COP19 Official Side Event

"Japan's Research and Observation for IPCC AR5 WGI"

Japan Pavilion, Warsaw, Poland, 1630-1800, 12 November 2013

Greenhouse gases observation from space by GOSAT

&

Ocean and Antarctic observation researches

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IBUKI Launch Date 12:54, January 23, 2009 (JST)

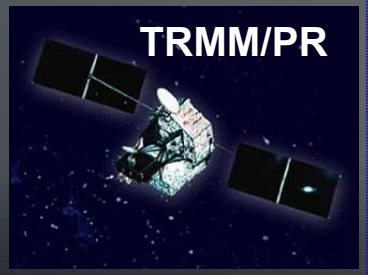
JAMSTEC

JAXA

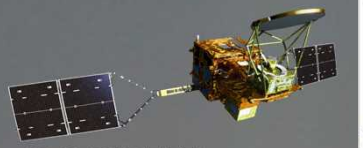
JAXA satellite programs

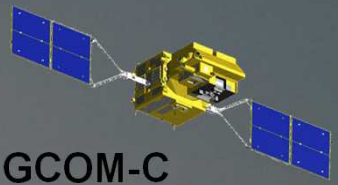
Late 1990s | 2000s | 2003 (JAXA established)

Earth Observation



Climate Change/Water



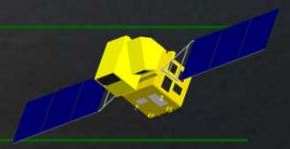


Global Warming

GOSAT-2
2018~

Land Use

Disaster Monitoring



Next Gene.
(optical)

Communications

COMETS | DRTS | WINDS

Technology Development

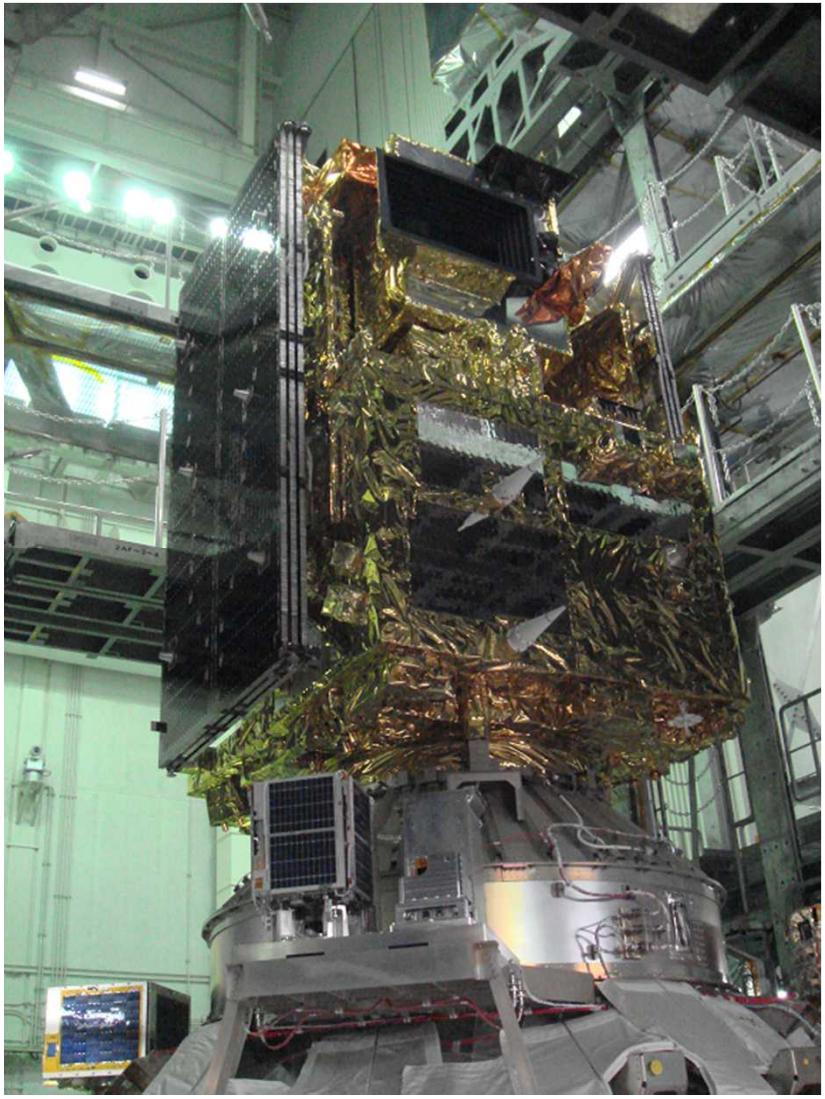
Positioning

QZSS

ETS-Ⅵ | ETS-Ⅶ | DICETS | ETS-Ⅷ

Greenhouse gases observing satellite (GOSAT)

- Monitoring global distribution of Greenhouse Gases from space.
- Observe Carbon dioxide and Methane at 100-1000km spatial scale with relative accuracy of 1% (4ppm) for CO_2 and 2% (34ppb) for CH_4.
- Joint project by JAXA, NIES (National Institute for Environmental Studies), and MOE (Ministry of the Environment) .
- Launch: 23 January 2009 by H2A launch vehicle
- Mission lifetime: 5 years to 2014

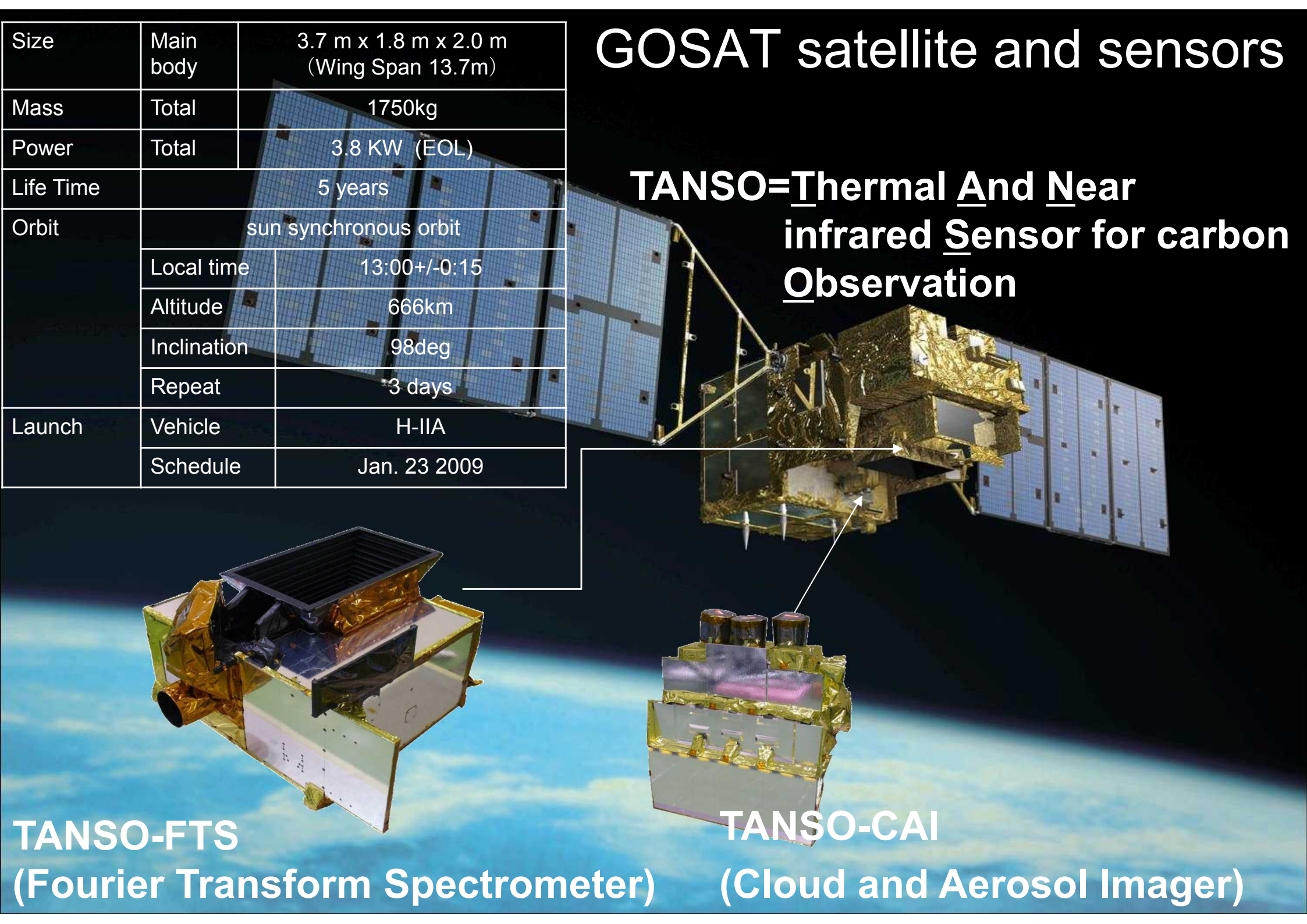


GOSAT satellite at Tanegashima Spece Center

GOSAT satellite and sensors

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

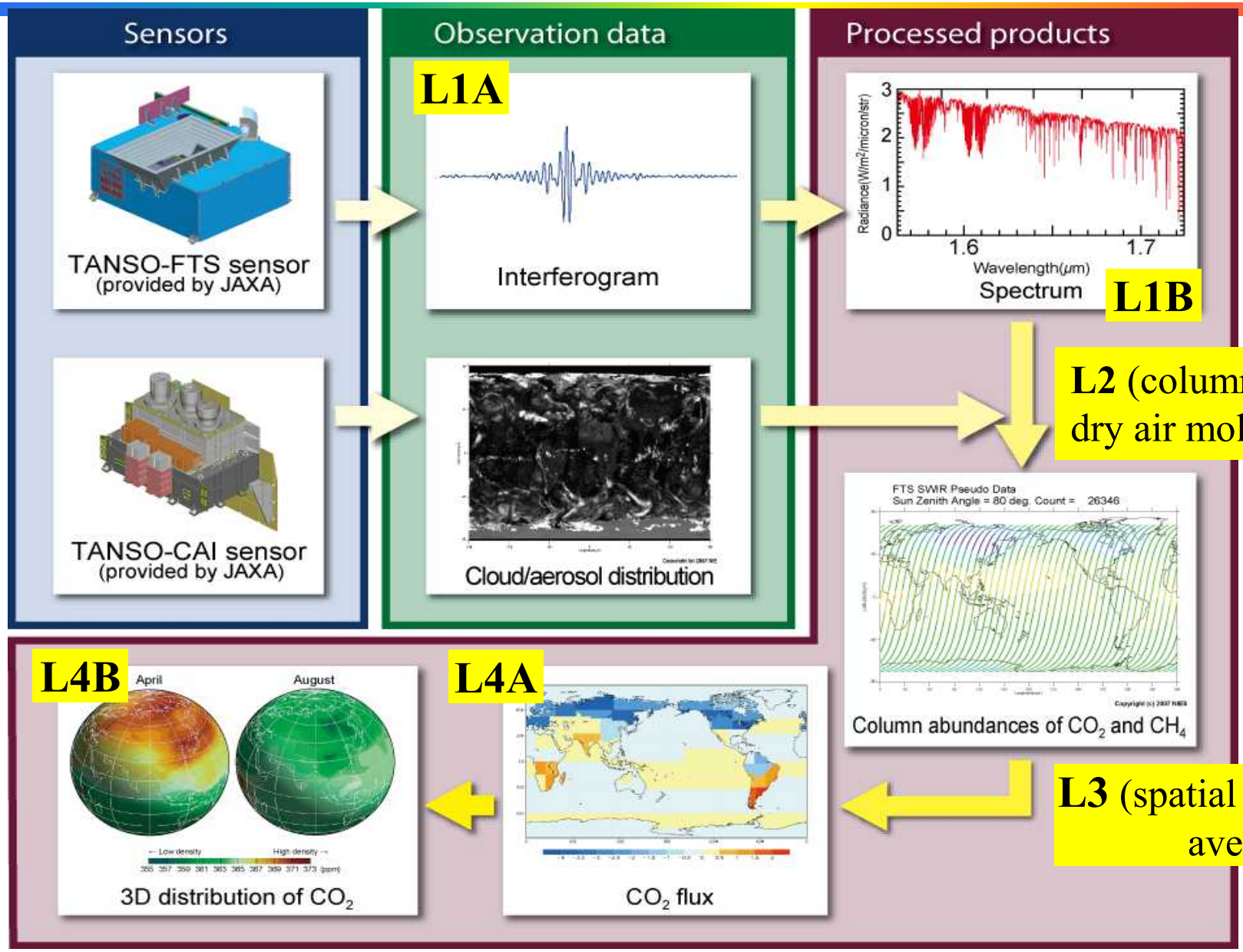
TANSO=Thermal And Near infrared Sensor for carbon Observation



TANSO-FTS
(Fourier Transform Spectrometer)

TANSO-CAI
(Cloud and Aerosol Imager)

GOSAT Data Processing

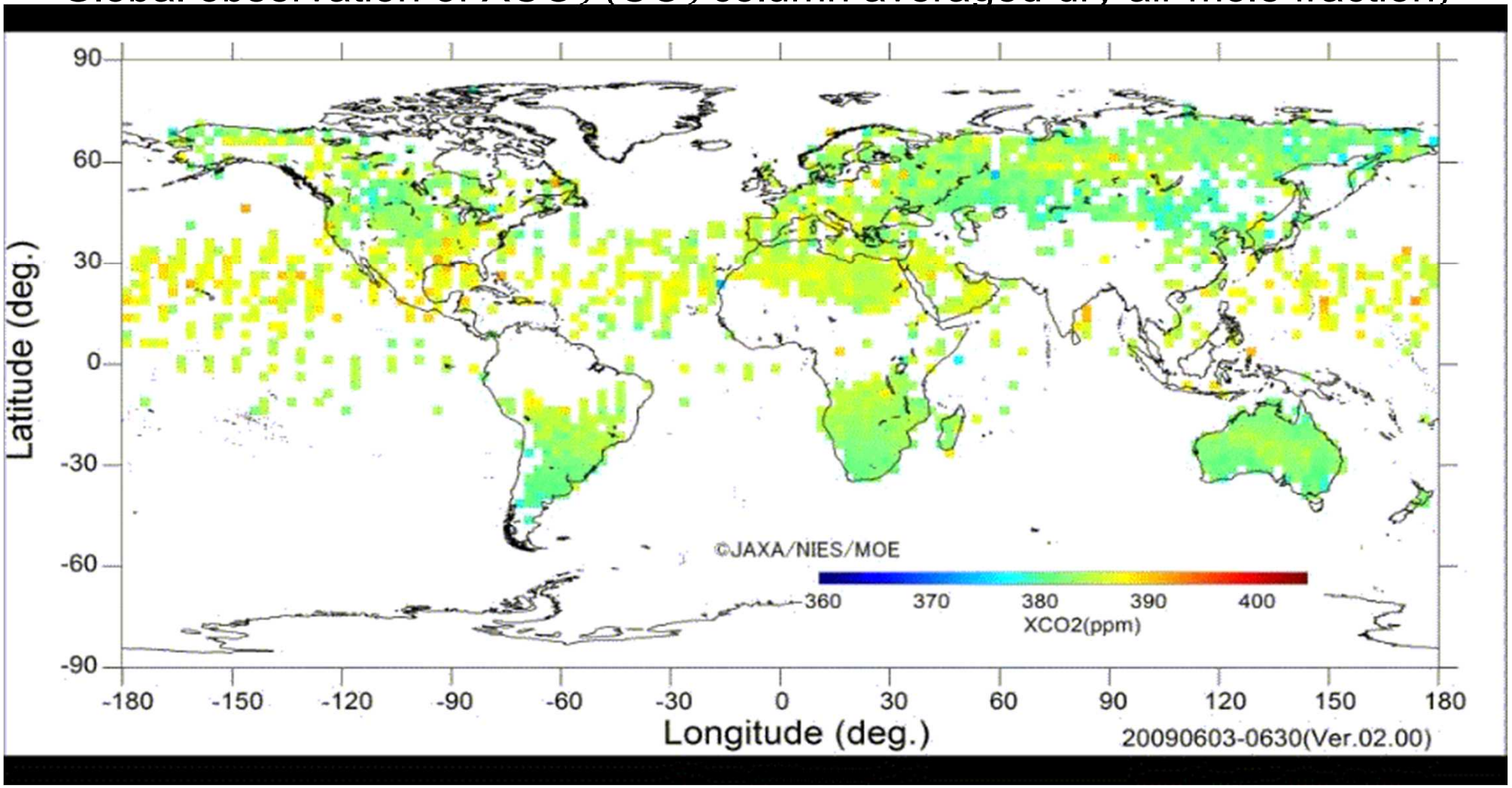


JAXA ->
Sensor,
Level1,
Calibration

NIES ->
Level2, 3, 4,
Validation

Monthly averaged CO_2 observation from space

Global observation of XCO_2 (CO_2 column averaged dry air mole fraction)

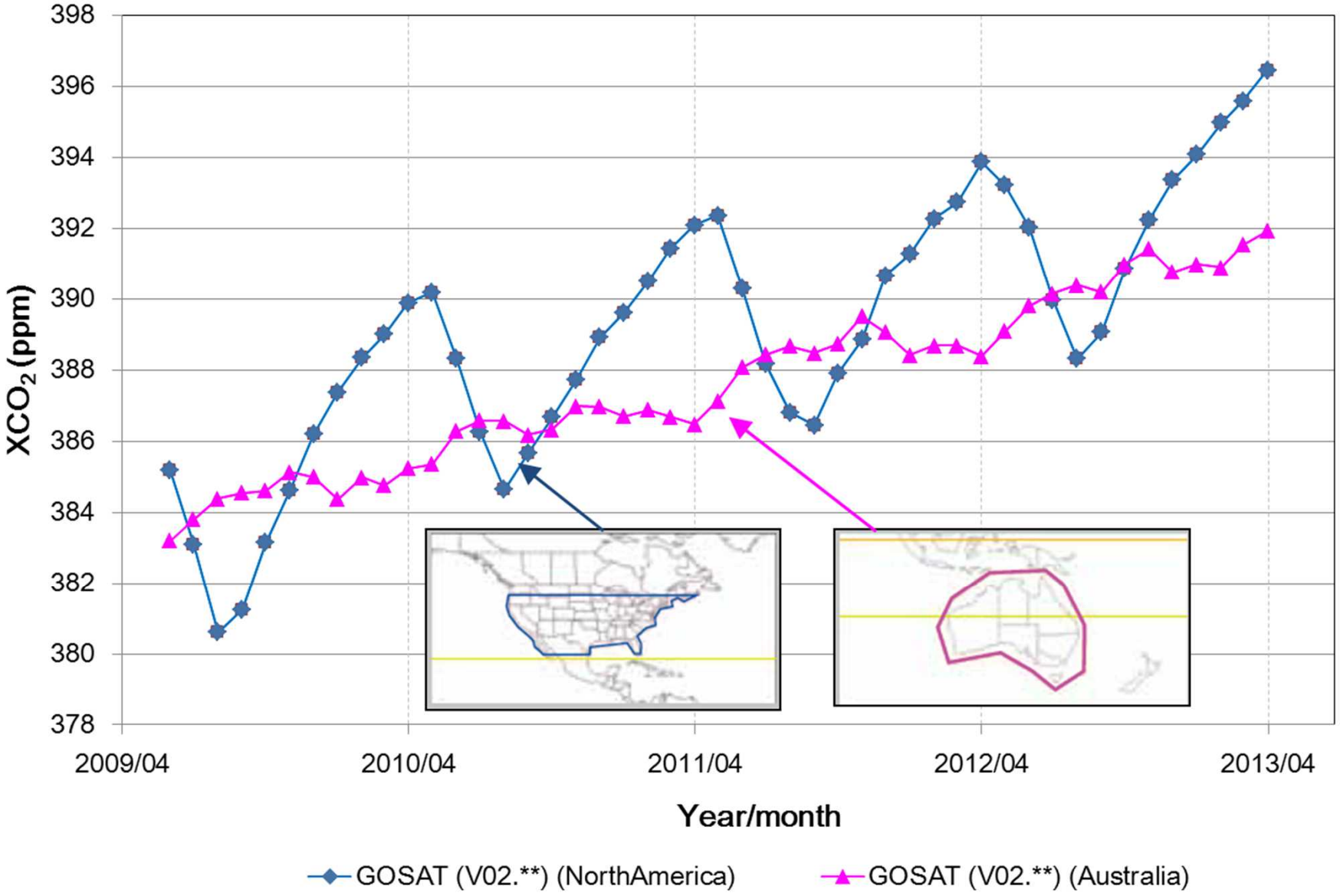


XCO_2 is validated with an uncertainty of -1.2 +/- 2.0 ppm (-0.3 +/- 0.5 %).

GOSAT achieves the CO_2 observation precision of 0.5% (2ppm) much higher than the mission goal of 1% (4ppm).

from GOSAT User Interface Gateway (GUIG)

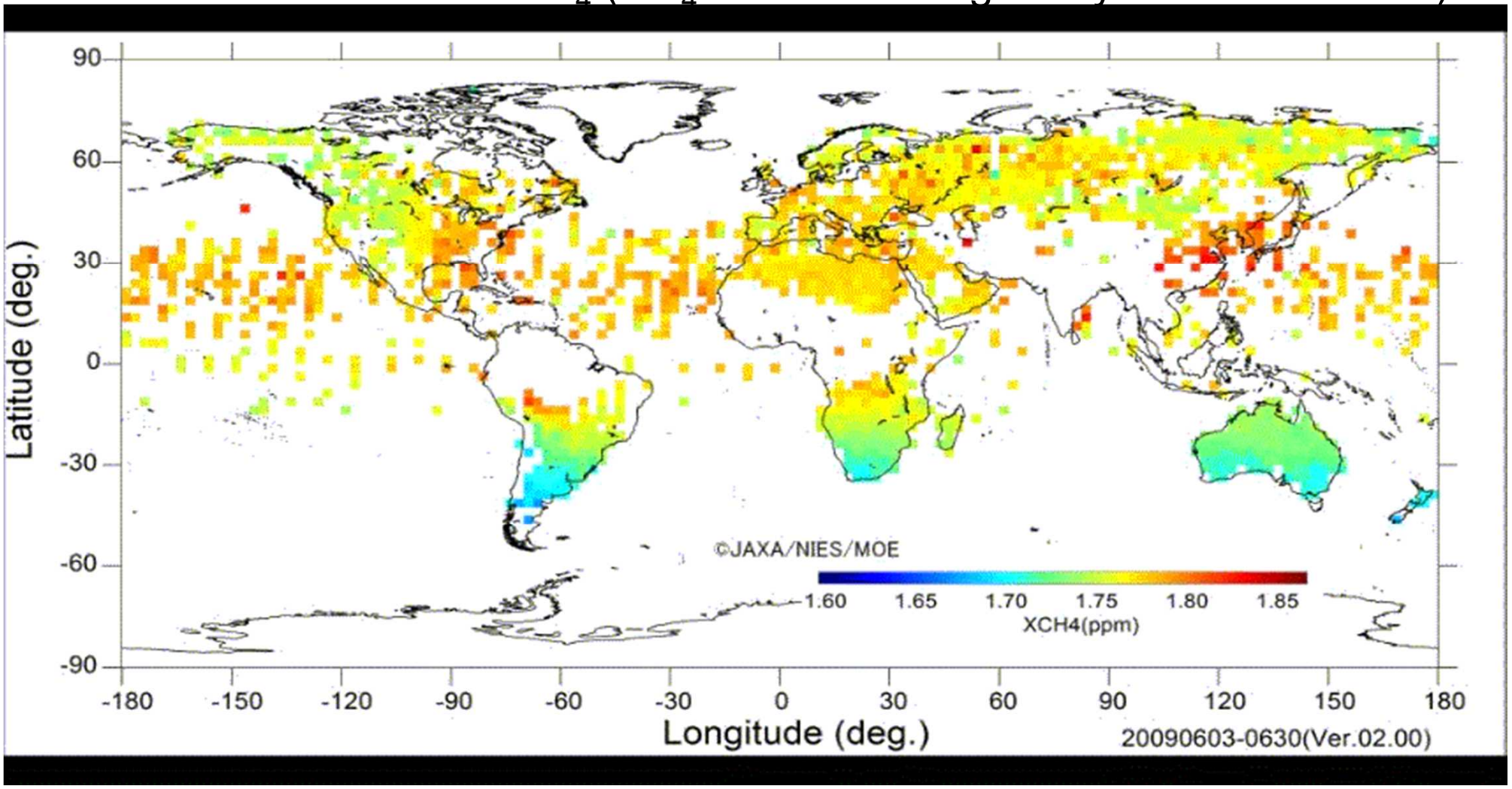
Monthly regional averages of XCO_2



from GOSAT Leaflet

Monthly averaged CH_4 observation from space

Global observation of XCH_4 (CH_4 column averaged dry air mole fraction)



XCH_4 is validated with an uncertainty of -7 +/- 12 ppb (-0.4 +/- 0.7 %).

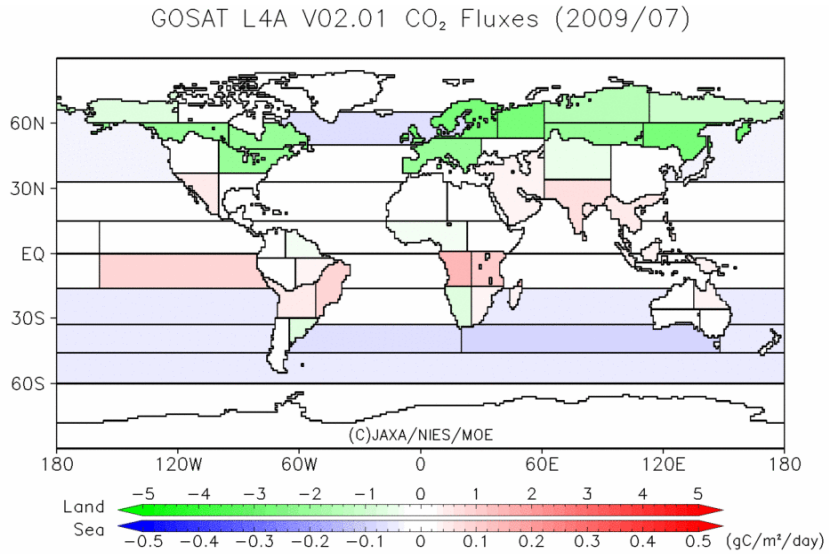
GOSAT achieves the CH_4 observation precision of 0.7% (12ppb) much higher than the mission goal of 2% (34ppb).

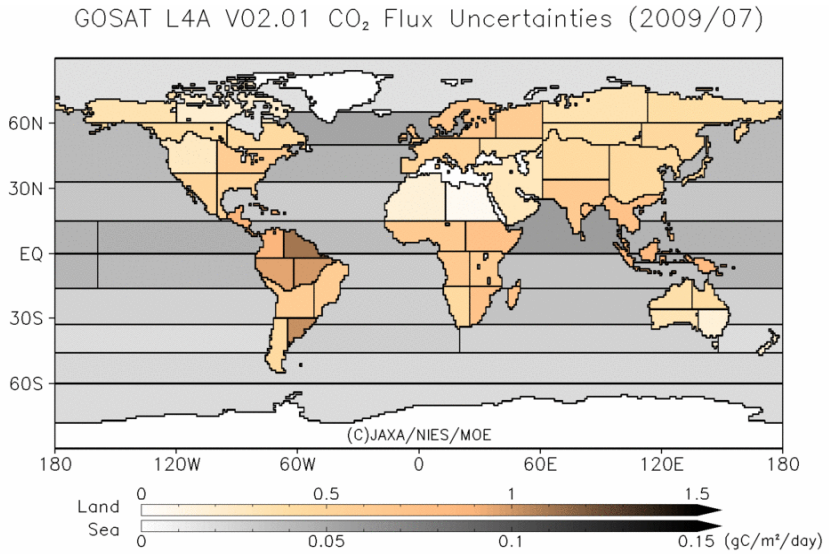
from GOSAT User Interface Gateway (GUIG)

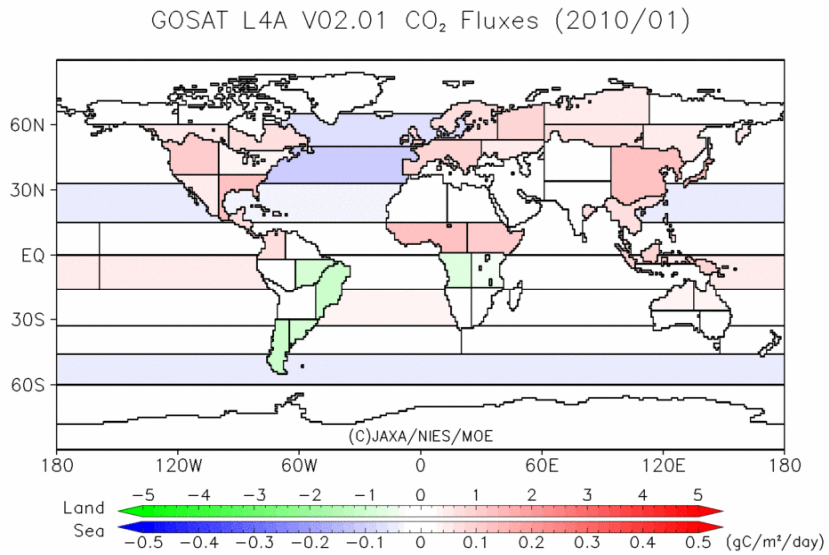
Global CO_2 flux estimation by GOSAT

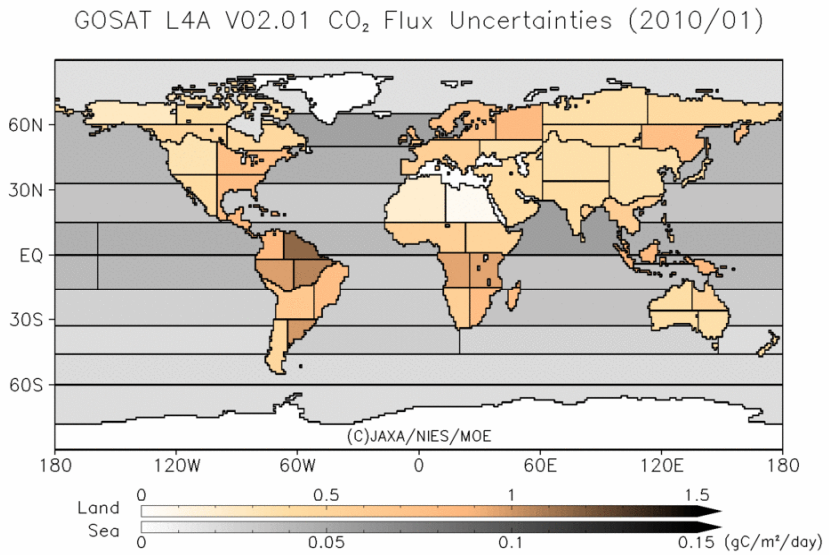
July 2009
Summer in NH

January 2010
Winter in NH









Sink in land
Sink in sea

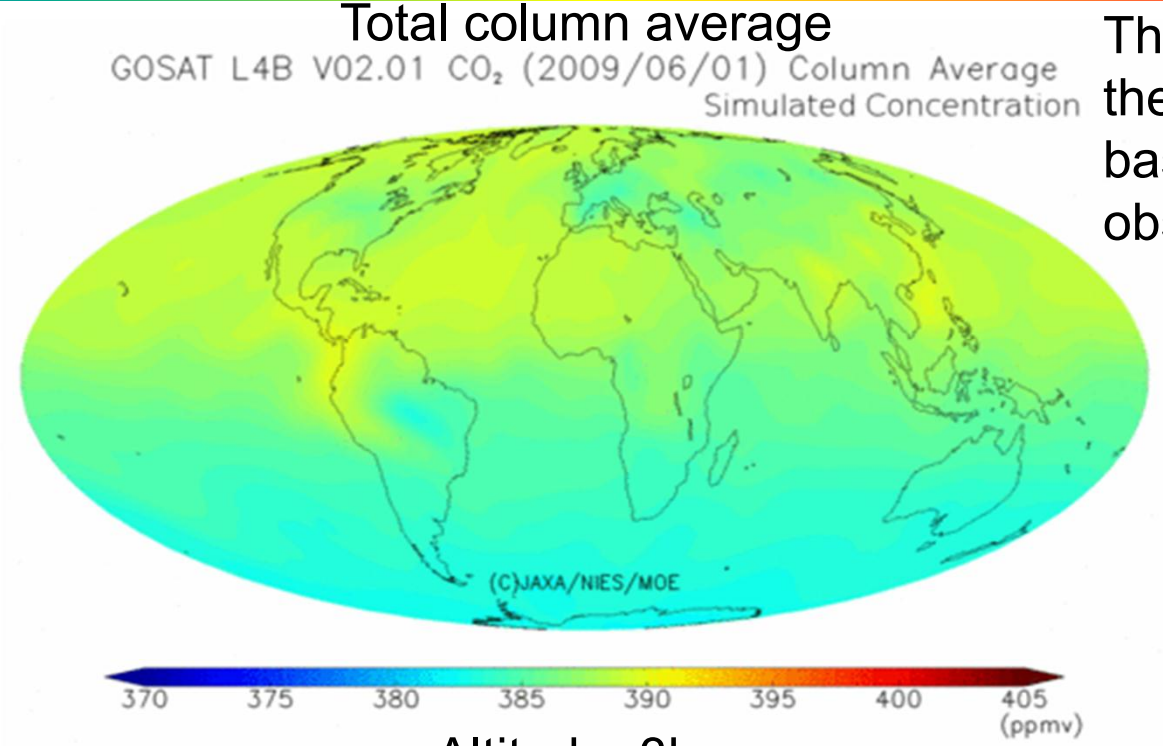
Source

Large Uncertainty

from GOSAT User Interface Gateway (GUIG)

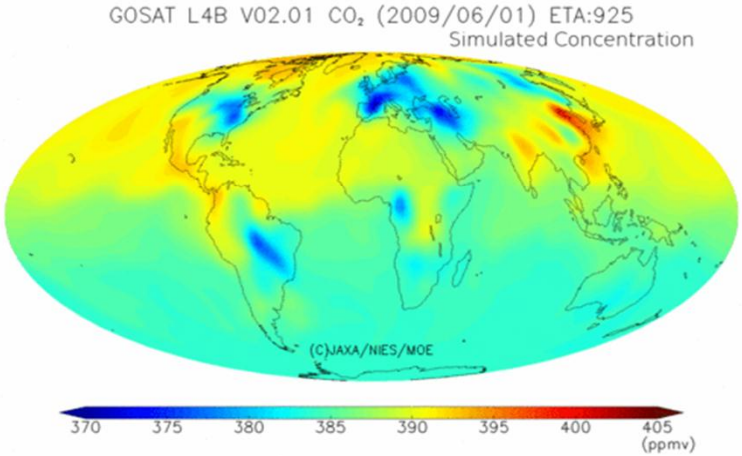
Simulation of global CO_2 distribution

Total column average

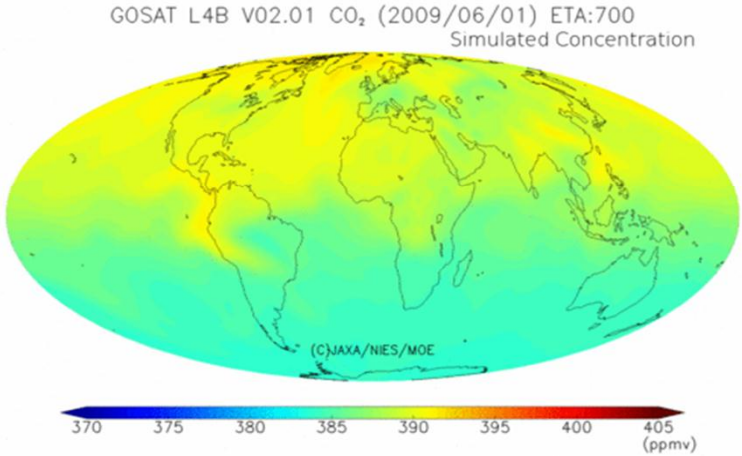


This simulation includes the CO_2 flux information based on the GOSAT observation.

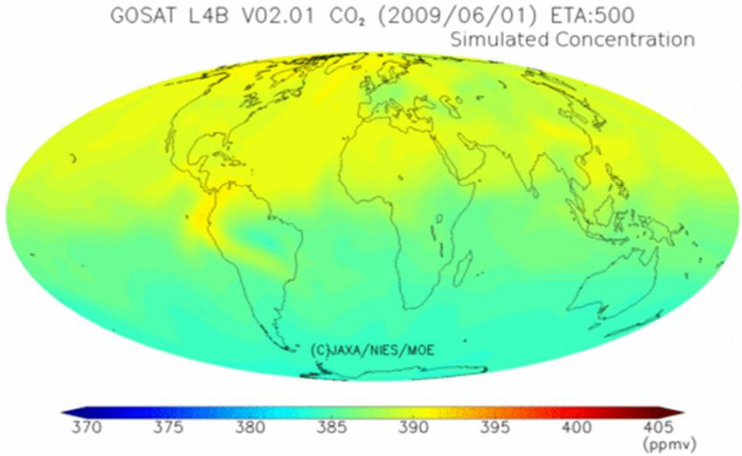
Altitude~800m



Altitude~3km



Altitude~5km



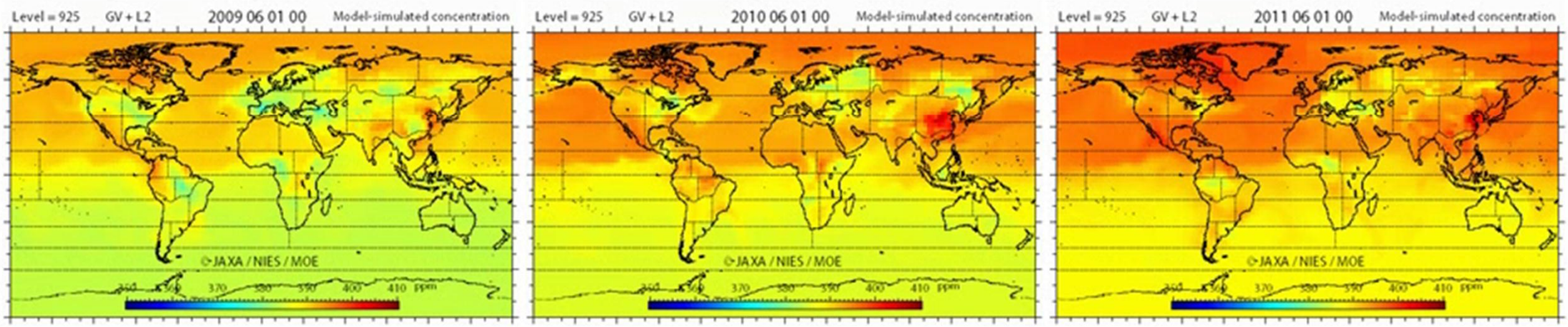
from GOSAT User Interface Gateway (GUIG)

GOSAT L4B Data Product
Model-simulated concentration

(6hr-step, 0.925 sigma-level, 2.5° × 2.5° grid)

MM DD HH
06 01 00

2009.6~2010.5 2010.6~2011.5 2011.6~2011.10



350 360 370 380 390 400 410 ppm

GOSAT referred in IPCC AR5

Atmospheric change of **CH_4** is monitored in vertical averaged concentration by remote sensing from ground-based instruments and space-borne satellites.

- Ground-based FTIR (Total Carbon Column Observing Network, TCCON; http://www.tccon.caltech.edu/)
- AIRS (since 2002; http://airs.jpl.nasa.gov)
- TES (since 2004; http://tes.jpl.nasa.gov)
- IASI (since 2006; Crévoisier et al., 2009)
- SCIAMACHY (2003–2012; Frankenberg et al., 2008)
- **GOSAT-TANSO-FTS (since 2009; Morino et al., 2011)**

- *In-situ* measurement is precisely (~0.2%) at limited surface locations.
- Satellite measurement is lower precision (~2%, currently ~0.7%) with global coverage.

Atmospheric change of CO_2 from satellite measurements is not referred in AR5.

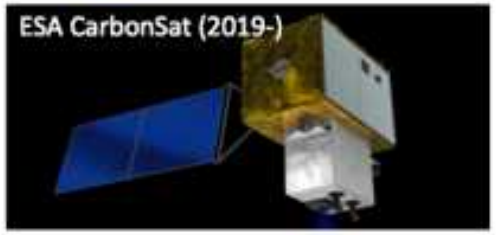
GOSAT-2 - the next GHGs mission

Timeline of Total Column CO2 Observing Satellites

Goal of the GOSAT series mission

Reduction of observation gap and flux estimation error	CO_2 observation and flux estimation with higher accuracy than GOSAT	Contribution to MRV approach to reduce GHGs emission	GHGs steady observation from space
GOSAT (2009～)	GOSAT-2 (2017～) **Early in 2018**	GOSAT-3	GOSAT-4 and after

from H24-10th SAC report, MOE and NIES, March 21, 2012



from Matsunaga's presentation, GOSAT workshop 2013, March 2013.

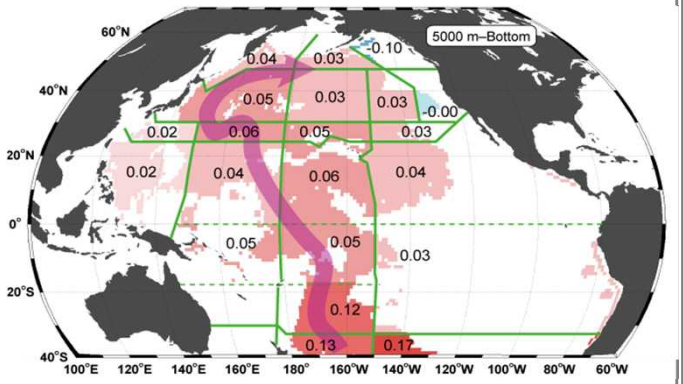
Examples of the earth observation research by MEXT

JAMSTEC 独立行政法人 海洋研究開発機構 JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY

Scientific Results from Ocean Climate Change Research Program of JAMSTEC

◆ Bottom Water Warming

- **High quality hydrographic observations were conducted** mainly in the Pacific Ocean.
- **Bottom water warming has been found in the almost entire region in the Pacific Ocean.**
- According to analyses using the Earth Simulator, **the warming trend is significant** and the possible process is that **change in air-sea interaction in the Southern Ocean could propagate into the north Pacific quickly.**



Horizontal distribution of heat content change rate in the layer between 5000m and the bottom of the Pacific (W/m²). Red indicates heat content increase. Purple arrow indicates a pathway of deep water formed in the Southern Oceans.

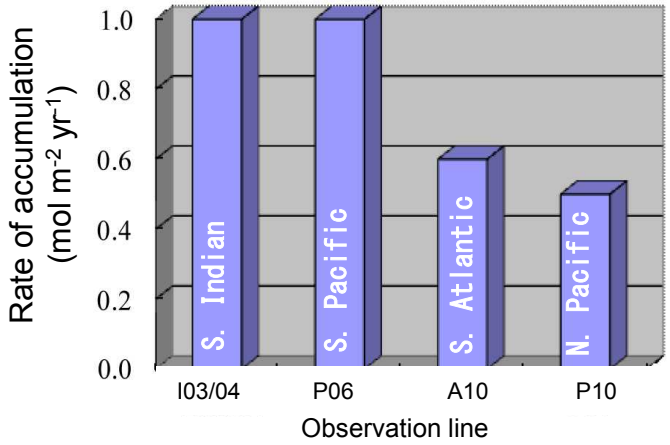
◆CO_2 uptake by the ocean

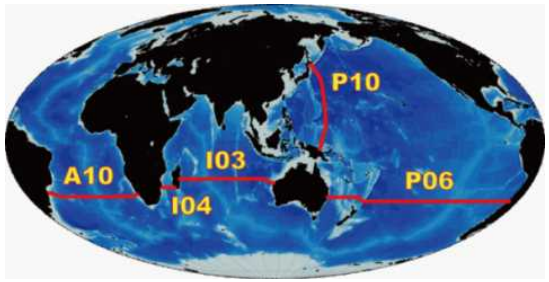
Murata et al. (2007; 2009; 2010)

- **Calculation of rates of [1]anthropogenic CO_2 accumulation in the North and South Pacific, South Atlantic, and South India by [2]Repeat Hydrography observations.**

*1CO_2 emitted into the atmosphere as a result of human activities such as burning of fossil fuels, deforestation, and cement production.

*2Program of ship-based trans-oceanic observation conducted over a decade for the purpose of collecting high-accurate data





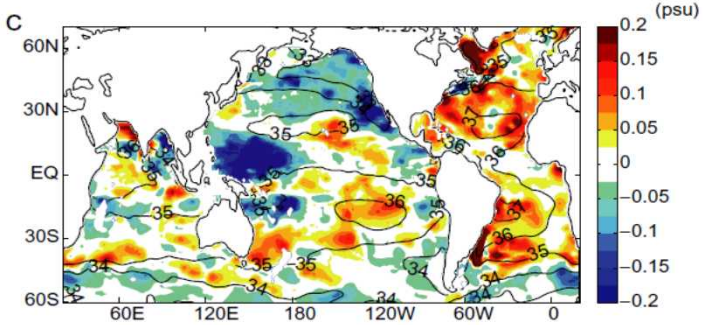
Repeat hydrography lines occupied by JAMSTEC

◆ Global water circulation enhancement

- Long term global surface salinity trend was detected comparing **Argo data for 2003-2007 with historical data in 1960-1989.**
- **High (low) salinity areas clearly became more saline (freshening) in the subtropical (subpolar /tropical) regions.**
- The intensification of surface salinity contrast suggests more excess evaporation (precipitation), indicating **an enhancement of global water cycle in association with the global warming.**

*3Argo is an international project that is conducted under the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of UNESCO (IOC) and other related institutions. The aim of the project is to build a real time, high resolution monitoring system for upper and middle layers of the world ocean.

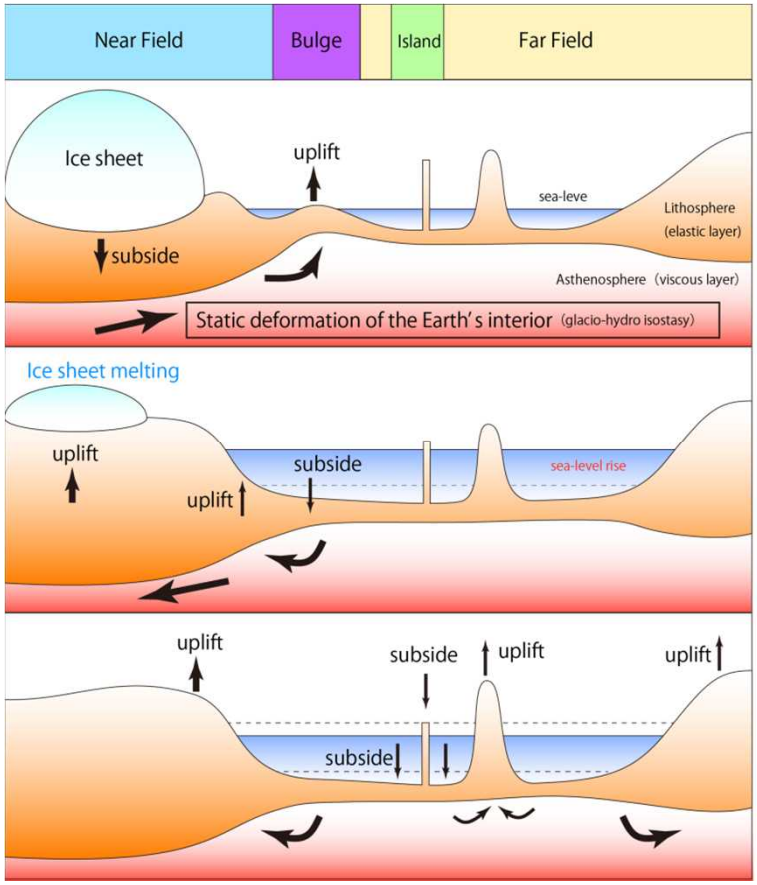
Surface salinity difference between 2003–07 and1960–89



Japan Argo: http://www.jamstec.go.jp/J-ARGO

Antarctic Research Expedition

Collaboration between CEREGE (CNRS, Aix-Marseille Univ.) and the Universities of Oxford and Tokyo and NIPR, clarified the timing and volume of the rapid ice sheet collapse associated with the abrupt climatic events during the last glacial-interglacial transition. This result is expected to make a significant contribution to understand the mechanism of climate change in comparison with the paleoclimate records obtained from the ice cores in Greenland and Antarctica.



Last Glacial Maximum (LGM)

- decrease sea water volume
- crustal subsidence by ice load in the glaciated region

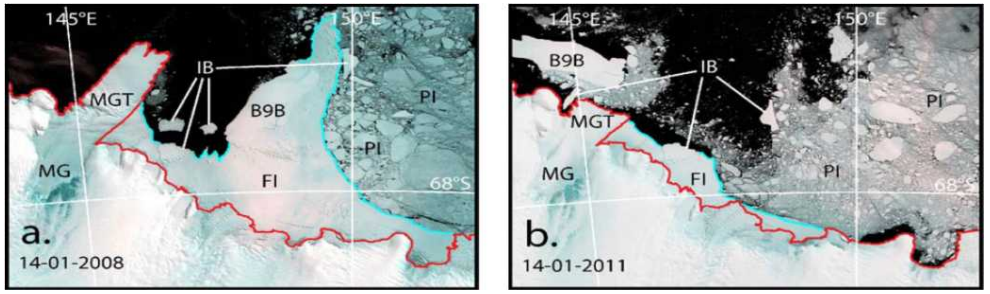
ca.14000 yr before present (Melt Water Pulse-1a event)

- sea-level rise by rapid ice sheet melting

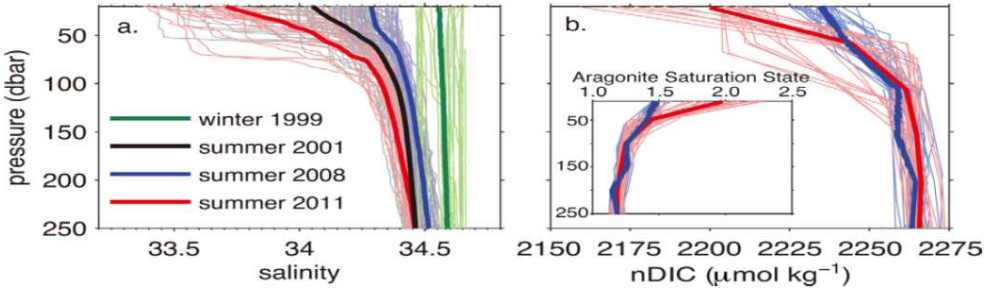
Present

- ocean floor subsidence by increased ocean water load

Calving of the Mertz Glacier Tongue (MGT) in February 2010 reduced sea ice production, dense water formation, AABW production from this region, and enhanced carbon uptake. Our study suggests that changes in the Antarctic icescape can also have substantial consequences for dense water formation, carbon uptake, and biological productivity of Antarctic shelf waters.



MODIS satellite images of the Mertz Polynya and surrounds. The areas of fast ice (FI) and pack ice (PI) and the location of iceberg B9B are indicated (a) before and (b) after MGT calving.



(a) Upper ocean salinity profiles and (b) nDIC profiles in the Mertz Polynya in winter 1999 (green), summer 2001 (black), summer 2008 (blue), and summer 2011 (red).

COP19 Japan's exhibits on space observations

Japan booth *[Level+2, No.74]*

- GOSAT & GOSAT-2
- GPM/DPR (GSMap)
- EarthCARE/CPR

NIES booth *[Level+1, No.54]*

- GOSAT & GOSAT-2