



JAXA's Water Cycle Observation Programs and Applications

Japan Aerospace Exploration Agency



December 2007
3rd Asian Water Cycle Symposium
Ohita International House



Japan's Basic Strategy for Earth Observation

Council for Science & Technology Policy (March 2005)

- Needs for an integrated observation by satellites, ships, buoys, ground stations and so on
- Establishment of a integrated observation system based upon user needs
- One of tools for policy making
- Contribution to GEOSS, especially in the following 3 Societal Benefit Areas
 - Water, Climate & Disaster

A National Key Technology

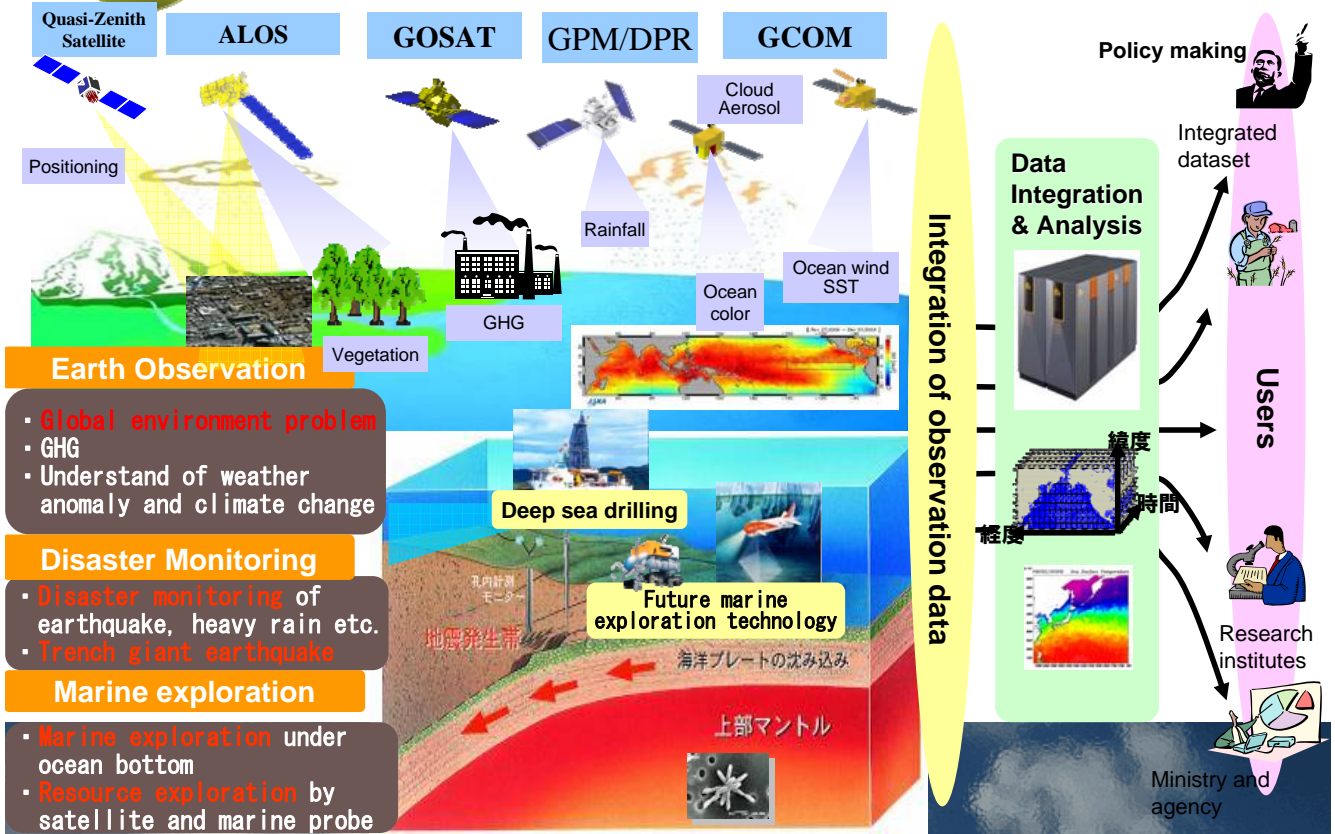
“Integrated Marine Exploration and Earth Observation System”

- Earth Observation
- Disaster Monitoring
- Marine Exploration



“Integrated Marine Exploration and Earth Observation System”

Establishment of a fundamental system for Earth observation, disaster monitoring and marine exploration system as a national key technology for Japanese national security



Japan's EO Long Term Plan

Japanese Contribution Field	Observation Parameter	Sensor Type	JFY	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Reduction and Prevention of Disasters	Land-cover change, volcanic ash fall, flooded area, etc.	Passive optical sensor (Visible and IR high resolution sensor)		Terra/ASTER			ALOS / PRISM, AVNR-2						Disaster Monitoring Mission (optical)				Disaster Monitoring Mission (geostationary satellite)					
	Crustal deformation, biomass, flooded area, etc.	Active radio wave sensor (L-band synthetic aperture radar)			ALOS / PALSAR								Disaster Monitoring Mission (SAR)									
Climate Change including Water Cycle Variation	3D structure of precipitation, soil moisture, etc.	Active radio wave sensor (Precipitation radar)		TRMM/PR									GPM/DPR (Dual frequency Precipitation Radar)									
	Precipitation, water vapor, sea surface temperature, etc.	Active microwave sensor (Microwave radiometer)		Aqua/AMSR-E									GCOM-W/AMSR2									
	Sea surface wind vector, etc.	Active radio wave sensor (Microwave scatterometer)		ADEOS-II/SeaWinds									GCOM-W/Microwave Scatterometer									
	Cloud optical thickness, aerosol optical thickness, land biomass, etc.	Passive optical sensor (Multi-spectral radiometer)		ADEOS-II/GLI									GCOM-C/SGLI									
Global Warming and Carbon Cycle Change	3D distribution of cloud and aerosol, etc.	Active radio wave sensor (Cloud profiling radar)		EarthCARE/ICPR																		
	Carbon dioxide(CO ₂), methane(CH ₄), etc.	Passive optical sensor (IR spectrometer)		ADEOS-II/LAS-II								GOSAT / Greenhouse gas Observation Sensor (GOS)										
		Active optical sensor (LIDAR)																				

Legend: Approved Project (Blue), Planned Project (Red), GEOS 10-Year Implementation Period (Light Blue)

Legend: Satellite name/Sensor name (Blue), Japanese Satellite/Japanese Sensor (Red), Foreign satellite/Foreign Sensor (Light Blue)

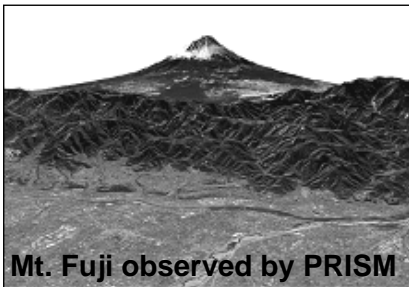


Advanced Land Observing Satellite (ALOS)

■ Launch: 24 January, 2006.

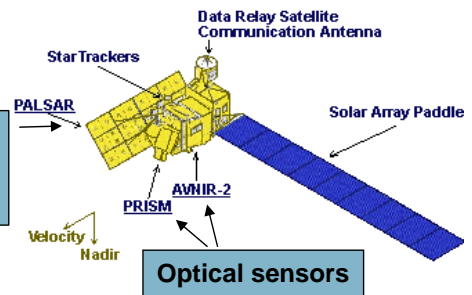
■ Objectives:

- Cartography
- Regional observation
- Disaster monitoring
- Resource surveying

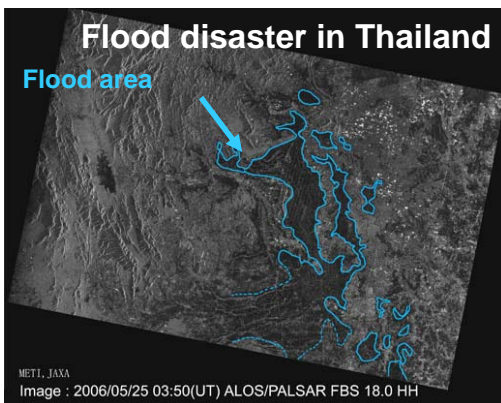


Mt. Fuji observed by PRISM

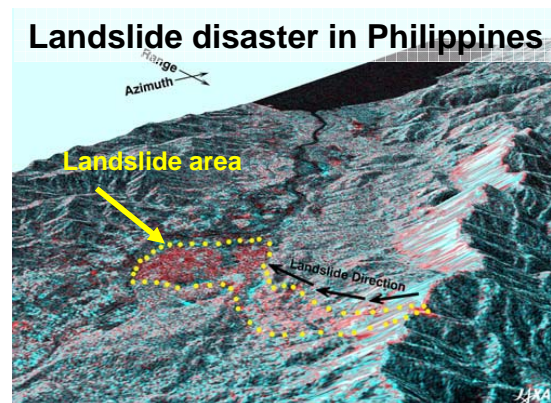
PALSAR(L-band SAR)
Cloud-free
Day-night observation



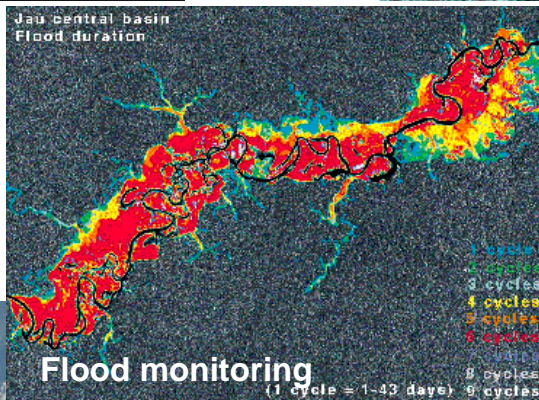
Observation from space plays significant role for disaster management



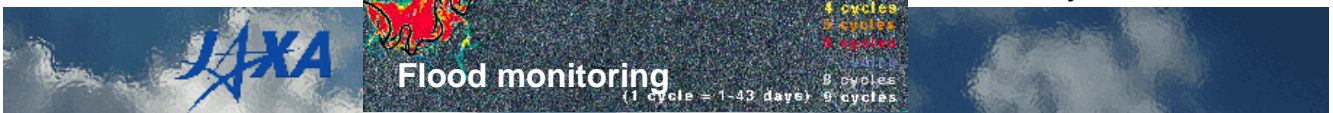
Northern Thailand, observed by ALOS/PALSAR



Leyte Island, Philippines, observed by ALOS/PALSAR



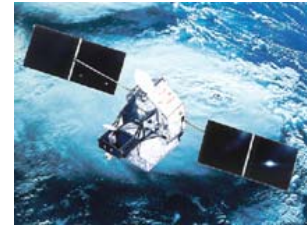
Jau River, Amazon, Brazil, observed by JERS-1/SAR



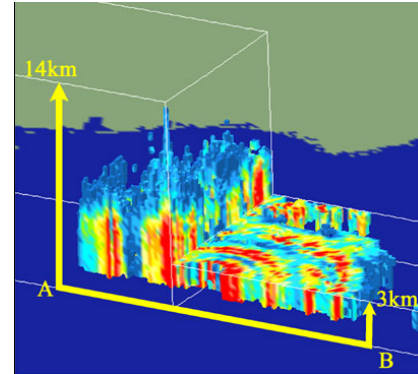
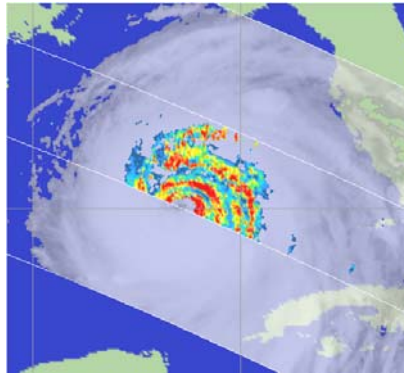


Tropical Rainfall Measuring Mission (TRMM)

- Japan-U.S. joint mission, flying since Nov. 1997
- World's first space-borne precipitation radar (PR) with microwave radiometer and visible-infrared sensor.
- Three-dimensional observation of rainfall by PR.



Hurricane KATRINA approaching South US, observed by TRMM at 0323Z 28 Aug. 2005.



TRMM Tropical Cyclone Real-time Monitoring (North-western Pacific)

- Near real-time browse images of tropical cyclones (typhoons) for the North-western Pacific region, observed by TRMM is available.
- Database of past tropical cyclones for global region, observed by TRMM, AMSR and AMSR-E, are also available.

<http://www.eorc.jaxa.jp/TRMM/>

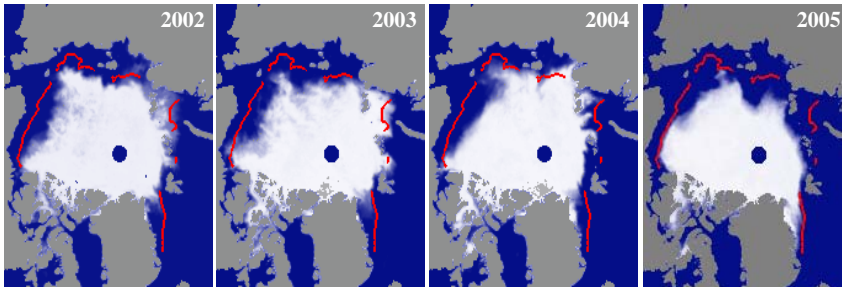
Earth Observation Research Center, Japan Aerospace Exploration Agency
 JAXA EORC ALL RIGHTS RESERVED.
 EORC Typhoon Database Secretariat





Advanced Microwave Scanning Radiometer for EOS (AMSR-E)

- Observing various shapes of water over ocean (water vapor, precipitation, cloud water, SST, and sea ice) and land (soil moisture and snow water equivalence).
- Four-years of continuous data records have been archived from 2002.



Sea ice monitoring by AMSR-E.

Yearly changes of monthly sea ice distribution over north polar regions in summer (red lines indicate average extent between 1988 and 2000, provided by NSIDC).



Future mission: Global Precipitation Measurement (GPM)

Core Satellite

Dual-frequency Precipitation Radar and microwave radiometer

- Observation of rainfall with more accurate and higher resolution
- Adjustment of data from constellation satellites

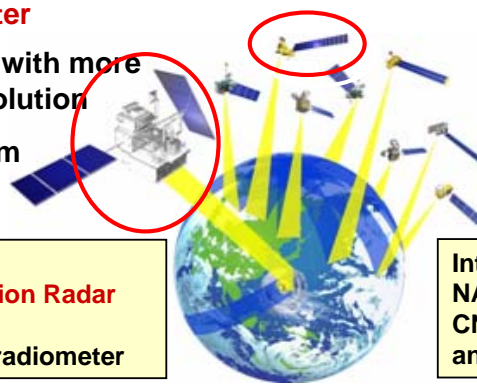
JAXA (Japan)
Dual-frequency Precipitation Radar
NASA(US)
Satellite bus, microwave radiometer

Constellation Satellites

Each carrying microwave radiometers, provided by international partners

- More frequent Observation

International Partners : NOAA(US), NASA(US), JAXA (Japan), CNES/ISRO(France/India) and others



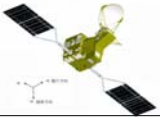
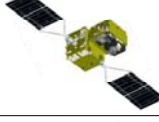
Global Observation every 3 hours

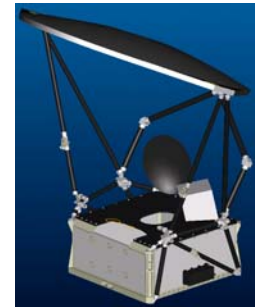




Future mission: Global Change Observation Mission (GCOM)

- Establish and demonstrate global and long-term Earth observation system for understanding climate variability and water-energy cycle.
- 2 satellites (**GCOM-W and C**) series of 3 generations with 1-year overlap will result in over 13 years homogeneous and steady observation. (**W: water and C: climate**)
- GCOM-W will focus on variability of **global water-energy cycle** and **extend successful AMSR-E observation** to contribute to world water relevant issues.

GCOM-W & -C characteristics		
	GCOM-W	GCOM-C
Design		
Orbit (TBD)	<ul style="list-style-type: none"> ■ Sun-synchronous ■ Altitude: 699.6km ■ Inclination: 98.19deg ■ Asc. local time: 13:30 	<ul style="list-style-type: none"> ■ Sun-synchronous ■ Altitude: 798km ■ Inclination: 99.36deg ■ Dsc. local time: 10:30
Instruments	■ AMSR2 Microwave imager	■ SGLI Near-UV ~ TIR imager
Launch Date	JFY 2011	JFY 2012
Mission Life	5 years (x3 satellites; total 13 years)	
Launch Vehicle	H-IIA	



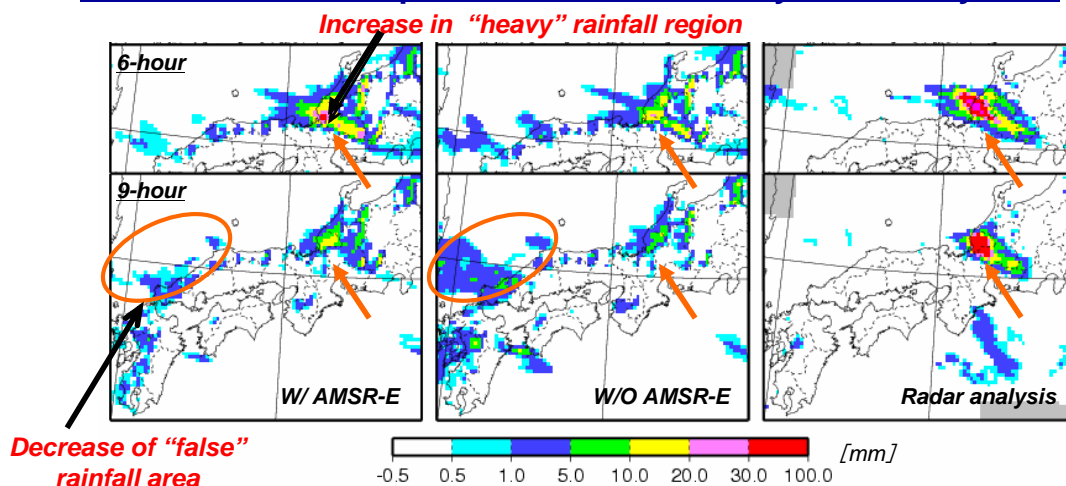
AMSR2 of GCOM-W satellites



Expected application (1): Numerical Weather Prediction

- Japan Meteorological Agency (JMA) started to use AMSR-E data for the meso-scale numerical weather prediction from November 2004, and for global model from May 2006.

Data assimilation experiment for Fukui heavy rain in July 2004



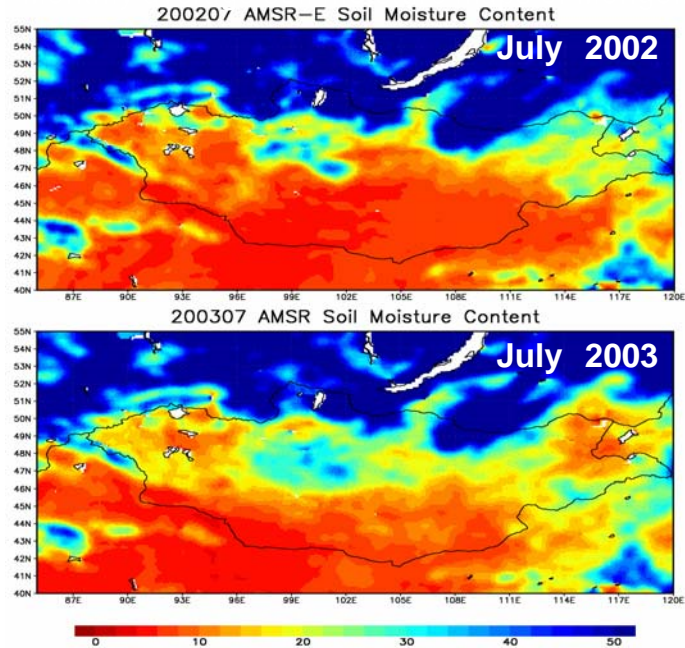
All results were provided by Numerical Prediction Division, JMA



Expected application (2): Monitoring of soil moisture content

- Soil moisture is important in regional agricultural management and in regional/global climate.
- Because of its fine resolution, AMSR-E currently has the best capability for soil moisture monitoring.
- The wetter land surface condition in 2003 derived from AMSR/AMSR-E is consistent with that year's large amounts of winter snow and summer rain.

Monthly average soil moisture maps of Mongolia

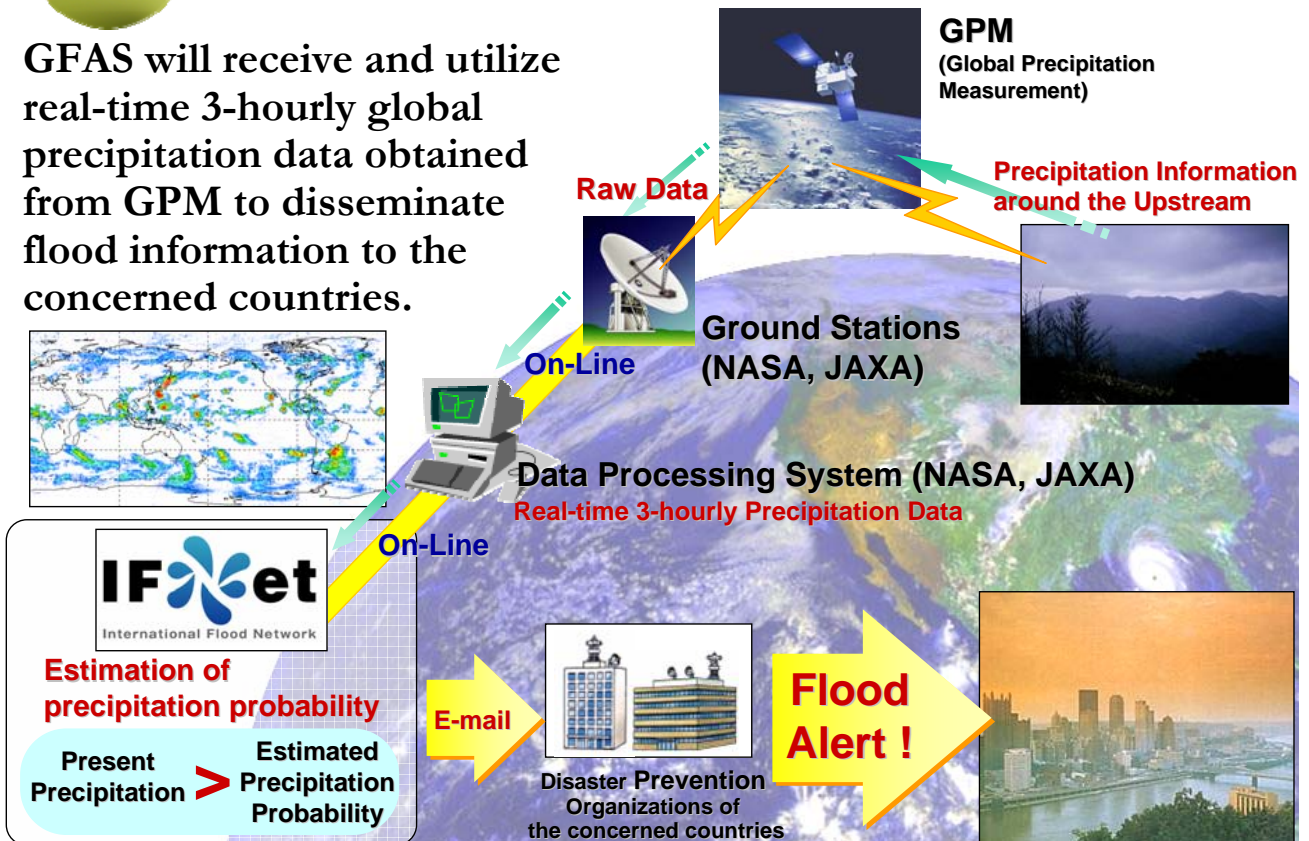


This is a cooperative research project between JAXA, Unv. of Tokyo and Hiroshima Univ.



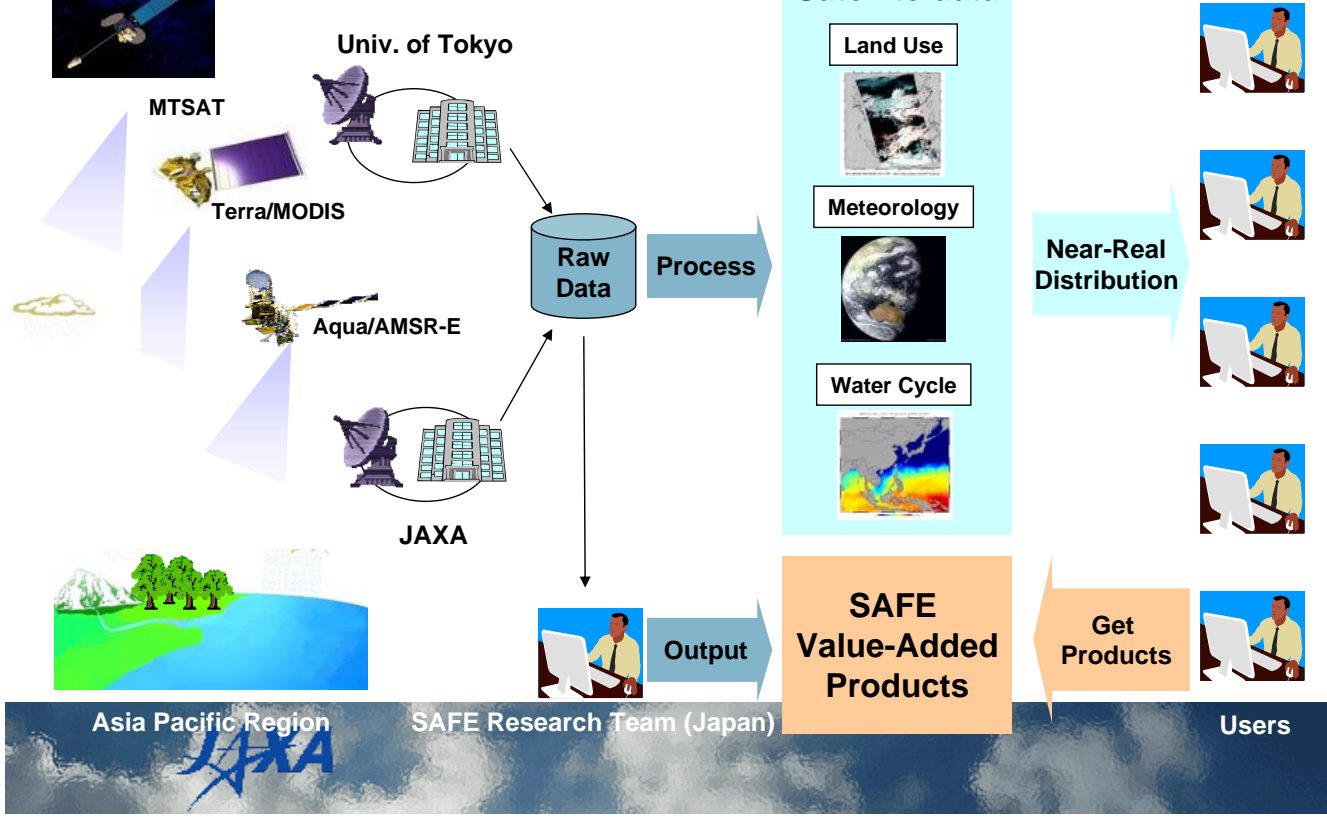
Global Flood Alert System (GFAS)

GFAS will receive and utilize real-time 3-hourly global precipitation data obtained from GPM to disseminate flood information to the concerned countries.



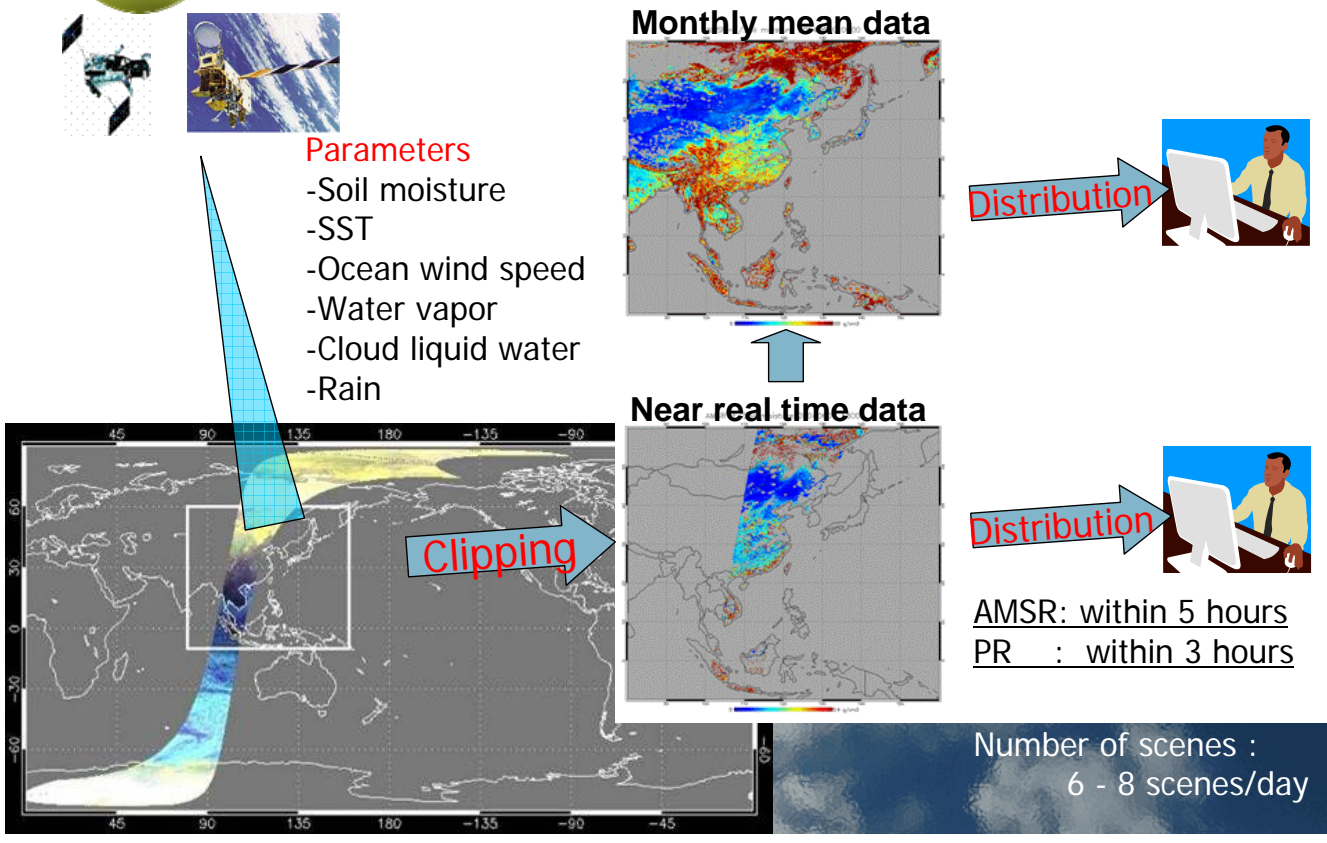


Sentinel Asia For Environment (SAFE)



A water resources monitoring system

Near real time water cycle dataset by **AMSR-E** and **PR**





CEOP Satellite Dataset

- JAXA will produce ALOS datasets in addition to existing datasets of ADEOS-II, TRIMM, etc.
- ALOS datasets will consist of Reference Site (RS) dataset , River Basin dataset and agricultural dataset.

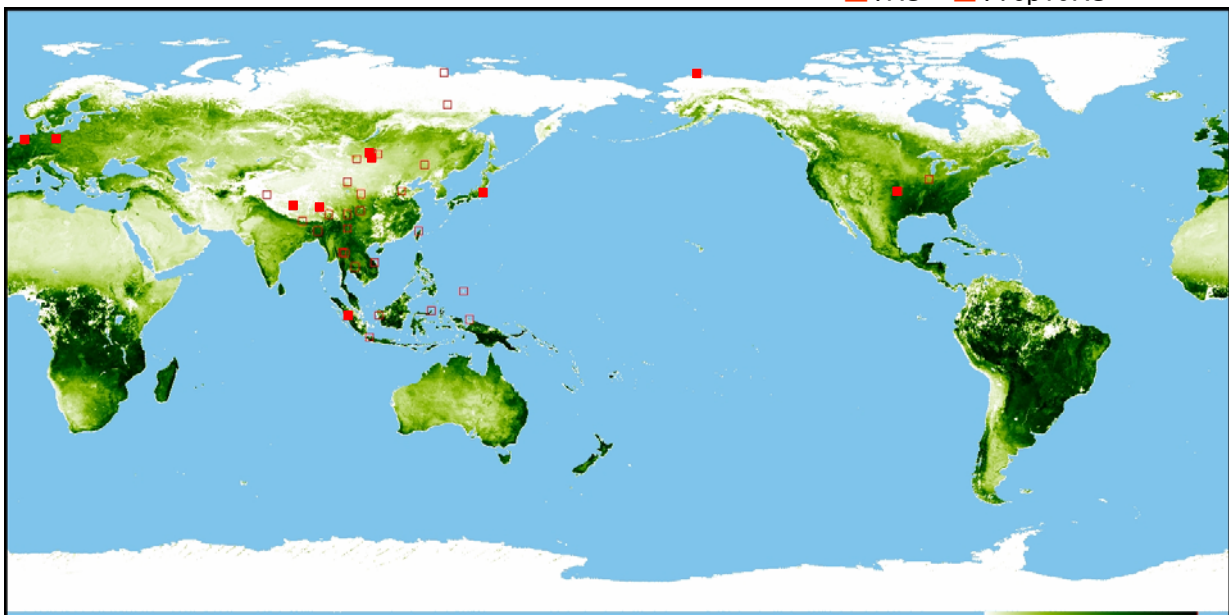
Satellite	Sensor	Parameter	Processing center
ADEOS-II	GLI	Cloud Optical Thickness, Aerosol radiance, Vegetation Index, Chlorophyll-a, Snow Grain Size, Cloud flag...etc.	JAXA
	AMSR	Brightness temperature, Sea temperature and wind speed, Water vapor, Soil moisture, Snow water ...etc.	
Aqua	AMSR-E		
TRMM	PR	Rain profile, Near surface rain, Averaged rain	NASA/GSFC
	TMI	Brightness temperature, Surface rain, Cloud ice/liquid water, Precipitation ice/water	
DMSP-13,14,15	SSM/I	Brightness temperature	NASA/GHRC
ALOS	PRISM	Radiance	JAXA
	AVNIR-2	Radiance	
	PALSAR	Amplitude	



CEOP Reference Site

Reference Site Dataset will produced in order of priority.

□:RS ■:Top10RS





Observed scenes and plans for RS

No.	Reference Site Name	Observed scenes* ¹					Observation plan* ²				
		PRISM	AVNIR-2	PALSAR			PRISM* ³	AVNIR-2	PALSAR		
				FBD343	PLR215	SCAN			FBD343	PLR215	SCAN
1	Mongolia /Mandalgobi	50	24	16	20	5	9,10,11	9,16,17	12,13,14	-	16
2	Mongolia /Ulaanbaatar	34	13	10	27	8	9,10,11	9,16,17	12,13,14	-	16
3	Tibet/Naqu	35	32	15	49	2	9,10,11	9,16,17	12,13,14	-	16
4	Tibet/Gaize	37	26	5	10	9	9,10,11	9,16,17	12,13,14	-	16
5	Tsukuba	51	21	0	34	2	9-15, 17	9,10,11,12,13,14,15,17	12,13,14	10,11	12
6	Western Maritime Continent	23	9	0	34	15	9,11,12,16,17	10,11,15,16	12,13,14	10,11	10
7	Lindenberg	6	3	0	29	6	11,12	12,13	12,13	10,11	9,17
8	Cabauw	32	0	0	31	16	11,12	12,13	12,13,14	10,11	9,17
9	ARM/Southern Great Plains	0	11	10	6	0	12,13	11,12	12,14	-	16
10	ARM/Northern Slope of Alaska	12	17	0	44	39	11,14	10,14	13,14	10,11	9,17

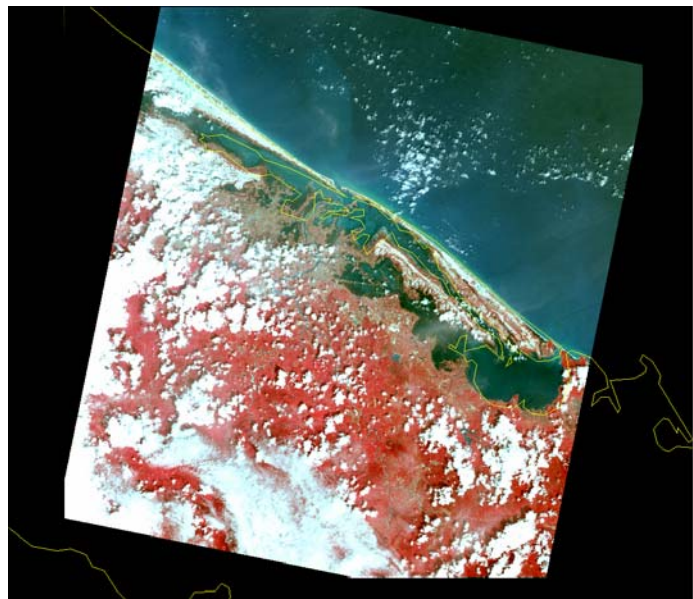


ALOS dataset for River Basin

River Basin:

17 rivers in 17 countries are chosen from all over the world.

JAXA will produce dataset of Huong river in Vietnam in this year.



AVNIR-2

Obs.Date: Oct. 07, 2006





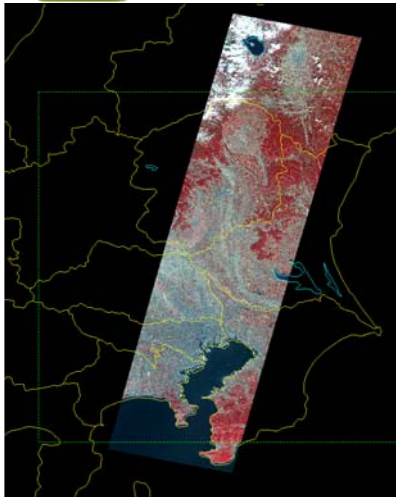
ALOS dataset description

- The dataset consists of path mosaiced geo-coded data are generated from standard products.
- Each scene is fully or partially covers RS area.
- Scenes of optical sensors that have less than 10% cloud cover are counted.

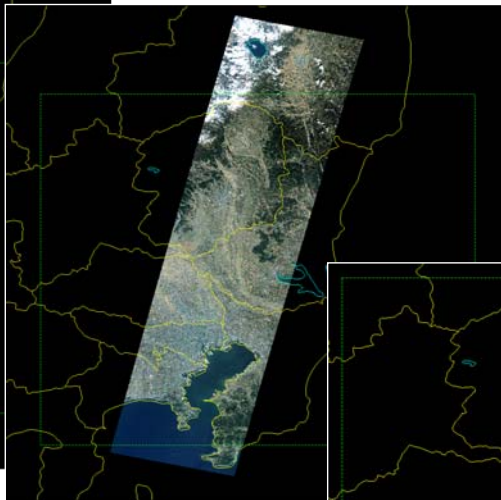
Sensors	PRISM	AVNIR-2	PALSAR		
Observation mode	OB2(Nadir35km) or OB1(Nadir70km)	Obs	FBD	PLR	WB1(SCAN)
Pointing Angle/ Off nadir Angle (°)	±1.2(OB2)or 0(OB1)	0	34.3	12.5	27.1
Product Level	1B2G(UTM)	1B2G(UTM)	1.5G(UTM)	1.5G(UTM)	1.5G(UTM)
Parameter	Radiance	Radiance	Amplitude	Amplitude	Amplitude
Spatial Resolution (m)	2.5	10	12.5	12.5	100
Swath (km)	35(OB2) or 70(OB1)	70	70	35	350
Processing	Path Mosaic				



Sample Images (PRISM, AVNIR-2: Tsukuba)

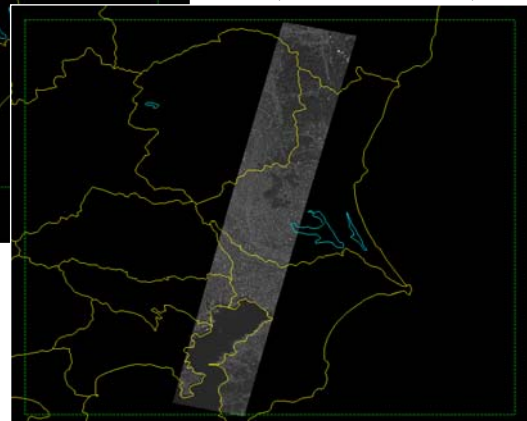


Obs.Date: Mar. 01, 2007
(R:G:B)=(4:3:2)



(R:G:B)=(3:2:1)

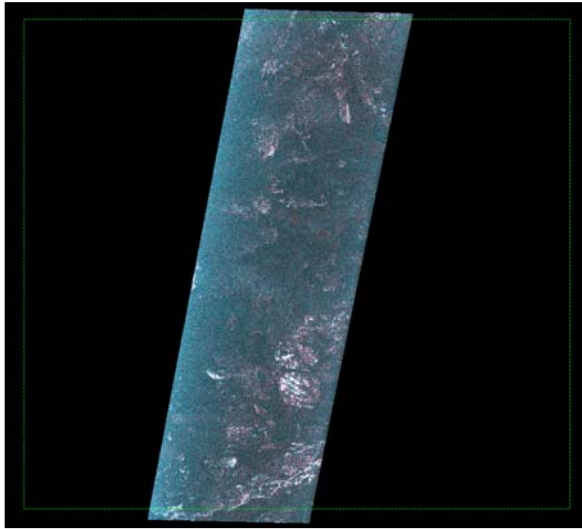
Obs.Date:
Mar. 01, 2007
OB1
(Nadir 35km swath)





Sample Images (PALSAR:Mongolia, Tibet)

Mongolia/Mandalgobi



FBD34.3
Obs.Date: May 01, 2007
(R:G:B)=(HH:HV:HV)

Tibet/Naqu



PLR21.5
Obs.Date: May 18, 2007
(R:G:B)=(HH:HV:VV)



Summary

- JAXA has been developing satellites for water cycle observation to contribute to GEOSS.
- Increase of satellite data use for societal benefits is a major goal of JAXA. It has been developing applications of satellite data for water resource management in cooperation with other organizations and researchers.
- AWCI is a key regional task of GEOSS and provides a significant opportunity for demonstration of satellite data applications for IWRM in this region.

