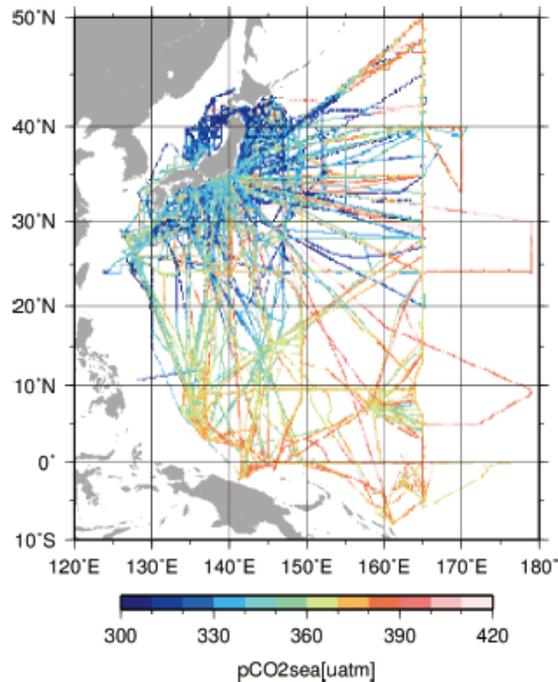
Data: WDCGG/GAW <https://gaw.kishou.go.jp/>
 NIES Global Environmental Database
<http://db.cger.nies.go.jp/portal/>



Ship-based Monitoring

船舶による海洋表層温室効果ガス分圧観測

Monitoring in the western North Pacific
by Research Vessels (JMA)



R/V Ryofu Maru



R/V Keifu Maru

Observations of atmospheric and surface
seawater $p\text{CO}_2$ by two research vessels
from 1980s to the present



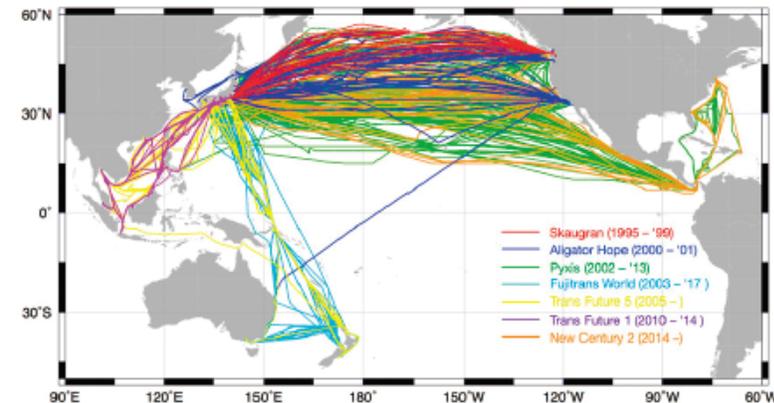
Data: JMA Observation Data/Oceanic Carbon Cycle Products

https://www.data.jma.go.jp/gmd/kaiyou/db/vessel_obs/data-report/html/ship/ship_e.php

https://www.data.jma.go.jp/gmd/kaiyou/english/oceanic_carbon_cycle_index.html

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

Monitoring in the western North Pacific
by Volunteer Observing Ships (NIES)



Observation routes



Trans Future 5



Fujitrans World



New Century 2



Airborne-based Monitoring

航空機による大気中温室効果ガス

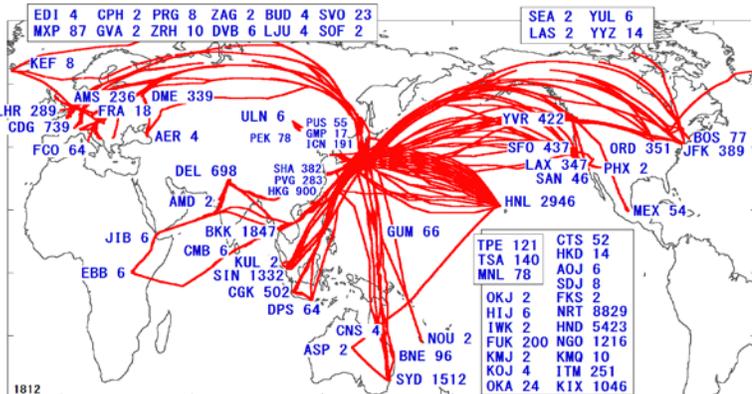
CONTRAIL (Comprehensive Observation Network for TRace gases by AirLiner)



Forward Cargo Room
Continuous CO₂ Measuring Equipment

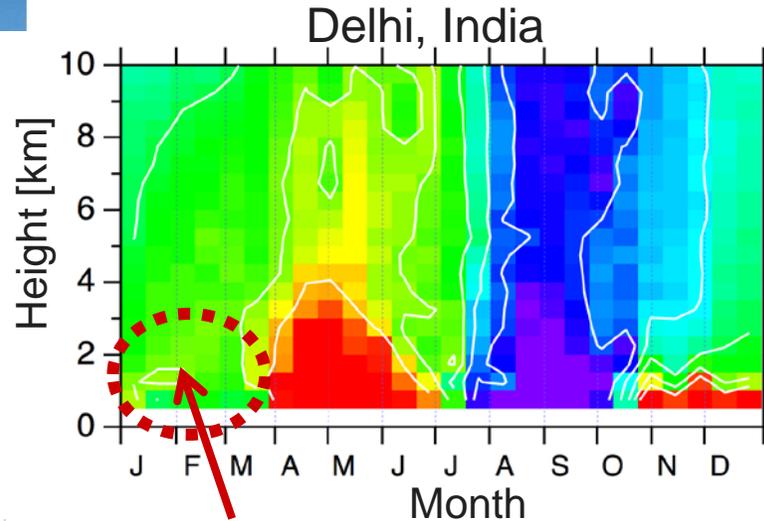
Aft Cargo Room
Automatic Air Sampling Equipment

Boeing 777 aircraft and two research equipment

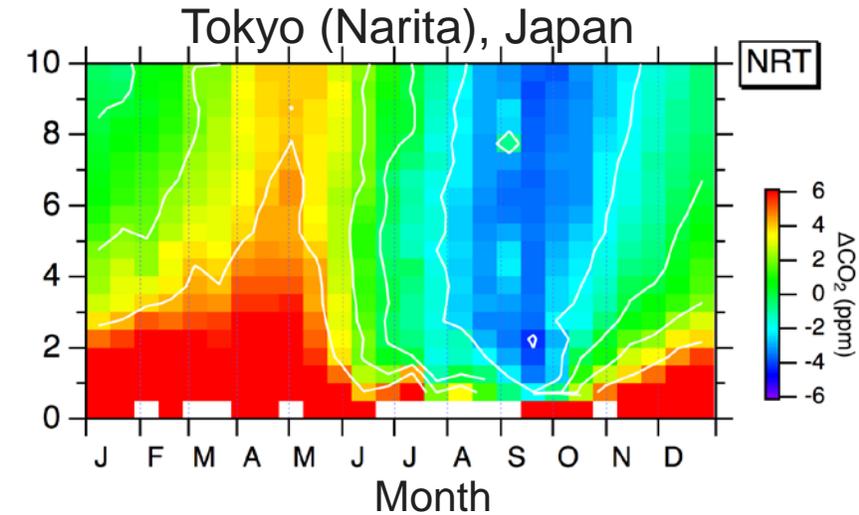


Powerful high-precision data for verifying models and satellite observations

Vertical distribution of CO₂ concentration and its seasonal change



Uptake from winter crops



← 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/10.17595/20180208.001-e.html>

Umezawa et al. *GRL* (2016)
Umezawa et al. *ACP* (2018)

Satellite-based Monitoring

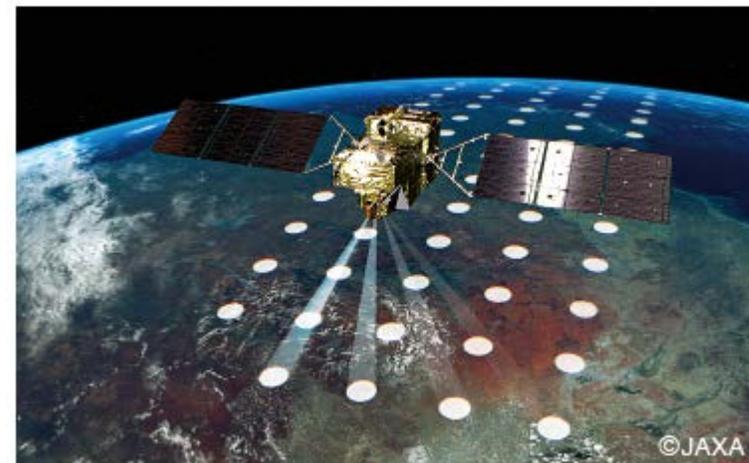
Data: GOSAT Data Archive Service (GDAS)
https://data2.gosat.nies.go.jp/index_en.html
 GOSAT-2 Product Archive
<https://prdct.gosat-2.nies.go.jp/en/index.html>

GOSATにより観測された地球全大気平均の温室効果ガス濃度



©JAXA

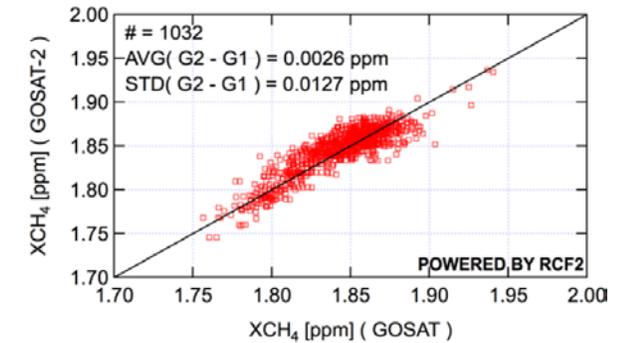
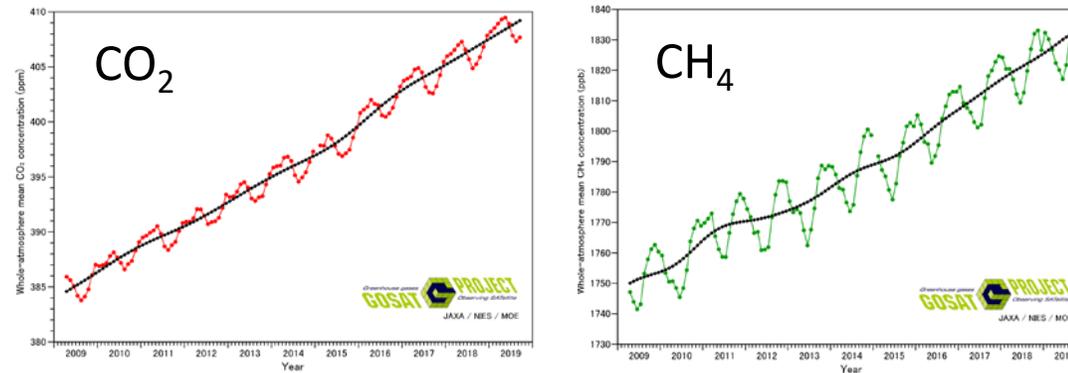
GOSAT



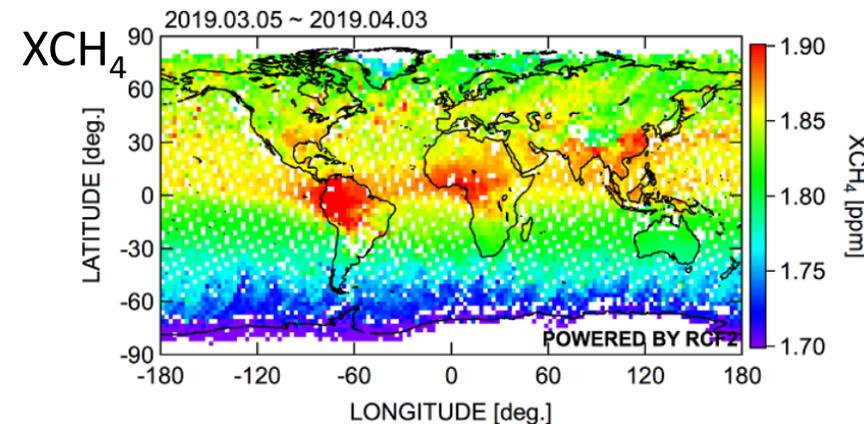
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GOSAT-2

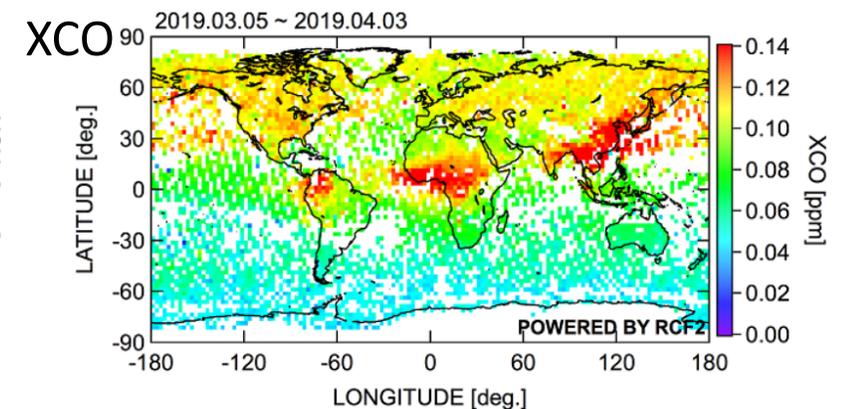
Whole-atmosphere monthly mean CO₂ and CH₄ concentrations based on GOSAT observations



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.

Upscaling Terrestrial Carbon and GHG Fluxes

陸域生態系における温室効果ガスフラックス観測ネットワークとその広域評価



Fuji-Hokuroku, Japan (NIES)



Teshio, Japan (Hokkaido Univ., NIES)



Takayama, Japan (AIST)



Sakaerat, Thailand (AIST)



Automated chambers for soil efflux monitoring at Pasoh, Malaysia (NIES)

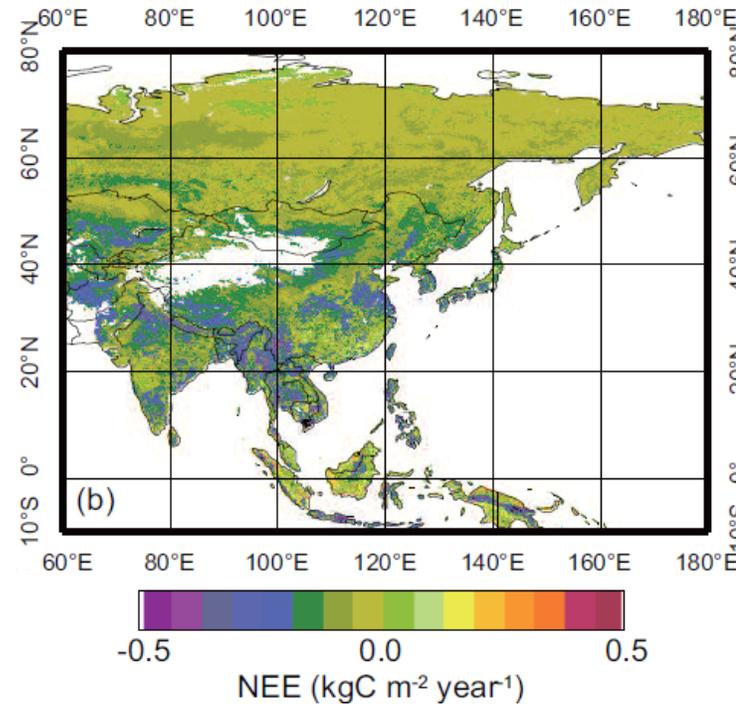


Mae Klong, Thailand (AIST)

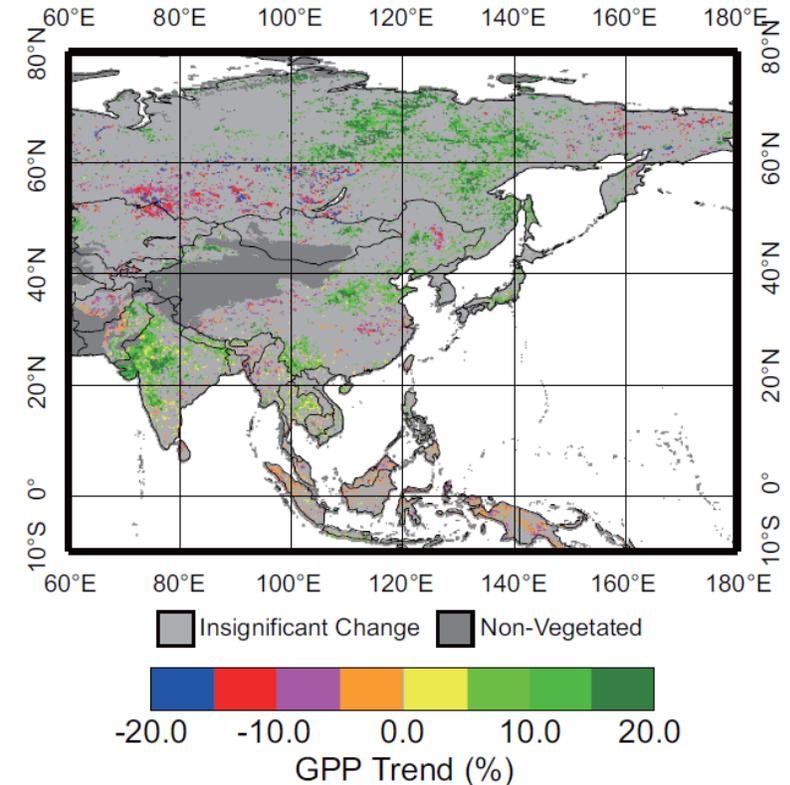


Poker Flat Research Range Flux Observation Supersite in Alaska, USA (JAMSTEC, IARC)

Net Ecosystem Exchange



GPP trend



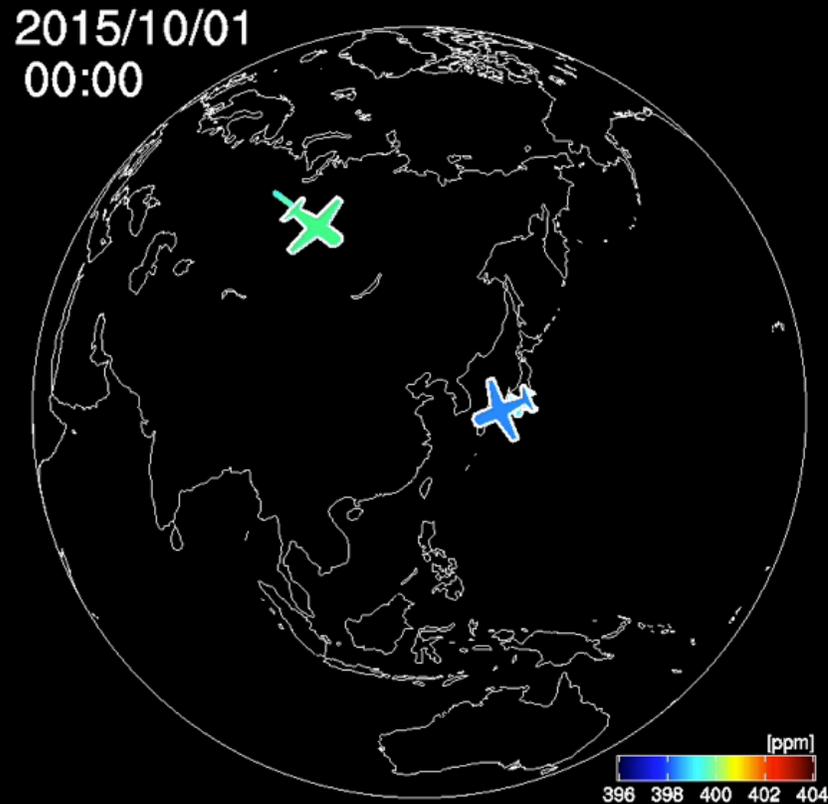
(Ichii *et al.* JGR, 2017)



Data and Site Information:
 AsiaFlux <http://asiaflux.net>
 FLUXNET (Fluxdata) <http://fluxnet.fluxdata.org/>

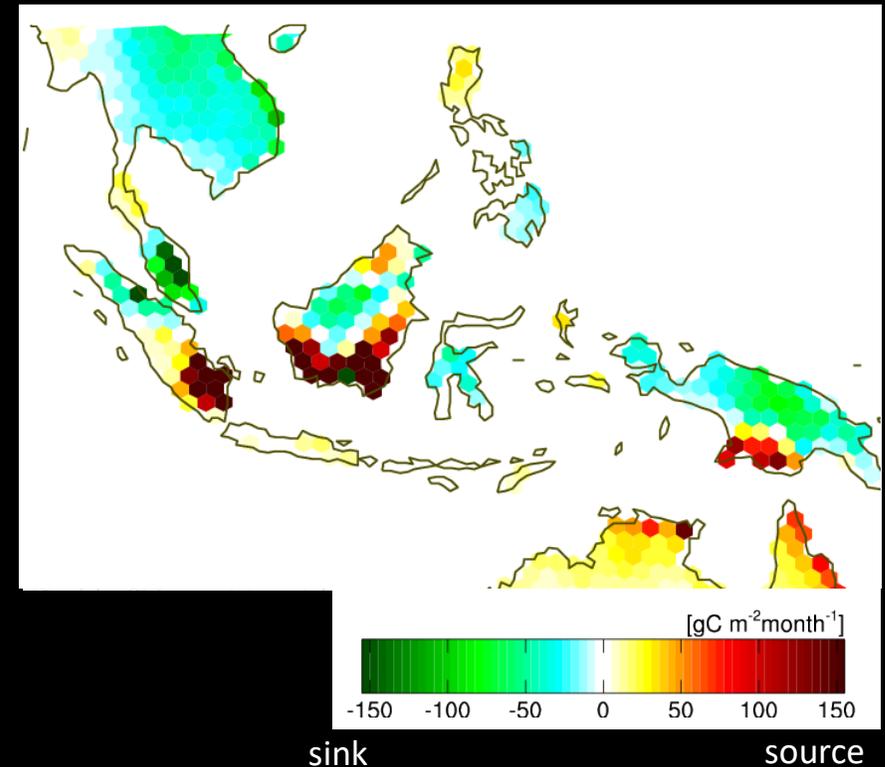
Data Integration and Inverse Model Estimation of GHG Sources and Sinks

CO₂ concentration distribution at 10 km (250 hPa)
estimated using NICAM-TM and CONTRAIL flight data



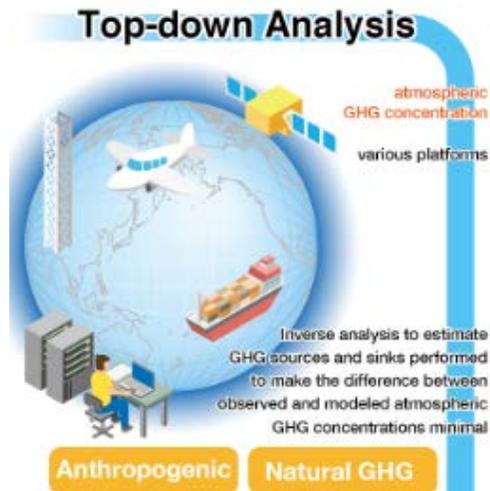
Southeast Asia for Oct 2015

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



温室効果ガス(GHG)インベントリの高精度化に向けて（今後の課題）

① 大気観測からGHG収支を逆推定



② 海・陸上の現場観測からGHG収支を広域推定



人為起源吸排出

③ GHG Inventory

GHGインベントリデータから排出量の空間分布を推定



① トップダウン

② フラックススケールアップ

③ GHGインベントリ

三者の不整合を検出、問題を解消することで精度向上



GHG国別インベントリと独立のデータを作成・提供

⇒パリ協定のグローバルストックテイク

（第1回2023年、第2回2028年）へ貢献



過去～現在の人為・自然GHG収支を高い時・空間分解能で推定

⇒地球システムモデルに与える社会経済シナリオの確認

⇒近未来の温暖化対策の効果を予測、信頼性向上

パリ協定への貢献に向けた日本における 温室効果ガス観測及びデータ利活用の取組 (案)

Expected Product/Data

Global GHG sources and sinks

GHG emission from Cities and Countries

