

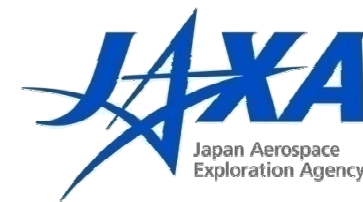
# Overview of IBUKI, the Greenhouse Gases Observing Satellite (GOSAT)

Japan Aerospace Exploration Agency



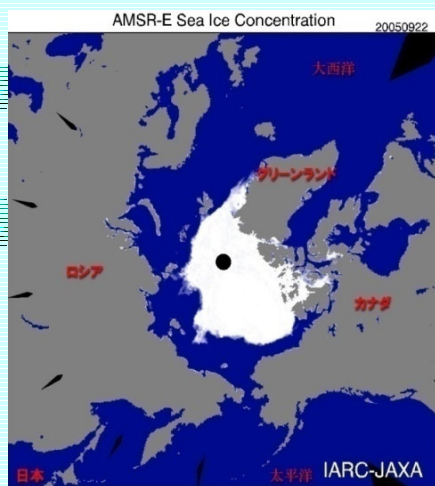
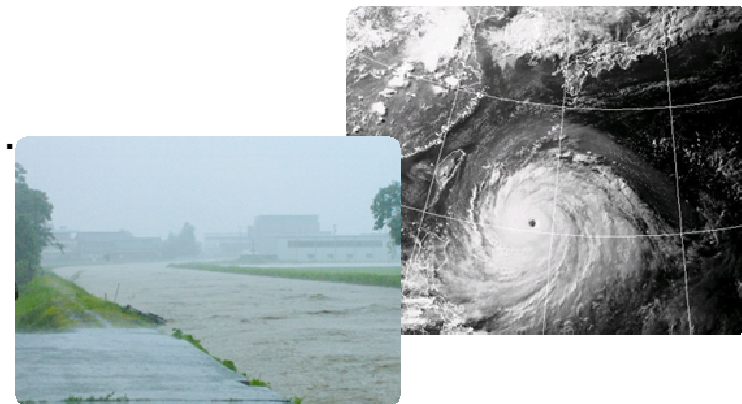


# Background

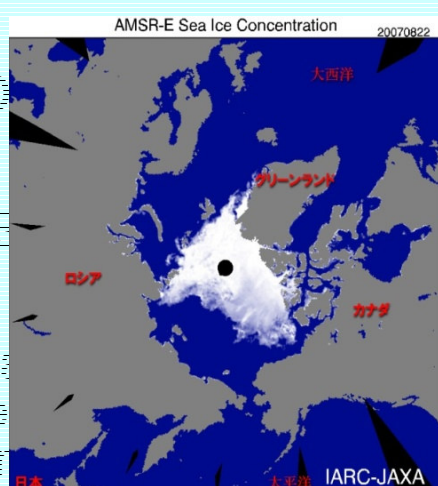


## Global warming:

- Very serious problem for human beings
- Cause of extreme weather events
  - Heavy rain, Typhoon, Heat wave, Drought ...
- Rising sea level
  - Melting Arctic ice, Tuvalu ...
- Ecosystem changes
- Food and water shortage etc...



Sep. 2005



Sep. 2007

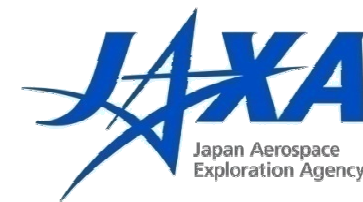
Change of Arctic sea-ice concentration  
(by AMSR-E (JAXA) boarded on Aqua(NASA))



... temperatures since  
... observed increase in



# Background



To understand the mechanism of global warming  
To promote countermeasures against global warming



Need to monitor the global distribution of  
greenhouse gases concentration

CO<sub>2</sub> and CH<sub>4</sub> are the primary contributors to greenhouse effect.  
(According to the 4th Assessment Report of IPCC, almost 80% of temperature gain is being caused by effects from these gases)

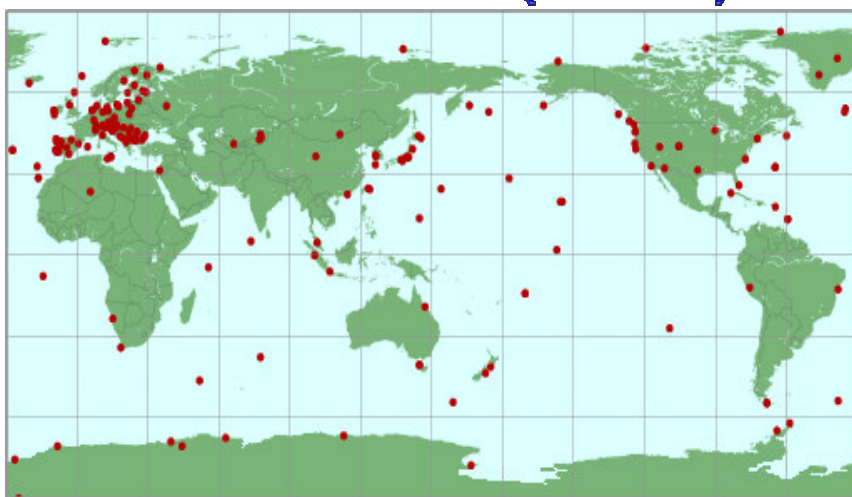


# Background



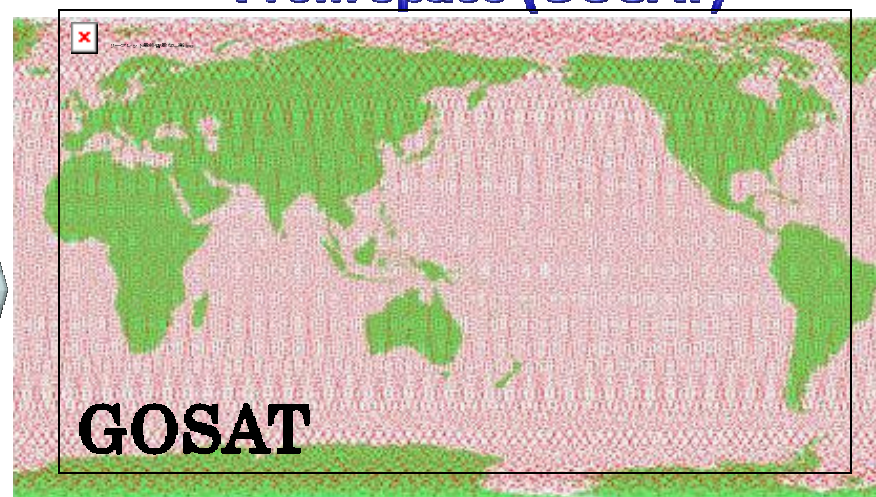
## GHG observing points

### Ground Stations (Current)



(By WDCGG)

### From space (GOSAT)



- **286 ground stations** in the world (as of May. 2009)
- The number of stations is limited, and they are distributed unevenly around the world.

- **Over 56,000 points every 3 days**
- Global and frequent observation with single instrument

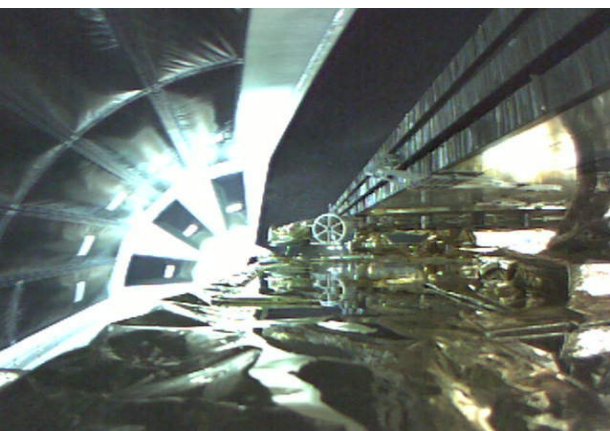
WDCGG: World Data Centre for Greenhouse Gases



# Launch



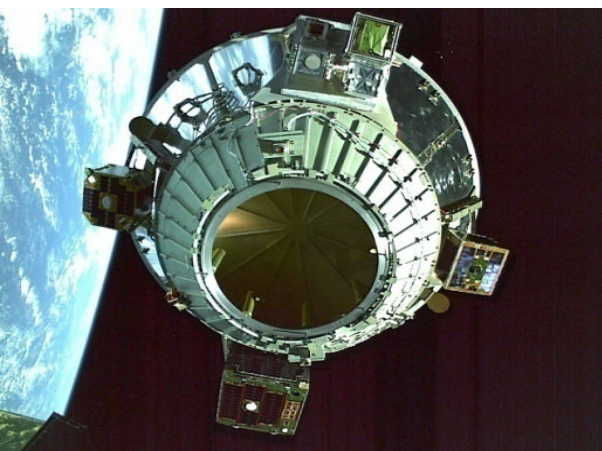
The GOSAT was launched by the H-IIA Launch Vehicle No.15 at 3:54 a.m. on January 23, 2009(UT) from the Tanegashima Space Center, and the separation of the GOSAT was confirmed at 16 minutes after lift-off.



← Fairing Separation



Solar Array deployment



← Separation of GOSAT (H-IIA second stage, PAF, and 7 small satellites)



Launch of GOSAT

←The photographs taken by the CMOS camera on the GOSAT

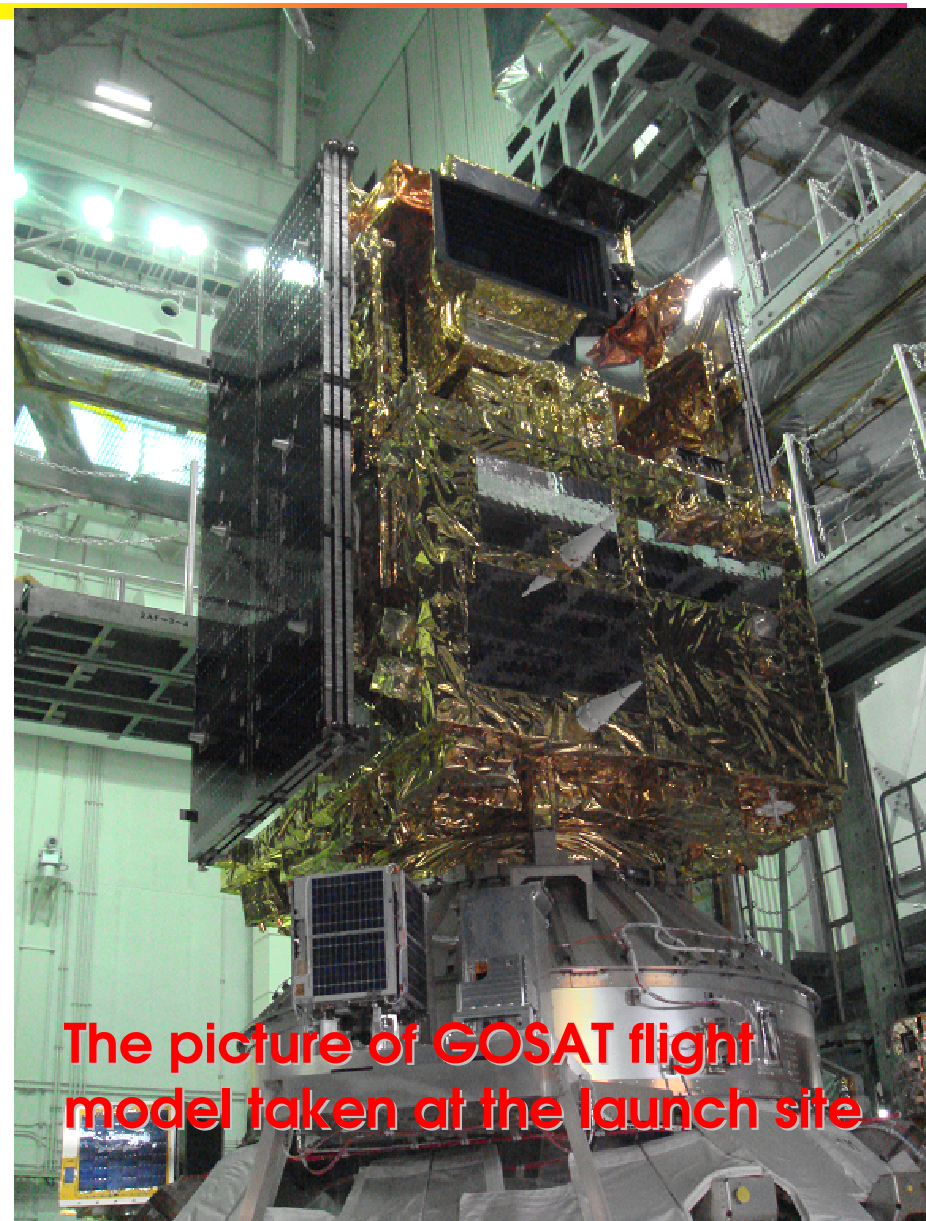


# Overview of IBUKI (GOSAT)



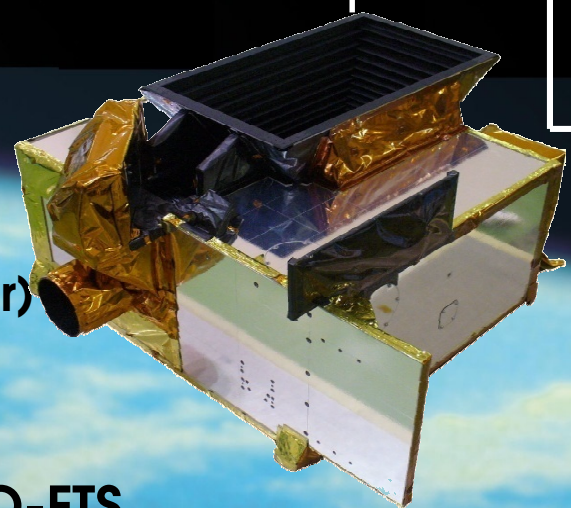
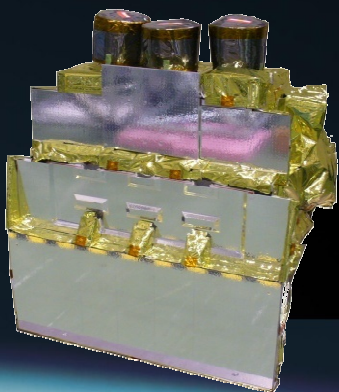
## GOSAT:

- ✿ The **G**reenhouse gases **O**bserving **SAT**ellite.
- ✿ A satellite to monitor global distribution of **Greenhouse Gases (GHG)**;
  - ✿ Carbon dioxide and Methane
  - ✿ at 100-1000km spatial scale
  - ✿ with relative accuracy of 0.3-1% (1-4ppm) for CO<sub>2</sub> and 0.6-2% (10-34ppb) for CH<sub>4</sub>
- ✿ A joint project of
  - ✿ JAXA (Japan Aerospace Exploration Agency),
  - ✿ MOE (Ministry of the Environment) and
  - ✿ NIES (National Institute for Environmental Studies).





# Main Specifications



<b>Size</b>	<b>Main body</b>	<b>2.0m x 1.8m x 3.7m (Wing Span 13.7m)</b>
<b>Mass</b>	<b>Total</b>	<b>1,750 kg</b>
<b>Power</b>	<b>Total</b>	<b>3.8 kW (EOL)</b>
<b>Life Span</b>	<b>5 years</b>	
<b>Orbit</b>	<b>Altitude</b>	<b>666km</b>
	<b>Inclination</b>	<b>98deg</b>
	<b>Recurrent Period</b>	<b>3 days</b>
<b>Launch</b>	<b>Vehicle</b>	<b>H-IIA</b>
	<b>Date</b>	<b>January 23, 2009</b>

**Sub:**  
**TANSO-CAI**  
**(Cloud and Aerosol Imager)**

**Main:**  
**TANSO-FTS**  
**(Fourier Transform Spectrometer)**

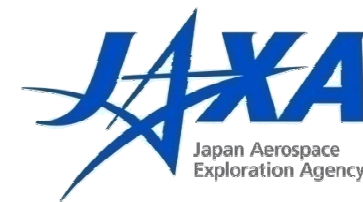
**TANSO=**  
**Thermal And Near infrared**  
**Sensor for carbon**  
**Observation**







# Observation pattern

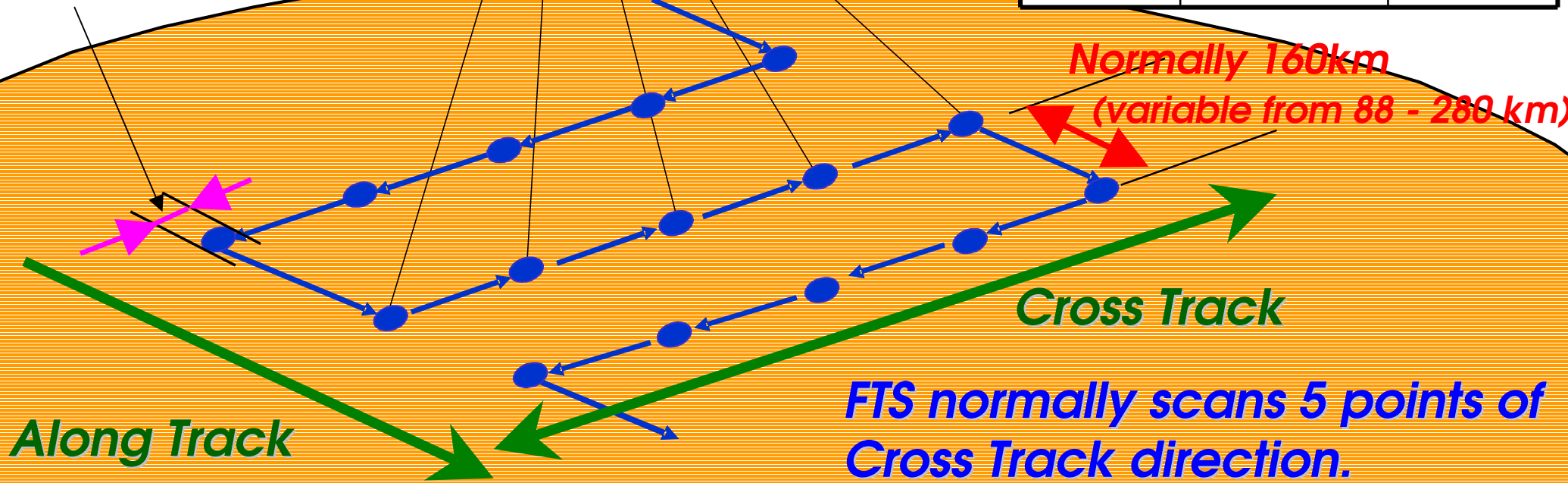


Footprint

**FTS IFOV: 10.5 km**

(IFOV: Instantaneous field of View)

Cross-track pattern	Distance bet. points (at 30deg in latitude)	Exposure (sec)
1	790 km	4x3
3	260 km	4x3
5	160 km	4
7	110 km	2
9	88 km	1

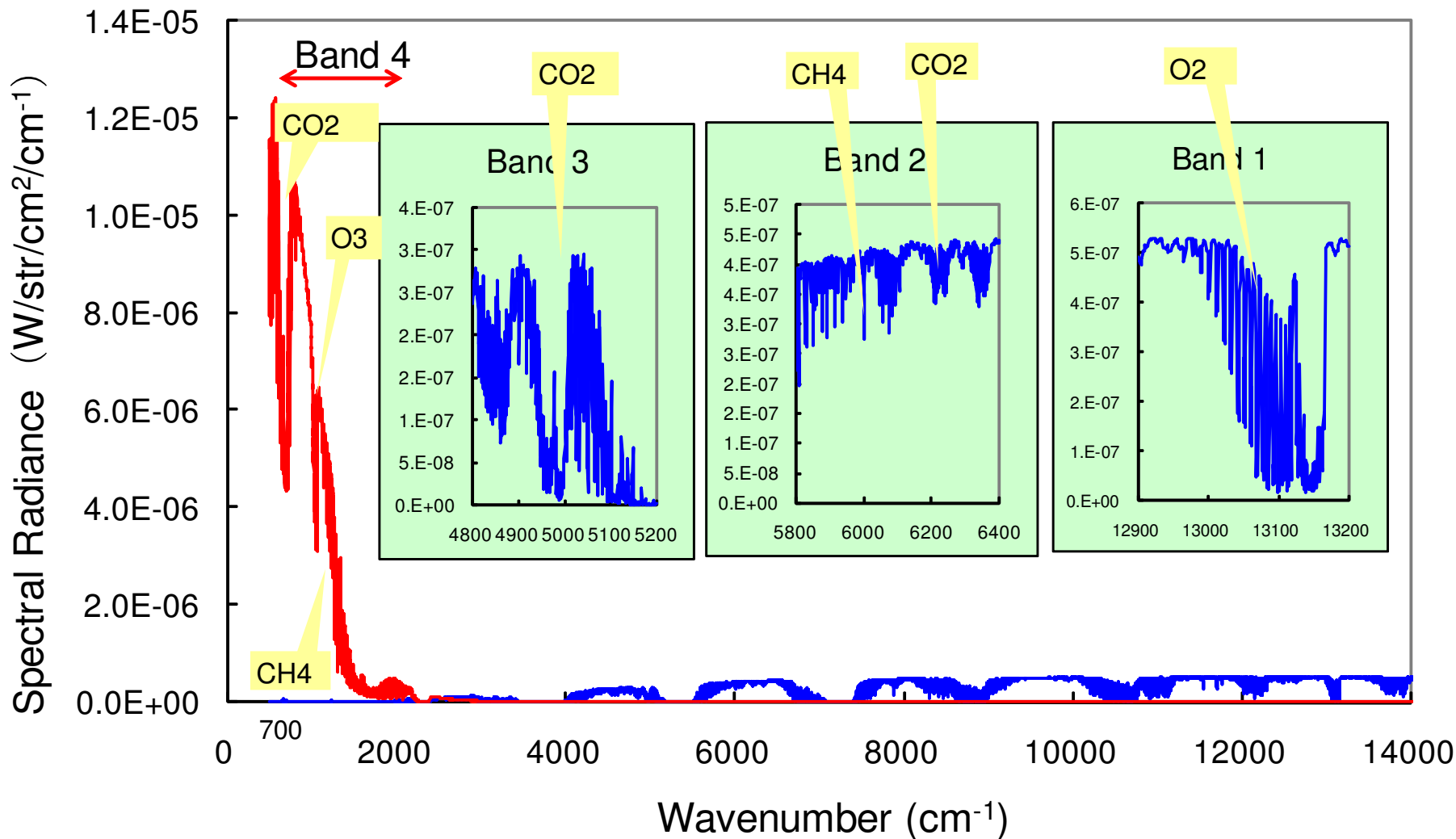




# Observation bands of TANSO-FTS



This figure shows the detectable region of TANSO-FTS.

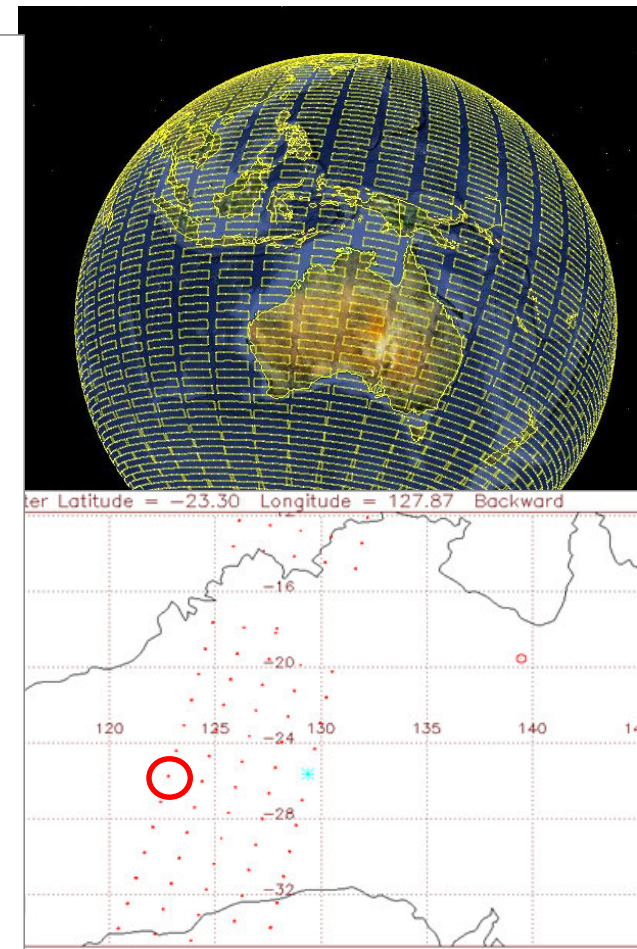
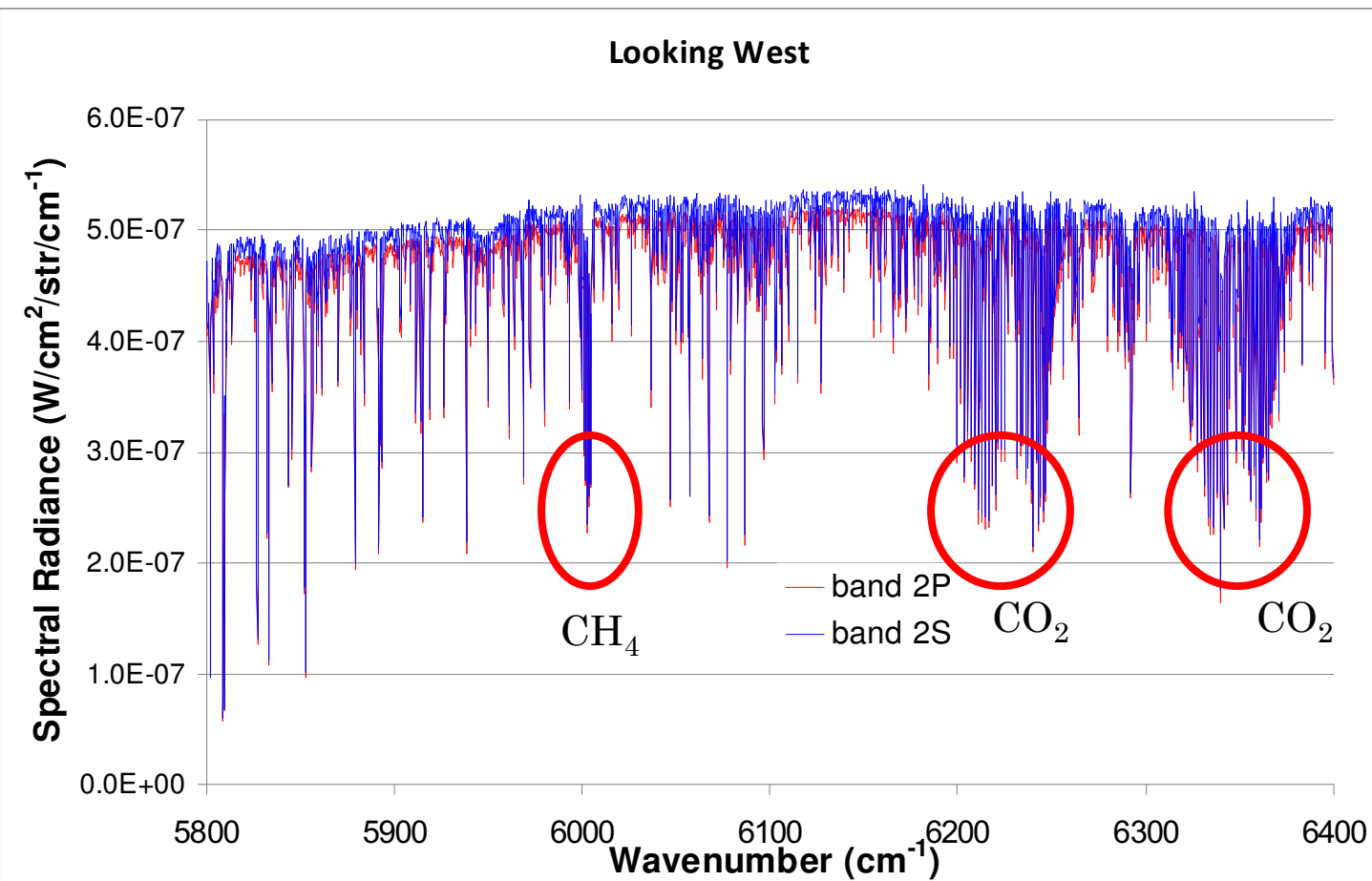




# Flight data of TANSO-FTS

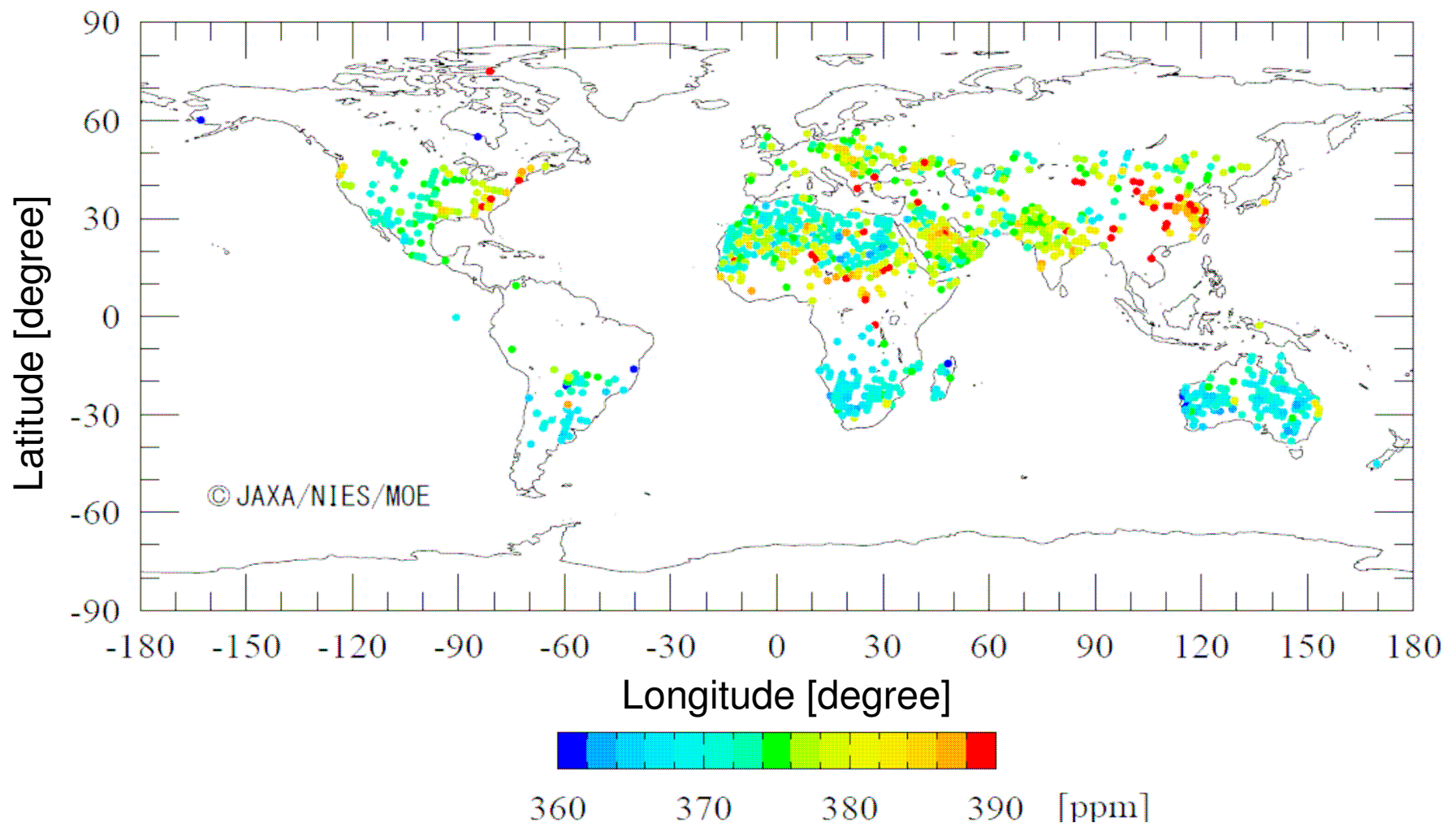


Spectral data of April 8, 2009 Over the Australia, Looking west.



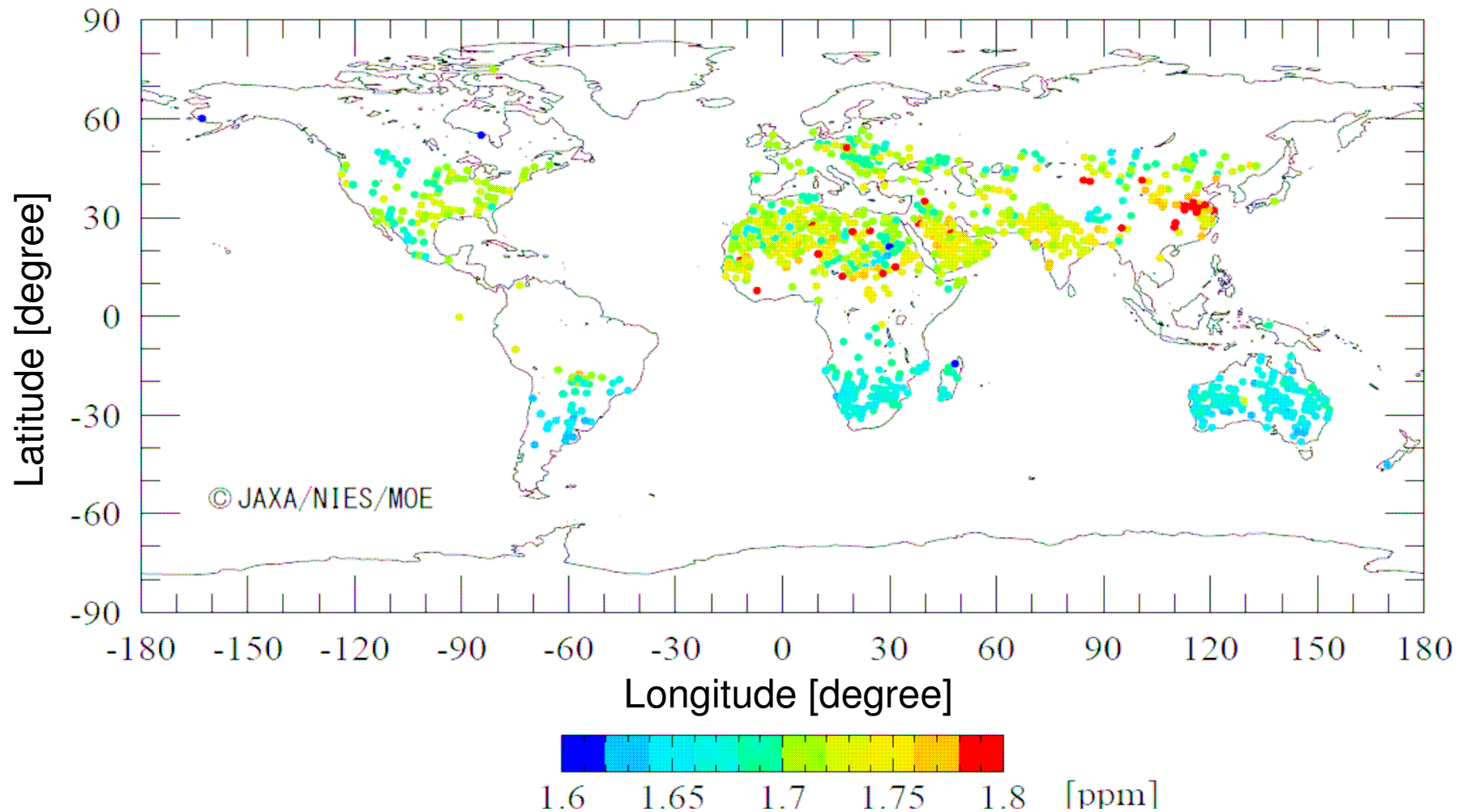
L1B data of Band2

# First analysis of **Carbon dioxide** column averaged density (preliminary) (Observation data from April 20 to April 28)



- The hemispheric gradient with larger values over the North Hemisphere is consistent with other measurements.
- Derived CO2 values are generally lower than model predictions, because of using uncalibrated radiance spectrum data.

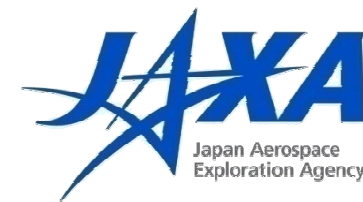
# First analysis of **Methane** column averaged density (preliminary) (Observation data from April 20 to April 28)



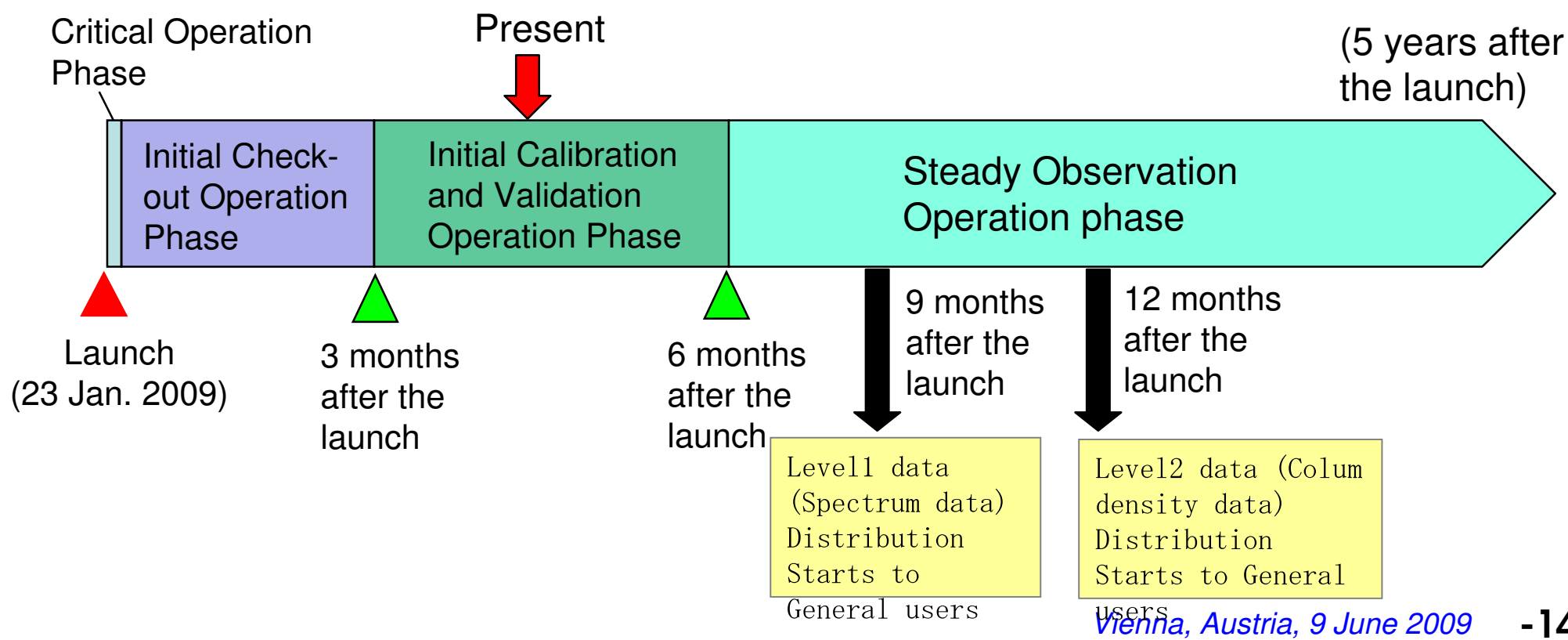
- The hemispheric gradient with larger values over the North Hemisphere is consistent with other measurements.
- Derived CH<sub>4</sub> values are generally lower than model predictions, because of using uncalibrated radiance spectrum data.



# Satellite operation plan and Data distribution plan



- The distribution of the data taken by IBUKI
  - was previously started on 23 April 2009, to the researchers approved and registered who are studying calibration, validation and algorithm.
  - will be started at 23 Oct. 2009 and 23 January 2010, to general users.





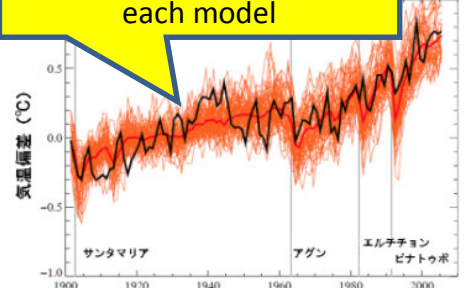
# GOSAT contributions to IPCC and COP



## Global warming prediction using global climate models

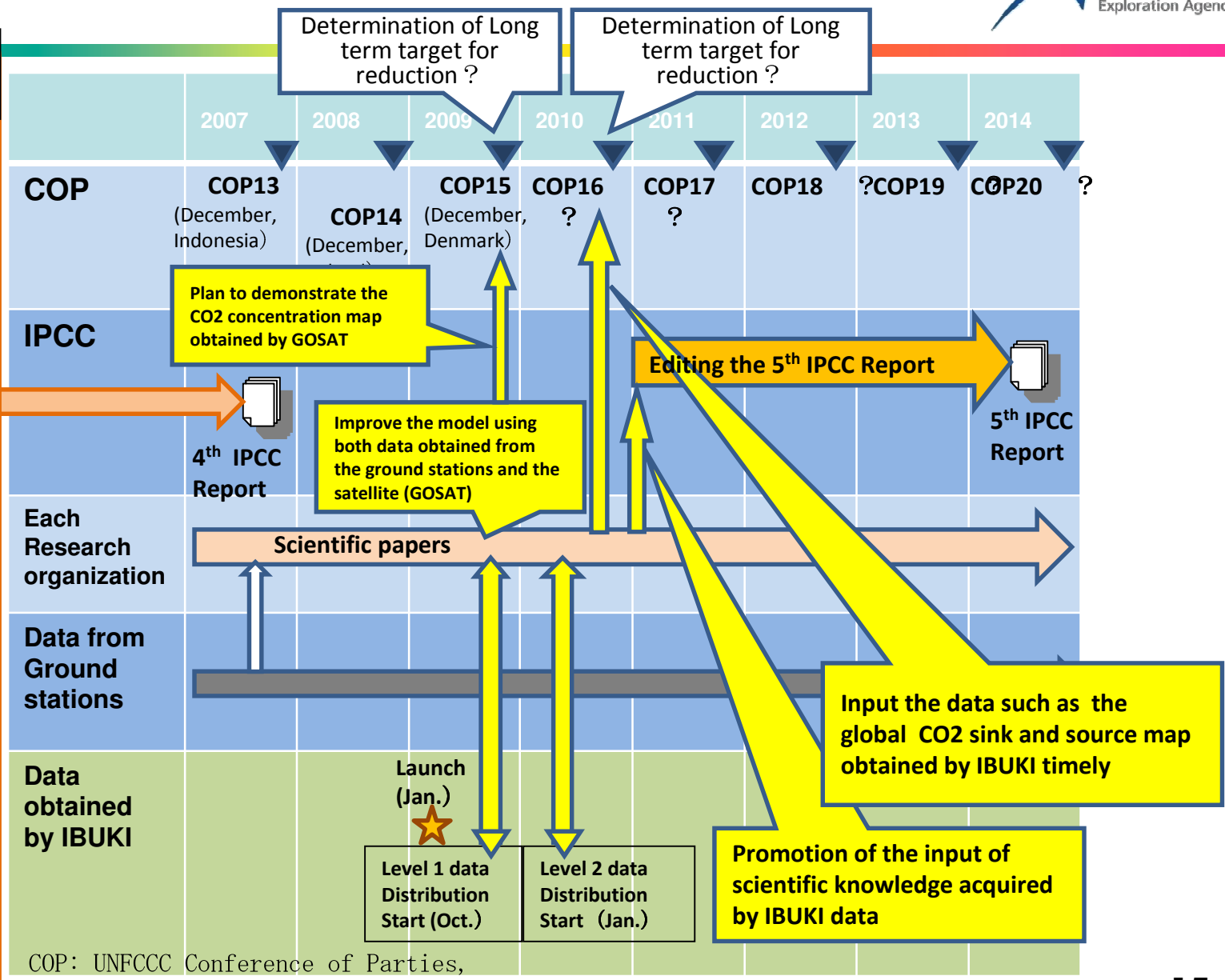
No.	Model	Researcher	Country	No.	Model	Researcher	Country
1	BCM2D	Researcher		12	IPDL-CM2.1	Dynamic Laboratory (GFDL)	USA
2	CCSM3	National Center for Atmospheric Research	USA	13	ES-S-AOM	National Aeronautics and Space Administration (NASA)	USA
3	CGCM3.1 (G4)	Canadian Centre for Climate Modelling and Analysis	Canada	14	ES-EH	National Institute for Space Science and Space Technology (NASDA)	Japan
4	CGCM3.1 (G3)			15	ES-SR		USA
5	ENM4-CM3	Meteo-France/Centre National de Recherches Meteorologiques	France	16	NM-CM3.0	Institute for Numerical Meteorology	Russia
6	CSIRO-Mk3.0	Commonwealth Scientific and Industrial Research Centre	Australia	17	PSL-CM4	Centre Pierre Simon Laplace	France
7	ECHAM5-MPI-OM	Max-Planck Institute for Meteorology	Germany	18	MRO-C3.2 (G1)	Center for Global System Research (東京大学, National Institute for Environmental Studies)	Japan
8	ECHAM5			19	MRO-C3.2 (G2)		Japan
9	ECHAM5			20	MRI-CGCM2.3.2a	Metropolitan Research Institute	Japan
10	FGOALS-g1	National Key Laboratory of Numerical Modeling for Middle and High Atmosphere Sciences and Earth Surface Sciences and Data Processing Center	China	21	PCM	National Center for Atmospheric Research	USA
				22	UKMO-	Hadley Centre for Climate Prediction	UK

Large difference between each model



## Comparison with atmospheric transport models (TRANSCOM)

No.	Model	Researcher	Country	No.	Model	Researcher	Country
1	AM2	NOAA/GFDL	USA	14	TEAM	CCSR 東京大学 気候システム研究センター	Japan
2	AM2t	NOAA/GFDL	USA	15	NES05	NIES 国立環境研究所	Japan
3	CCAM	CSIRO	Australia	16	PCM	CSU	USA
4	CCSR_NES1	FRCCG 地球環境フロンティア研究センター	Japan	17	PCM	GSFC	USA
5	CCSR_NES2	FRCCG 地球環境フロンティア研究センター	Japan	18	REM0	MPBGC	Germany
6	CDTM	JMA (気象庁)	Japan	19	STAG	AIST 産業技術総合研究所	Japan
7	CHMERE	LSCF	France	20	STAGN	AIST 産業技術総合研究所	Japan
8	COMET	ECN	Netherlands	21	TM3_Jg	MPBGC	Germany
9	DEHM	NERI	Denmark	22	TM3_Jg	MPBGC	Germany
10	FS	ECMWF	UK	23	TM5_at10x2	NOAA/ESRL	USA
11	MFACT	LLNL	USA	24	TM5_atm1x1	NOAA/ESRL	USA
12	LMZJ	LSCF	France	25	TM5_atm1x1	SRON	Netherlands
13	LMZJ_THERM	LSCF	France				



COP: UNFCCC Conference of Parties,  
 IPCC: Intergovernmental Panel on Climate Change

Vienna, Austria, 9 June 2009



# Conclusion



- ✿ GOSAT was launched on 23 January 2009.
- ✿ The initial check out was completed on 10 April.
- ✿ It was confirmed that all function of the mission instruments, TANSO-FTS and TANSO-CAI work normally together with the satellite bus.
- ✿ The initial calibration and validation phase has started and will continue until around the end of July.
- ✿ The distribution of the GOSAT data was started on 23 April 2009 to the registered researchers and it will be extended to general users from 23 October and 23 January 2010 respectively.
- ✿ The press release about the first analysis result of the carbon dioxide and methane was issued on 28 May 2009.