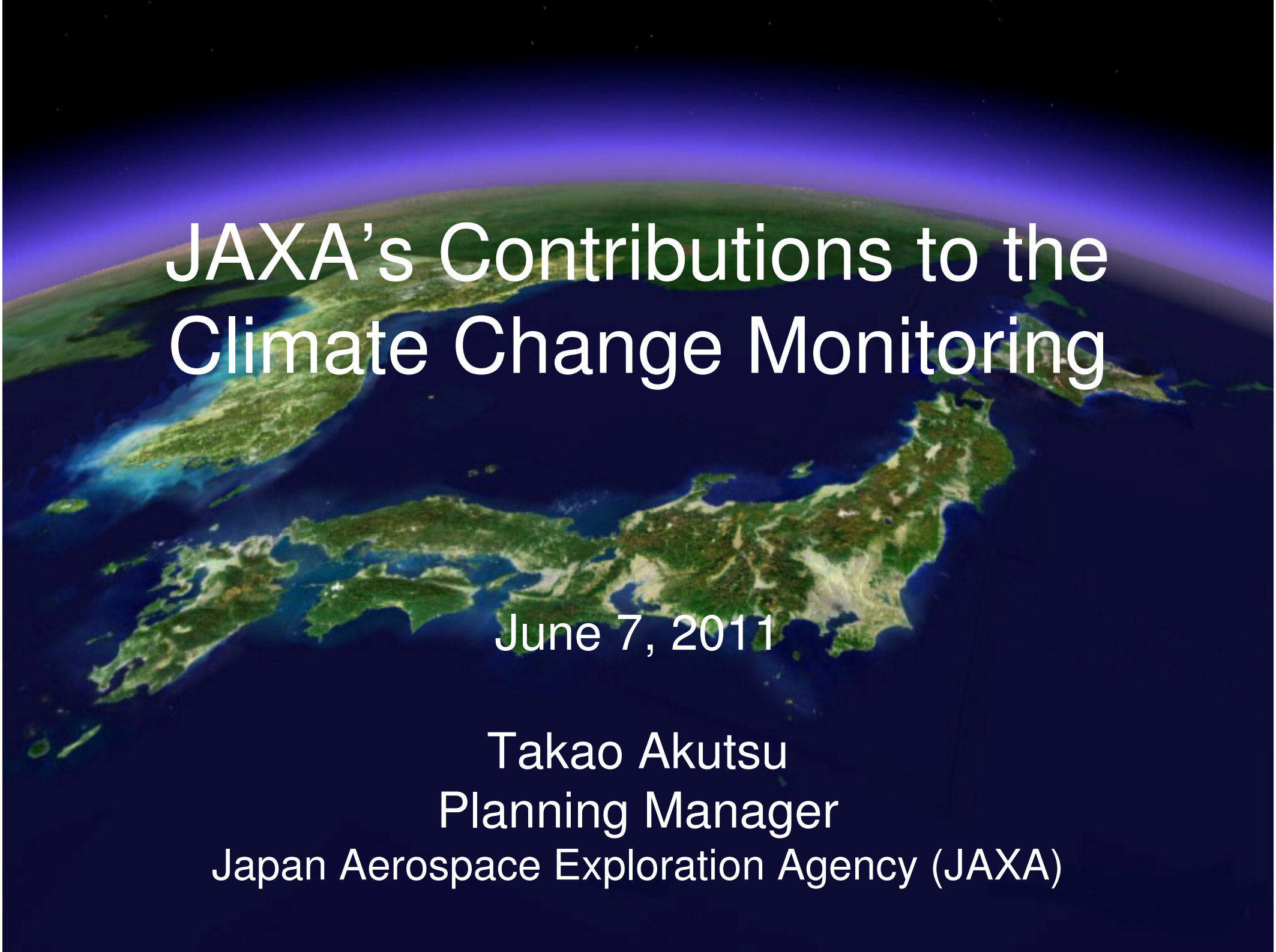


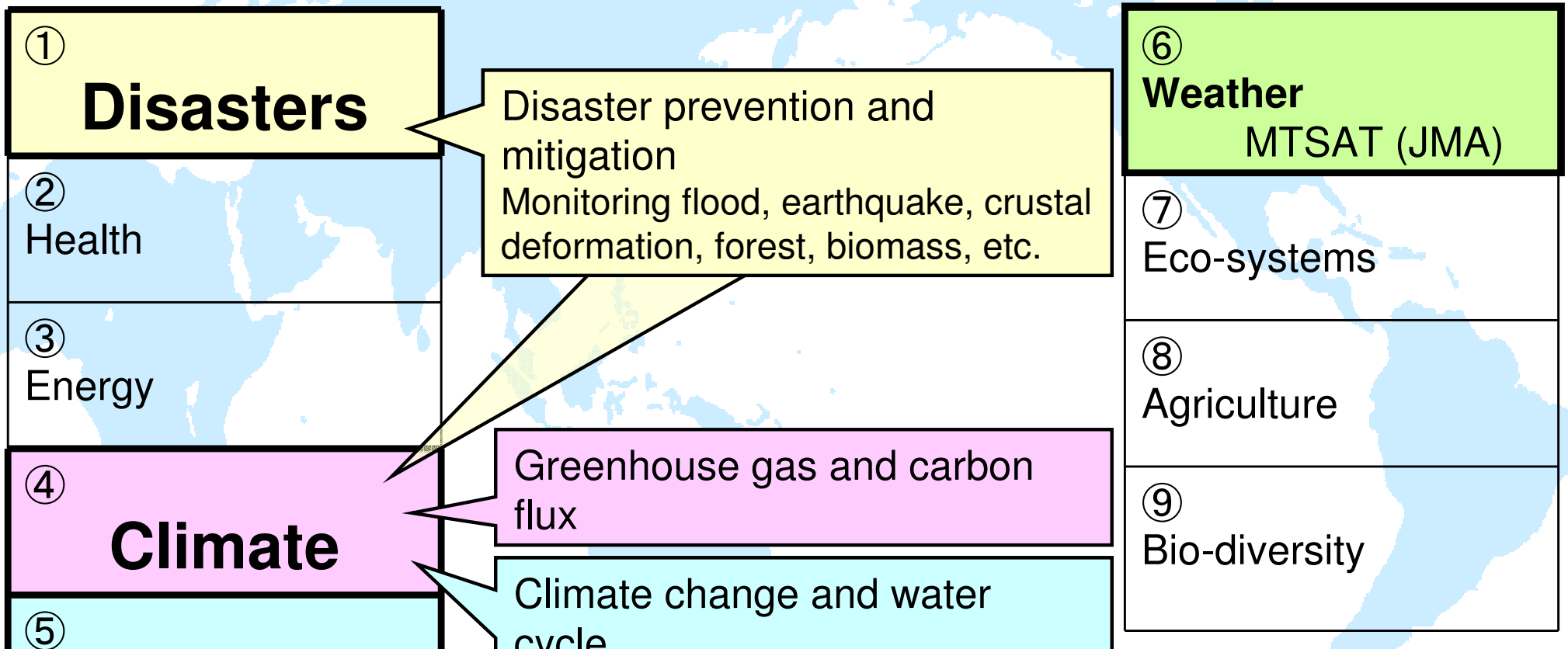
JAXA's Contributions to the Climate Change Monitoring

June 7, 2011

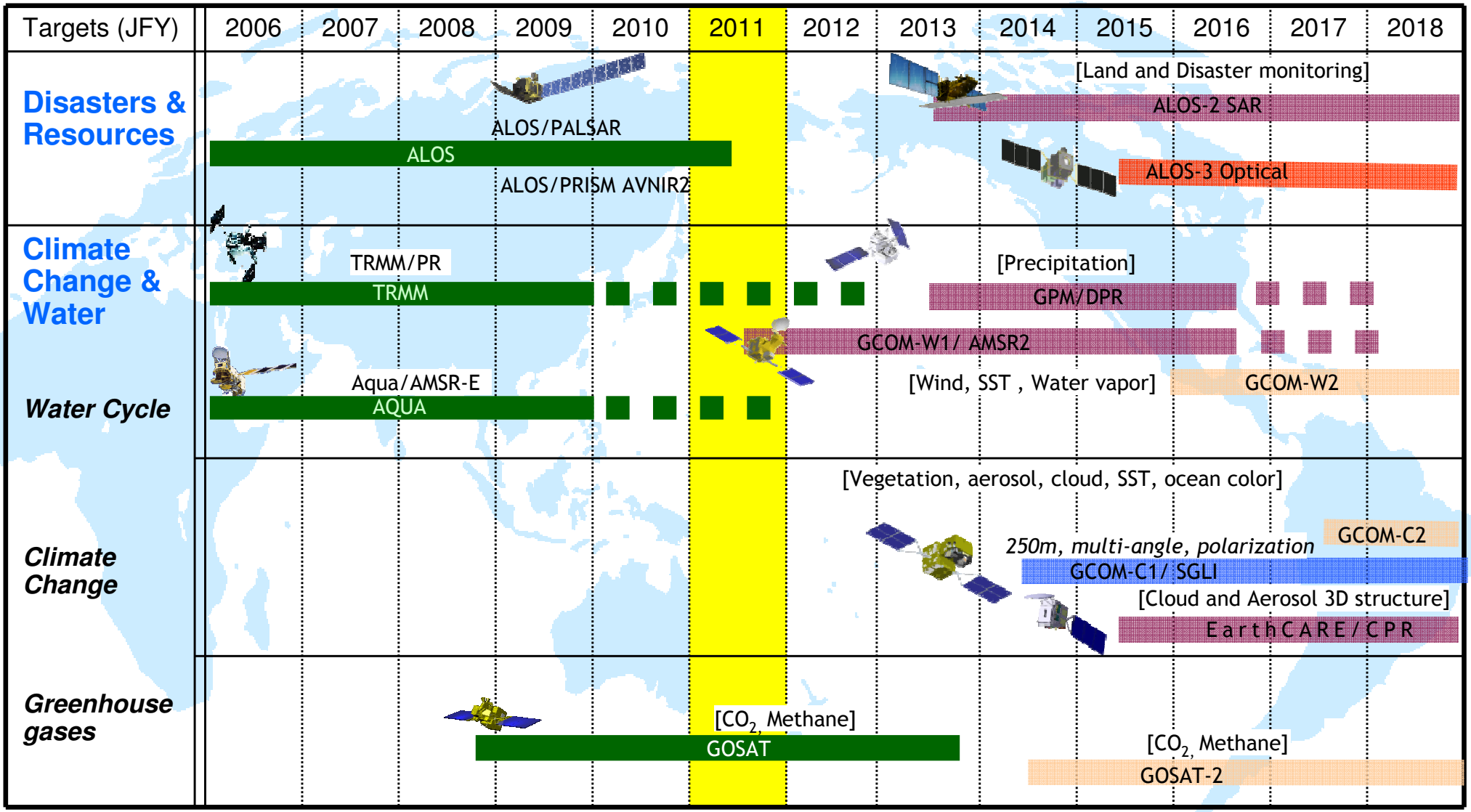
Takao Akutsu
Planning Manager
Japan Aerospace Exploration Agency (JAXA)

Japanese Main Activities of Earth Observation

GEOSS 10 years implementation plan



Long-Term Plan of JAXA Earth Observation



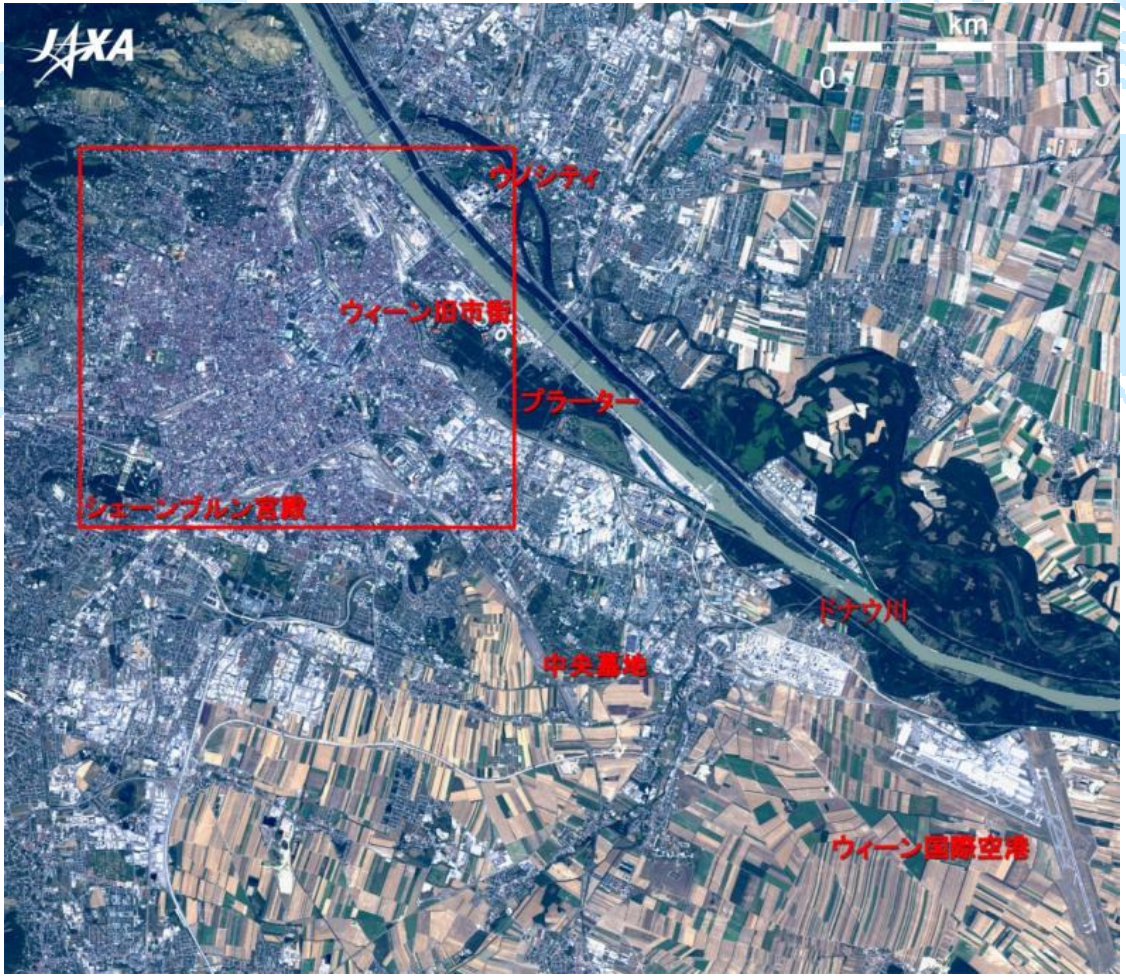
Mission status

On orbit | Phase C/D | Phase B | Phase A | Pre-Phase A | Extension

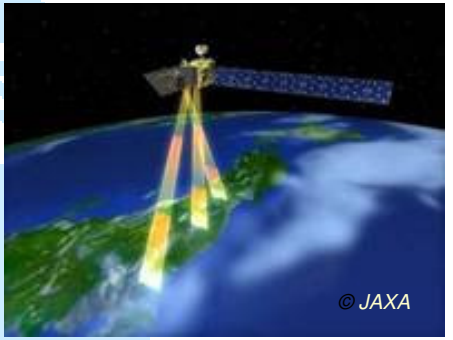
Advanced Land Observing Satellite (ALOS)

ALOS

- Disaster monitoring
- Cartography
- Regional observation
- Resources surveying

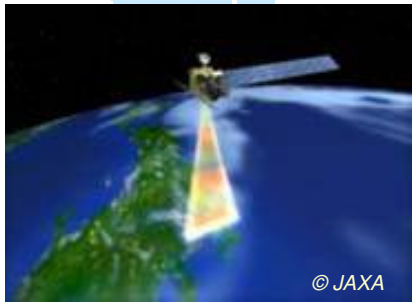


ALOS AVNIR-2 image over Vienna observed on July 27, 2007



PRISM

Panchromatic Remote sensing Instrument for Stereo Mapping



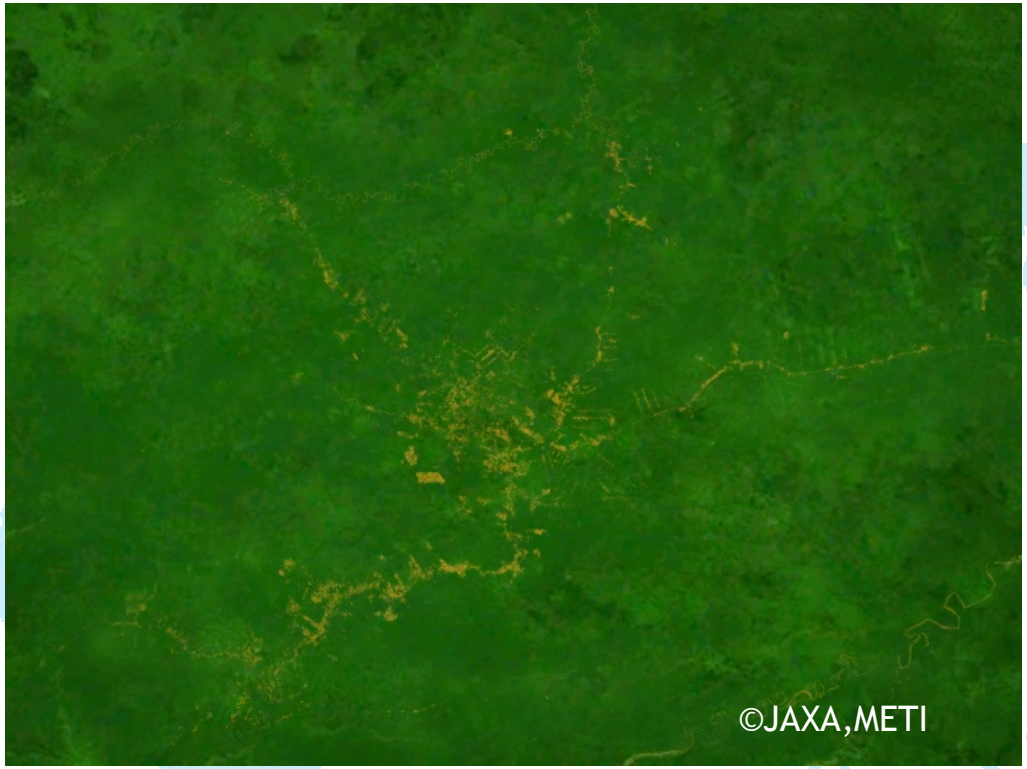
AVNIR-2

Advanced Visible and Near Infrared Radiometer type 2

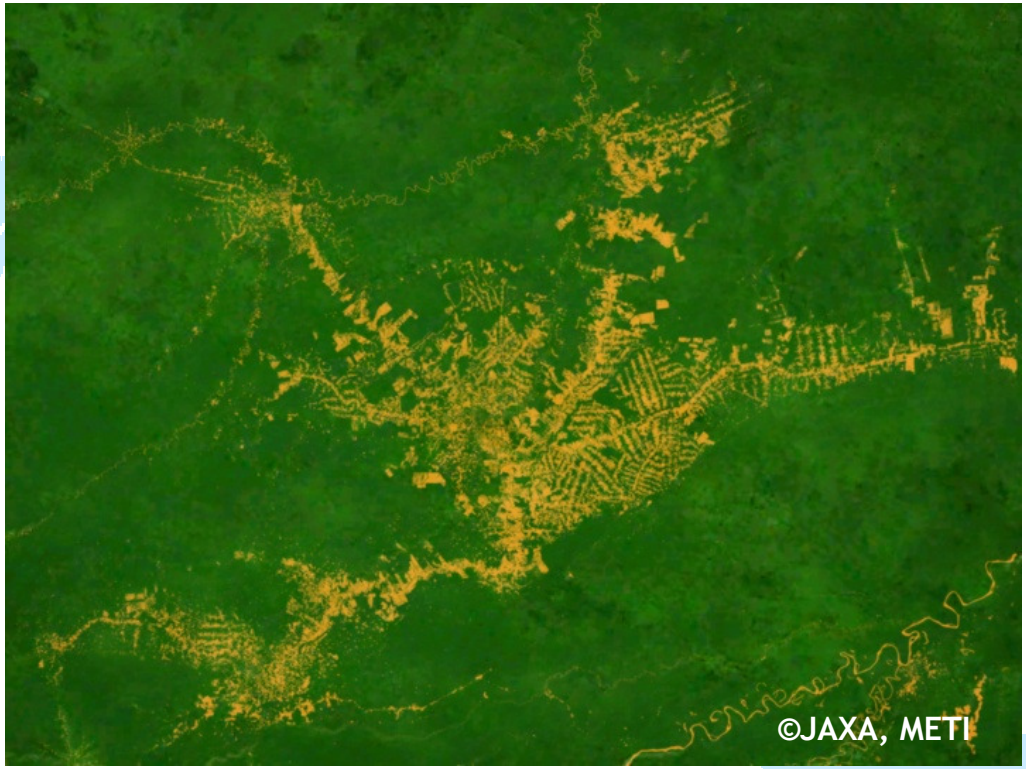
PALSAR

Phased Array type L-band Synthetic Aperture Radar

Monitor the Forest in Amazon (illegal logging)



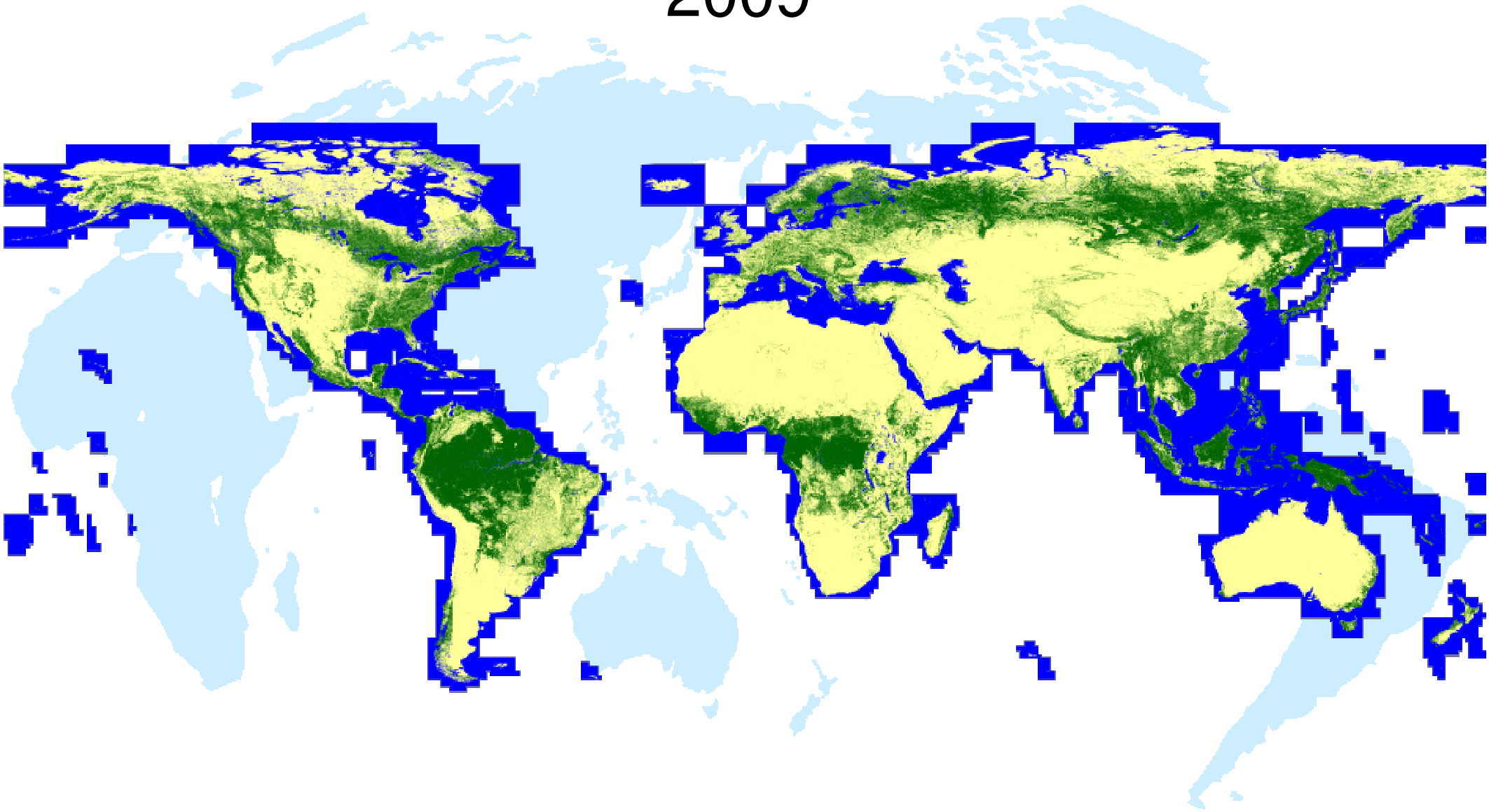
1995 (JERS-1)



2007 (ALOS)

- **Within seven days after the data acquisitions, JAXA provides the quickly processed SAR images to IBAMA.**
- **The data are being utilized for the illegal deforestation monitoring.**
- **JAXA initiates REDD+ cooperation using ALOS with INPE last November. JAXA and INPE will verify the utilisation of the SAR onboard ALOS to monitor tropical deforestation.**

PALSAR 10m Global Forest/Non-Forest Map 2009



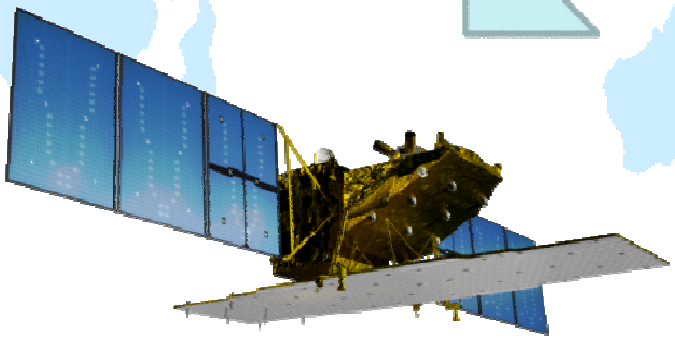
ALOS to ALOS-2 and ALOS-3

ALOS Jan. 2006-May 2011

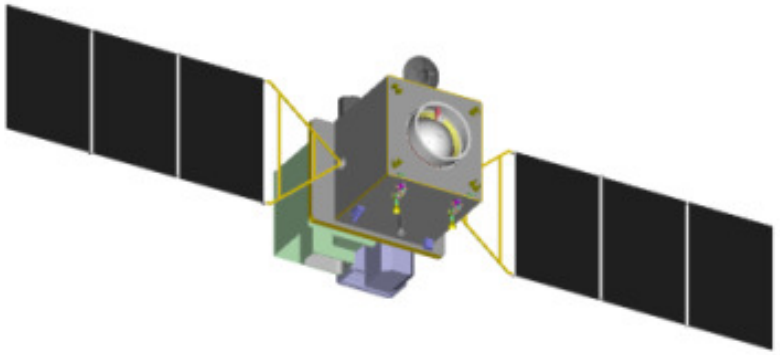
PALSAR

PRISM

AVNIR-2



ALOS-2 (SAR satellite)
Launch 2013

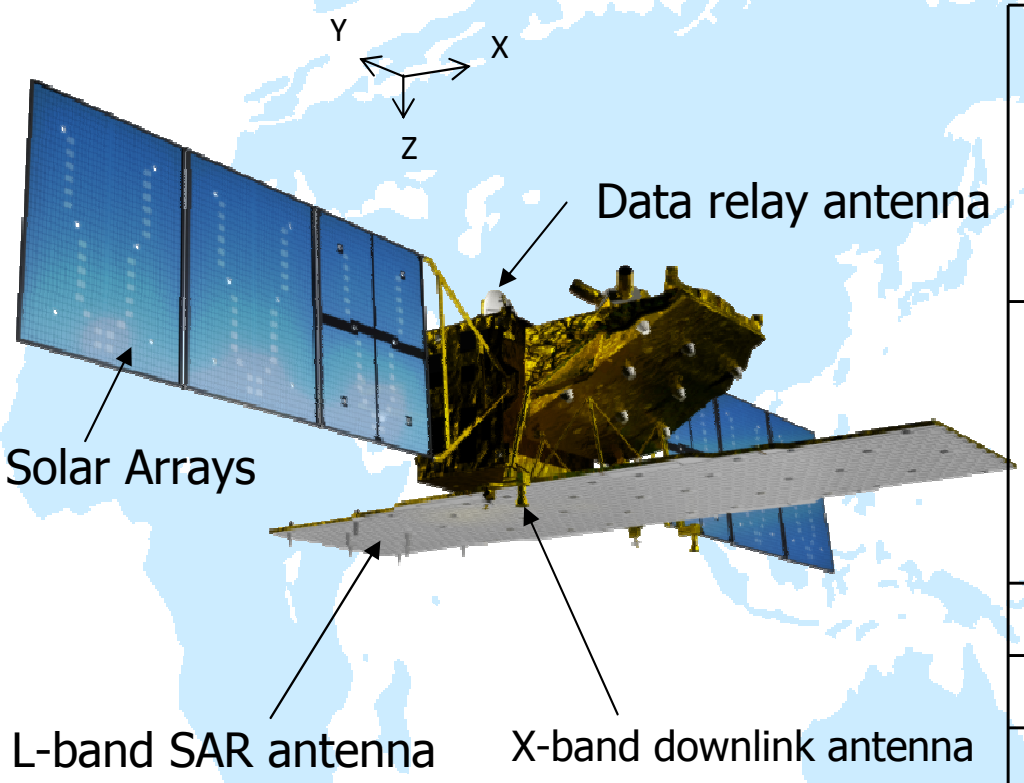


ALOS-3 (Optical satellite)
Launch 2015

ALOS-2 satellite

Phase C/D

ALOS-2 in-orbit configuration



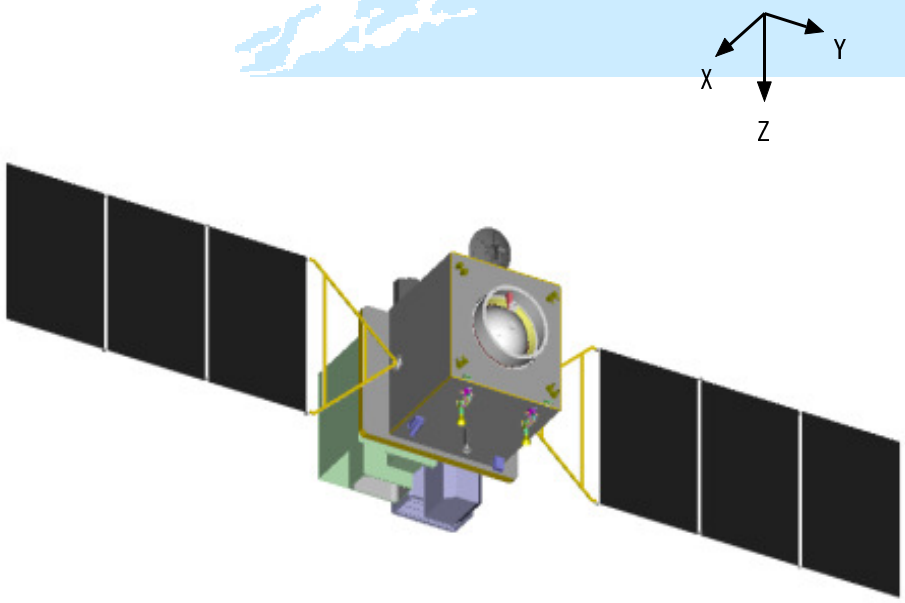
Specification

Observation mode	Stripmap: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km swath Spotlight: 1×3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: 14days Orbit control: ≦+/-500m
Life time	5 years (target: 7 years)
Launch	JFY2013, H-IIA launch vehicle
Downlink	X-band: 800Mbps(16QAM) 400/200Mbps(QPSK) Ka-band: 278Mbps (QPSK)

Experimental	Compact InfraRed Camera (CIRC)

ALOS-3

Phase A



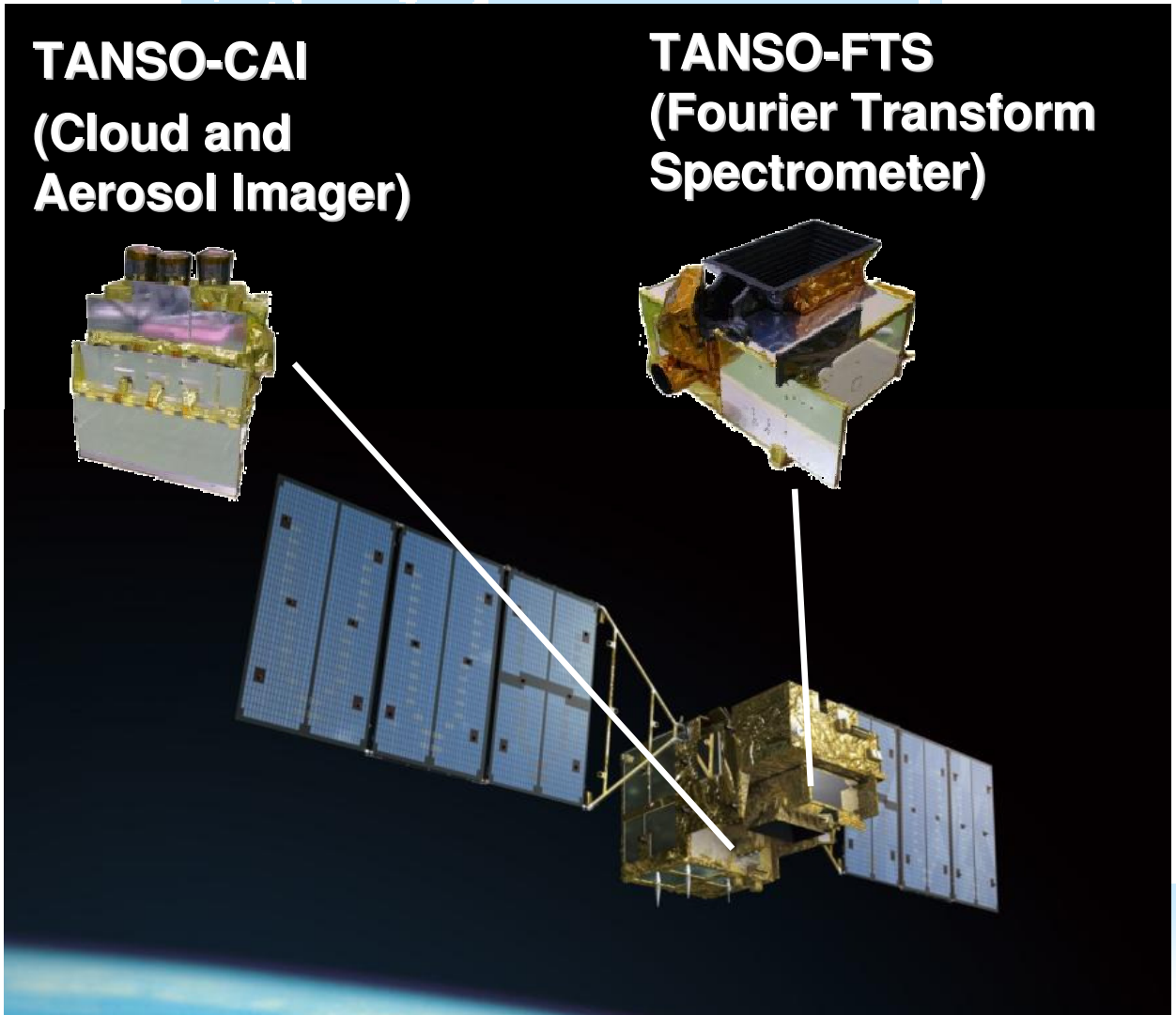
ALOS-3 in-orbit configuration

ALOS-3 mission
Panchromatic observation 0.8 m GSD and 50km wide swath
Stereo images by nadir-looking and backward-looking panchromatic imagers
Multi-spectral(4 bands) observation
Near real-time data transmission using data relay satellite

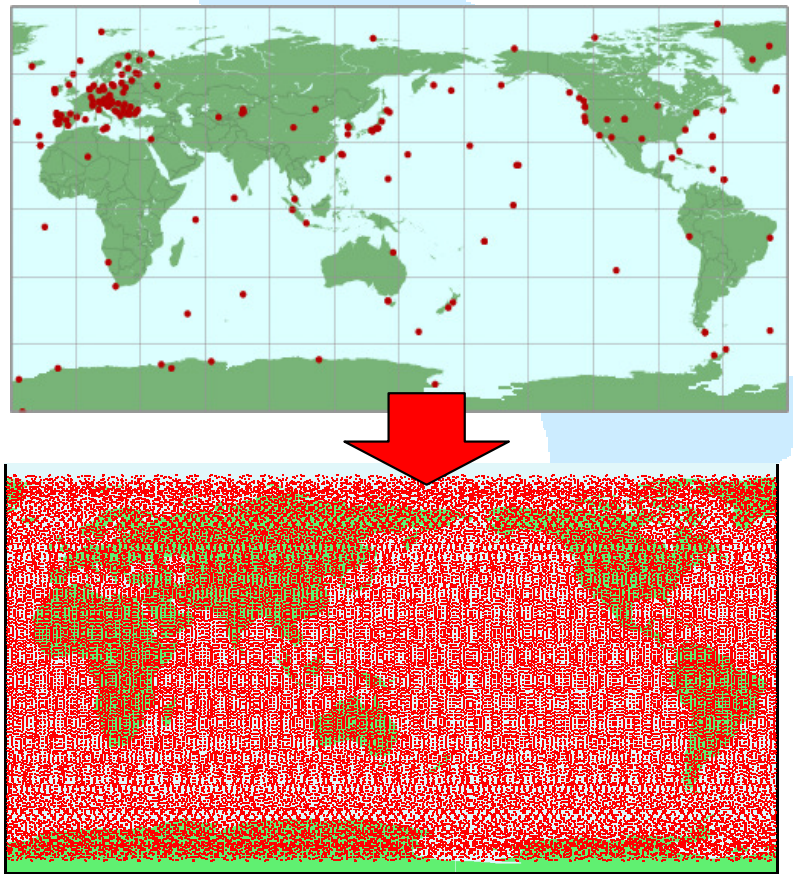
Status: Phase-up review planned in 2011

Greenhouse Gases Observing Satellite (GOSAT) (1)

GOSAT enables global (with 56,000 points) and frequent (at every 3 days) monitoring CO2 and CH4 column density. (Launched in Jan 2009)



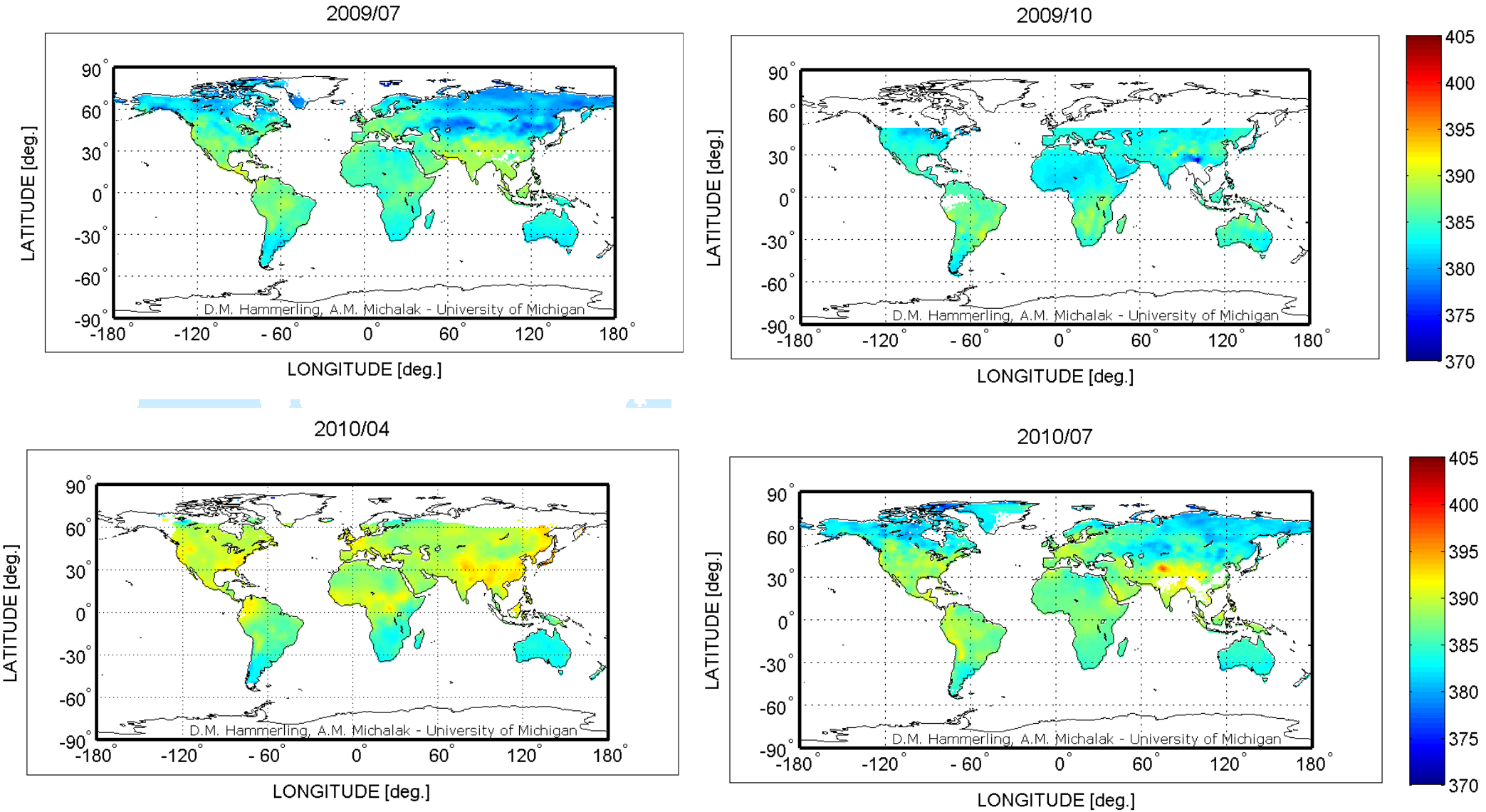
Current Ground-based Observation Points (320pts)
Provided by WMO WDCGG



Increase of Observation Points using GOSAT (56,000pts)

Greenhouse Gases Observing Satellite (GOSAT) (2)

CO2 column averaged dry air mole fraction processed by ACOS team



REDD+ and Satellite Observation

Observation from Space will benefit to the REDD/REDD+ framework in the area of the development of MRV (Measuring, Reporting and Verification).

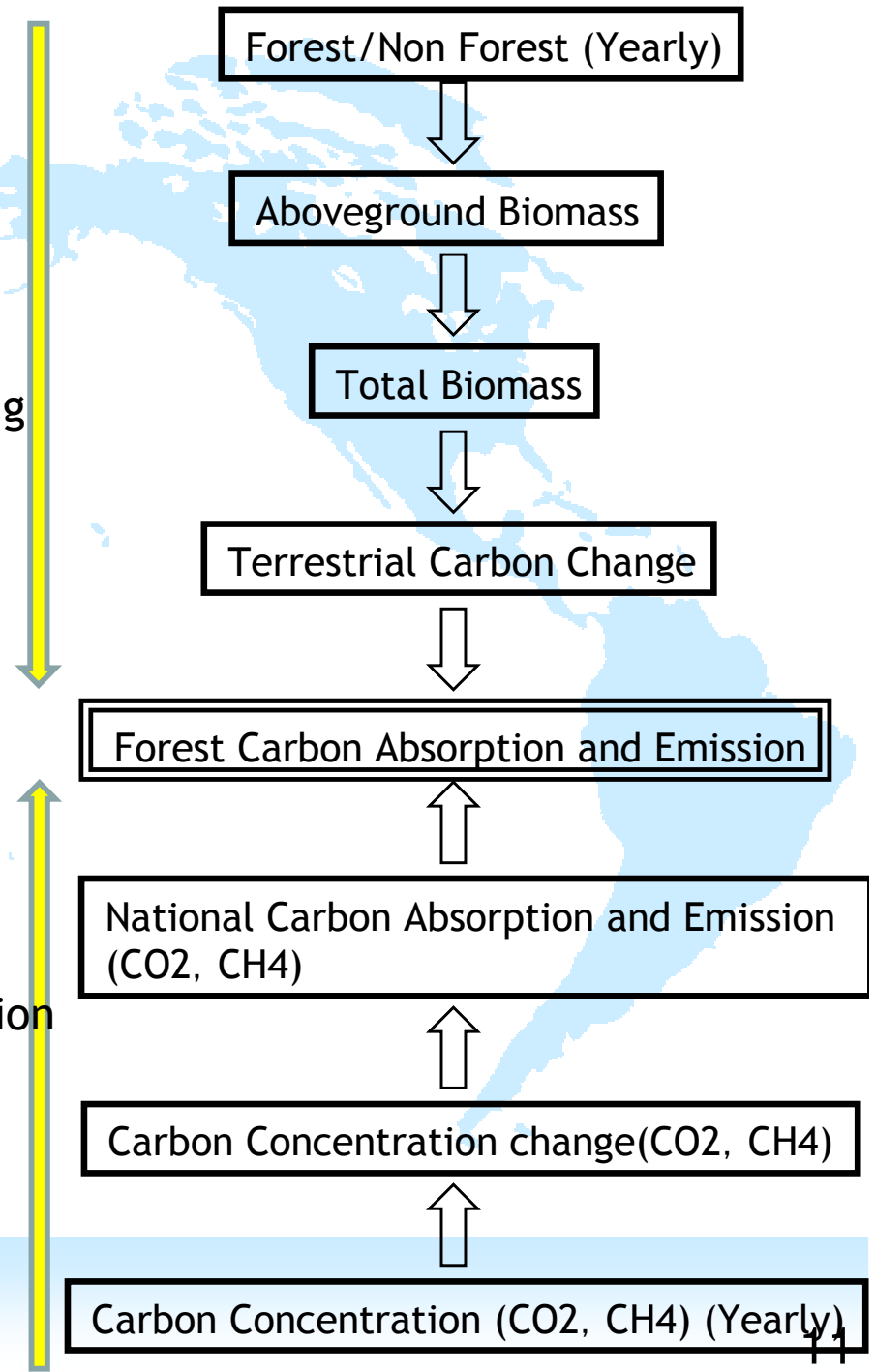
Measurement

→Forest monitoring by SAR

Reporting

Verification

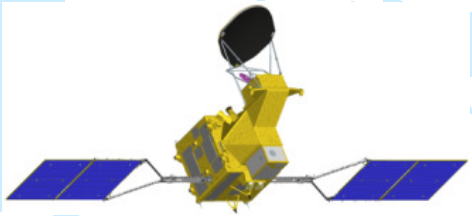
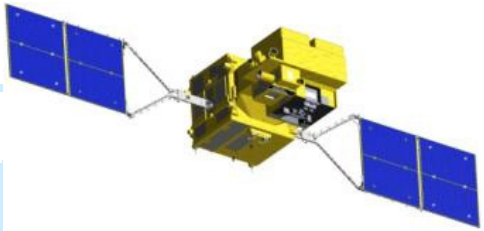
→GHG observation by FTS

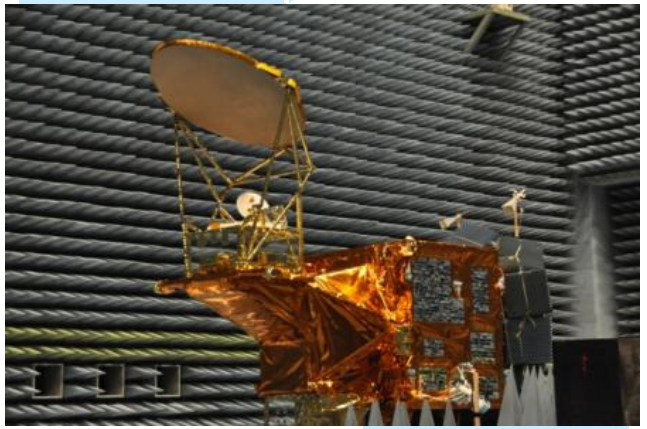


Global Change Observation Mission (GCOM) (1)

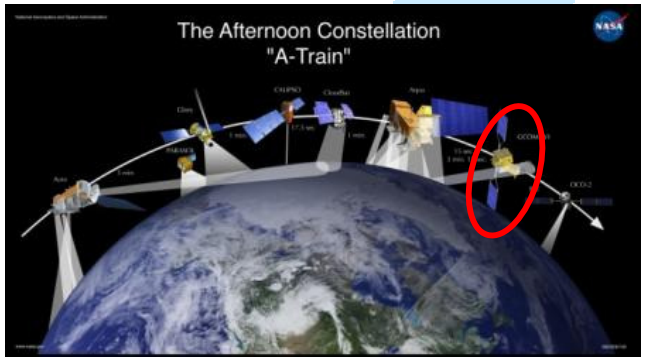
Main Mission

- **Establish and demonstrate the global and long-term Earth observing system (contribute to GEOSS)**
- **Contribute to improvement of climate change prediction in concert with climate model research institutions**

	GCOM-W	GCOM-C
Orbit	Type : Sun-synchronous orbit Altitude : 699.6 km (A-Train) Inclination : 98.2 degrees Local sun time : 13:30±15min	Type : Sun-synchronous orbit Altitude : 798 km Inclination : 98.6 degrees Local sun time : 10:30±15min
Satellite overview		
Mission life	5 years	
Launch vehicle	H2A launch vehicle	
Instrument	AMSR 2 (Advanced Microwave Scanning Radiometer-2)	SGLI (Second Generation Global Imager)
Launch	JFY 2011 (GCOM-W1)	JFY 2014 (GCOM-C1)



GCOM-W1 EMC Test

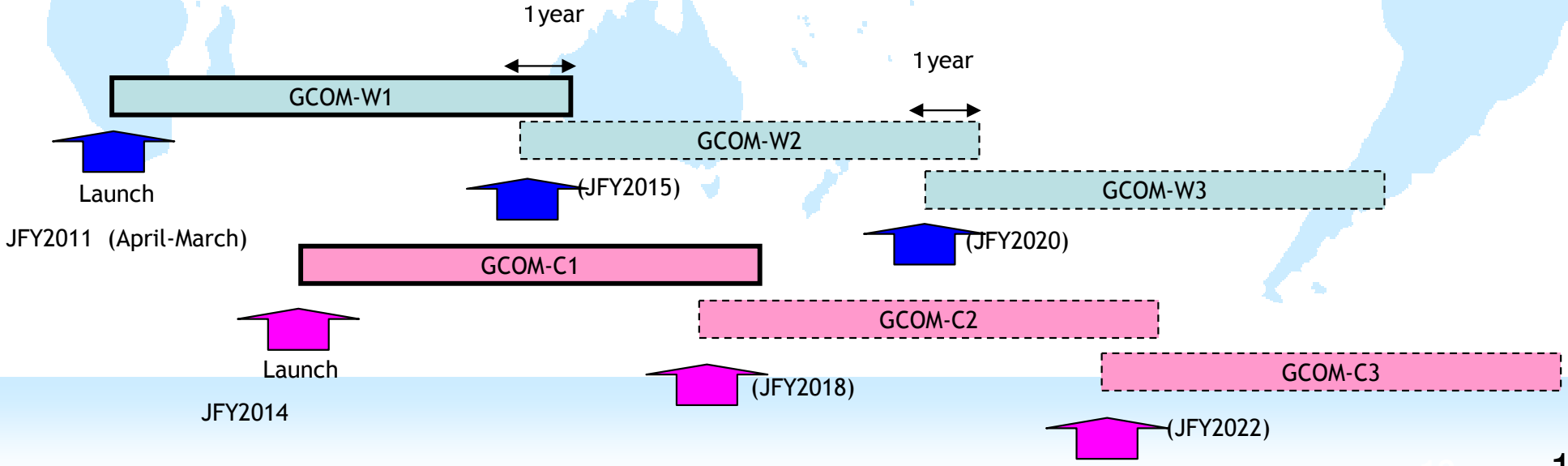


GCOM-W1 in A-Train

GCOM-W1 participates to "A-Train", afternoon orbit constellation led by NASA.

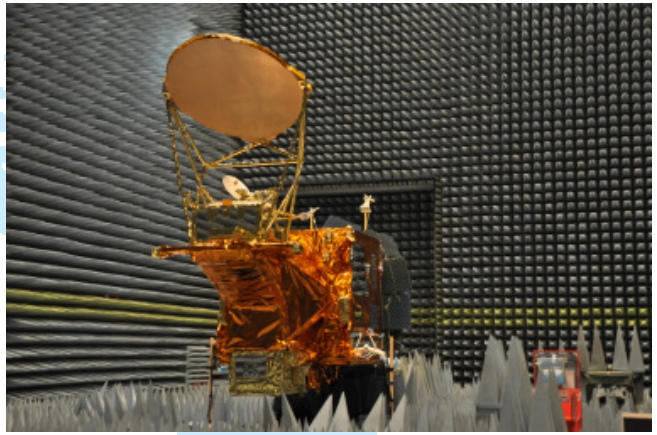
GCOM Mission (2)

- GCOM consists of GCOM-W and GCOM-C series:
  - GCOM-W with AMSR2 (Advanced Microwave Scanning Radiometer2) and its follow-on will contribute to the observations related to global water and energy circulation.
  - GCOM-C with SGLI (Second-generation Global Imager) and its follow-on will contribute to the surface and atmospheric measurements related to the carbon cycle and radiation budget.
- GCOM is a long-term mission to observe more than 10 years:
  - Three consecutive generations of satellites with one year overlap in orbit enables over 13 year-observation in total.

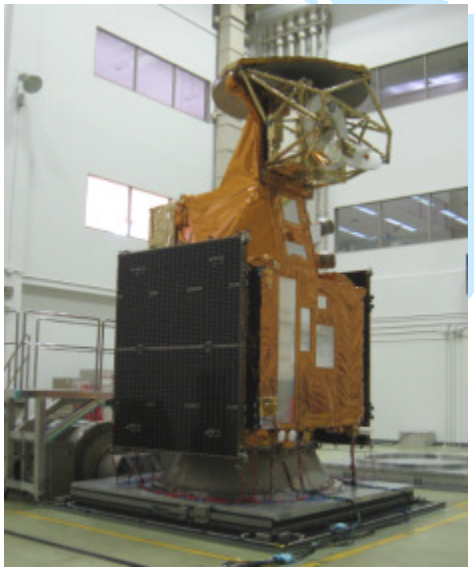


GCOM-W1 status

- First satellite of GCOM series 15 years long-term observation program
- AMSR-2: Passive Microwave with six bands between 7 to 89 GHz
- 99 % of the global observation in two days
- The 3rd RA has been finished in last March
- Cooperation with NOAA is under discussion
- Participate the A-train
- Initial electrical performance and mechanical environment tests (vibration, acoustic etc.) completed End of Feb, 2011.
- The thermal vacuum test in this summer.
- To be launched in early 2012 by H-IIA sharing with KOMPSAT-3 (minimum impact of the earthquake)



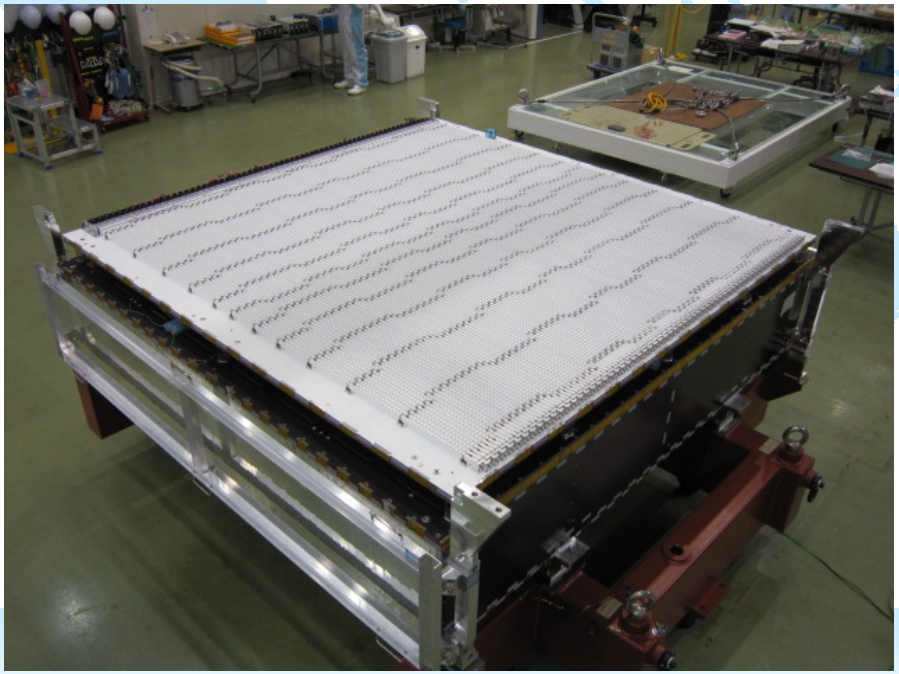
Electric Magnetic Compatibility Test
(November 2010)



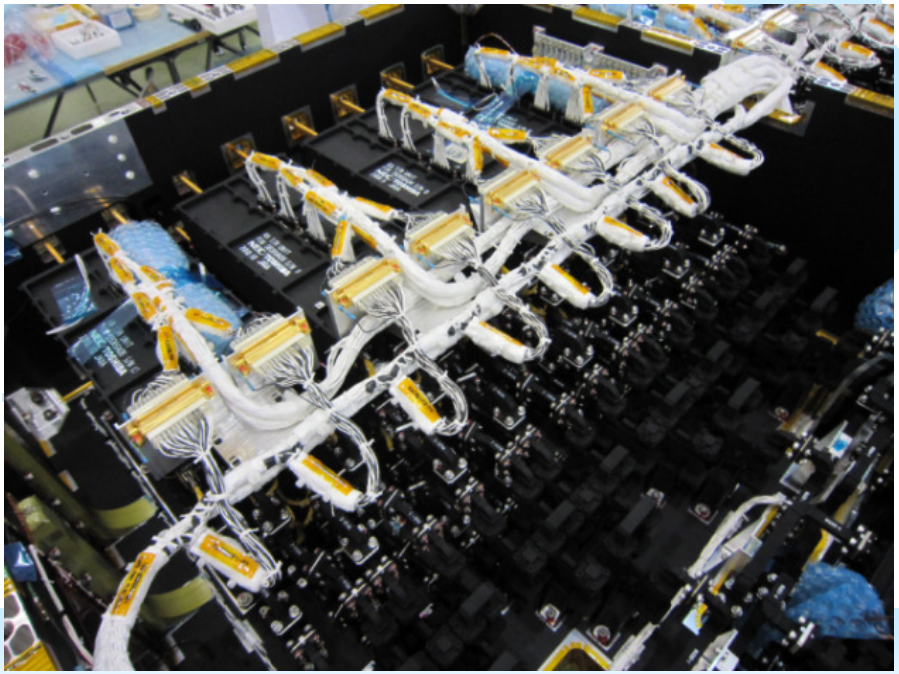
Vibration Test
(January 2011)

GPM/DPR (Dual-frequency Precipitation Radar)

- **JAXA's primary contribution in GPM**
  - ✓ **Development of the DPR (Dual-frequency Precipitation Radar) onboard the GPM core observatory**
    - **Delivered to NASA for integration to the GPM core observatory in late October, 2011.**
  - ✓ **Launch of the GPM core observatory by H-IIA in 2013**
  - ✓ **Joint development of the GPM standard algorithm with NASA**
- **Characteristics and the role of the DPR**
  - ✓ **High sensitivity**
    - **0.7 mm/Hr (PR on TRMM) → 0.2mm/Hr (DPR on GPM)**
  - ✓ **Dual frequency (Ku-band and Ka band) matched beam observation**

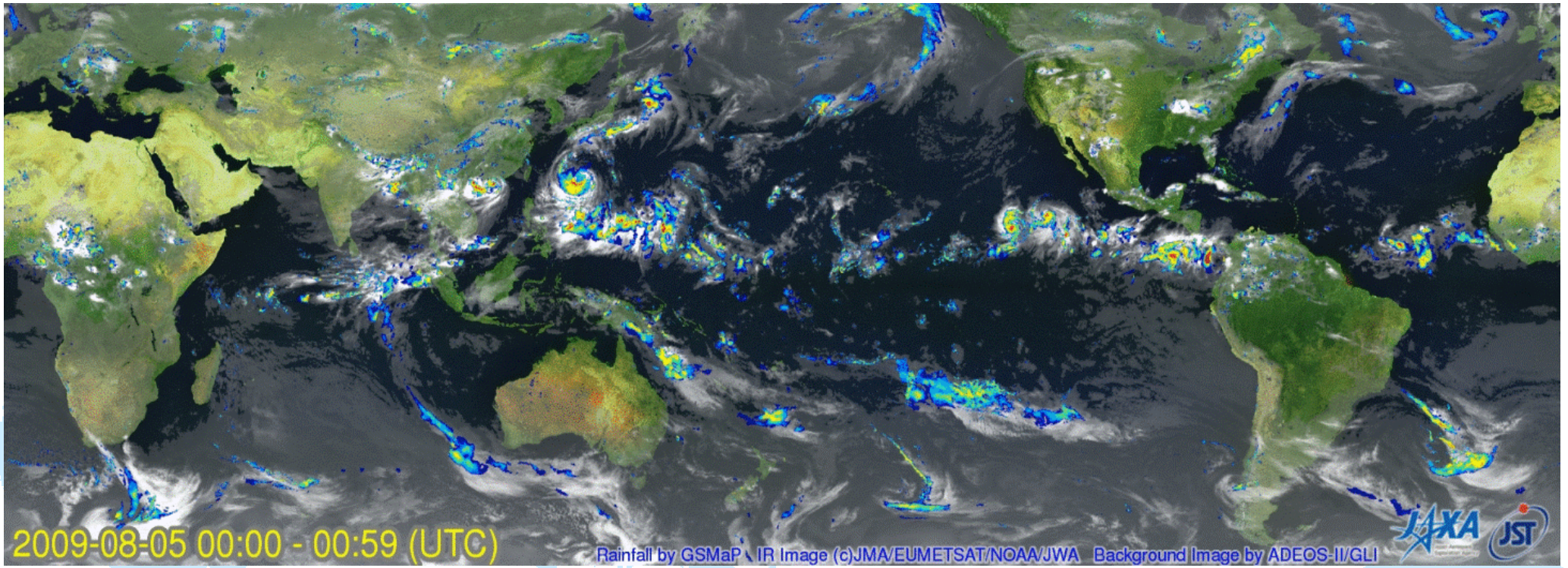


KuPR PFM

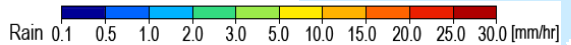


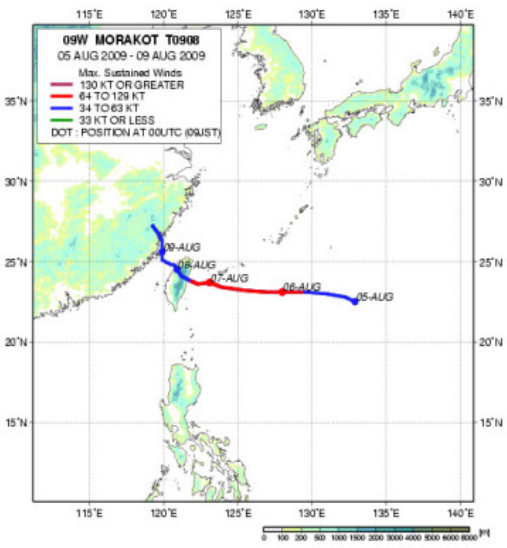
KaPR PFM under integration

Global Rainfall Map in Near Real Time



Typhoon MORAKOT (09W): Aug. 5 – 10, 2009 (Big impact in Chinese Taipei)





- Global rainfall map merging TRMM, AMSR-E and other satellite information
- Available 4-hour after observation, hourly update
- http://sharaku.eorc.jaxa.jp/GSMaP/

Earth CARE/Cloud Profiling RADAR

International cooperation mission ESA and Japan (JAXA/NICT)

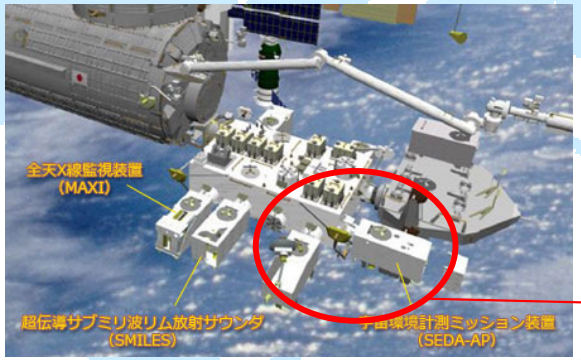
- **JAXA's contribution to EarthCARE**
  - **Provide Cloud Profiling Radar (94GHz Doppler Radar) to ESA in Nov 2013**
  - **Ground Segment in Japan for CPR processing and archive all EarthCARE products for JAXA users**
  - **Jointly organize Europe/Japan Science Team to develop high level products**
- **CPR characteristics**
  - **Very high sensitivity (-35dBZ) to observe most of clouds**
  - **Doppler measurement capability in cloud (-10∼+10 m/s, < 1m/s accuracy)**
  - **Very fine co-registration with EarthCARE/ATLID(LIDAR) to keep ideal synergy observation**

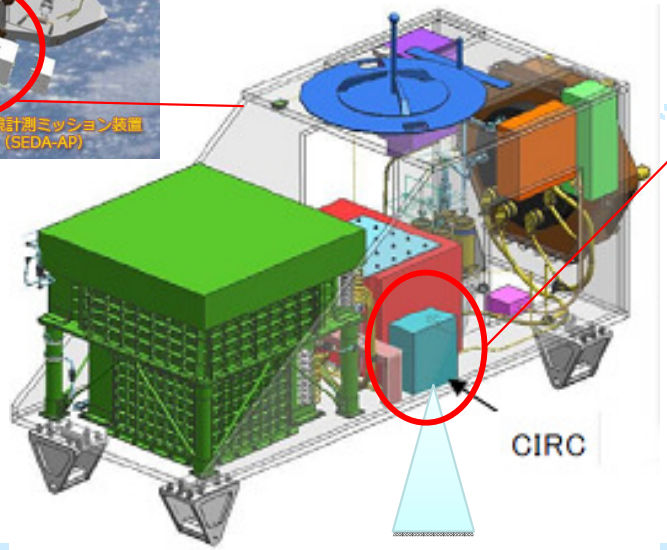
CPR Engineering Model

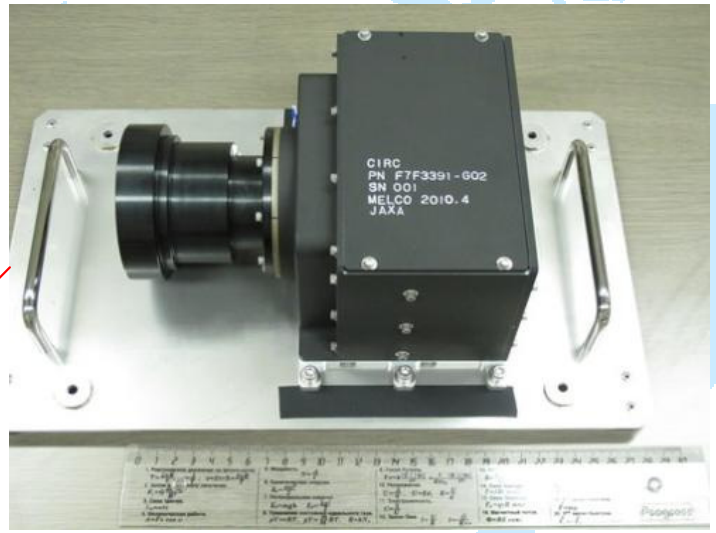
Earth Observation utilizing ISS

JAXA promotes Earth Observation missions following SMILES such as:

- **Live broadcasting of global phenomena by astronauts onboard ISS**
- **Kibo Exposed Facility payloads**
  - **Compact InfraRed Camera (CIRC)**
  - **CO2 Lidar, Doppler lidar, etc.**







Summary

- International cooperation is an essential tool for climate change monitoring on the global level, since it requires satellite constellations and many kinds of onboard sensors.
- JAXA will further contribute to international efforts toward the climate change monitoring such as IPCC, through the monitoring of greenhouse gases, forest and carbon tracking and so on.