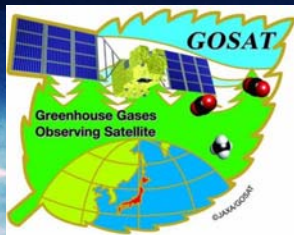
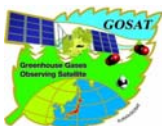


Space Apps COVID-19 Challenge GOSAT/GOSAT-2 Greenhouse gas (GHG) measurements

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GHG observation by GOSAT and GOSAT-2

GOSATとGOSAT-2によるGHG観測



GOSAT measures CO₂ and CH₄ from space since 2009 over 11 years.
GOSAT-2 has started since October 2018 adding CO.

GOSATは2009年から11年間、宇宙から二酸化炭素とメタンを観測している。
GOSAT-2は2018年10月から一酸化炭素も含めて観測している。

Retrieval parameters (導出物理量):

XCO₂: column-averaged dry-air mole fraction of carbon dioxide [ppm]
(乾燥空気中における気柱CO₂濃度)

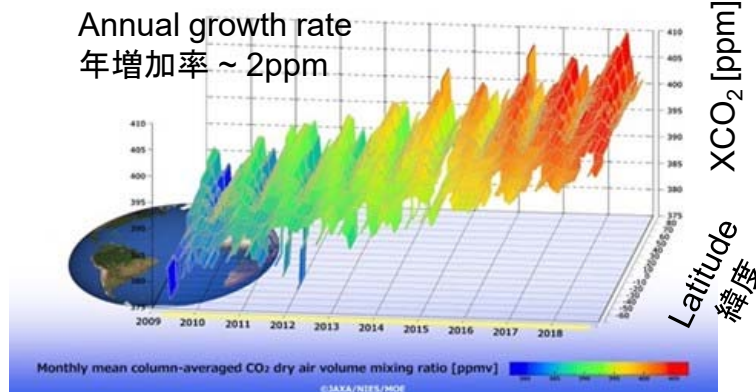
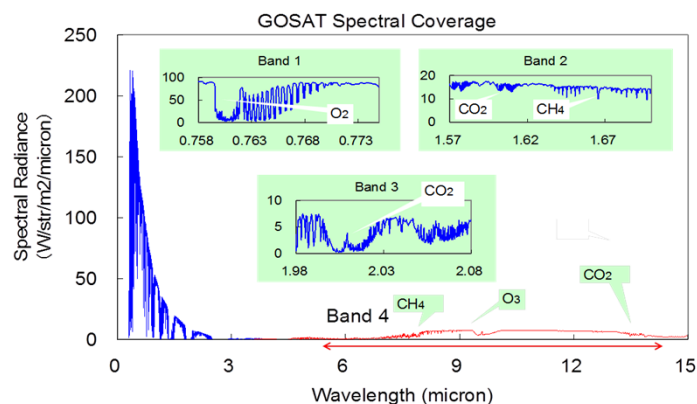
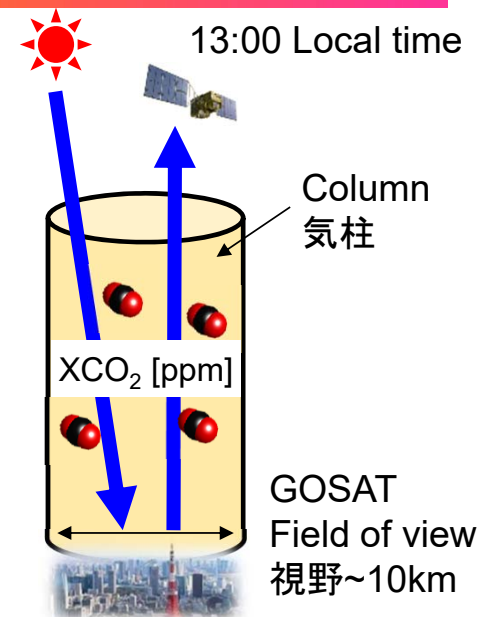
XCH₄: that of methane (気柱メタン濃度)

XCO: that of carbon monoxide (気柱一酸化炭素濃度)

AOT: aerosol optical thickness (エアロゾル光学的厚さ)

Psurf: surface pressure (地表面気圧)

SIF: solar-induced fluorescence by plant photosynthesis (光合成による植物蛍光)

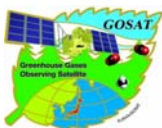


$$\text{Airmass} = \text{O}_2 \text{ amount} / 0.2095$$

$$\text{XCO}_2 = \text{CO}_2 \text{ amount} / \text{Airmass}$$

Oxygen is ~20% of the airmass.
酸素は大気量の約20%である。

ppm = parts per million (百万分の1)



Partial Column Product of GOSAT and GOSAT-2

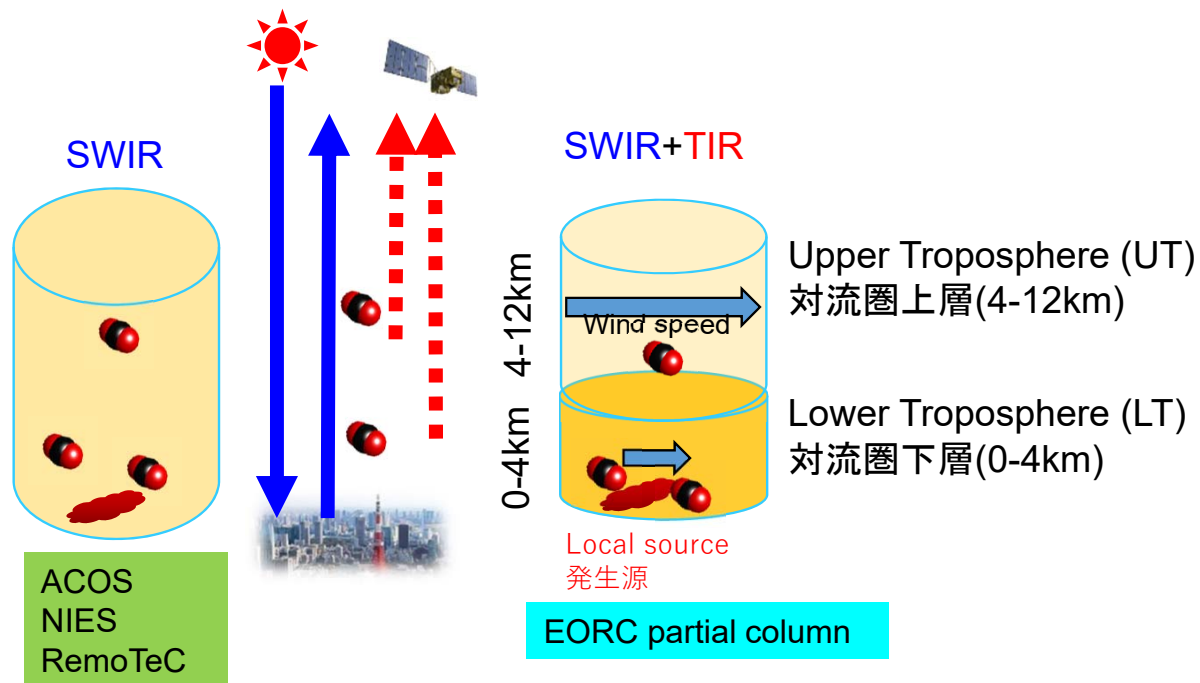
GOSATとGOSAT-2による対流圏2層プロダクト



GOSAT measures both
 solar reflected light from the Earth's surface (SWIR)
 and
 thermal emission from the Earth's atmosphere (TIR)
 providing CO₂ partial-column densities of UT and LT.

GOSATは
 地表面の太陽反射光 (SWIR)
 地球大気の熱放射 (TIR)
 を光源として、大気中のCO₂濃度を対流圏2層で測れる。

Lower Troposphere has much local source information.
 対流圏下層はより発生源の情報を含む。



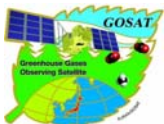
ACOS
 NIES
 RemoTeC

EORC partial column

EORC partial column schedule

- (1) GOSAT trend viewer (mega cities, large emission sources, CAL/VAL points) using V220
 Jan 2016-April 2020 (becomes available by the end of May)
- (2) GOSAT-2 Global and all the period
 Feb 2019-March 2020 (becomes available by the end of May)
- (3) GOSAT Global 2009-2020
 EORC Partial Column Product using V226 for V230 (to be released in summer)



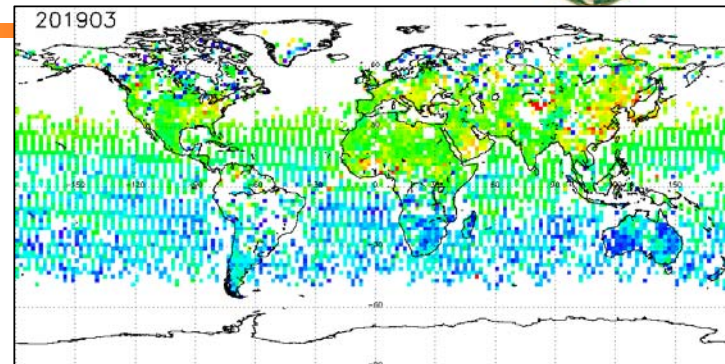
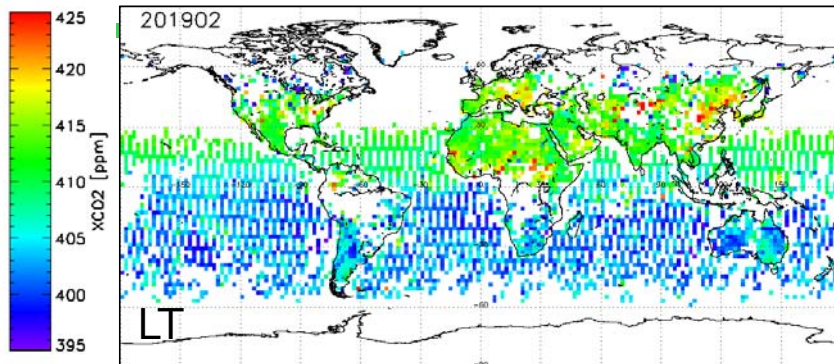


CO₂ Partial column of lower (0-4 km), upper (4-12 km) troposphere and the difference
 CO₂濃度解析例：対流圏下層(0-4 km)、対流圏上層(4-12 km)、下層上層差分



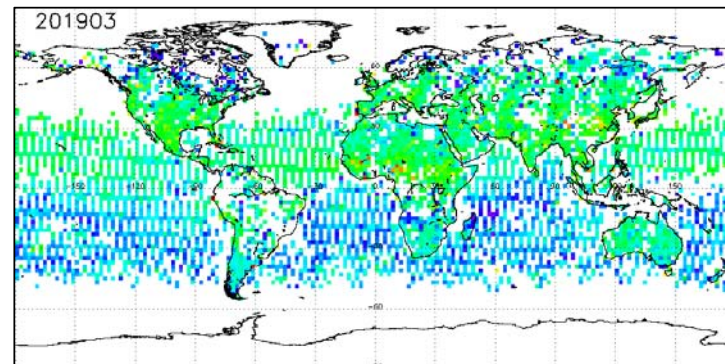
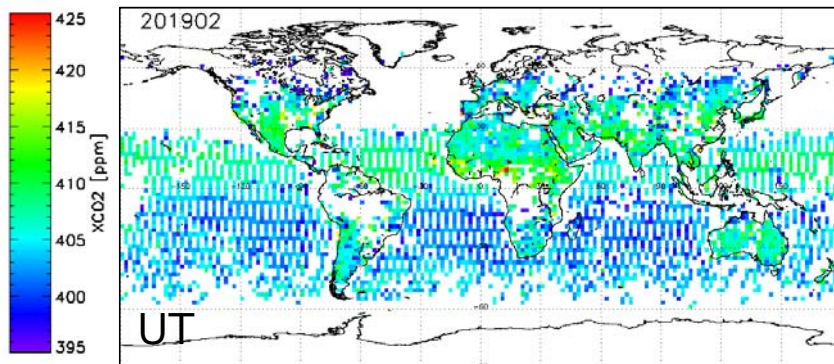
XCO2_low(LT)

Background + Local source?
 背景場 + 排出源?



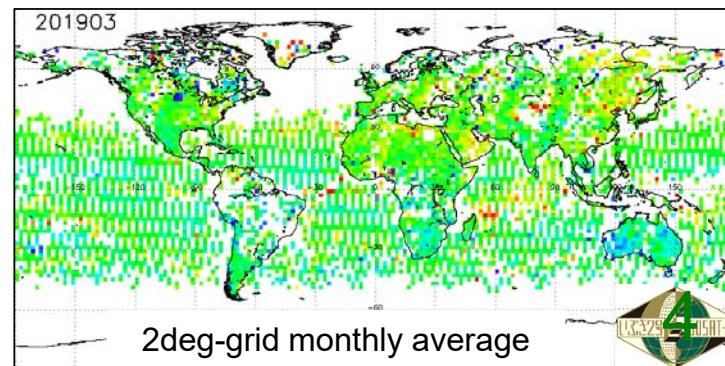
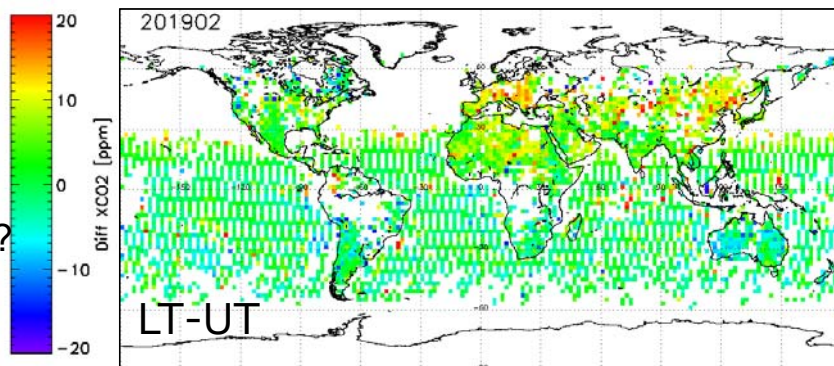
XCO2_upper(UT)

Background?
 背景場?



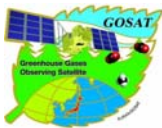
XCO2_low-upper

Enhance "Local source" information?
 排出源情報が強調/抽出される?



2deg-grid monthly average

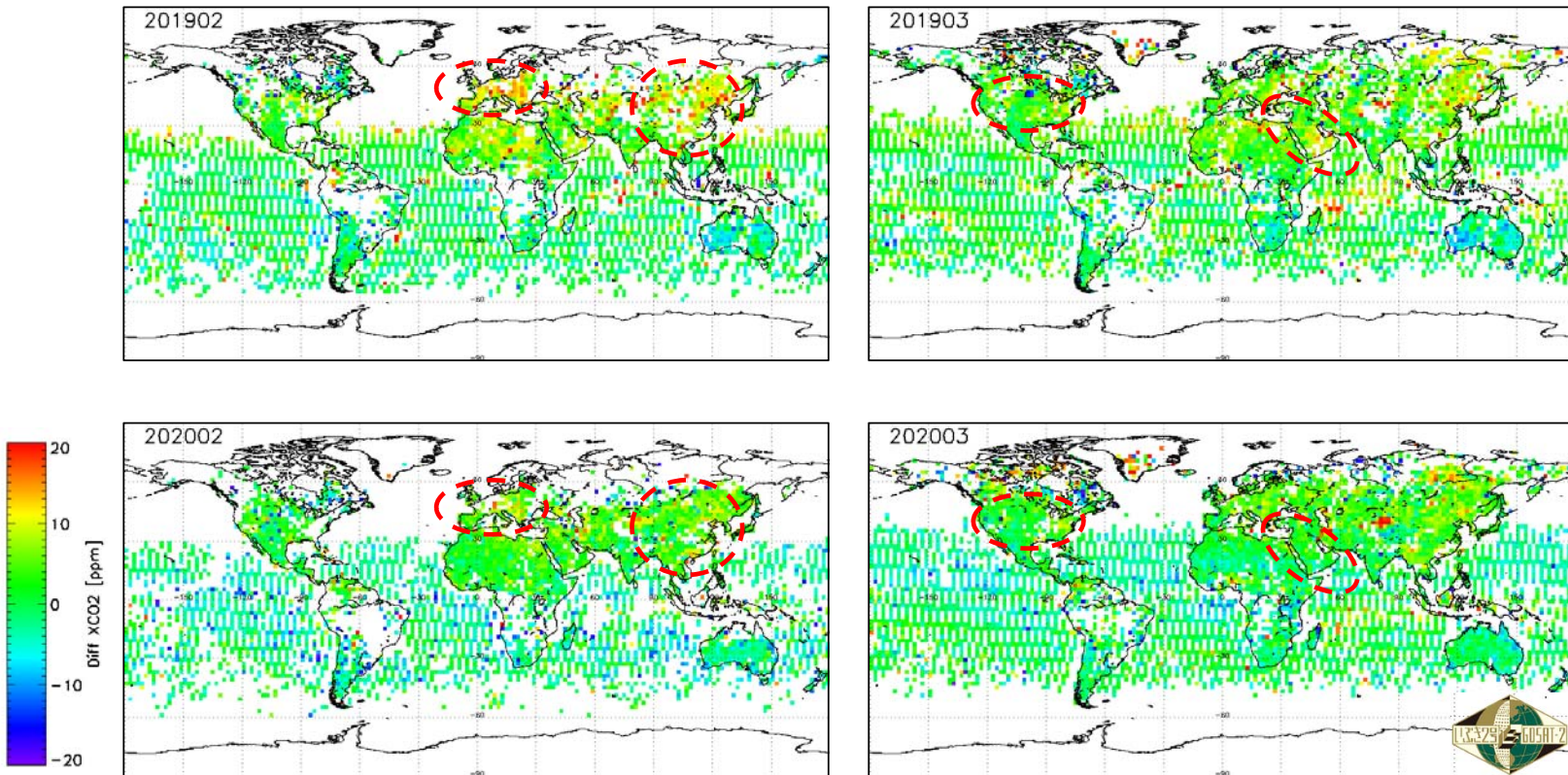




CO₂ Partial column difference between LT (0-4 km) and UT (4-12 km)
 CO₂濃度差 = 対流圏下層(0-4 km) - 対流圏上層(4-12 km)



XCO2_low-upper

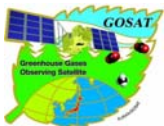


Feb2020: Less CO₂ emission in China and Europe than 2019?

2020年2月: 中国、欧州のCO₂排出が減った影響が見えたか?

Mar2020: Less CO₂ emission in US and Middle East than 2019?

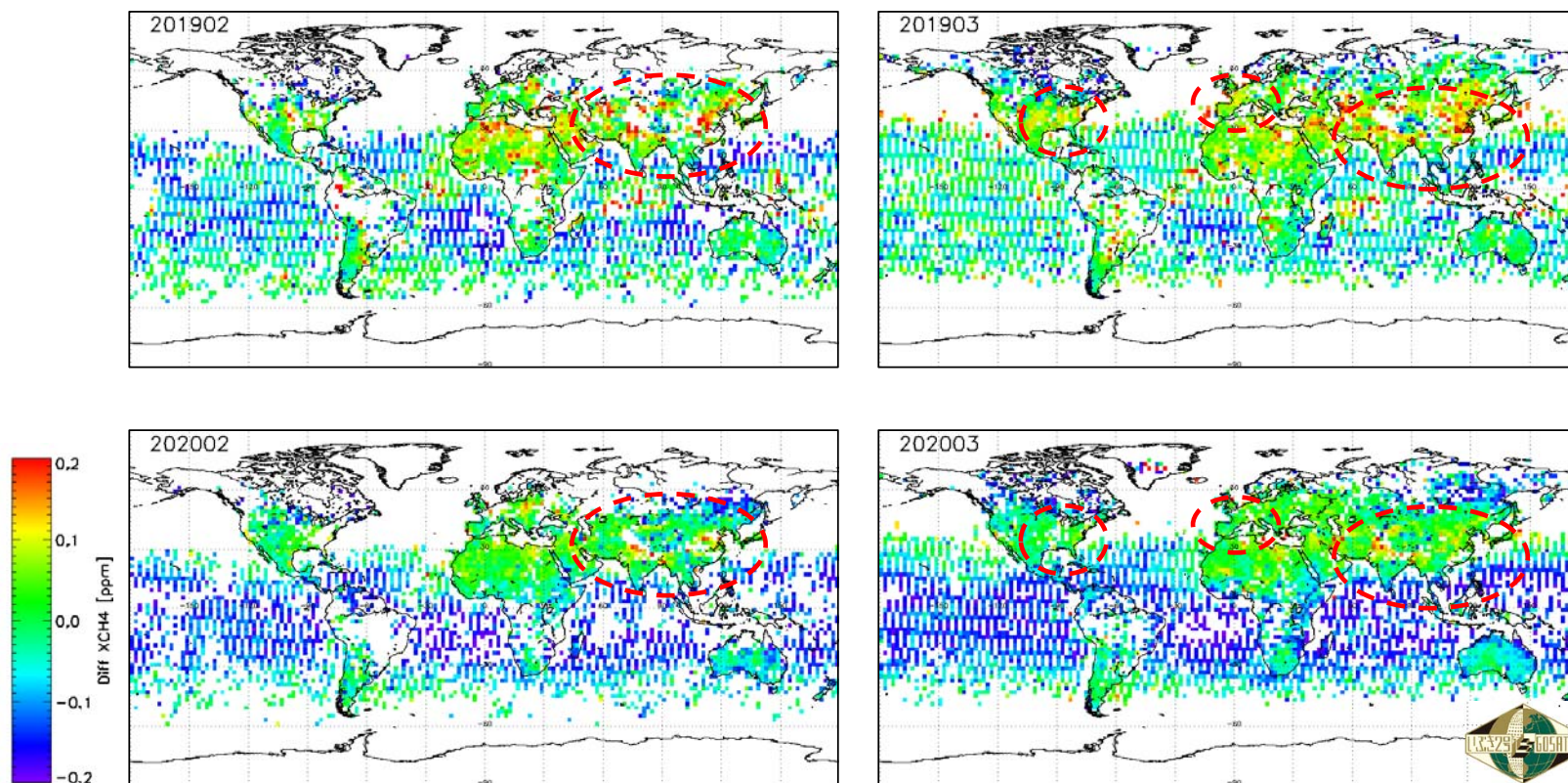
2020年3月: 米国、中東のCO₂排出が減った影響が見えたか?



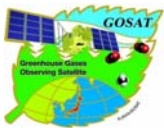
CH₄ Partial column difference between LT (0-4 km) and UT (4-12 km) CH₄濃度差 = 対流圏下層(0-4 km) - 対流圏上層(4-12 km)



XCH4_low-upper



Anthropogenic CH₄ is different emission sources from CO₂, i.e., coal mining, oil digging...
人為起源メタンはCO₂とは異なる排出源である。例えば、石炭採掘、石油掘削。



Global partial column GHGs of GOSAT and GOSAT-2

GOSAT/GOSAT-2 対流圏2層GHG全球プロダクト



GOSAT-2 EORC Daily Partial Column GHGs

Google Satellite

-1 days 2020 03 01 +1 days

Select Date

<https://www.eorc.jaxa.jp/GOSAT/GPCG/index.html>

Data Policy

User Guide

Select View

- CO₂ Partial Column
- CO₂ Total Column
- CH₄ Partial Column
- CH₄ Total Column
- CO Total Column
- AOT 550nm
- AOT 760nm
- AOT 880nm
- Psrf
- SIF

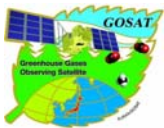
Data download

CO2 total



2000 km





GOSAT GHGs Trend Viewer – partial column for local

GOSAT GHG時系列モニタ – 都市の2層情報

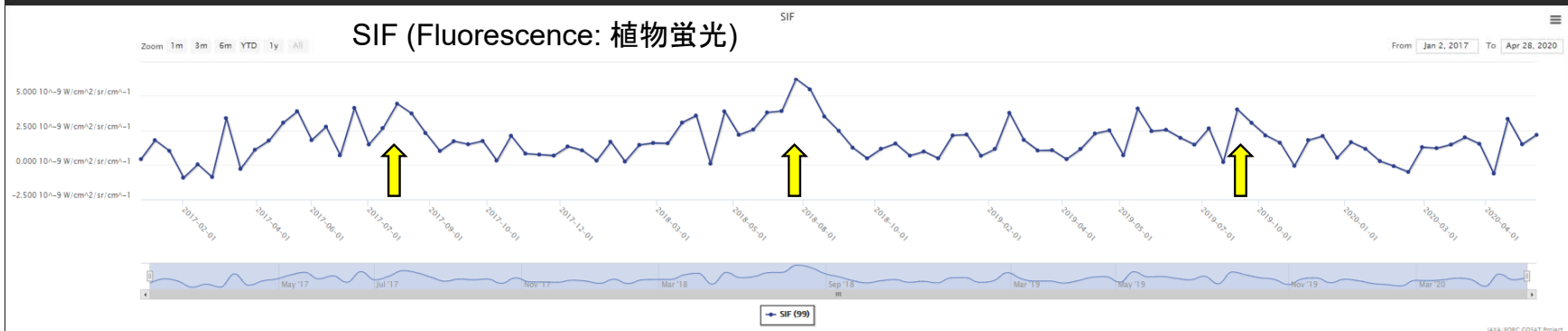


Beijing
北京



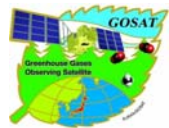
LT(0-4km)
UT(4-12km)

In winter
LT – UT CO₂ difference
2020 smallest?
LT-UT濃度差分は、
2020年が最小?



In summer
SIF ↑
XCO₂_LT ↓
Large CO₂ absorption by
surface plant activities
夏は地表の植物活動により
CO₂吸収が大きい

• Beijing1: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/Verc.K.V3/Megacity/Beijing1_Verc.K.V3.csv](https://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/Verc.K.V3/Megacity/Beijing1_Verc.K.V3.csv) ← Data available



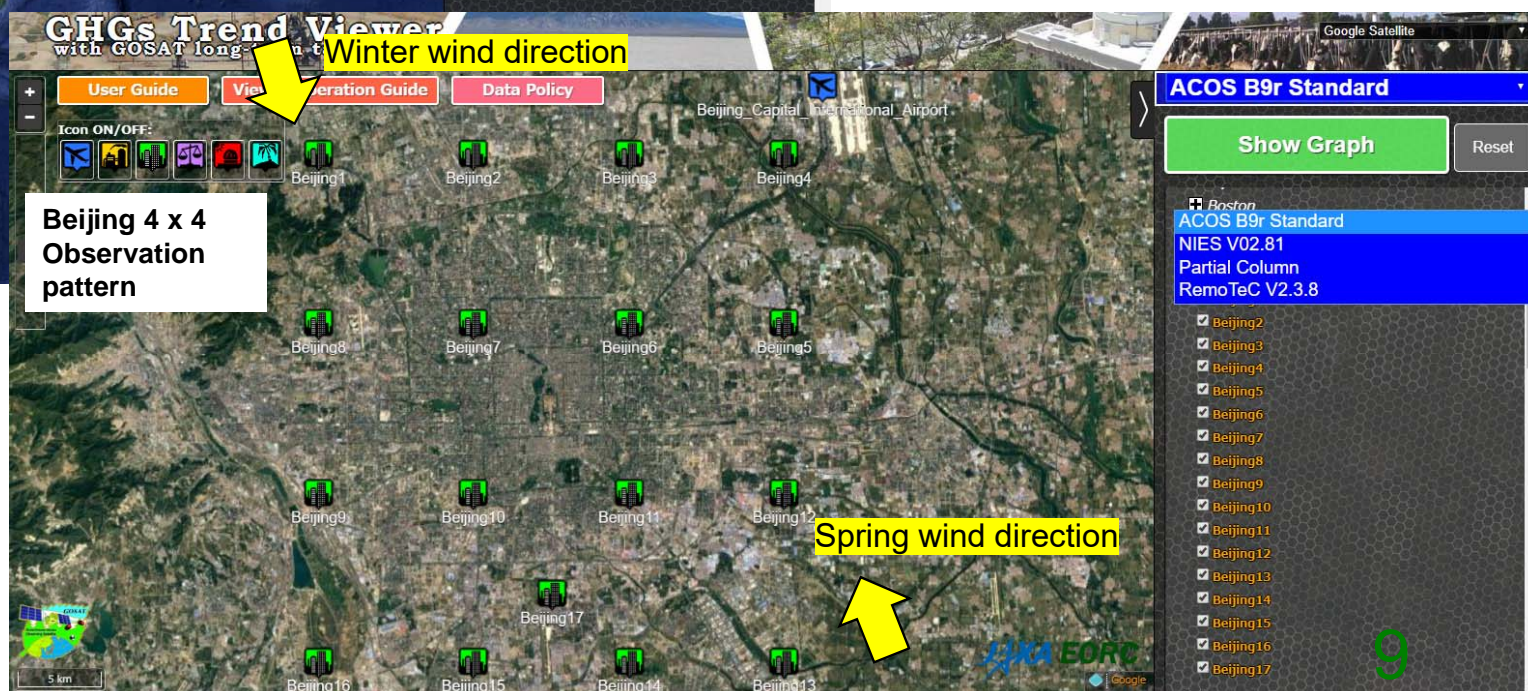
GOSAT GHGs Trend Viewer – multiple points comparison

GOSAT GHG時系列モニタ – 複数地点の比較



Select "Product" -> NIES
 ACOS by NASA
 RemoTeC by SRON
 Partial Column by EORC

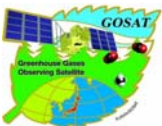
空港
 排出源
 大都市
 データ校正地点
 データ検証地点



Beijing 4 x 4
 Observation
 pattern

CO₂ emission from city
 ||
 Megacity - Background

Megacity(local source)=Beijing
 Background(no source)=Baotou



GOSAT GHG Trend Viewer – get multiple points data

GOSAT GHG時系列モニタ – 複数地点データ取得

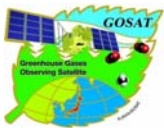


GHG Trend Viewer
with GOSAT Long term target observation

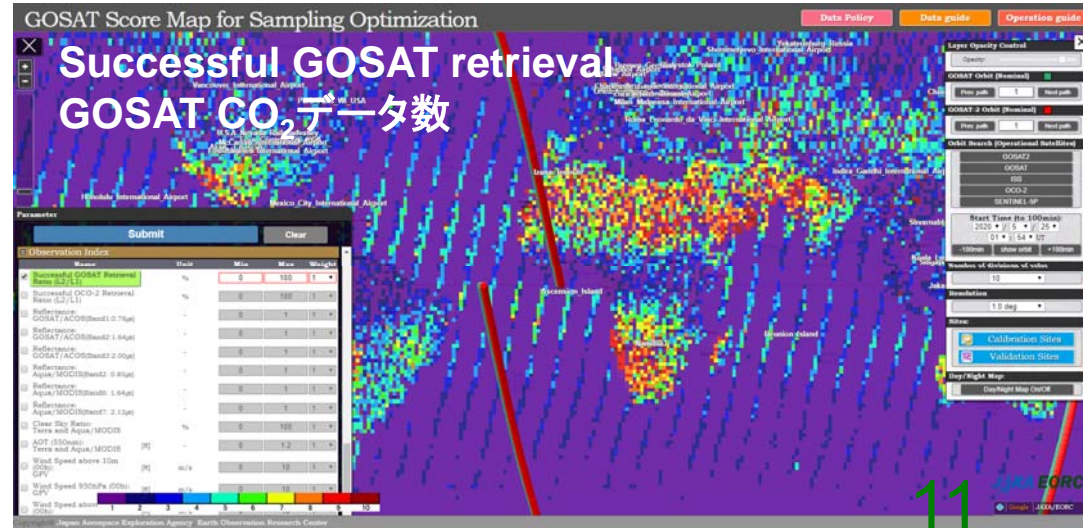
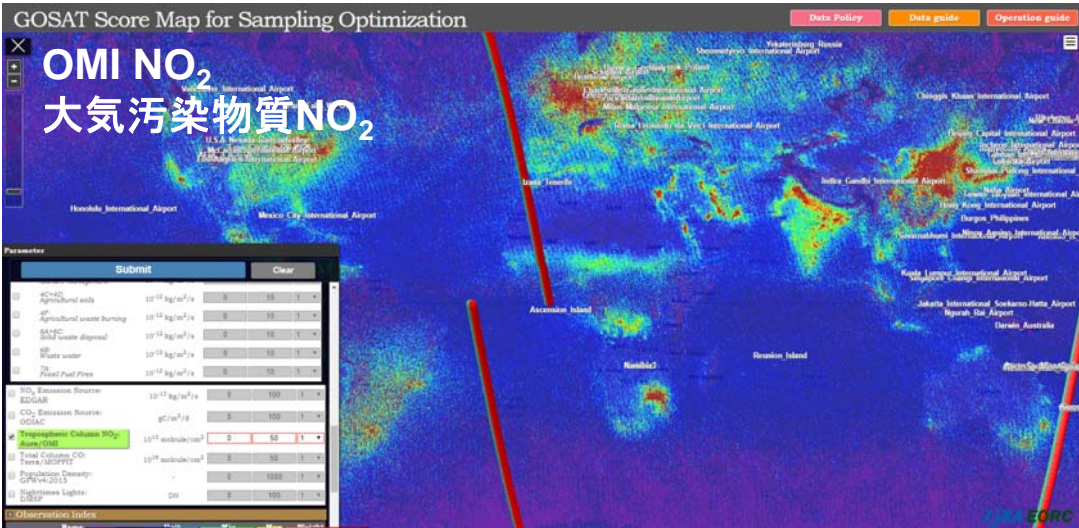
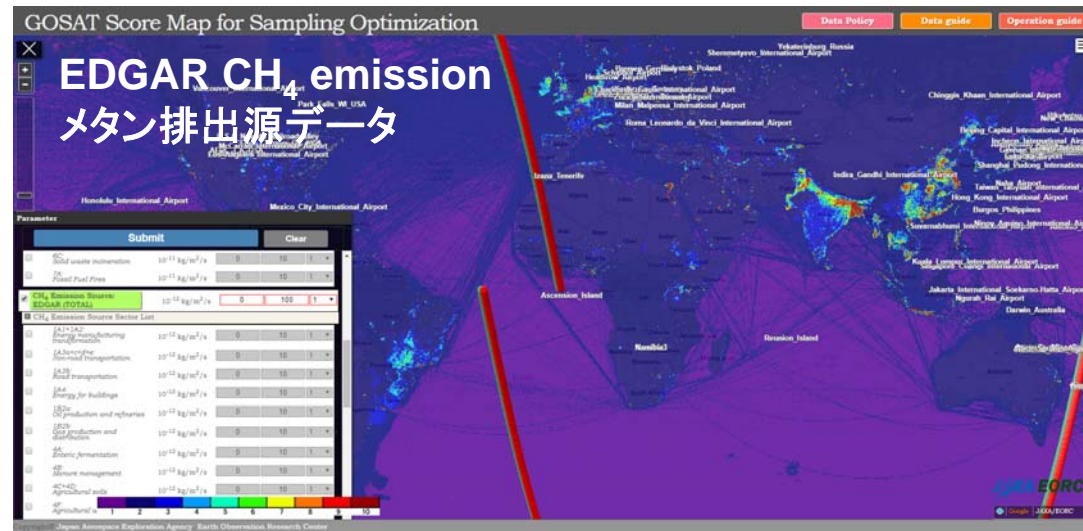
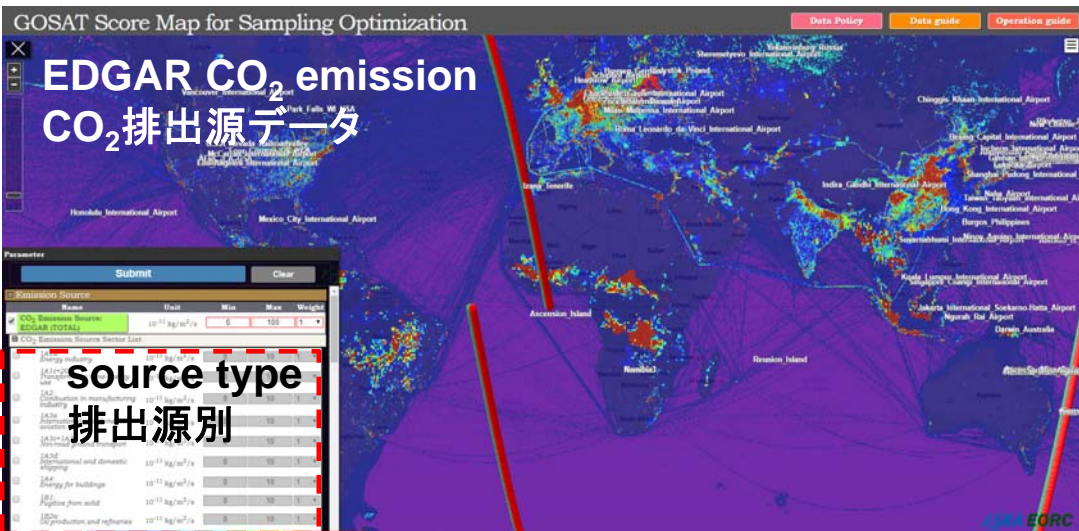


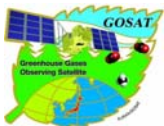
- Beijing1: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing1_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing1_info.csv)
- Beijing2: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing2_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing2_info.csv)
- Beijing3: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing3_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing3_info.csv)
- Beijing4: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing4_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing4_info.csv)
- Beijing5: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing5_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing5_info.csv)
- Beijing6: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing6_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing6_info.csv)
- Beijing7: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing7_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing7_info.csv)
- Beijing8: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing8_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Megacity/Beijing8_info.csv)
- Baotou_ReferencePoint3: [//www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Calibration/Baotou_ReferencePoint3_info.csv](http://www.eorc.jaxa.jp/GOSAT/CO2_monitor/data/ACOS_L2_B9r/Calibration/Baotou_ReferencePoint3_info.csv)

Data available



Related database for emission source 排出源に関するデータベース





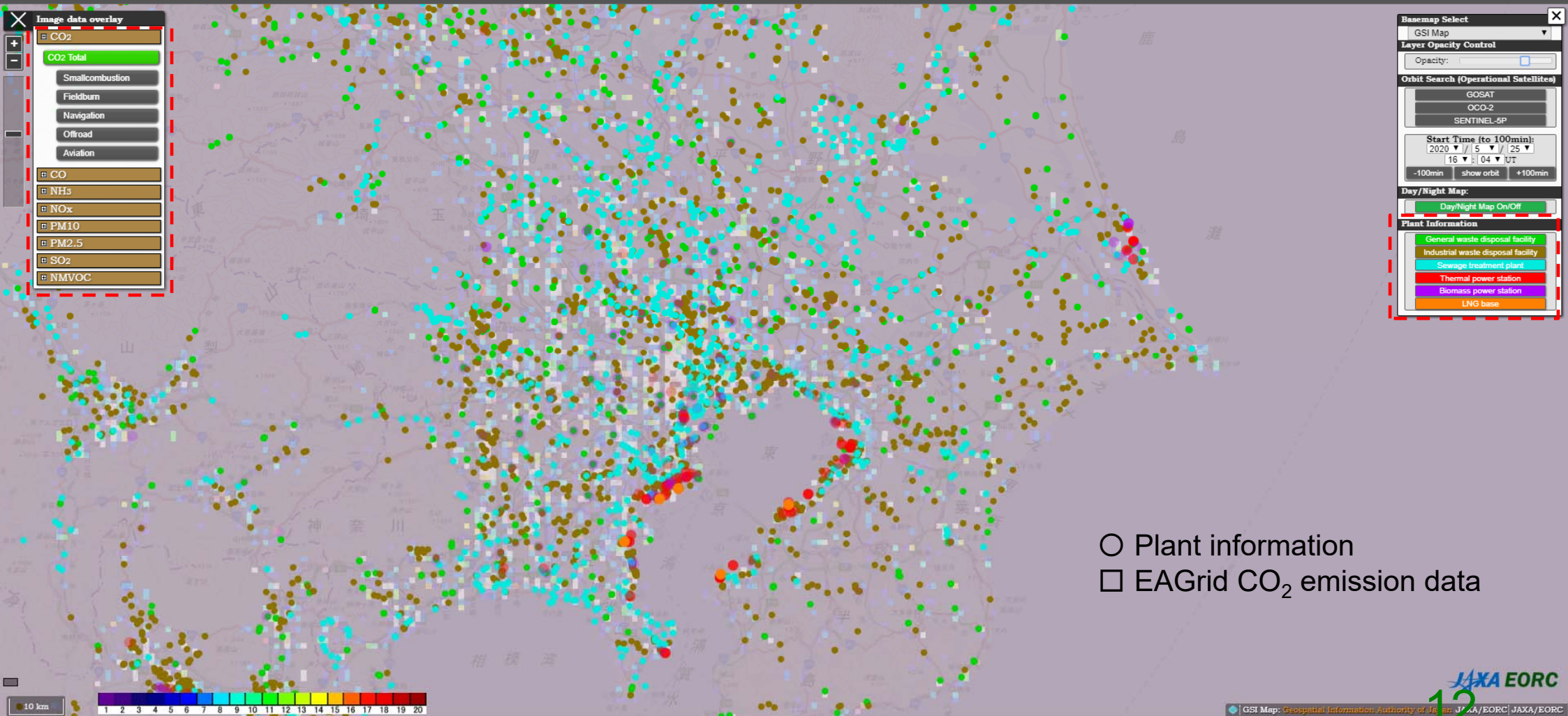
Local GHG Emission Source Sectors 日本域ローカルGHG排出源データ



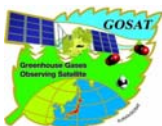
Local GHG Emission Source Sectors

Data Policy

Data guide



○ Plant information
 □ EAGrid CO₂ emission data



GHG Datasets of GOSAT and GOSAT-2 GOSAT/GOSAT-2のGHGデータセット



JAXA data portal site “JAXA for Earth”

<http://earth.jaxa.jp/en.html>

<http://earth.jaxa.jp/>

The GOSAT EORC research products are available from

<https://www.eorc.jaxa.jp/GOSAT/product.html>

https://www.eorc.jaxa.jp/GOSAT/product_j.html

Product lists:

- ・GHGs Trend Viewer for Local (GOSAT時系列モニター複数プロダクト)
NIES, ACOS by NASA, RemoTeC by SRON, Partial column by EORC
- ・GOSAT-2 EORC Daily Partial Column for Global (全球対流圏2層データ)
- ・Local GHG Emission Source Sectors (ローカルな温室効果ガス排出源データ)
- ・GOSAT Score Map (排出源に関するデータベース)