# Current Status and Future Plan of JAXA Earth Observation Program

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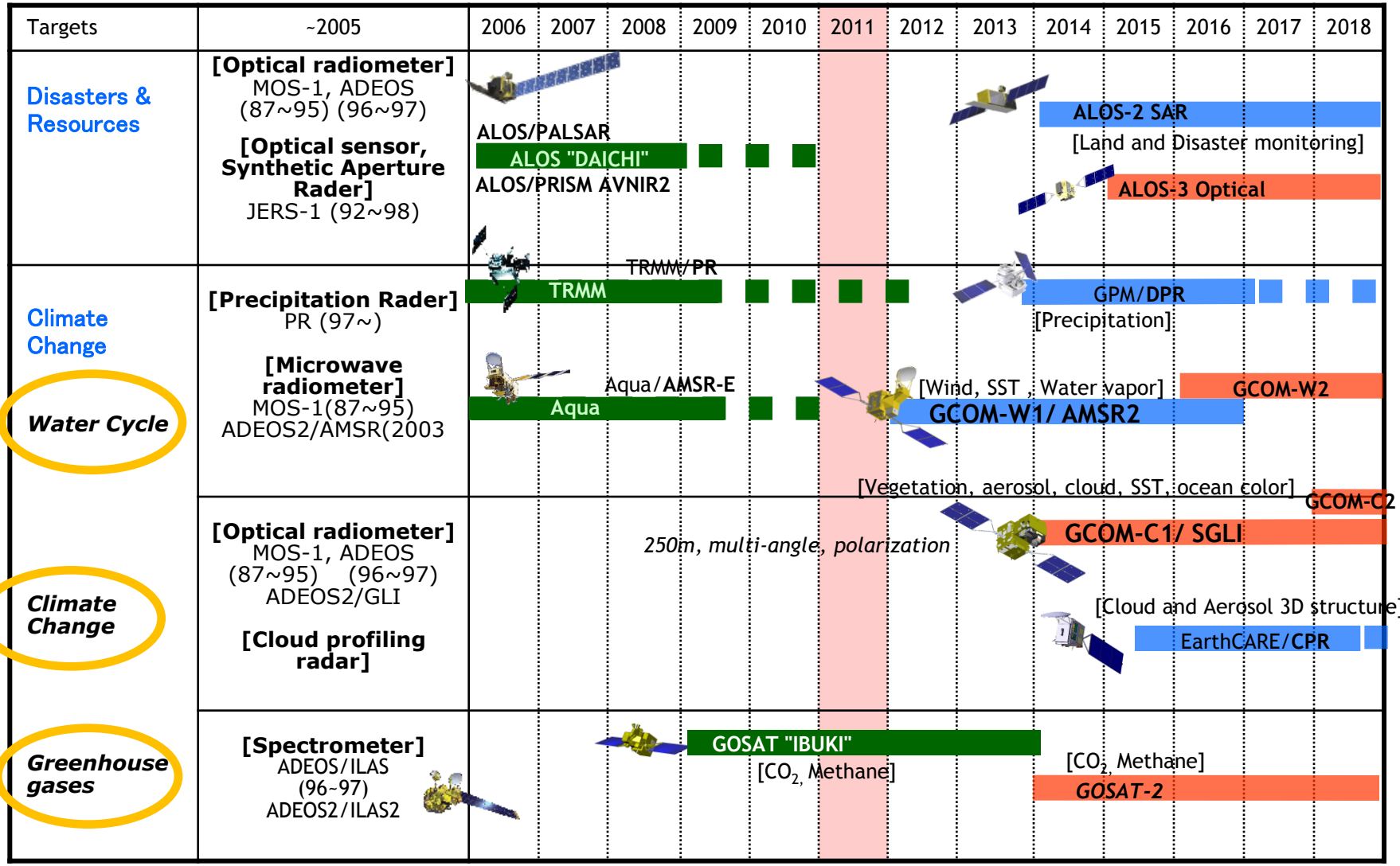
**JAXA/EORC**

6-9 December 2011, Tokyo, Japan
The Second Asia/Oceania Meteorological Satellite Users' Conference

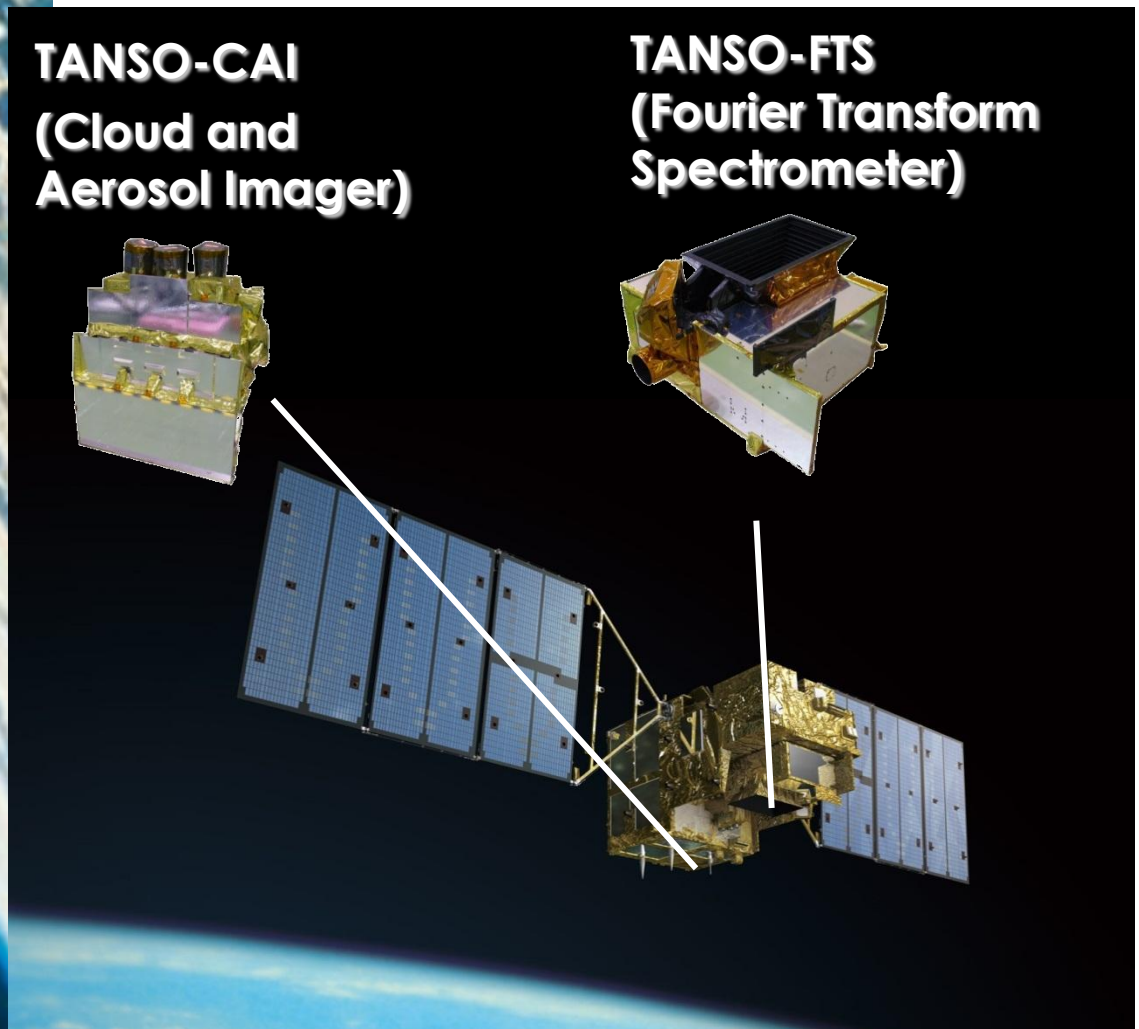
# Long-Term Plan of Earth Observation by JAXA



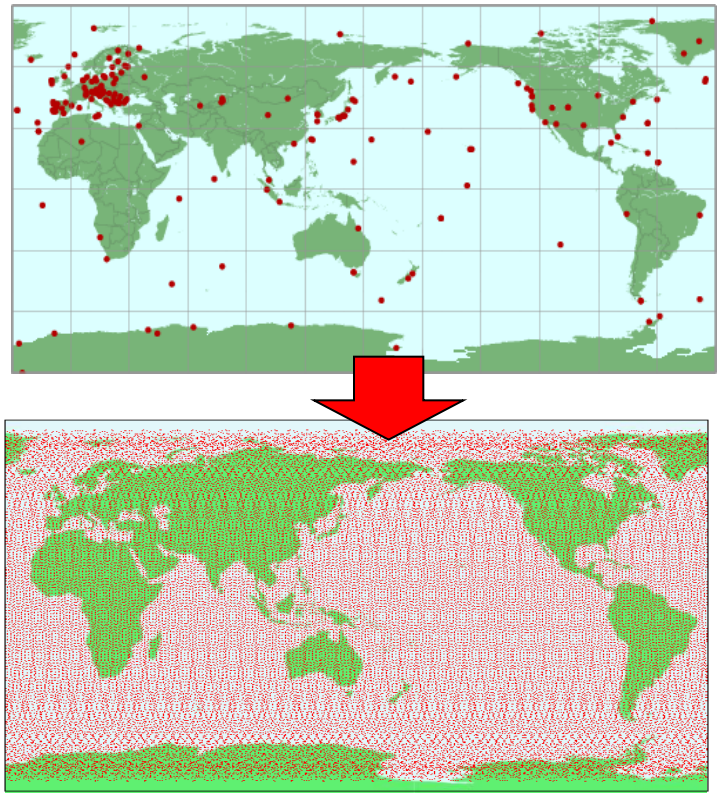
# CURRENT EARTH OBSERVATION PROGRAMS

# Greenhouse Gases Observing Satellite (GOSAT), Ibuki

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



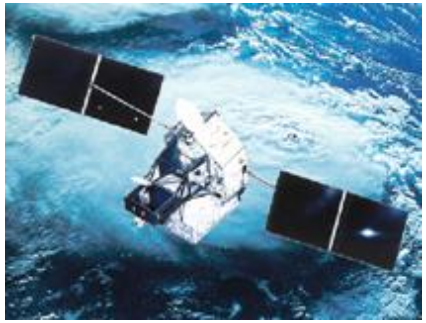

Current Ground-based Observation Points (320pts) *Provided by WMO WDCGG*



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

# Tropical Rainfall Measuring Mission

- TRMM is ;
  - Japan-U.S. joint mission, flying since Nov. 1997
  - World‘s first and only space-borne precipitation radar (PR) on-board with microwave radiometer and visible-infrared sensor
  - Still operational, and continues to provide the data
- Results of the TRMM
  - Accurate and highly stable rain measurement in the tropical and sub-tropical region, over the land as well as the ocean
  - More than 10 years rain observation data archive
  - Proved that the radar (PR) and microwave radiometer (TMI) is a very good combination for rainfall measurement
  - PR greatly contribute to the improvement of the rainfall retrieval error by microwave radiometer
  - Precipitation system three dimensional structure, diurnal cycle, seasonal change, long term variation such as El-Nino and La-Nina observation
  - New products development such as latent heating, soil moisture, and sea surface temperature
  - Demonstrated that TRMM data is valuable for the operational use, such as flood prediction, numerical weather forecast, typhoon prediction



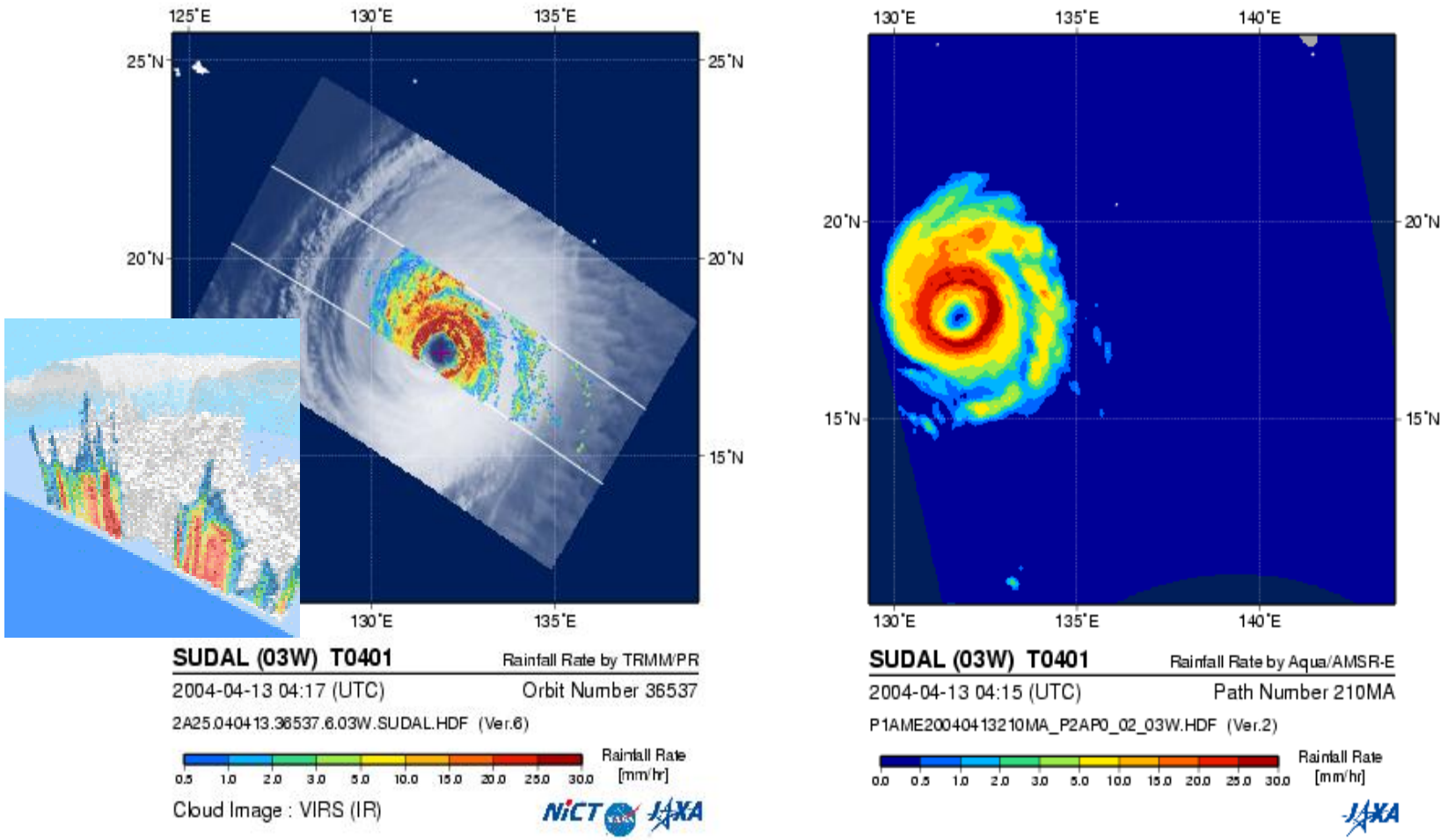
**US-Japan joint mission**

**Japan: PR, launch**

**US: satellite, TMI, VIRS, CERES, LIS, operation**

| | |
|---|---|
| Launch | 28 Nov. 1997 (JST) |
| Altitude | About 350km (since 2001, boosted to 402km to extend mission operation) |
| Inc. angle | About 35 degree, non-sun-synchronous orbit |
| Design life | 3-year and 2month (still operating) |
| Instruments | Precipitation Radar (PR)<br>TRMM Microwave Imager (TMI) Visible Infrared Scanner (VIRS)<br>Lightning Imaging Sensor (LIS)<br>CERES (not in operation) |

# Precipitation Radar and Microwave Radiometer




Typhoon “SUDAL”, April 13th 2004 (UTC)

Precipitation Distribution

TRMM/PR and VIRS (Left), Aqua/AMSR-E (Right)

# Satellite Combined Product
## Global Precipitation Map


TRMM
TMI


Aqua
AMSR-E


DMSP
SSM/I, SSMIS


NOAA
AMSU


Geostational
Meteorological
Satellite

Precipitaton
Physical
Model from
Radar
Observation

Precipitation data estimated by each Microwave Imager/sounder

Combining multiple data retrivals for hourly Precipitation Map

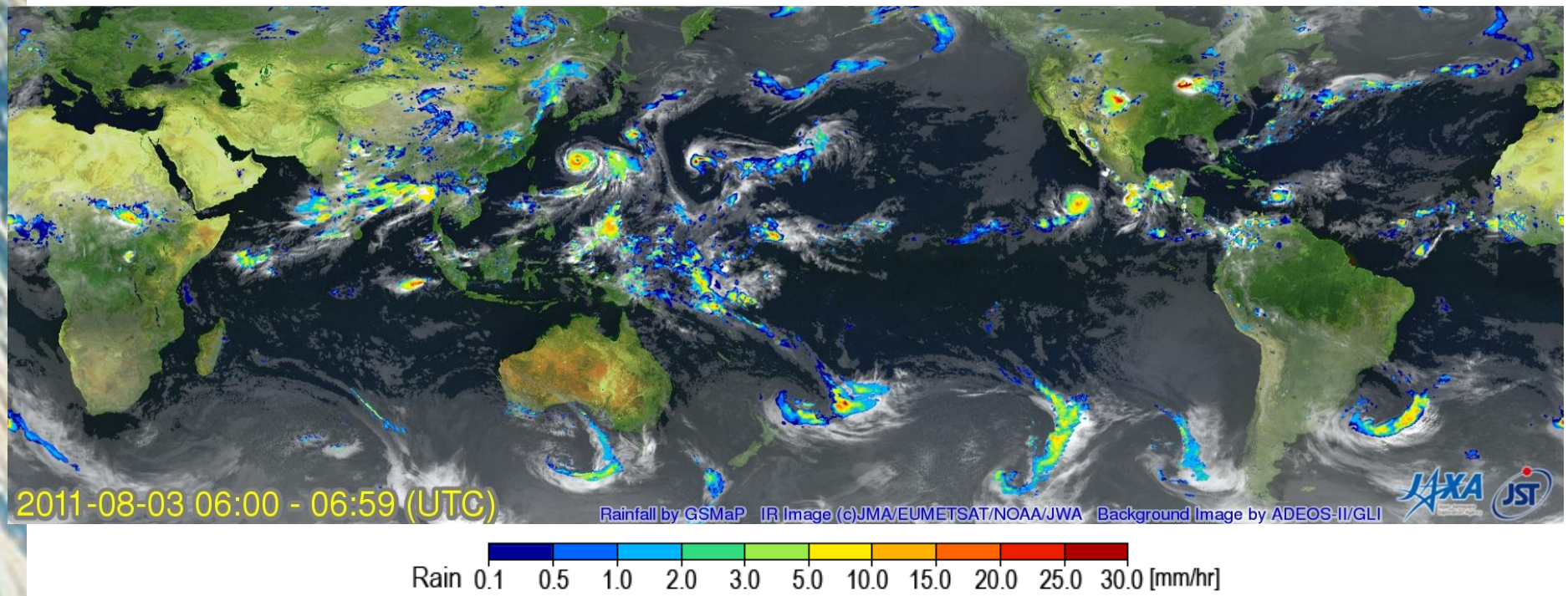
Cloud Moving Vector

Global Precipitation Map

Hourly 0.1 degree grid

# JAXA/ EORC Global Rainfall Watch
## GSMaP (Global Satellite Mapping for Precipitation)

Typhoon “MUIFA” 2011/08/03 06Z




- Hourly mean, 0.1 degree grid, available on-line 4hours after observation
- Browse image, Google Earth (KMZ), 24hours movie are available
- Binary data for research use
- Application testbeds for Flood forecast, weather service, crop yeild forecast

**Global Rainfall Map in near-real-time -- http://sharaku.eorc.jaxa.jp/GSMaP/**

# Sentinel Asia

Sentinel Asia is a voluntary initiative by a collaboration between space agencies and disaster management agencies, applying remote sensing and Web-GIS technologies to assist disaster management in the Asia-Pacific region.

**Main Activities**

**(1) Emergency observation**

**(2) Working Group (WG)**

- **Wildfire**
- **Flood**
- **Glacial Lake Outburst Flood (GLOF)**
- **Tsunami**

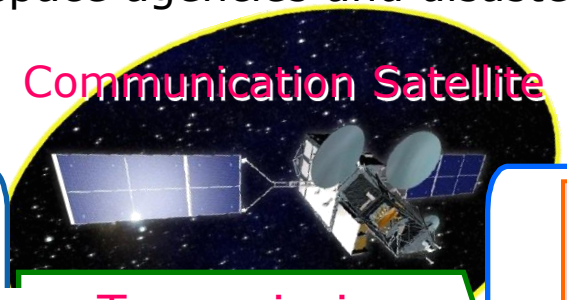
**(3) Capacity building**

- **human resource development**
- **promotion of utilization**


http://sentinel.tksc.jaxa.jp/

# Concept of Sentinel Asia Step2

Collaboration between space agencies and disaster management agencies




## Observation

Space Agency

Earth Observation Satellite

Value-added Information

Disaster Information

## Utilization

Disaster Management Organization

Transmission

Sharing (Web)

User Expansion

Governmental Organization (ADRC members)

Local Governmental Organization

End User

Human Network

Capacity Building・ Outreach

# Framework of Sentinel Asia

## Space Community

**APRSAF***

- Data Provision
- Promotion of Utilization
- Capacity Building

## Disaster Management Community

**ADRC****
**Member Countries**

- Utilization (User)

# Sentinel Asia

***Joint Project Team (JPT)***

Join Project Team consists of total 78 organizations including 67 organizations of 24 countries/region and 11 international organizations as of November 2011

JAXA is the secretariat of JPT.

* Asian-Pacific Regional Space Agency Forum

** Asian Disaster Reduction Center

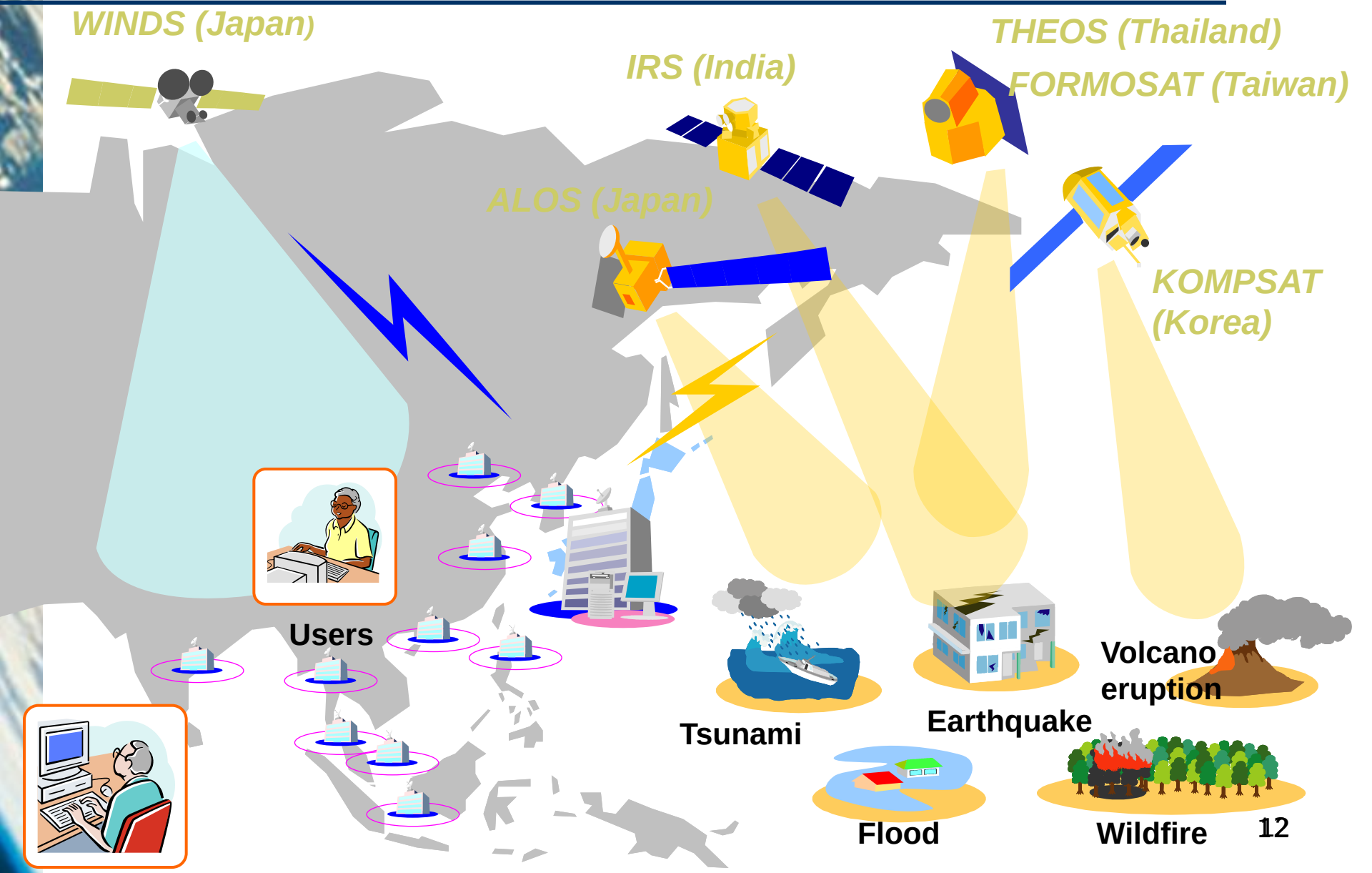
## International Community

**UN / ESCAP UN / OOSA**
**ASEAN AIT etc.**

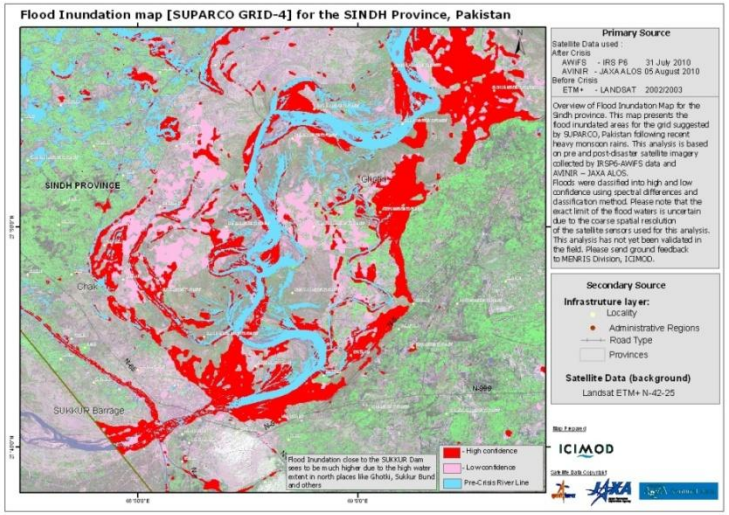
- International Cooperation

**JPT meeting in Putrajaya, Malaysia in July 2011**

# (1) Emergency Observation

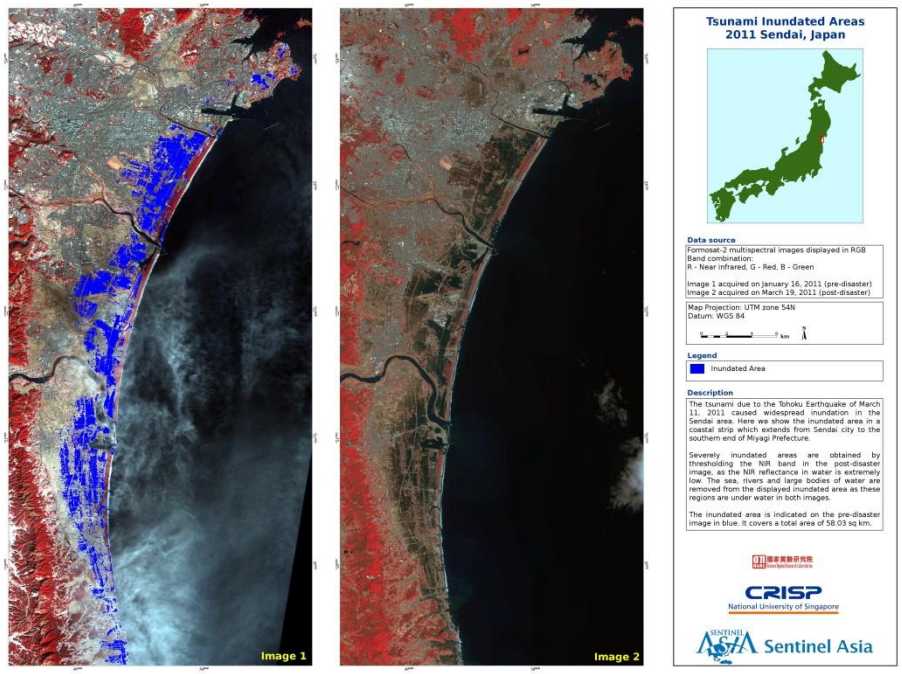


# Example of Emergency Observation




**Inundation map of Pakistan flood analyzed by ICIMOD, using ALOS data**

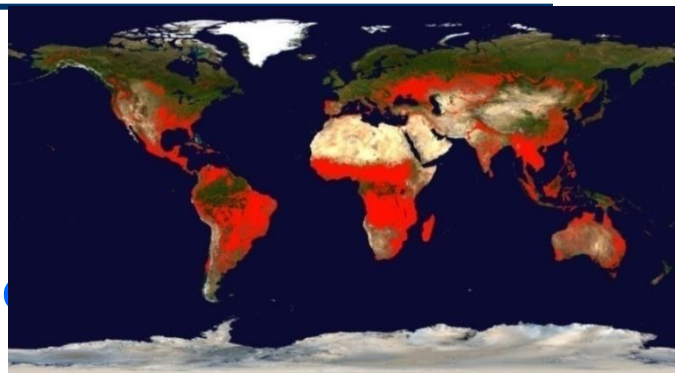
*(Photo is provided courtesy of ICIMOD)*




**Inundation map of Japanese tsunami analyzed by CRISP, using FORMOSAT-2 data**

# (2) Working Group Activities for Disaster Risk Reduction

- **Wildfire WG**
  - -To contribute to the Asia-Pacific region with wildfire management
  - -To contribution to REDD-plus
  - -JST-JICA(*) project for wildfire and carbon management in a peatlan in Kalimantan, Indonesia



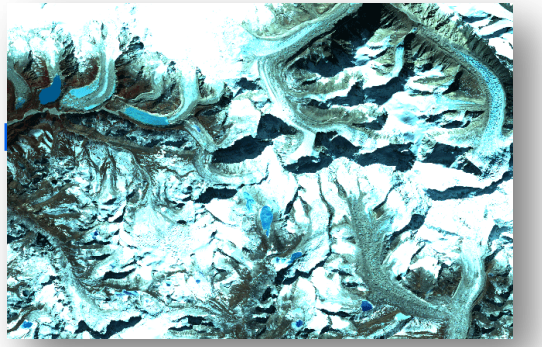
(*)JST: Japan Science and Technology Agency
JICA: Japan International Cooperation Agency

- **Flood WG**
  - -To contribute to the mitigation of flood disasters in Asia
  - -Flood analysis using IFAS

IFAS

Flood Forecasting Using Global Satellite Rainfall Information Based on
Integrated Flood Analysis System

- **GLOF WG** (Glacial Lake Outburst Flood)
  - - Monitor and establish early warning system in the risk areas
  - -Local awareness and knowledge transfe through capacity building

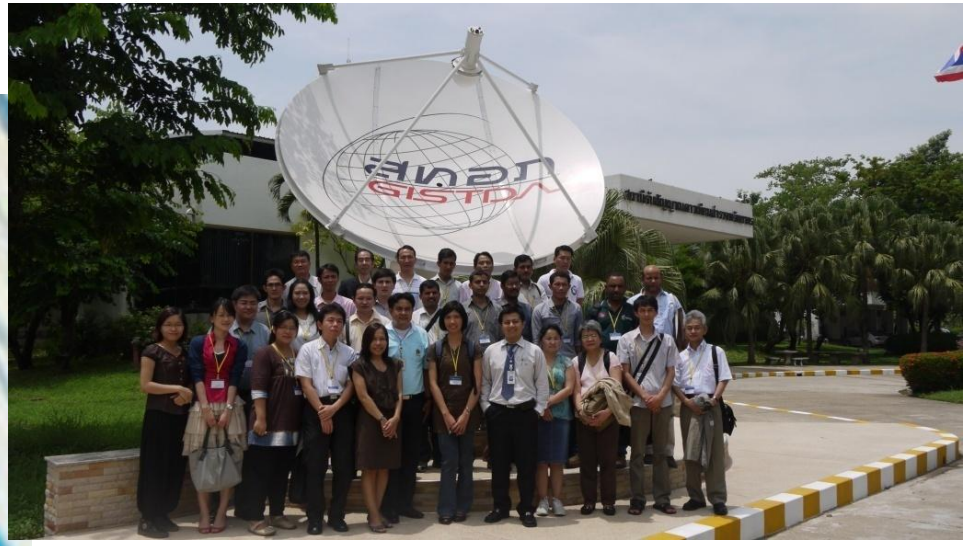


- **Tsunami WG**
  - - Tsunami early warning system

# (3) Capacity Building and Human Network

A good human network is the foundation of the project

The 7th Sentinel Asia System Operation Training by JAXA, hosted by ICIMOD in February-March 2011

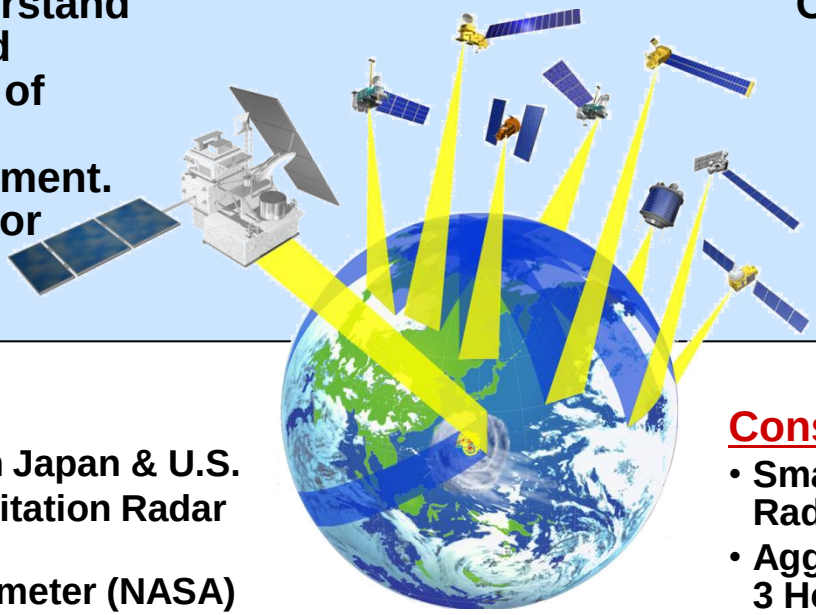



The 6th Sentinel Asia System Operation Training by JAXA, hosted by GISTDA in July 2010

# FUTURE EARTH OBSERVATION PROGRAMS

# Global Precipitation Measurement (GPM)

**OBJECTIVE: Understand the Horizontal and Vertical Structure of Rainfall and Its Microphysical Element. Provide Training for Constellation Radiometers.**



**OBJECTIVE: Provide Enough Sampling to Reduce Uncertainty in Short-term Rainfall Accumulations. Extend Scientific and Societal Applications.**

## Core Satellite

- Joint mission between Japan & U.S.
- Dual-frequency Precipitation Radar (JAXA and NICT)
- Multi-frequency Radiometer (NASA)
- JFY 2013, H2-A Launch
- Non-Sun Synchronous Orbit
- ~65° Inclination
- ~407 km Altitude

## Constellation Satellites

- Small Satellites with Microwave Radiometers
- Aggregate Revisit Time, 3 Hour goal
- Sun-Synchronous/Non-sun-synchronous orbit
- 500~900 km Altitude
- International Partners; NOAA, NASA, JAXA, CNES/ISRO, etc.

## Precipitation Validation Sites

- Global Ground Based Rain Measurement

## Global Precipitation Processing Centers

- Capable of Producing Global Precipitation Data Products as Defined by GPM Partners

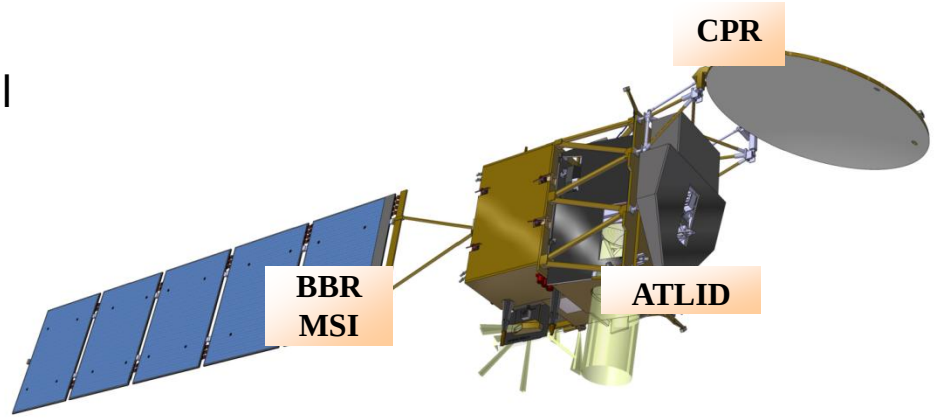
# Updated Plan of JAXA GPM Products

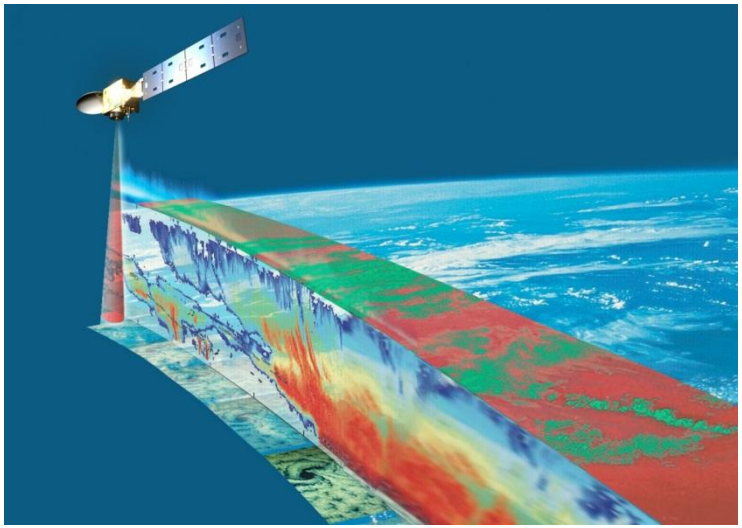
| Level | Algorithm | Product | Major physical parameter | Unit | Coverage |
|---|---|---|---|---|---|
| 1 | KuPR algorithm | KuPR product | Received power profile | Orbit | 245km (swath) |
| | KaPR algorithm | KaPR product | Received power profile | Orbit | 125km (swath) |
| 2 | DPR algorithm (Japan-US joint) | KuPR product | Radar reflectivity profile, normalized radar surface cross section ($\sigma^0$), rain type, bright-band height, attenuation corrected radar reflectivity profile, rain rate profile | Orbit | 245km (swath) |
| | | KaPR product | Radar reflectivity profile, normalized radar surface cross section ($\sigma^0$), rain type, bright-band height, attenuation corrected radar reflectivity profile, rain rate profile | Orbit | 125km (swath) |
| | | Dual-frequency precipitation product | Rain rate profile, drop size distribution, precipitation status (rain/snow), attenuation profile | Orbit | 245km (swath) |
| | DPR/GMI combined algorithm (Japan-US joint) | DPR/GMI combined product | rain rate profile, surface rain rate | Orbit | 245km/800km (swath) |
| 3 | DPR algorithm (Japan-US joint) | Dual-frequency precipitation product | Mean rainfall, observation number, rain pixel number, mean bright-band height, storm height | Monthly | Global |
| | DPR/GMI combined algorithm (Japan-US joint) | DPR/GMI combined product | Mean rainfall, observation number, rain pixel number, | Monthly | Global |
| | Global precipitation map algorithm | Global precipitation map product | Mean rainfall, observation number, rain pixel number | 1-hr/ monthly | Global (Horizontal: 0.1º grid box) |

# EarthCARE/CPR

## Climate monitoring of earth radiation, cloud and aerosol
## Cooperation between ESA and Japan (JAXA/NICT)

- **Mission**
  - Vertical profile of clouds, aerosol
  - Interaction between clouds and aerosol
  - Cloud stability and precipitation
- **Orbit**
  - Sun synchronous
  - Equator crossing time 13:45
  - Altitude 400km
- **Instrument**
  - CPR (Cloud Profile Radar)
  - ATLID (Atmospheric LIDAR)
  - MSI (Multi-Spectral Imager)
  - BBR (Broad Band Radiometer)
- **Task sharing**
  - JAXA/NICT（CPR）
  - ESA（LIDAR, MSI, BBR, Spacecraft)
- **Launch target**
  - In 2015



# EarthCARE Japanese Standard Products *Draft (1/2)

| Sensor(s) | Processing Level | Product Name | Primary Parameters | Product Resolution | | Release Accuracy | Standard Accuracy | Target Accuracy | Volume |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Horizontal | Vertical | | | | |
| CPR | L1b | Received Echo Power Products | Received Echo Power | 0.5km | 100m | < 4.7dB | < 2.7dB | – | 140MB |
| | | | Radar Reflectivity | | | < 4.7dB | < 2.7dB | < 2.7dB | |
| | | | Surface Radar Cross Section | | – | < 4.7dB | < 2.7dB | < 2.7dB | |
| CPR | L1b | Doppler Products | Doppler Velocity | 0.5km | 100m | – | < 1m/s | < 0.2m/s | 200MB |
| | | | Covariance of Pulse Pair | | | – | – | – | |
| CPR | L2a | CPR Echo Product | Integrated Reflective factor | 1km<br>10km | 100m<br>500m | – | – | – | 300MB |
| | | | Integrated Doppler Velocity | | | – | – | – | |
| | | | gas correction factor | | | – | – | – | |
| CPR | L2a | Cloud Mask without Doppler | Cloud Mask | 1km<br>10km | 100m<br>500m | 30% accuracy on a 0,10 probability scale for 10km | 10% on a 0,10 probability scale 10km | 5% on 0, 10 probability scale | 20MB |
| | | Cloud Type Products without Doppler | Cloud Particle Type | 1km<br>10km | 100m<br>500m | 100% on a 0,10 probability scale for 10km | 50% on a 0,,10 probability scale | 20% | 20MB |
| | | Cloud Products without Doppler | Radar Reflectivity with attenuation correction | 1km | 100m | < 7.6dB | < 5.7dB | < 4.5dB | 510MB |
| | | | Reff of Liquid & Ice and LWC & IWC | | | – | ±100% | ±50% | |
| | | | Optical Thickness | | – | – | ±100% | ±50% | |
| MSI | L2a | Cloud Flag | Cloud Flag including Cloud Phase | 500m | – | 15% Ocean<br>20% Land (*1) | – | 10% (*2) | 380MB |
| | | Cloud Products | Cloud Optical Thickness (Liquid) | 500m | – | 15% (*3) | – | 50% (*4) | 250MB |
| | | | Reff of Liquid (1.6um & 2.16um) | | | 20% (*5) | – | 50% (*4) | |
| | | | Cloud Top Temperature & Pressure & Height | | | 1K (*6) | – | 1.5K (*7) | |

*3 By comaring other imager's product. Limited to mid-latitude ocean area.

*4 By comparing liquid water path (g/m2) obtained from ground-based Microwave Radiometer. (TBD T- and A-window size).

*5 By comaring other imager's product. Limited to mid-latitude ocean area.

*6 Simply defined by brightness temperature error of the 11μm channel.

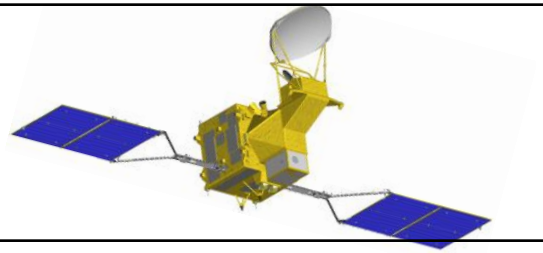
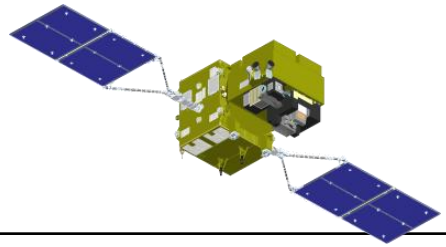
*7 Aircraft and/or sonde measurements for moderately thick water clouds.

# EarthCARE Japanese Standard Products *Draft (2/2)

| Sensor(s) | Processing Level | Product Name | Primary Parameters | Product Resolution | | Release Accuracy | Standard Accuracy | Target Accuracy | Volume |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Horizontal | Vertical | | | | |
| ATLID | L2a | Feature Mask Products | Feature Mask | 200m<br>1km<br>10km | 100m<br>100m<br>100m | 100% | 40% | 10% | 330MB |
| | | Target Products | Target Mask | 1km<br>10km | 100m<br>100m | 100% | 40% | 10% | 70MB |
| | | Aerosol Products | Ext. & Backscat. Coeff. and Lidar & Depolarization Ratio | 10km | 100m | ±60%, 90%, 150%, 150% | ±40%, 70%, 110%, 130% | ±20%, 50%, 70%, 100% | 400MB |
| | | Cloud Products | Ext. & Backscat. Coeff. and Lidar & Depolarization Ratio | 1km<br>10km | 100m<br>100m | ±50%, 90%, 140%, 150% | ±30%, 70%, 100%, 100% | ±15%, 50%, 65%, 100% | 400MB |
| | | Atmospheric Boundary Layer | Planetary Boundary Layer Height | 1km<br>10km | 100m<br>100m | ±500m | ±300m | ±100m | 2MB |
| CPR + ATLID | L2b | Cloud Mask without doppler | Cloud Mask | 1km<br>10km | 100m<br>500m | – | – | – | 20MB |
| | | Cloud Type Products without doppler | Cloud Particle Type | 1km<br>10km | 100m<br>500m | – | – | – | 100MB |
| | | Cloud Products without Doppler | Reff of Liquid & Ice | 1km<br>10km | 100m<br>500m | – | – | ±50%(Liquid)/<br>±30%(ice) | 400MB |
| | | | LWC & IWC | | | – | – | ±50%(Liquid)/<br>±30%(IWC) | |
| | | | Optical Thickness | 1km | – | – | – | ±50% | 2MB |
| CPR + ATLID + MSI | L2b | Cloud Products | Cloud Particle Type | 1km<br>10km | 100m<br>500m | – | – | – | 510MB |
| | | | Reff of Liquid & Ice | | | – | – | – | |
| | | | LWC & IWC | | | – | – | – | |
| | | | Optical Thickness | | – | – | – | – | |
| CPR + ATLID + MSI + BBR | L2b | Four Sensors Synergy by 1D RT computation with all the EarthCARE products | SW & LW Radiative Flux | 10km | – | – | – | 10W/m2 | 1MB |
| | | | SW & LW Radiative Heating Rate | | 500m | – | – | – | 5MB |

# Concept of the Global Change Observation Mission (GCOM)

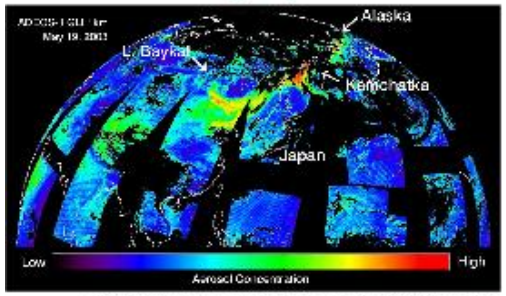
- GCOM aims to construct, use, and verify systems that enable continuous global-scale observations of effective geophysical parameters for elucidating global climate change and water circulation mechanisms.
- GCOM will consist of 2 satellite series (GCOM-W and C) spanning 3 generations in order to perform uniform and stable global observations for 13 years.

| | GCOM-W | GCOM-C |
|---|---|---|
| Orbit | Type : Sun-synchronous, sub-recurrent<br>Altitude : Approx. 700 km<br>Inclination : 98.19 degrees<br>Local time of ascending node : 13:30 (Join in the "A-Train") | Type : Sun-synchronous, sub-recurrent<br>Altitude : Approx. 800 km<br>Inclination : 98.6 degrees<br>Local time of descending node : 10:30 |
| Satellite overview |  |  |
| Mission life | 5 years | |
| Launch vehicle | H2A launch vehicle | |
| Instrument | Advanced Microwave Scanning Radiometer 2 (AMSR2) | Second Generation Global Imager (SGLI) |
| Launch (target) | Japanese Fiscal Year (JFY) 2011 | JFY 2014 (TBD) |

# GCOM Observation Parameters

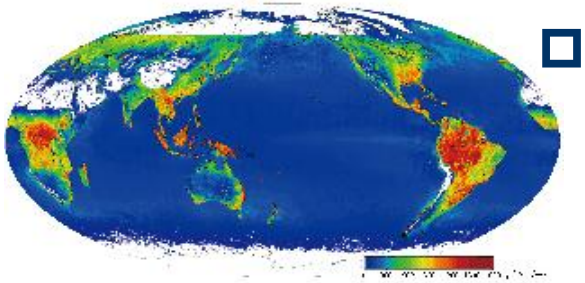
## GCOM - Climate (GCOM-C)

### Aerosol properties




A first land and ocean aerosol distribution with ADEOS-II/GLI near-ultraviolet 1 km resolution band

### Primary production

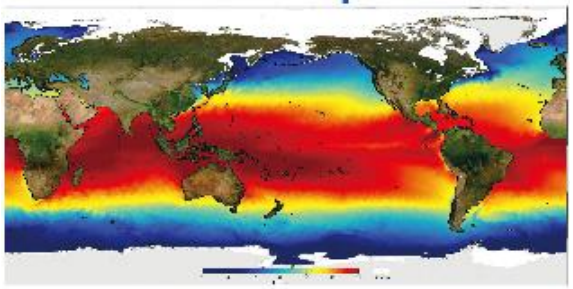


Global primary production derived from ADEOS-II/GLI in 2003

- Climate change observation will be performed by the SGLI on the GCOM-C satellite.
- GCOM-C sensors will observe clouds, aerosol, ocean color (marine organisms), vegetation, snow and ice.

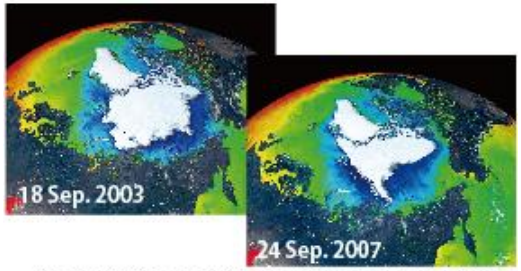
## GCOM - Water (GCOM-W)

### Sea surface temperature



Global sea surface temperature derived from Aqua/AMSR-E in March 2009

### Sea-ice concentration




Sea ice: Sea ice concentration derived from Aqua/AMSR-E
Ocean: Clear-sky brightness temp. derived from Terra/MODIS
Land: Clear-sky reflectance derived from Terra/MODIS

- Water cycle variation will be observed by the AMSR2 on the GCOM-W satellite.
- GCOM-W will observe precipitation, water vapor, sea surface wind speed, sea water temperature, soil moisture, snow depth and etc…

# GCOM-W/AMSR2 Standard Products

| Product | Range | Comments |
|---|---|---|
| Brightness temperatures | | |
| Brightness temperatures | 2.7-340K | Global, 6 frequency with dual polarizations |
| Geophysical parameters | | |
| Integrated water vapour | 0 - 70kg/m$^2$ | Over global ocean*, columnar integrated value |
| Integrated cloud liquid water | 0 - 1.0kg/m$^2$ | Over global ocean*, columnar integrated value |
| Precipitation | 0 - 20mm/h | Global (except over ice and snow), surface rain rate |
| Sea surface temperature | -2 - 35℃ | Global ocean* |
| Sea surface wind speed | 0 - 30m/s | Global ocean* |
| Sea ice concentration | 0 - 100% | High latitude ocean areas |
| Snow depth | 0 - 100cm | Land surface (except dense forest regions) |
| Soil moisture | 0 - 40% | Land surface (except ice sheet and dense forest regions) |

# GCOM-C/SGLI Products

## *GCOM-C products accuracy targets (Standard-1)*

| Area | group | Product | Day/night | Grid size | Release threshold[*1] | Standard accuracy[*1] | Target accuracy[*1] |
|---|---|---|---|---|---|---|---|
| Common | radiance | TOA radiance (including system geometric correction) | TIR and land 2.2μm: both<br>Other VNR,SWI: daytime (+special operation) | VNR,SWI Land/coast: 250m, offshore: 1km, polarimetory:1km<br>TIR Land/coast: 500m, offshore: 1km | Radiometric 5% (absolute[*3])[*5]<br>Geometric<1pixel | VNR,SWI: 5% (absolute[*3]), 1% (relative[*4])<br>TIR: 0.5K (@300K)<br>Geometric<0.5pixel | VNR,SWI: 3% (absolute[*3]), 0.5% (relative[*4])<br>TIR: 0.5K (@300K)<br>Geometric<0.3pixel |
| Land | Surface reflectance | Precise geometric correction | both | 250m | <1pixel[*6] | <0.5pixel[*6] | <0.25pixel[*6] |
| | | Atmospheric corrected reflectance (incl. cloud detection) | Daytime | 250m | 0.3 (<=443nm), 0.2 (>443nm) (scene) [*7] | 0.1 (<=443nm), 0.05 (>443nm) (scene) [*7] | 0.05 (<=443nm), 0.025 (>443nm) (scene)[*7] |
| | Vegetation and carbon cycle | Vegetation index | | 250m | Grass:25%(scene), forest:20%(scene) | Grass:20%(scene), forest:15%(scene) | Grass:10%(scene), forest:10%(scene) |
| | | Above-ground biomass | | 1km | Grass:50%, forest: 100% | Grass:30%, forest:50% | Grass:10%, forest:20% |
| | | Vegetation roughness index | | 1km | Grass&forest: 40% (scene) | Grass& forest:20% (scene) | Grass&forest:10% (scene) |
| | | Shadow index | | 250m, 1km | Grass&forest: 30% (scene) | Grass& forest:20% (scene) | Grass&forest:10% (scene) |
| | | fAPAR | | 250m | Grass:50%, forest: 50% | Grass:30%, forest:20% | Grass:20%, forest:10% |
| | | Leaf area index | | 250m | Grass:50%, forest: 50% | Grass:30%, forest:30% | Grass:20%, forest:20% |
| | temperature | Surface temperature | Both | 500m | <3.0K (scene) | <2.5K (scene) | <1.5K (scene) |

Common note:

*1: The “release threshold” is minimum levels for the first data release at one year from launch. The "standard" and "research" accuracies correspond to full- and extra success criteria of the mission respectively. Accuracies are shown by RMSE basically.

Radiance data note:

*2: TOA radiance is derived from sensor output with the sensor characteristics, and other products are physical parameters estimated using algorithms including knowledge of physical, biological and optical processes

*3: absolute error is defined as offset + noise

*4: relative error is defined as relative errors among channels, FOV, and so on.

*5: Release threshold of radiance is defined as estimated errors from vicarious, onboard solar diffuser, and onboard blackbody calibration because of lack of long-term moon samples

Land data note:

*6: Defined as RMSD from GCP

*7: Defined with land reflectance~0.2, solar zenith<30deg, and flat surface. Release threshold is defined with AOT@500nm<0.25

# GCOM-C/SGLI Products

## *GCOM-C products accuracy targets (Standard-2)*

| Area | Group | Product | Day/night | Grid size | Release threshold*1 | Standard accuracy*1 | Target accuracy*1 |
|---|---|---|---|---|---|---|---|
| Atmosphere | Cloud | Cloud flag/Classification | Both | 1km | 10% (with whole-sky camera) | Incl. below cloud amount | Incl. below cloud amount |
| | | Classified cloud fraction | Daytime | 1km (scene), 0.1deg (global) | 20% (on solar irradiance)*8 | 15%(on solar irradiance)*8 | 10%(on solar irradiance)*8 |
| | | Cloud top temp/height | Both | | 1K*9 | 3K/2km (top temp/height)*10 | 1.5K/1km (temp/height)*10 |
| | | Water cloud OT/effective radius | Daytime | | 10%/30% (CloudOT/radius) *11 | 100% (as cloud liquid water*13) | 50%*12 / 20%*13 |
| | | Ice cloud optical thickness | | | 30%*11 | 70%*13 | 20%*13 |
| | aerosol | Aerosol over the ocean | | | 0.1(Monthly τa_670,865)*14 | 0.1(scene τa_670,865)*14 | 0.05(scene τa_670,865) |
| | | Land aerosol by near ultra violet | | | 0.15(Monthly τa_380)*14 | 0.15(scene τa_380)*14 | 0.1(scene τa_380 ) |
| | | Aerosol by Polarization | | | 0.15(Monthlyτa_670,865)*14 | 0.15(scene τa_670,865)*14 | 0.1(scene τa_670,865) |
| Ocean | Ocean color | Normalized water leaving radiance (incl. cloud detection) | Daytime | 250m (coast) 1km (offshore) 4~9km (global) | 60% (443~565nm) | 50% (<600nm) 0.5W/m²/str/um (>600nm) | 30% (<600nm) 0.25W/m²/str/um (>600nm) |
| | | Atmospheric correction param | | | 80% (AOT@865nm) | 50% (AOT@865nm) | 30% (AOT@865nm) |
| | | Photosynthetically available radiatioin | | | 20% (10km/month) | 15% (10km/month) | 10% (10km/month) |
| | In-water | Chlorophyll-a concentration | | | –60~+150% (offshore) | –60~+150% | –35~+50% (offshore), –50~+100% (coast) |
| | | Suspended solid concentration | | | –60~+150% (offshore) | –60~+150% | –50~+100% |
| | | Colored dissolved organic matter | | | –60~+150% (offshore) | –60~+150% | –50~+100% |
| | temperature | Sea surface temperature | Both | 500m (coast) 1km (offshore) 4~9km (global) | 0.8K (daytime) | 0.8K (day&night time) | 0.6K (day&night time) |
| Cryosphere | Area/ distribution | Snow and Ice covered area (incl. cloud detection) | Daytime | 250m (scene) 1km (global) | 10% (vicarious val with other sat. data) | 7% | 5% |
| | | OKhotsk sea-ice distribution | | 250m | 10% | 5% | 3% |
| | Surface properties | Snow and ice surface Temperature | | 500m (scene) 1km (global) | 5K (vicarious val with other sat. data and climatology) | 2K | 1K |
| | | Snow grain size of shallow layer | | 250m (scene) 1km (global) | 100%(vicarious val with climatology between temp-size) | 50% | 30% |

Atmosphere note:

*8: Comparison with in-situ observation on monthly 0.1-degree

*9: Vicarious val. on sea surface and comparison with objective analysis data

*10: Inter comparison with airplane remote sensing on water clouds of middle optical thickness

*11: Release threshold is defined by vicarious val with other satellite data (e.g., global monthly statistics in the mid-low latitudes)

*12: Comparison with cloud liquid water by in-situ microwave radiometer

*13: Comparison with optical thickness by sky-radiometer (the difference can be large due to time-space inconsistence and large error of the ground measurements)

*14: Estimated by experience of aerosol products by GLI and POLDER

# GCOM-C/SGLI Products

## *GCOM-C products accuracy targets (Research)*

| Area | Group | Product | Day/night | Grid size | Release threshold*1 |
|---|---|---|---|---|---|
| Land | Application | Land net primary production | Daytime | 1km | 30% (yearly) |
| | | Water stress trend | N/A | 500m | 10% *15 (error judgment rate) |
| | | Fire detection index | Both | 500m | 20% *16 (error judgment rate) |
| | | Land cover type | Daytime | 250m | 30% (error judgment rate) |
| | | Land surface albedo | | 1km | 10% |
| Atmos-phere | Cloud | Water cloud geometrical thickness | Daytime | 1km (scene), 0.1deg (global) | 300m |
| | Radiation budget | Long-wave radiation flux | | | Downward 10W/m2, upward 15W/m2 (monthly) |
| | | Short-wave radiation flux | | | Downward 13W/m2, upward 10W/m2 |
| Ocean | Ocean color | Euphotic zone depth | Daytime | 250m (coast), 1km (offshore), 4~9km (global) | 30% |
| | In-water | Inherent optical properties | | | a(440): RMSE<0.25, bbp(550): RMSE<0.25 |
| | Application | Ocean net primary productivity | | 500m (coast), 1km (offshore), 4~9km (global) | 70% (monthly) |
| | | Phytoplankton functional type | | 250m (coast), 1km (offshore), 4~9km (global) | error judgment rate of large/ small phytoplankton dominance<20%; or error judgment rate of the dominant phytoplankton functional group <40% |
| | | Redtide | | | error judgment rate <20% |
| | | multi sensor merged ocean color | | 250m (coast), 1km (offshore) | −35~+50% (offshore), −50~+100% (coast) |
| | | multi sensor merged SST | Both | 500m (coast), 1km (offshore) | 0.8K (day&night time) |
| Cryosphere | Area/ distribution | Snow and ice classification | N/A | 1km | 10% |
| | | Snow covered area in forest and mountain | Daytime | 250m | 30% |
| | Surface propaties | Snow grain size of subsurface layer | | 1km | 50% |
| | | Snow grain size of top layer | | 250m( scene), 1km (global) | 50% |
| | | Snow and ice albedo | | 1km | 7% |
| | | Snow impurity | | 250m( scene), 1km (global) | 50% |
| | | Ice sheet surface roughness | N/A | 1km | 0.05 (height/width) |
| | Boundary | Ice sheet boundary monitoring | N/A | 250m | <500m |

Research product note:

*15: Evaluate in semiarid regions (steppe climate etc.)

*16: Fires >1000K occupying >1/1000 on 1km pixel at night (using 2.2um of 1 km and thermal infrared channels)

# ALOS to ALOS-2 and ALOS-3

**ALOS** Jan. 2006-May 2011

Weight : 4 t

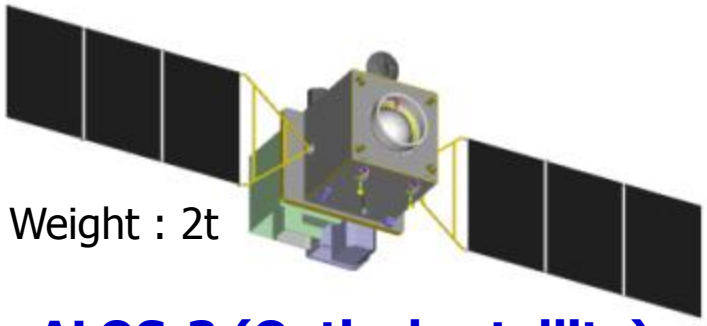
**PALSAR**

**PRISM**

**AVNIR-2**

Weight : 2t

**ALOS-2 (SAR satellite)**
**Launch in 2013**



Weight : 2t

**ALOS-3 (Optical satellite)**
**Launch in 2015**

# Summary

- JAXA has been developing, operating and providing data for the atmospheric research, climate change science communities and user organizations.
- 'DAICHI' (ALOS) operation was stopped by power generation anomaly on April 22, 2011. Following the success of 5yrs ALOS mission operation, ALOS-2 and 3 are currently being developed in order for minimize the data gap.
- Observation Halted by Advanced Microwave Scanning Radiometer-EOS (AMSR-E) onboard NASA Aqua satellite by its rotation torque anomaly on October 4, 2011.
- Forthcoming satellite missions dedicated and/or contribute to monitor the global hydrological cycles are ahead.
  - GCOM-W1 will be launched in JFY 2011.
  - GPM/DPR will be launched in JFY 2013.
  - ALOS-2 will be launced in JFY 2013.
  - GCOM-C1 will be launched in or later than JFY2014, and still need your support to realize this project.
  - EarthCARE/CPR will be launched in 2015.
  - ALOS-3 will be launced in or later than JFY 2015, and still need your support to realize this project.