JAXA's Contributions as a CEOS Member to GEO Water

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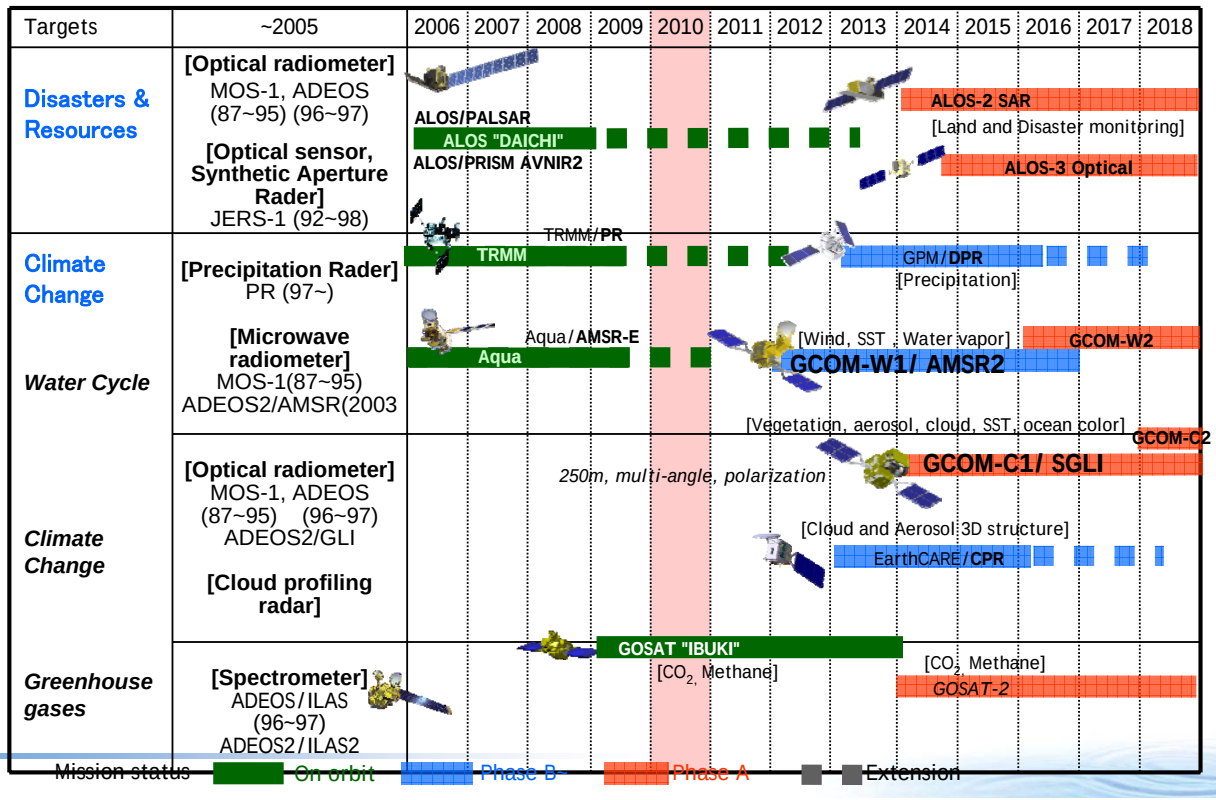
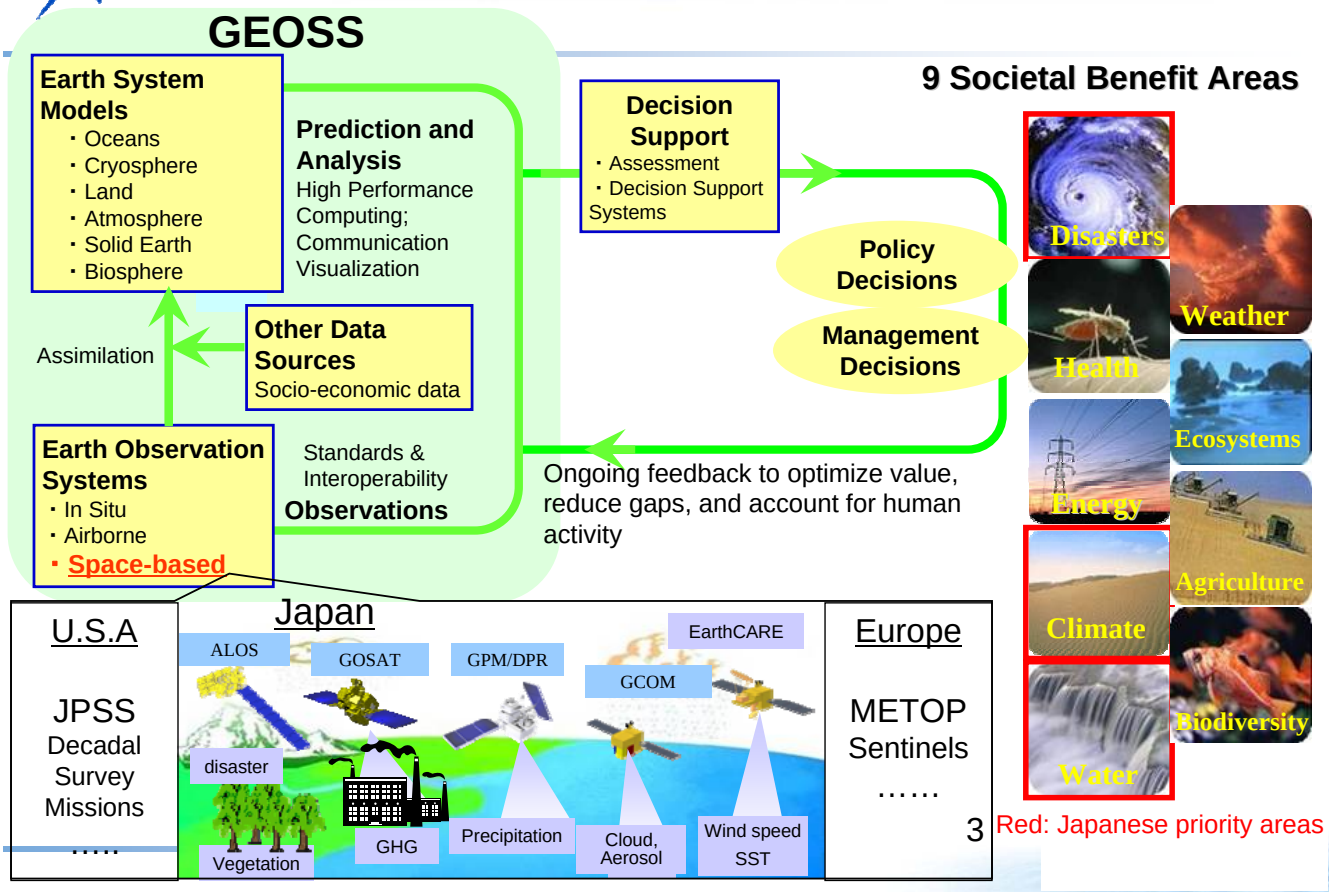
Typhoon Committee Integrated Workshop @ 6-10 Sep. 2010, Macao, China

Long-Term Plan of Earth Observation by JAXA



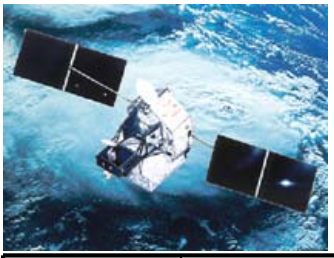
GEOSS 10yr Implementation Plan



TRMM
Tropical Rainfall Measuring Mission

Tropical Rainfall Measuring Mission (TRMM)

- Major characteristics
  - Focused on rainfall observation. First instantaneous rainfall observation by three different sensors. PR, active sensor, can observe 3D rainfall.
  - Targeting tropical and subtropical region, and chose non-sun-synchronous orbit to observe diurnal variation.
  - PR experienced a major anomaly in 29 May, but NASA and JAXA successfully switch to the backup systems on June 17 and PR became operational again.
- Major achievement in Japan
  - Demonstration of high quality and high reliability of a satellite onboard precipitation radar
  - Improvement of MWR precipitation retrieval by PR 3D observation
  - Pioneering precipitation system climatology by PR observation
  - Operational use in NWP etc.
  - New products including all-weather SST, global soil moisture



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)** **TRMM Microwave Imager (TMI)** **Visible Infrared Scanner (VIRS)** **Lightning Imaging Sensor (LIS)** **CERES (not in operation)**

Advanced Microwave Scanning Radiometer for EOS (AMSR-E)

- **Mission status**
  - Continuous observation over 7-years after the launch on May 4, 2002 onboard NASA's EOS Aqua satellite.
  - Stable brightness temperature records, except the loss of 89GHz-A data from November 2004.
  - AMSR-E data is used in NWP and typhoon analysis in JMA.
- **Instrument characteristics**
  - Multi-frequency microwave radiometer with dual polarization capability (developed by JAXA).
  - High-spatial resolution compared to existing instruments by large size antenna.
  - C-band (6.9GHz) channels for estimating SST and soil moisture.
  - Afternoon (1:30 pm) equatorial crossing time that is currently unique for microwave radiometers.

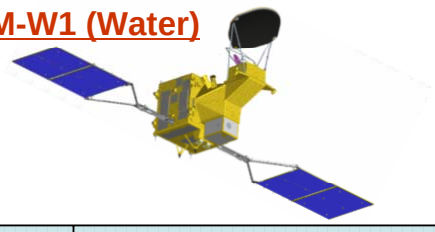
NASA's Aqua satellite

Pre-launch AMSR-E in Tsukuba Space Center

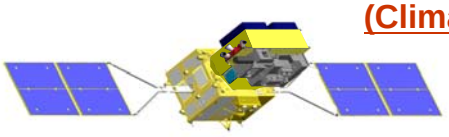
First Generation of GCOM-W and C

- 2 medium-sized satellites: GCOM-W and -C.
- 3 consecutive generations with 1 year overlaps for assuring long-term inter-calibrated data records.

GCOM-W1 (Water)

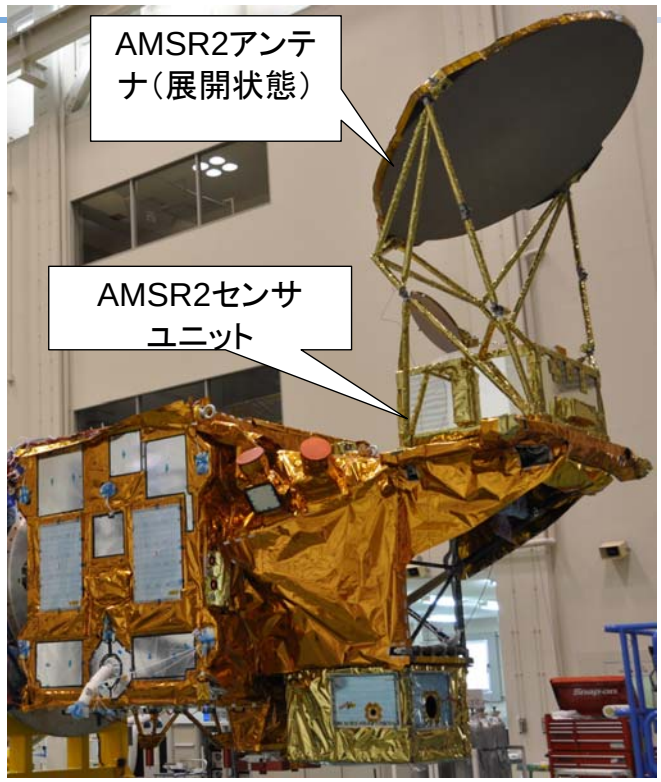


GCOM-C1 (Climate)



Satellite	GCOM-W1	GCOM-C1
Sensor	**AMSR2 : Advanced Microwave Scanning Radiometer 2**	**SGLI : Second Generation Global Imager**
Orbit	Sun synchronous orbit (A-Train orbit) Altitude：699.6km（on Equator） Inclination：98.2° Local sun time：13:30±15min	Sun synchronous orbit Altitude：798km（on Equator） Inclination：98.6° Local sun time：10:30±15 min
Life time	5 years	5 years
Launch	JFY 2011 by H-IIA Rocket	JFY 2014 by H-IIA Rocket
Satellite scale	5.1m（X）×17.5m（Y）×3.4m（Z）（on-orbit）	4.6m（X）×16.3m（Y）×2.8m（Z）（on orbit）
Satellite mass	1991kg	2093kg
Power generation	More than 3880W（EOL）	More than 4000W（EOL）

GCOM-W1衛星

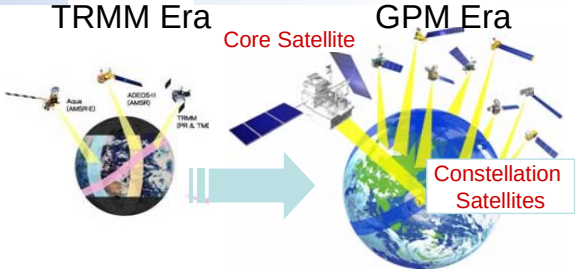


GCOM-W1衛星（展開後）

GCOM-W1衛星（衛星フェアリング格納時の状態）

Future mission: Global Precipitation Measurement

- The Global Precipitation Measurement (GPM) is an expanded mission of the Tropical Rainfall Measuring Mission (TRMM)



Core Satellite (JAXA, NASA)

Dual-frequency precipitation radar (DPR)

GPM Microwave Imager (GMI)

- Precipitation with high precision
- Discrimination between rain and snow
- Adjustment of data from constellation satellites

(launch in 2013)

Constellation Satellites (International Partners)

Microwave radiometers

Microwave sounders

- Global precipitation every 3 hours

(launch around 2013)

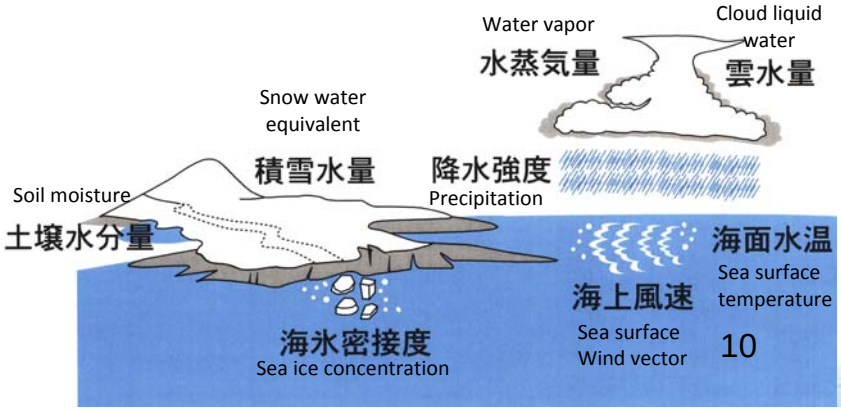
- Improve the accuracy of both long-term and short-term weather forecasts
- Improve water resource management in river control and irrigation systems for agriculture

JAXA Satellite Product Categories

- Standard Product
  - Core and proven products for achieving the mission goals.
  - Scheduled and operational processing.
- Near Real-time Product
  - Near real-time distribution to operational users to meet their needs.
  - Some optimization and/or simplification to meet timeliness.
- Subset Product
  - Sub-set of specific region or area, produced from standard products.
- Research Product
  - Product that uses research algorithm and is produced mainly for research objectives. Products are not produced operationally.

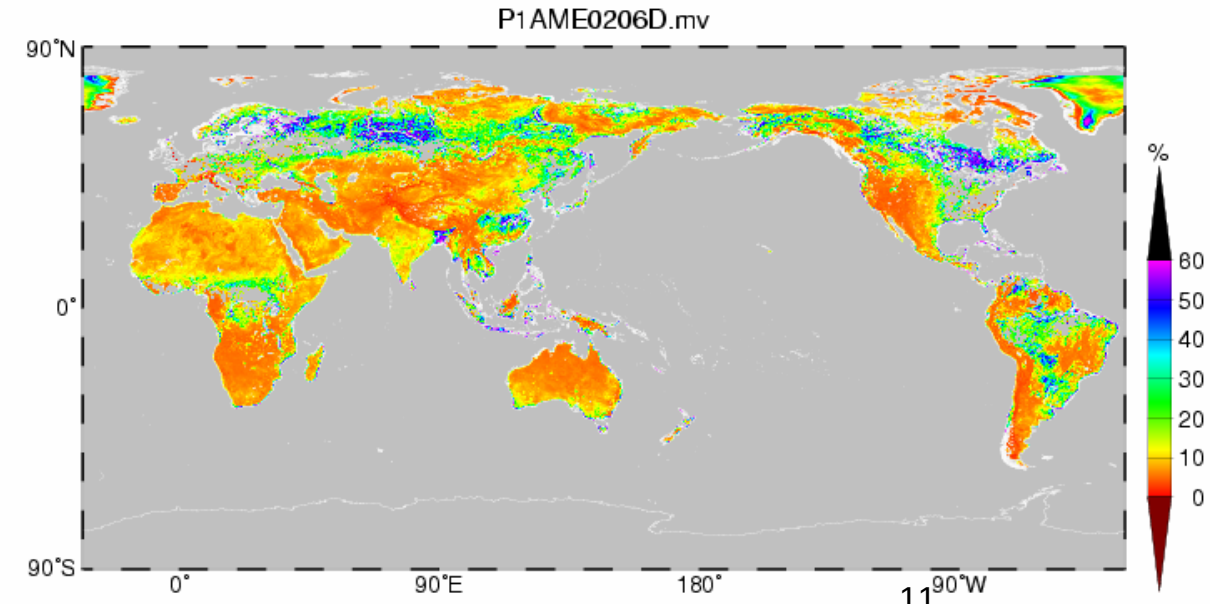
AMSR-E Geophysical Parameters

Geophysical products	Comments
AMSR follow-on instrument	
Integrated water vapor	Over global ocean*, columnar integrated value
Integrated cloud liquid water	Over global ocean*, columnar integrated value
Precipitation	Global (except over ice and snow), surface rain rate
Sea surface temperature	Global ocean*
Sea surface wind speed	Global ocean*
Sea ice concentration	High latitude ocean areas
Snow depth	Land surface (except dense forest regions)
Soil moisture	Land surface (except ice sheet and dense forest regions)



AMSR-E Soil Moisture

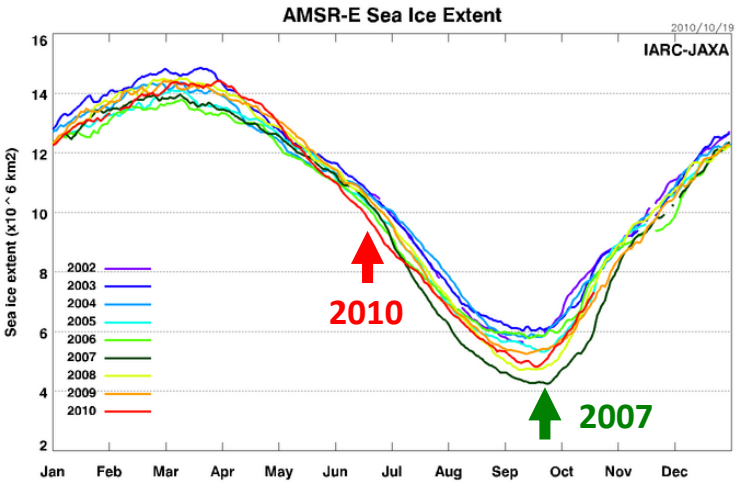
- C-band (7GHz) channels are currently best available frequency for retrieving global, long-term soil moisture content from satellite.
- Synergy with L-band radiometers (e.g., SMOS, SMAP) and high-resolution SAR instruments are desired.

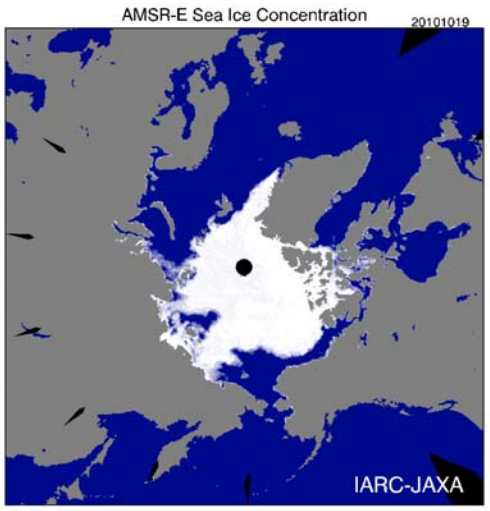


Soil moisture standard product is being generated by using 10GHz as a primary frequency due to the radio frequency interference issue in 6.9GHz band.

Arctic Sea-Ice Monitor by AMSR-E IARC-JAXA Information System

The latest value : 7,276,563 km^2 (October 19, 2010)

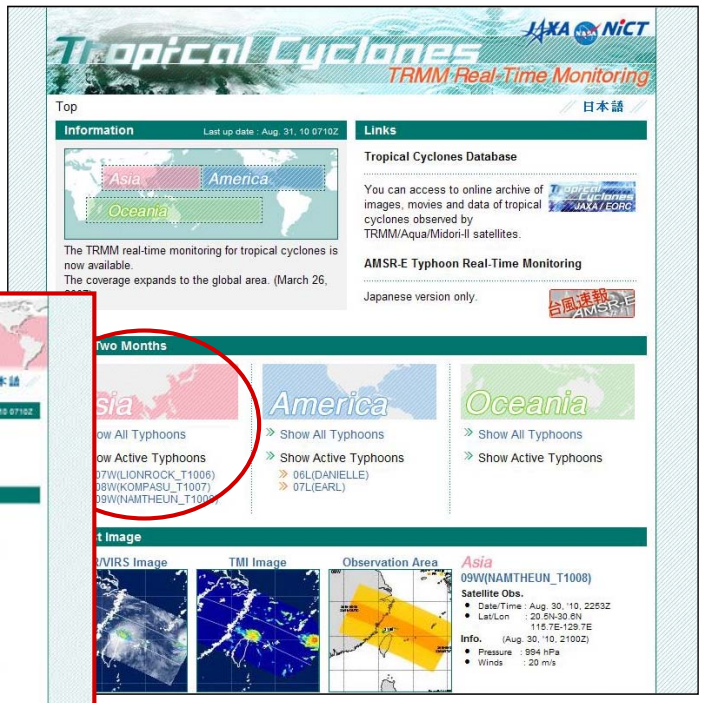


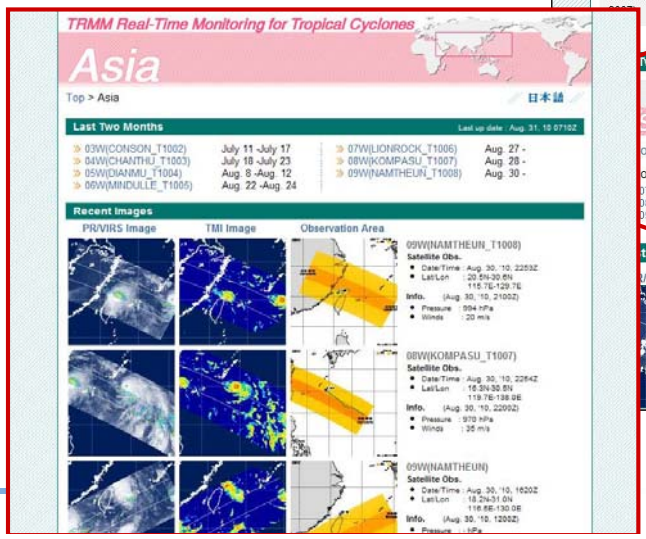


Time series of AMSR-E sea ice extent over Arctic Oceans. Daily updates are available at the Arctic Sea-Ice Monitor site maintained by the International Arctic Research Center (http://www.ijis.iarc.uaf.edu/cgi-bin/seaice-monitor.cgi).

TRMM Tropical Cyclone Real-Time Monitoring

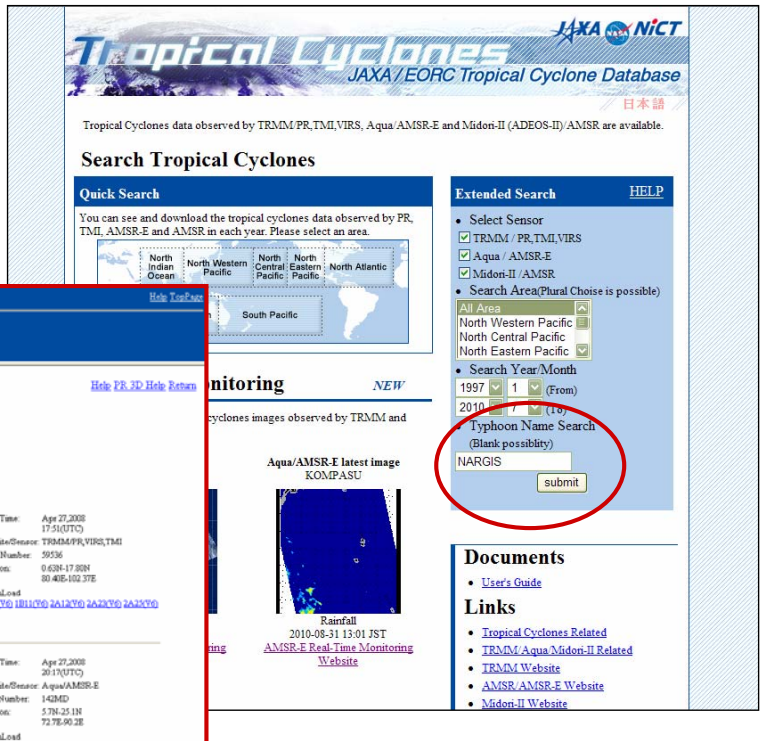
- Global regions (Asia, Americas, Oceania)
- Operating in near-real time (3-6 hours after observation)
- Browse images of PR, TMI and storm tracks are available

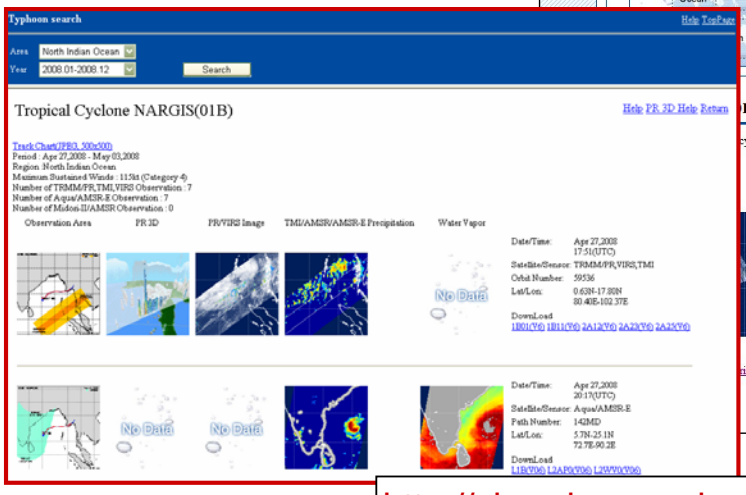




JAXA/EORC Tropical Cyclone Database

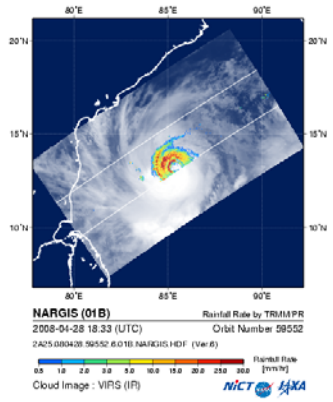
- Browse images, 3D movies and data of tropical cyclones observed by TRMM, AMSR-E, AMSR are available.
- Updated 1-1.5 months after observation.





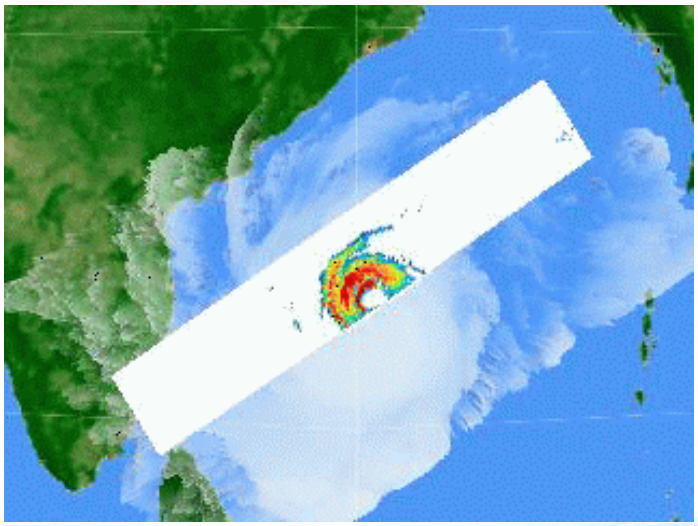
http://sharaku.eorc.jaxa.jp/TYP_DB/index_e.shtml

TRMM/PR 3D Observation of Cyclone “NARGIS”

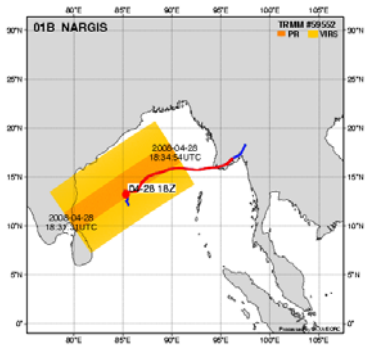


TRMM/PR 3D Observation of the cyclone NARGIS

Date/Time:Apr 28,2008 18:33(UTC)
Satellite/Sensor:TRMM/PR,VIRS
Lat/Lon:8.20N-18.84N, 79.66E-90.30E

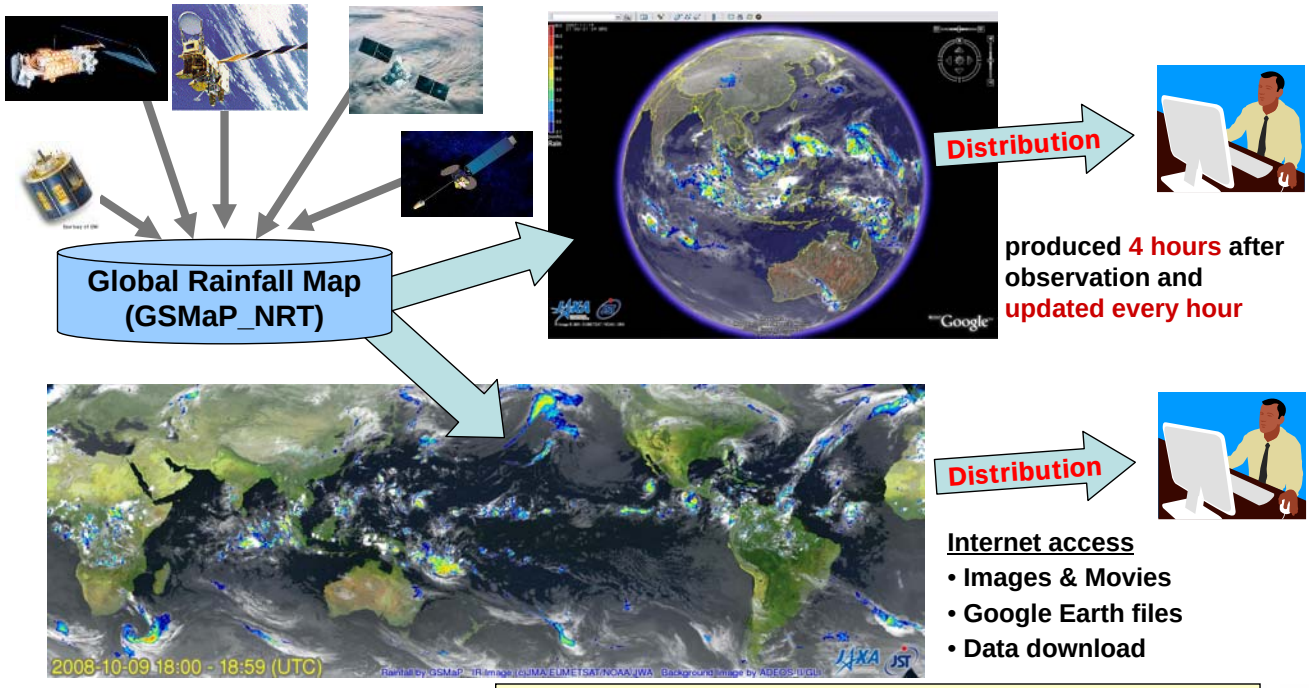


Track Chart and Observation Area



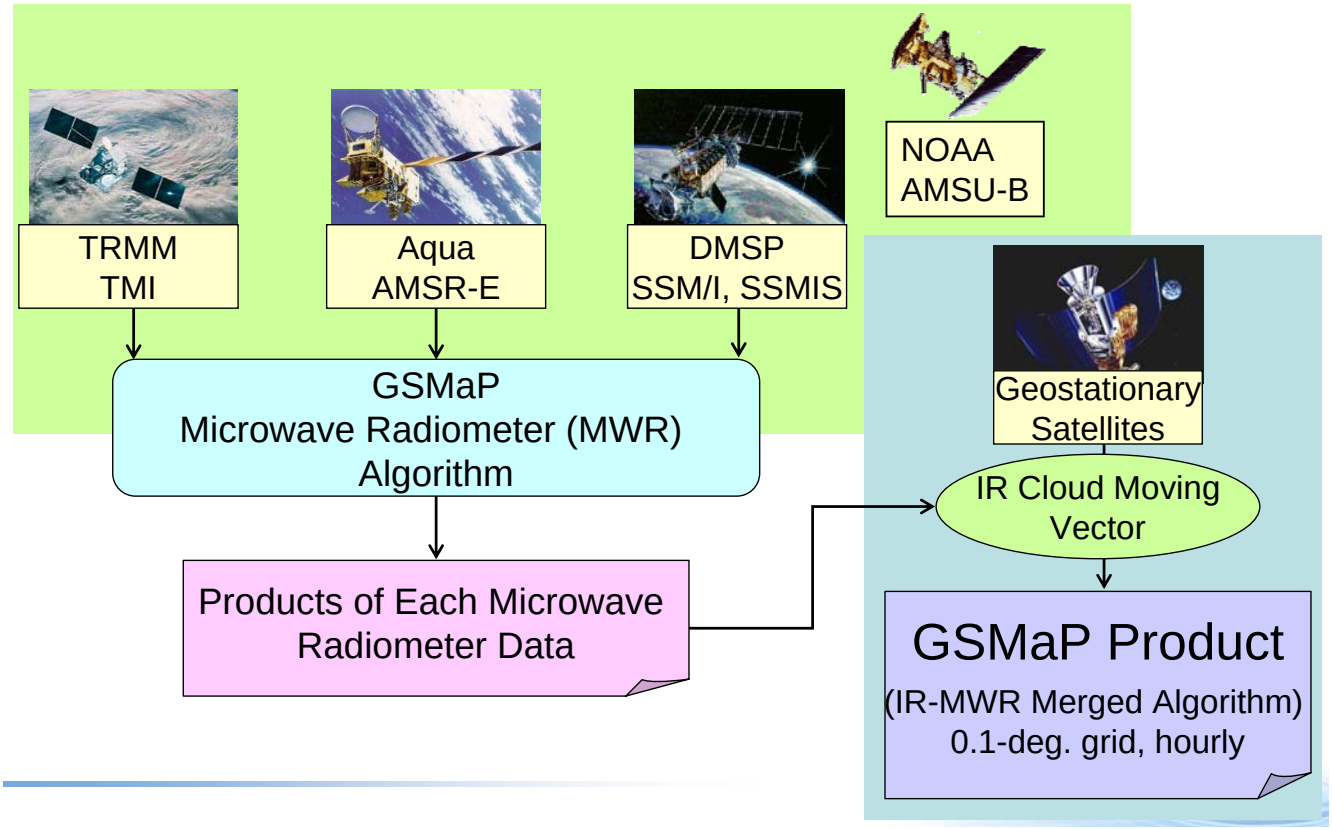
JAXA provides Global Rainfall Map from Satellites

We have started to release hourly global rainfall data (0.1x0.1deg. lat/lon) in near real time (about four hours after observations) and visualize the latest data quickly.



http://sharaku.eorc.jaxa.jp/GSMaP/

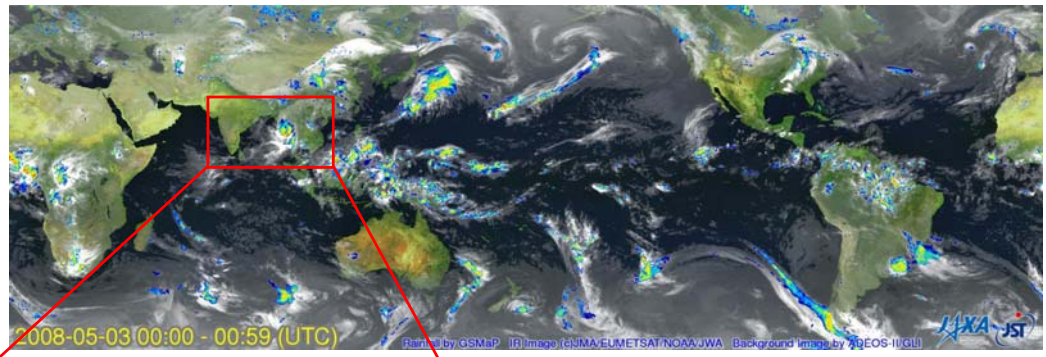
Production of GSMaP by Multi-satellite Data



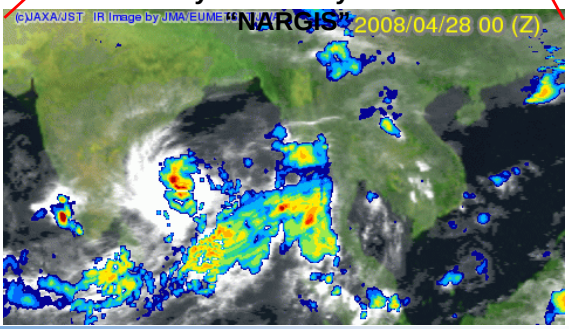
TRMM Tropical Rainfall Measuring Mission
JAXA

Rainfall observations by GSMaP_NRT

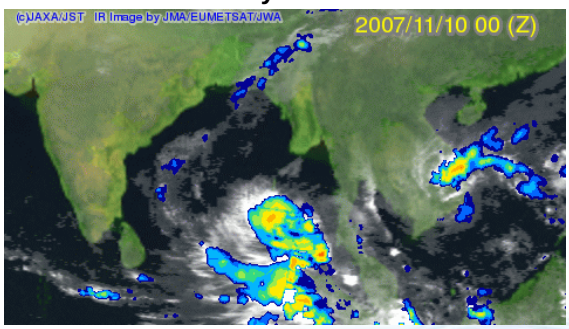
Global rainfall image with cloud images on 0UTC, 3rd May 2008



Movie from 28th April to 3rd May 2008 for cyclone "NARGIS"



Movie from 11th to 16th November 2007 for cyclone "SIDR"



http://sharaku.eorc.jaxa.jp/GSMaP/

Concluding Remarks

- TRMM: Satellite dedicated to rainfall observation
  - Simultaneous observation by world's first satellite-borne precipitation radar, microwave imager, and VIS-IR imager.
  - More than 12-years observation.
  - Tropical Cyclone Database by TRMM and Aqua/AMSR-E are available via internet, as well as Tropical Cyclone Monitoring for quick look.
- GCOM-W, C
  - Planned launch year of the GCOM-W1 satellite is the next year.
- GSMaP: High-frequent and high-resolution global rainfall map
  - Combining rainfall retrievals by several microwave radiometers and movement of rainfall region by Geostationary IR imagers.
  - 0.1-degree grid and hourly data for the region of 60N-60S are available via internet 4-hour after observation.
  - Can observe and analyze development of tropical cyclones with its strength in high temporal resolution.

CEOS PC/Current Status (cont.)

- ✓ **Field Campaigns**
  - Completed Pre-CHUVA Ground Validation experiment (NASA, INPE)
  - Completed LPVEX Ground Validation experiment (NASA, FMI, Environment Canada)
  - Planning for Mid-Latitude Continental Convective Clouds Experiment (MC3E): NASA-DOE field campaign at DOE-ASR Central Facility in Oklahoma, Apr-May 2011
  - Planning for GPM Cold-season Precipitation Experiment (GCPEX): GPM-Environment Canada campaign on snowfall retrieval, Ontario, Canada, Jan-Feb 2012
- ✓ **Meetings/Workshops held**
  - X-Calibration Working Group (WG) (in coordination with CGMS/GSICS), October 21-22, 2010, Asheville, NC, USA
  - Precipitation Measuring Missions Science Team, November 1-4, 2010, Seattle, WA, USA (NASA)
  - 4th Joint Precipitation Science Team Meeting, November (5, 2010, Seattle, WA, USA (NASA, JAXA)
- ✓ **Meetings/Workshops in planning**
  - 9th GPM International Planning Workshop, April 26-28, 2011, Fortaleza, Brazil (hosted by INPE)
  - 4th CEOS Precipitation Constellation Workshop, April 29, 2011, Fortaleza, Brazil (hosted by INPE)
  - X-Calibration Working Group (WG) (in coordination with CGMS/GSICS), March (TBC), 2011, College Park, MD, USA
  - X-Calibration Working Group (WG) (in coordination with CGMS/GSICS), July 29-30, 2011, Tokyo, Japan
- ✓ **Documents in draft**
  - 2009-2010 Precipitation Constellation Accomplishments
  - 2011-2012 Precipitation Constellation Work Plan

- Contributions to GEO/CEOS by providing data and information of EO satellite observation.
- Water theme
  - Operating TRMM, AMSR-E/Aqua, Future GCOM, GPM.
  - CEOS VC/Precipitation Constellation
    - NASA and JAXA are the lead agencies
    - *PC is developing Data Portal and mockup completed*
    - *Feasibility of interface to GEO Portal and GEO Clearinghouse needs to be assessed*
    - need to consider linkage to GEO/Water portal

- Tropical Cyclone Database
  http://sharaku.eorc.jaxa.jp/TYP_DB/index_e.shtml
- Tropical Cyclone Real-Time Monitoring
  - TRMM:
    http://www.eorc.jaxa.jp/TRMM/NRTtyphoon/index_e.htm
  - AMSR-E: http://sharaku.eorc.jaxa.jp/cgi-bin/adeos2/typhoon/typhoon.cgi?mode=view
- GSMaP_NRT
  http://sharaku.eorc.jaxa.jp/GSMaP/index.htm