
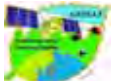



Day 2, session 6: Carbon Monitoring System Innovation, toward low carbon campus, city and region

SATELLITE MONITORING RESEARCH OF GHGS AND FUTURE POLICY EXTENSION

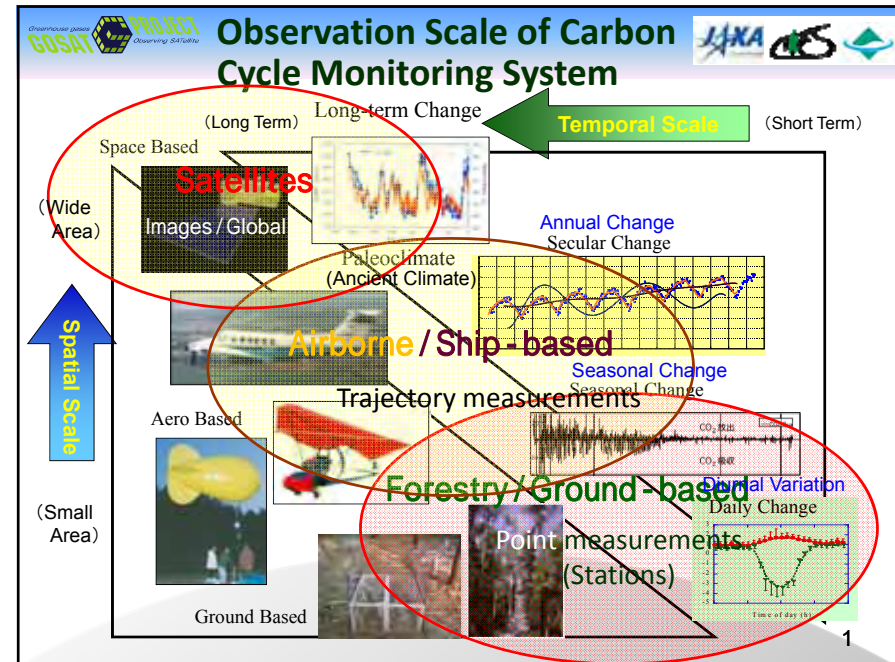
GOSAT (Greenhouse gases Observing SATellite)



Tatsuya YOKOTA
 NIES GOSAT Project Leader
 Head of Satellite Remote Sensing Research Section
 Center for Global Environmental Research
 National Institute for Environmental Studies, Japan

GOSAT project is a joint effort of JAXA, NIES, and MOE of Japan.



GOSAT standard data products (CO₂, CH₄ concentrations and images) are available for everybody!

- ◆ GOSAT is the world first satellite dedicated to observe greenhouse gases (GHGs).
- ◆ GOSAT has been operating for more than five years.
- ◆ Accuracies of carbon dioxide (CO₂) and methane (CH₄) concentrations are estimated as about much less than **1%** with data validation by ground-based instruments (TCCON FTS).
- ◆ GOSAT will change observation locations to much more usable ones for regional carbon estimation.
- ◆ GOSAT image data is also usable to detect smoke billowing by forest fire and vegetation activity change.

GOSAT (IBUKI) launched by H-IIA F-15 vehicle on January 23, 2009 (Photo by NIES)

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Size	Main body	3.7 m x 1.8 m x 2.0 m (Wing Span 13.7m)
	Mass	Total 1750kg
Power	Total	3.8 KW (EOL)
Life Time		5 years
Orbit	sun synchronous orbit	
	Local time	13:00+/-0:15
	Altitude	666km
	Inclination	98deg
	Repeat	3 days
Launch	Vehicle	H-IIA
	Schedule	Jan. 23 2009

TANSO onboard GOSAT

TANSO=Thermal And Near infrared Sensor for carbon Observation

TANSO (炭素) = Carbon

TANSO-FTS
(Fourier Transform Spectrometer)

SWIR reflected on the earth's surface
-TIR radiated from the ground and the atmosphere

TANSO-CAI
(Cloud and Aerosol Imager)

Ultraviolet (UV) (0.38 micron), visible (0.67 micron), NIR (0.87 micron), and SWIR (1.6 micron)

(Courtesy of JAXA)

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55-month-long GOSAT XCO₂ and XCH₄
(June 2009 – December 2013)

Records of the GOSAT Observation Locations for Valid Data Retrieved

Locations of GHG monitoring stations
(from WDCGG, as of Nov. 17, 2014)
Total: **328**
CO₂ measurement: **225**
CH₄ measurement: **211**

The number of **GOSAT** Level2 (Ver. 2) XCO₂ data in a year (2009.6-2010.5).
Red-white : 200 – 1000 data/year
Green-orange: 20 – 100 data/year
Blue : 0 – 10 data/year

(by H/ Takagi (NIES))

Satellites can fill the gaps in the ground-based monitoring network with several exceptions.

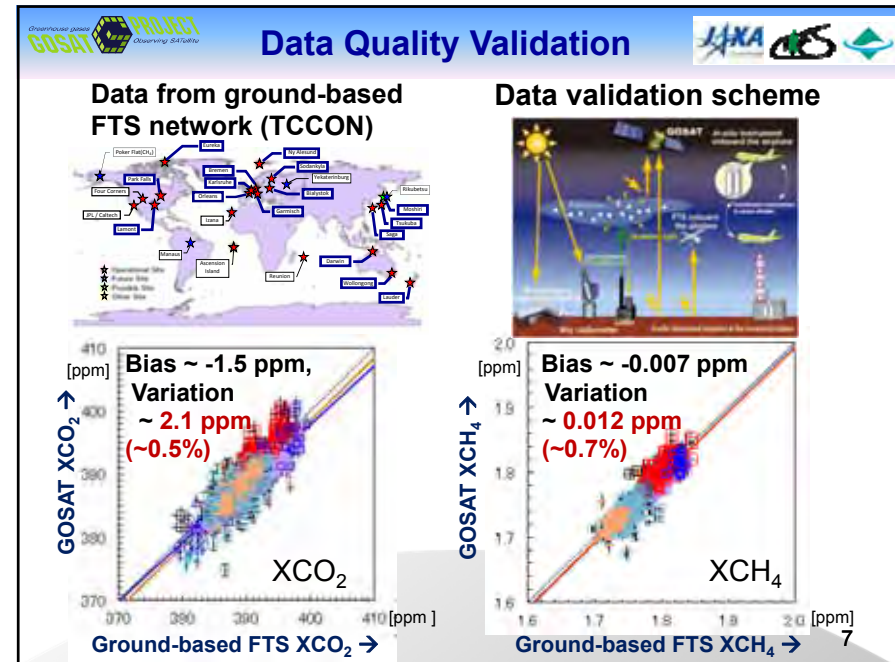
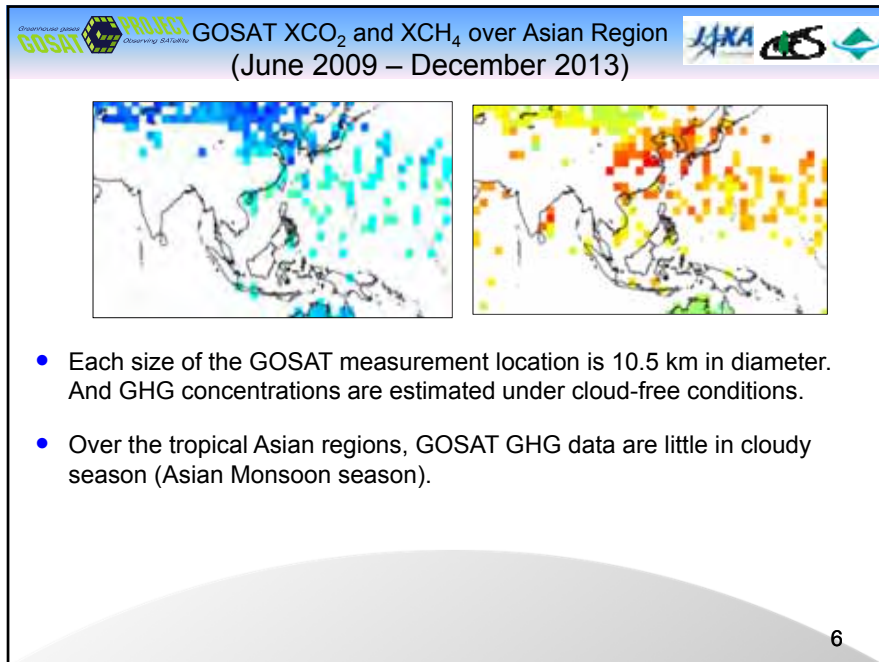
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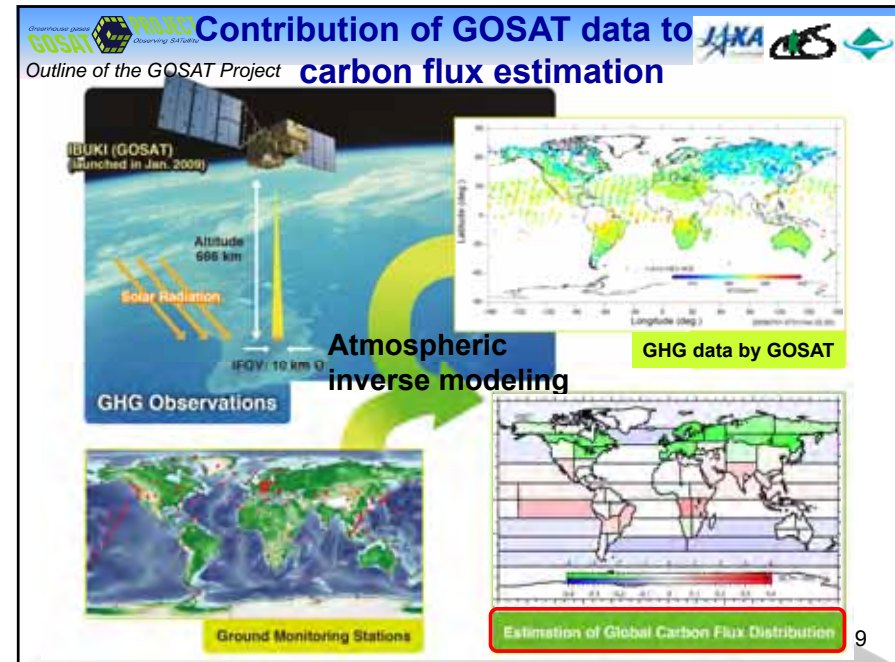
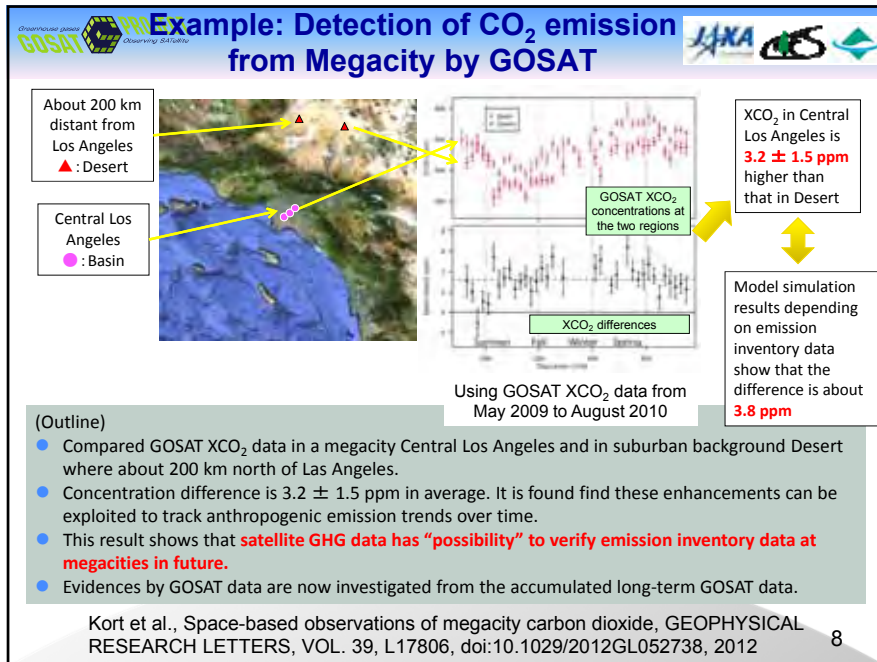
Global map of CO₂ observed by GOSAT
2009.06

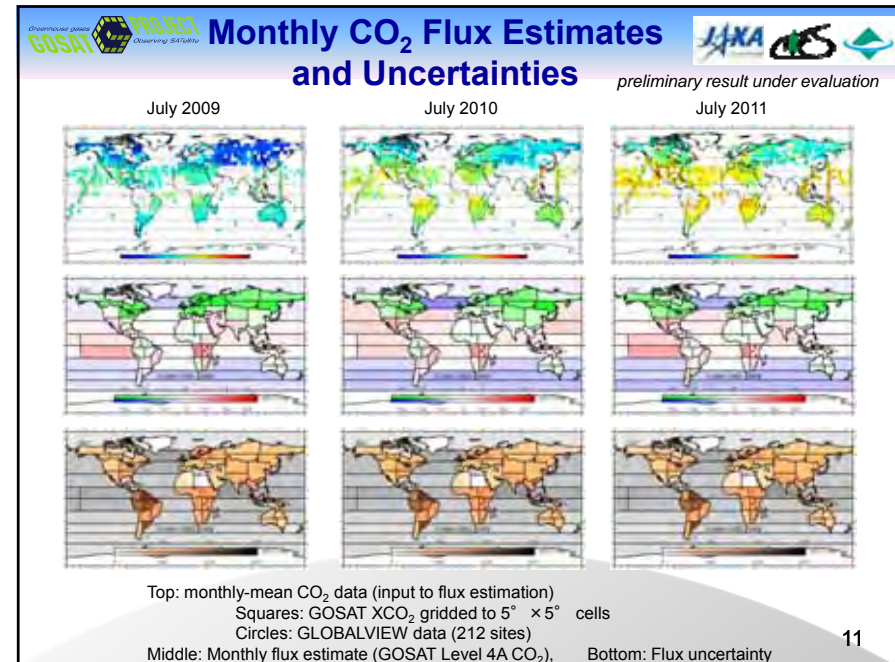
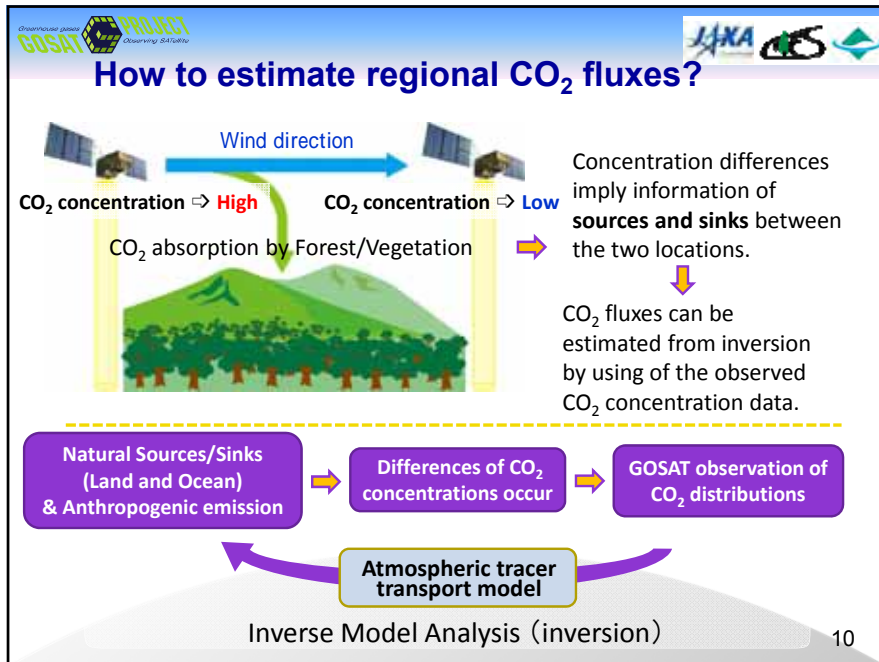
Global map of CH₄ observed by GOSAT
2009.06

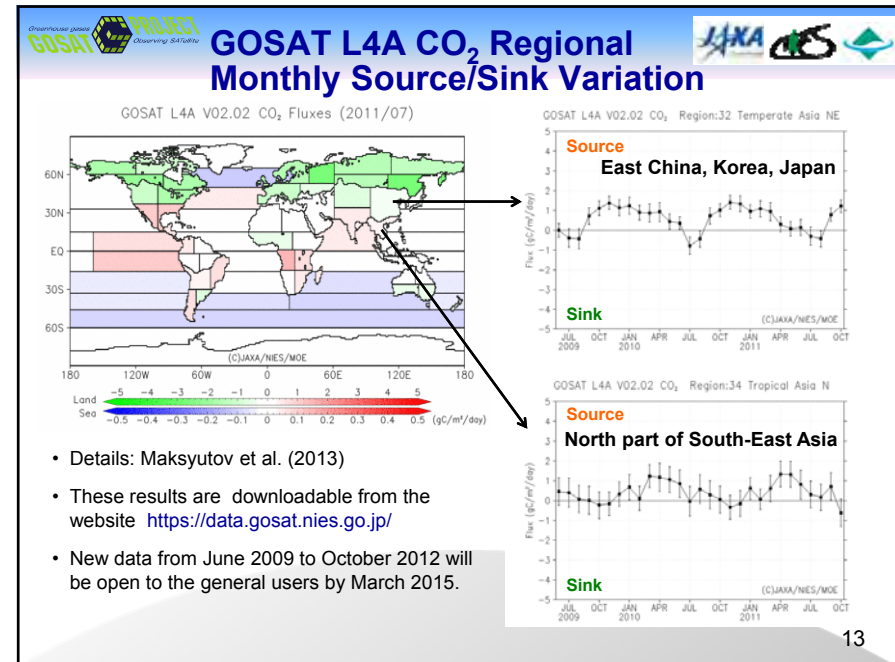
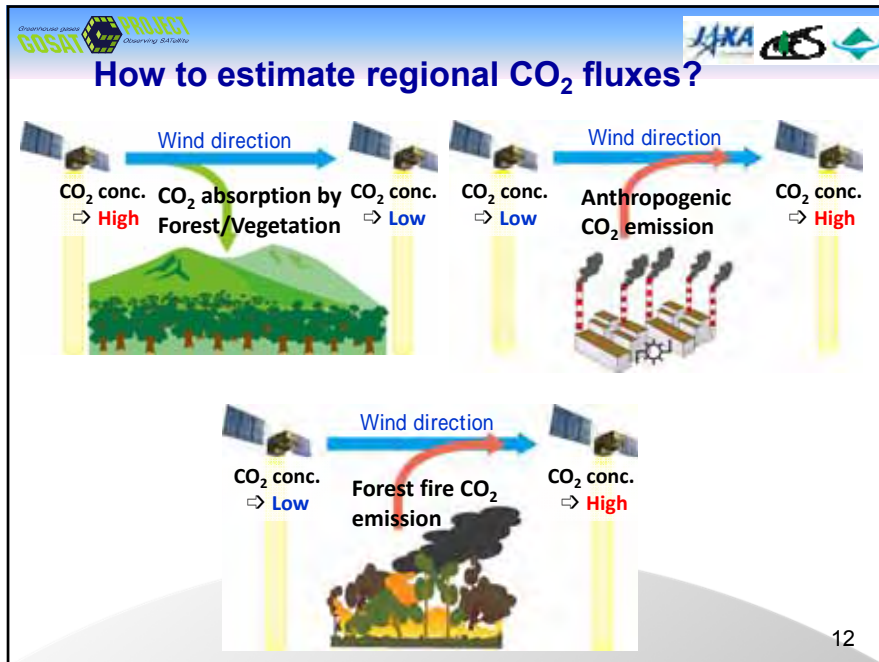
- GOSAT obtained XCO₂ and XCH₄ data for more than 5 years. Validation results suggest that relative accuracies (variations) of XCO₂ and XCH₄ are ≈ 2 ppm (≈ 0.5%) and 12 ppb (≈ 0.7%), respectively.
- Above movies are 1-month-moving average GOSAT XCO₂ and XCH₄ with three-day interval. The mesh size is 2.5 degree.
- Various interesting features are shown in these movies such as annual and seasonal variations of XCO₂ and localized anomalies of XCH₄.

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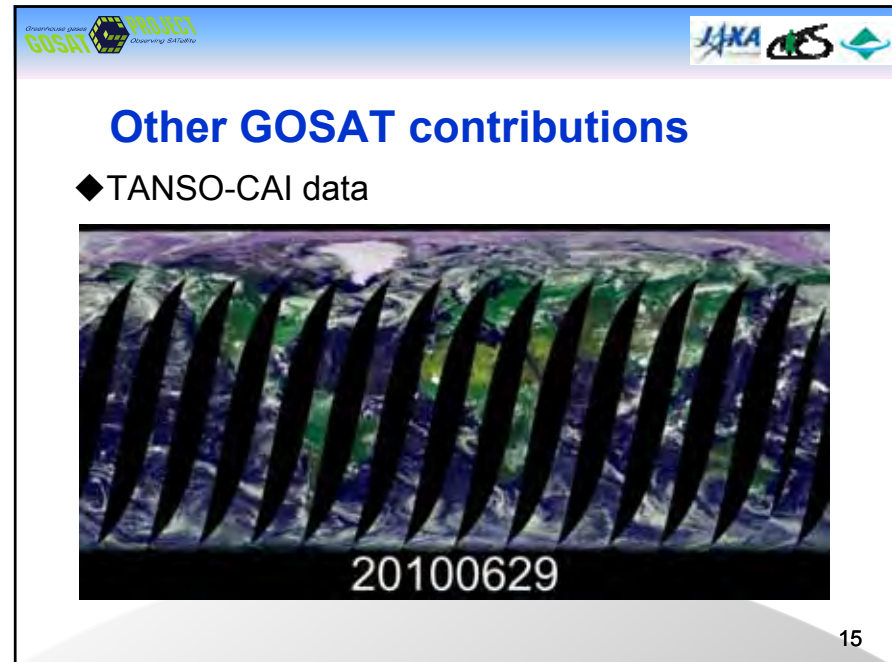
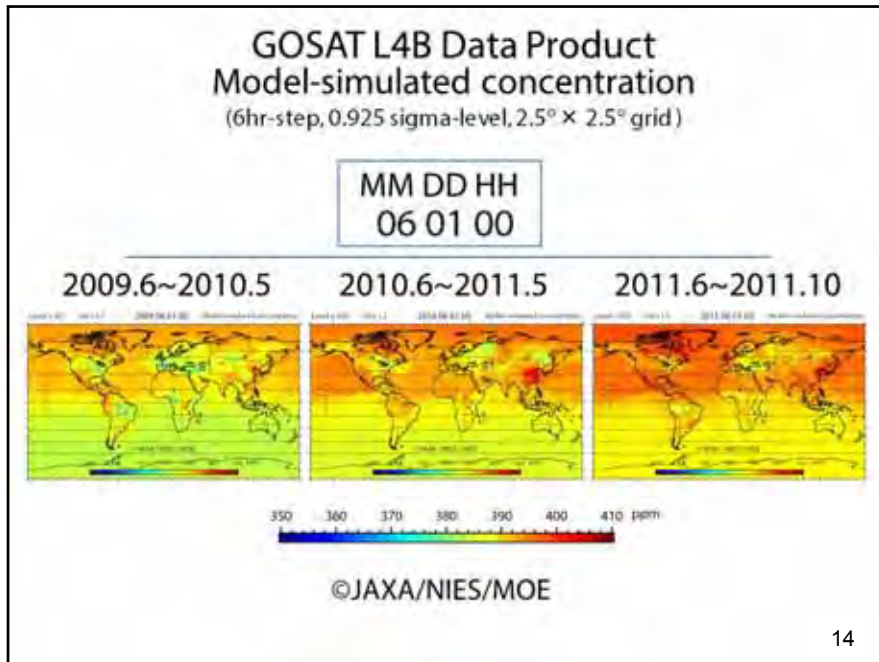








- Details: Maksyutov et al. (2013)
- These results are downloadable from the website <https://data.gosat.nies.go.jp/>
- New data from June 2009 to October 2012 will be open to the general users by March 2015.



Observation project **GOSAT** PROJECT
Observing Earth from Space

JAXA  

Smoke billowing from the forest fires on the Indonesian island of Sumatra (June 2013)



GOSAT CAI Image Coverage
[~960 km × 1340 km]

Thailand Cambodia Vietnam
Malaysia
Indonesia
Sumatra Is. Singapore
Java Is.

2月22日

GOSAT Orbit (A) GOSAT Orbit (B)

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Observation project **GOSAT** PROJECT
Observing Earth from Space

JAXA  



Smoke billowing from the forest fires on the Indonesian island of Sumatra (June 21, 2013)



Singapore

©JAXA/NIES/MOE

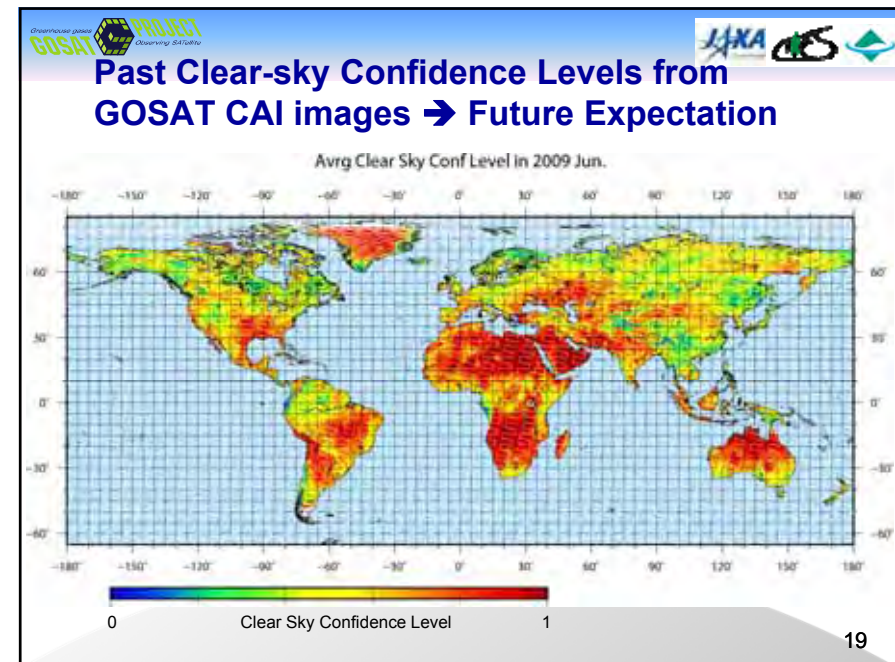
17

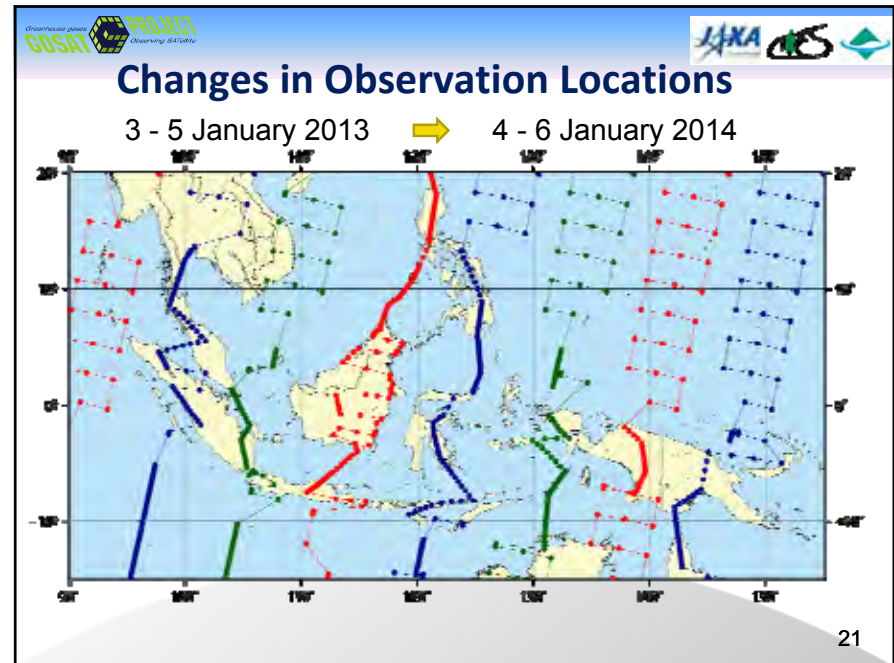
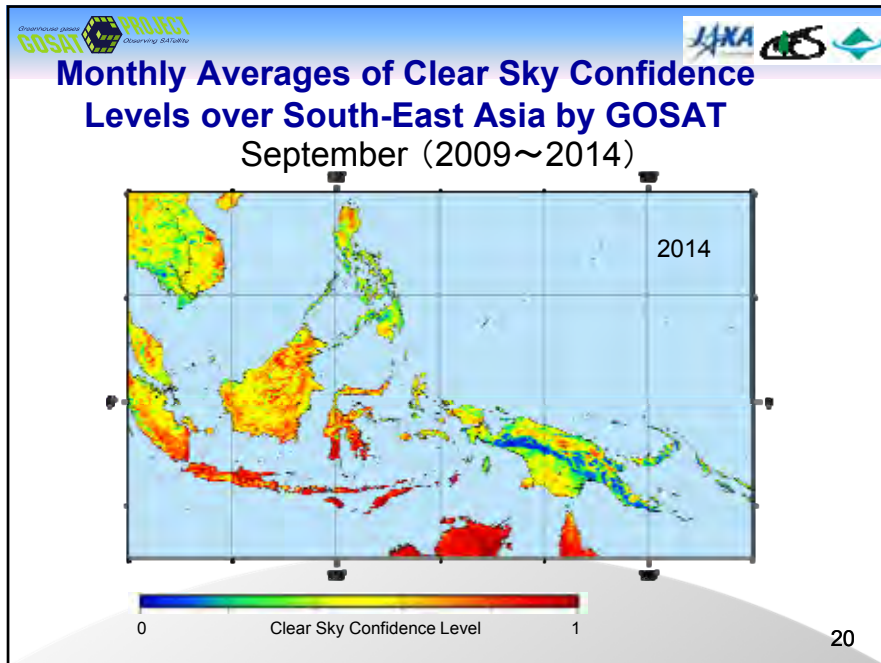



Future Policy Extension Plan of GOSAT/GOSAT-2 Measurements

- ◆ From *Global* to *Specific Regions*
- ◆ Regional commitment as a verification tool in MRV (Measurement, Reporting, and Verification)
- ◆ Much more data needed in the dedicated region
- ◆ Measurement location change trial

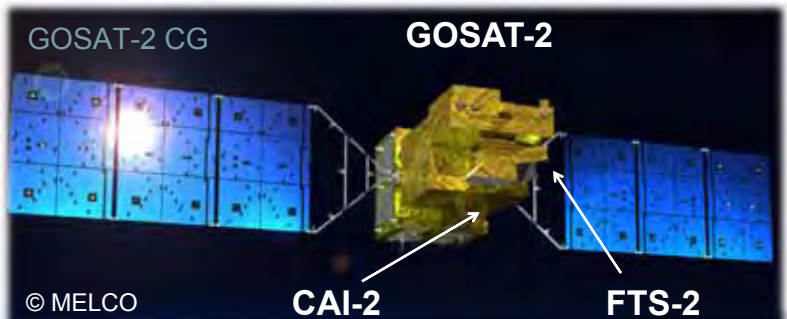
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GOSAT-2
to be launched in early 2018

- ◆ Much more GHG data available
 - Intelligent target pointing mechanism
- ◆ CO₂, CH₄, and CO measurements by FTS-2
- ◆ Atmospheric pollution parameter measurements by CAI-2



© MELCO

Visit our GOSAT Project Website
<http://www.gosat.nies.go.jp/>



World's first satellite dedicated to Global Greenhouse Gas Observation

GOSAT Project

The Greenhouse gases Observing SATellite (GOSAT) Project is a joint effort promoted by the Japan Aerospace Exploration Agency (JAXA), the National Institute for Environmental Studies (NIES) and the Ministry of the Environment (MOE). NIES organized the research team dedicated to the GOSAT project within its organization in April 2004, and since then has been working for the research and development with respect to GOSAT "IBUKI".

Observation satellite PROJECT
GOSAT Observing Satellites

Concluding Remarks

JAXA

- GOSAT observation data of CO₂ and CH₄ have effectively filled out gaps in the distribution data collected in ground-based monitoring networks globally with good precisions for scientific use. And these data seems to be applicable to policy extensions such as large CO₂ emission source monitoring in megacities and due to biomass burning.
- However, especially number of the data over tropical Asia is small by now. Therefore, we will change GOSAT observation locations in high probability of cloud-free regions carefully.
- GOSAT/GOSAT-2 data is also expected to contribute to policy makers by showing scientific evidences of GHG distribution status and carbon fluxes for building low carbon societies.

GOSAT Project Webpage:
<http://www.gosat.nies.go.jp/>

Data distribution → <http://data.gosat.nies.go.jp/>

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