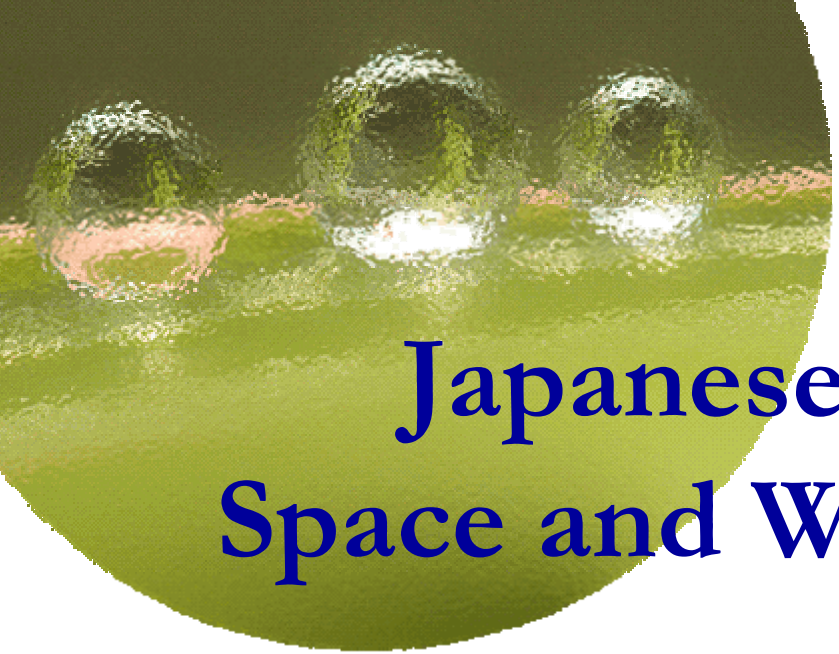


Japanese Programs on Space and Water Applications

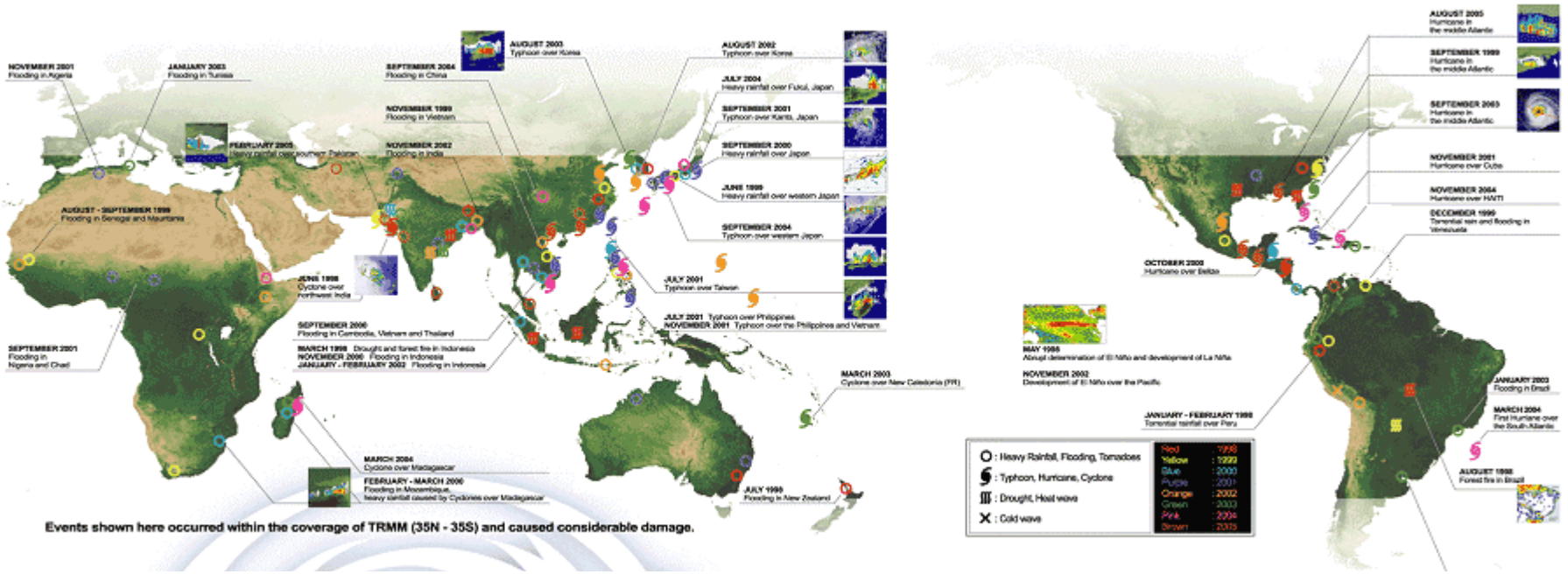
Tamotsu IGARASHI

Remote Sensing Technology Center of Japan

June 2006
COPUOS 2006
Vienna International Centre

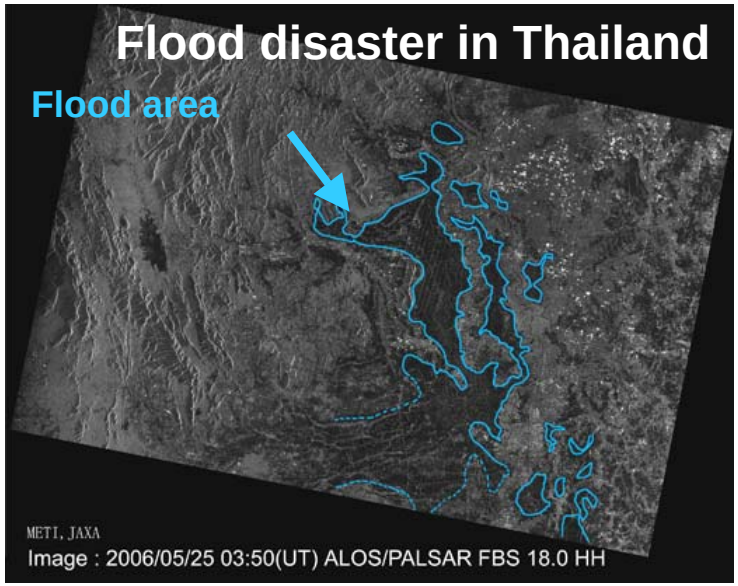
Water-related hazards/disasters may occur anywhere in the world

- Recent disasters, e.g.;
  - Flash floods in Northern Thailand (May 2006);
  - Landslide in Leyte Island, Philippines (Feb. 2006);
  - and so on ...

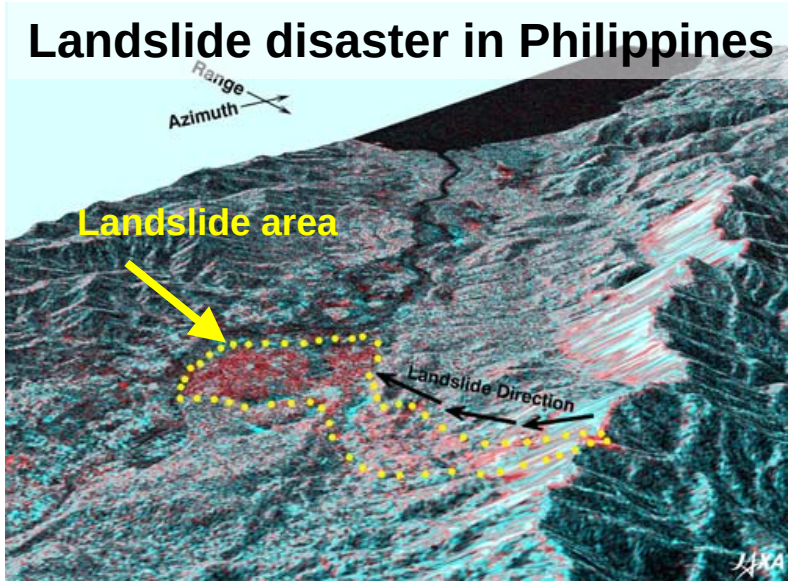


Major meteorological disasters within the coverage of TRMM (35N-35S) during 1998-2005

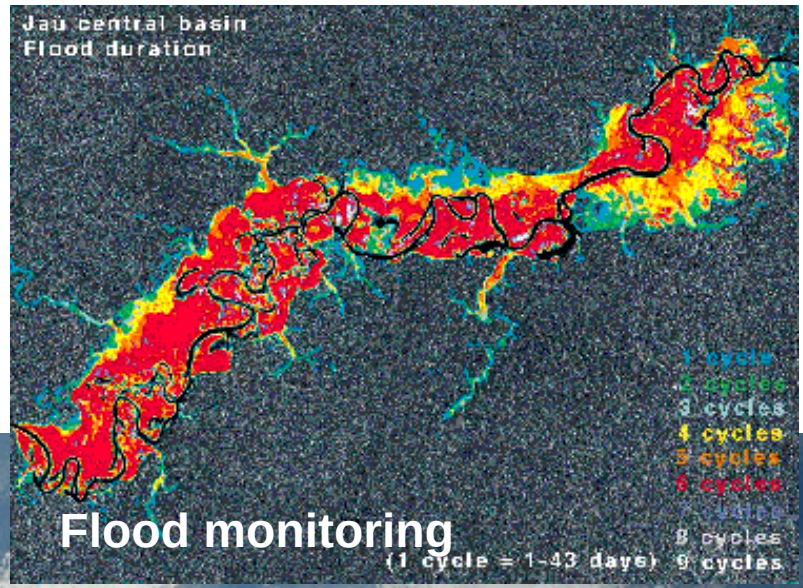
Observation from space plays significant role for disaster management



Northern Thailand, observed by ALOS/PALSAR



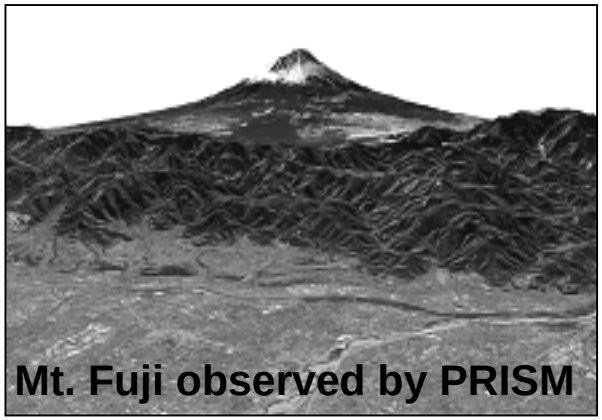
Leyte Island, Philippines, observed by ALOS/PALSAR



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

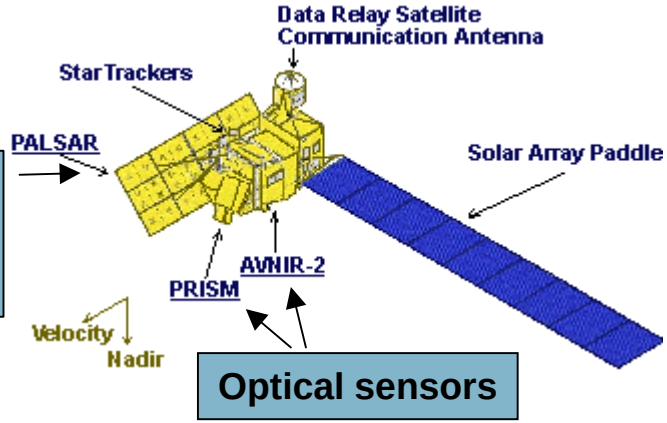
Advanced Land Observing Satellite (ALOS)

- Launch: 24 January, 2006.
- Objectives:
  - Cartography
  - Regional observation
  - Disaster monitoring
  - Resource surveying



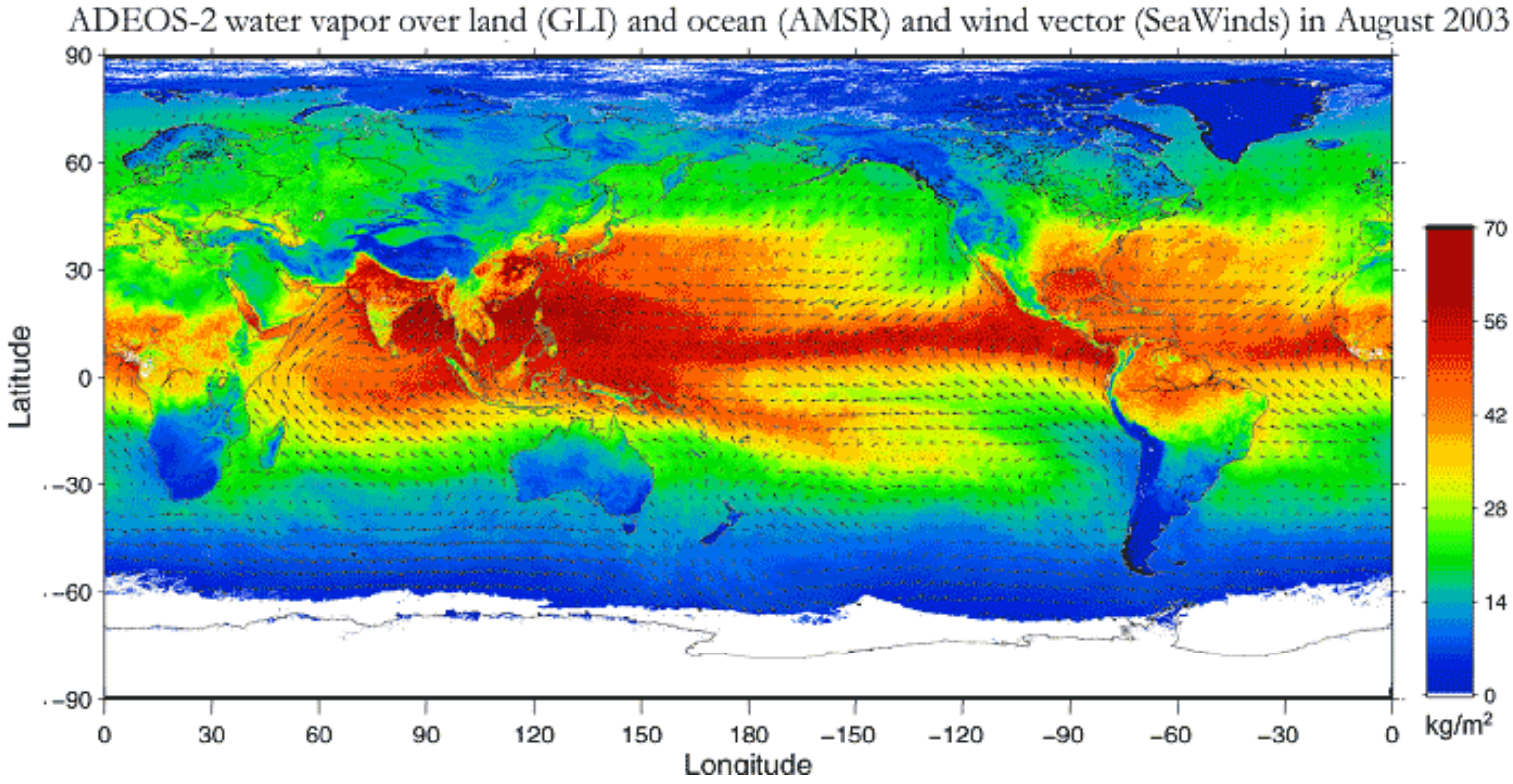
Mt. Fuji observed by PRISM

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



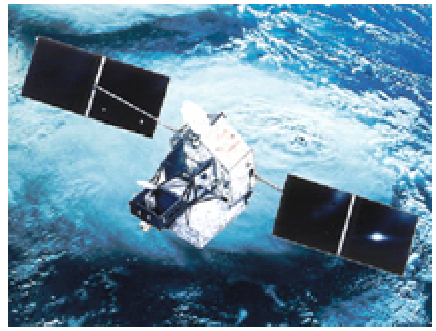
Water Cycle on the Earth

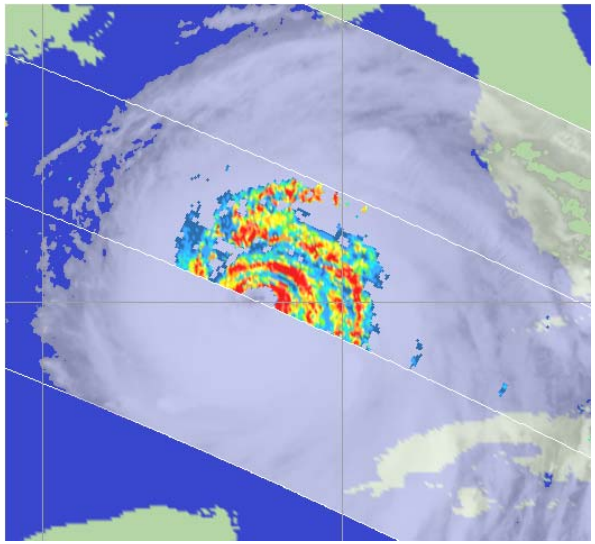
- **Global water vapor transport observed jointly by AMSR (water vapor over ocean), GLI (water vapor over land), and SeaWinds (ocean wind vector), aboard ADEOS-II satellite.**

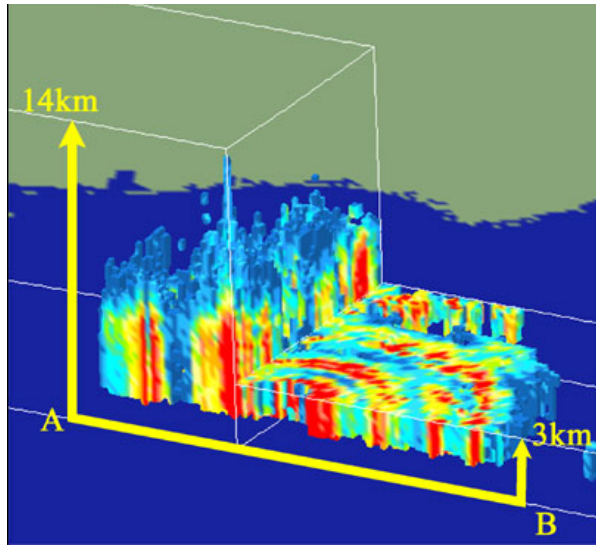


Tropical Rainfall Measuring Mission (TRMM)

- 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.





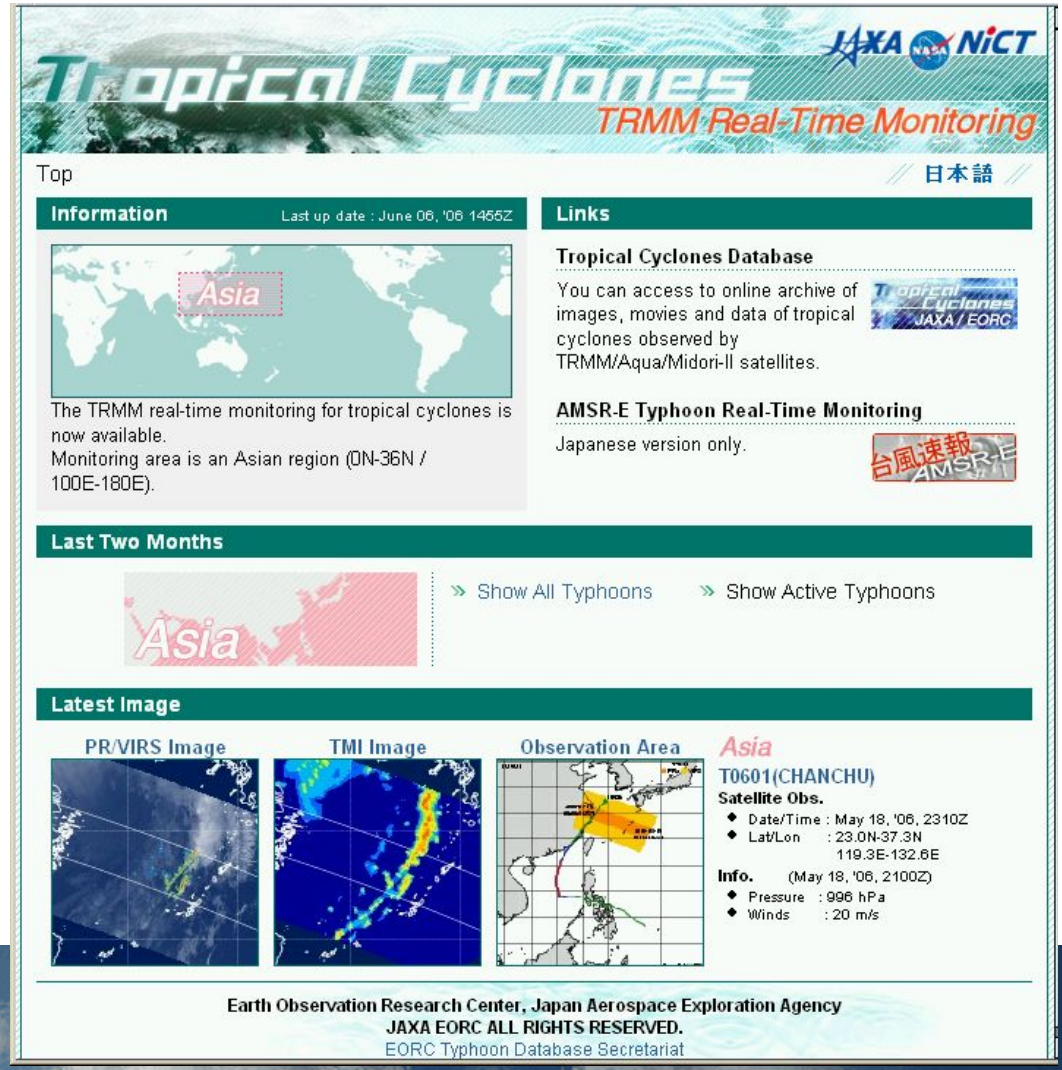


Hurricane KATRINA approaching South US, observed by TRMM at 0323Z 28 Aug. 2005.

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

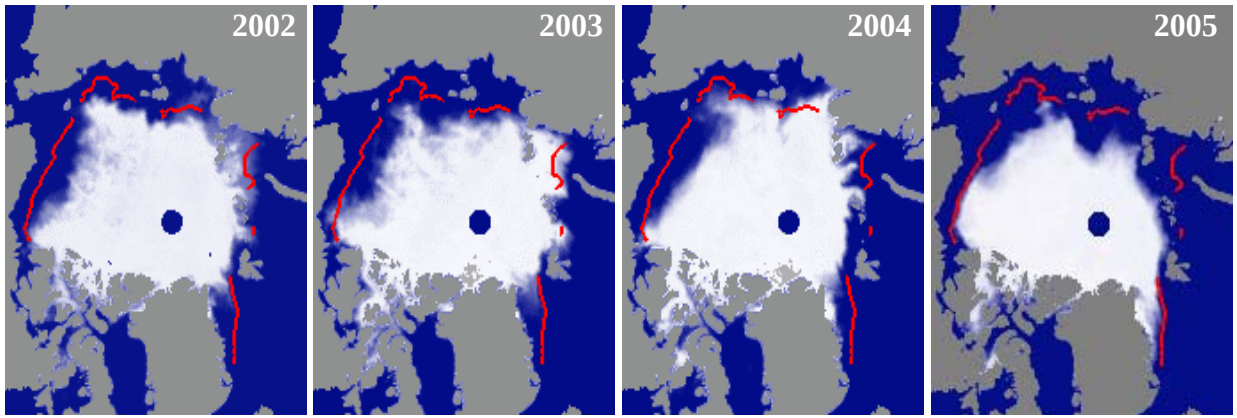
http://www.eorc.jaxa.jp/TRMM/

- 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.



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.

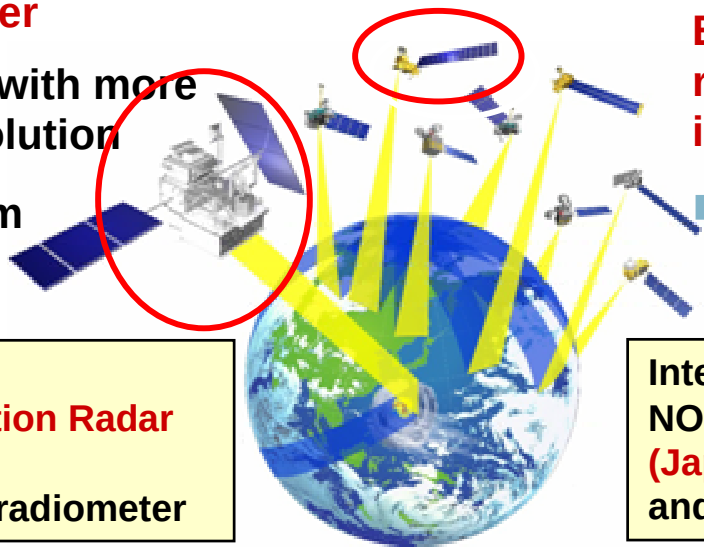
Yearly changes of monthly sea ice distribution over north polar regions in summer (red lines indicate average extent between 1988 and 2000, provided by NSIDC).

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



Constellation Satellites

Each carrying microwave radiometers, provided by international partners

- More frequent Observation

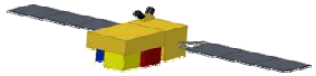
JAXA (Japan)
Dual-frequency Precipitation Radar
NASA(US)
Satellite bus, microwave radiometer

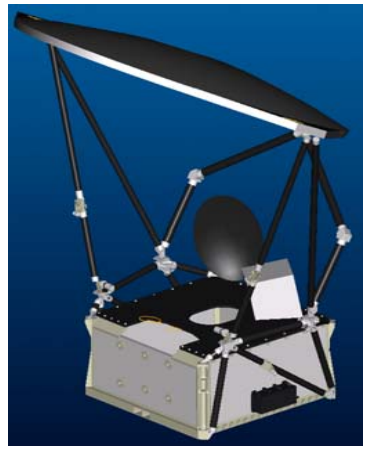
International Partners：
NOAA(US), NASA(US), JAXA (Japan), CNES/ISRO(France/India) and others

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 (TBD)		
Design	**GCOM-W** 	**GCOM-C** 
Orbit (TBD)	■Sun-synchronous ■Altitude: 699.6km ■Inclination: 98.19deg ■Asc. local time: 13:30	■Sun-synchronous ■Altitude: 798km ■Inclination: 99.36deg ■Dsc. local time: 10:30
Instruments	■AMSR follow-on Microwave imager	■SGLI Near-UV ~ TIR imager
Launch Date	JFY 2010	JFY 2011
Mission Life	5 years (×3 satellites; total 13 years)	
Launch Vehicle	H-IIA	

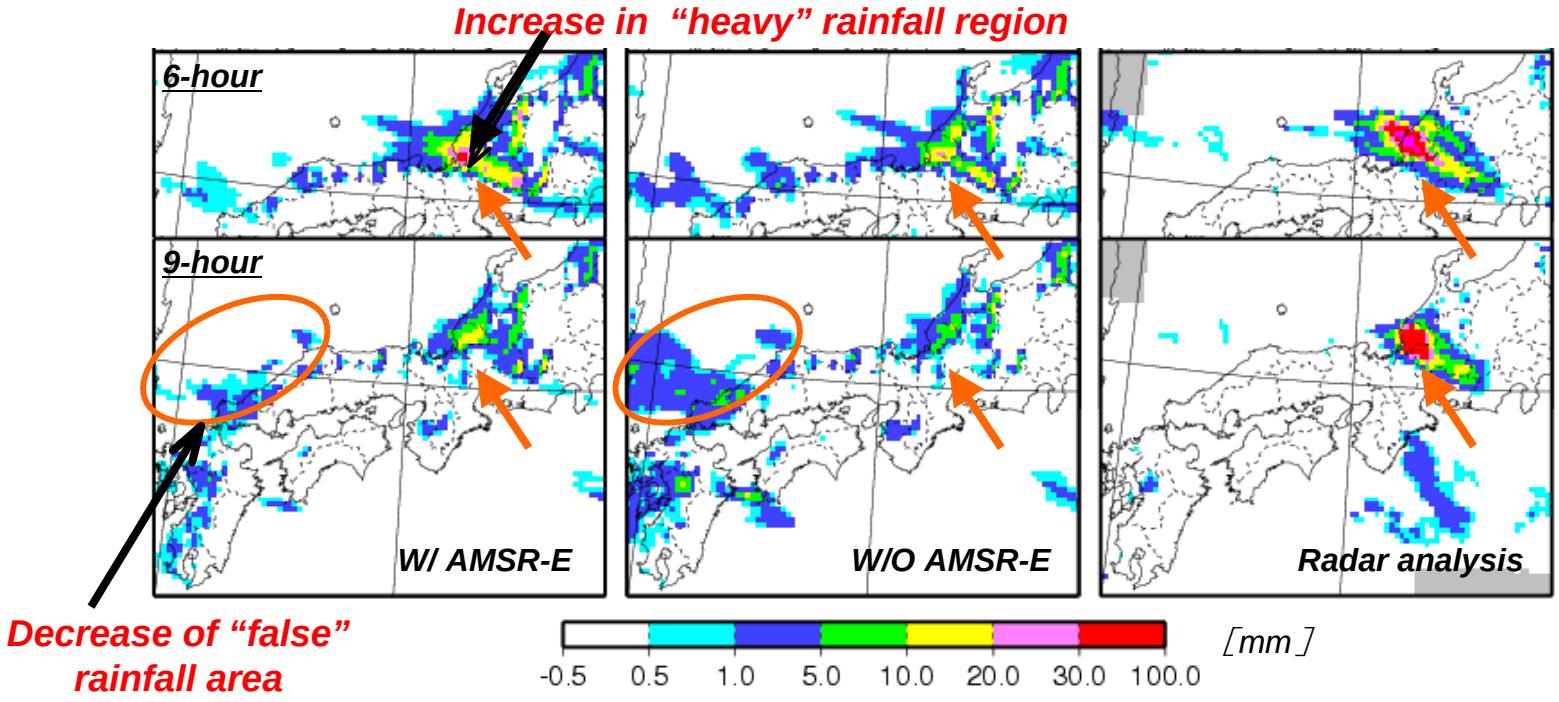


AMSR follow-on of GCOM-W satellites

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

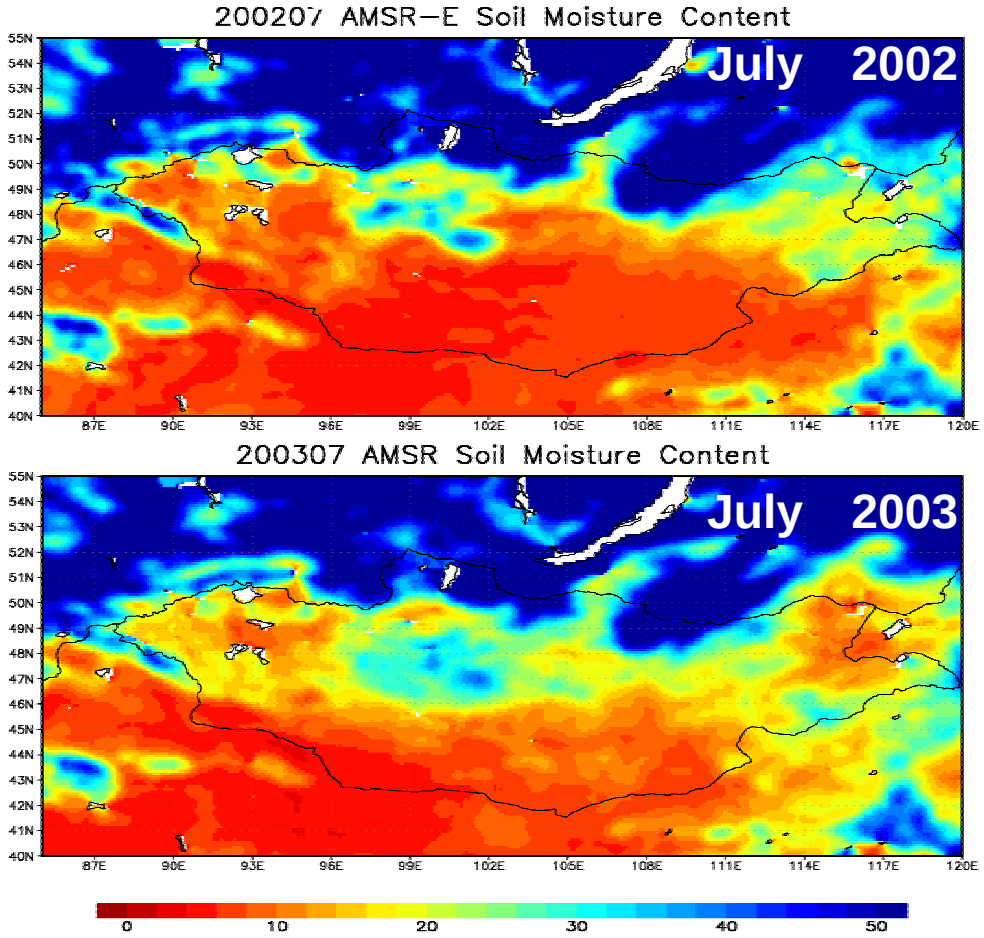


All results were provided by Numerical Prediction Division, JMA

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 have 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.

Scientific and societal significance of water-related satellite data

For example, global rain map may apply to ;

- Climate change assessment
  - Monitor variations in rainfall and rain areas associated with climate changes and global warming
- Improvement in weather forecasts
  - Data assimilation in numerical prediction systems
- Flood prediction
- Water resource management
  - River, dam, agricultural water, etc.
- Other applications
  - Agriculture, etc.

Coordinated Enhanced Observing Period (CEOP) initiated by GEWEX an Element of WCRP

CEOP HP : http://www.ceop.net

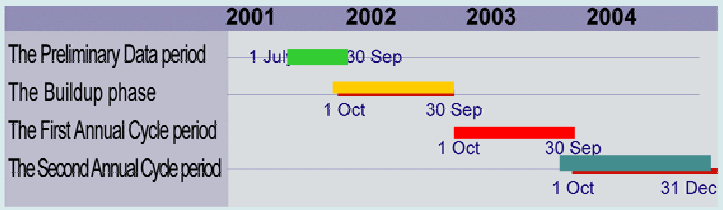
CEOP Objectives:

1. Water and Energy-Cycle Simulation and Prediction
2. Monsoon System Studies

CEOP Strategy:

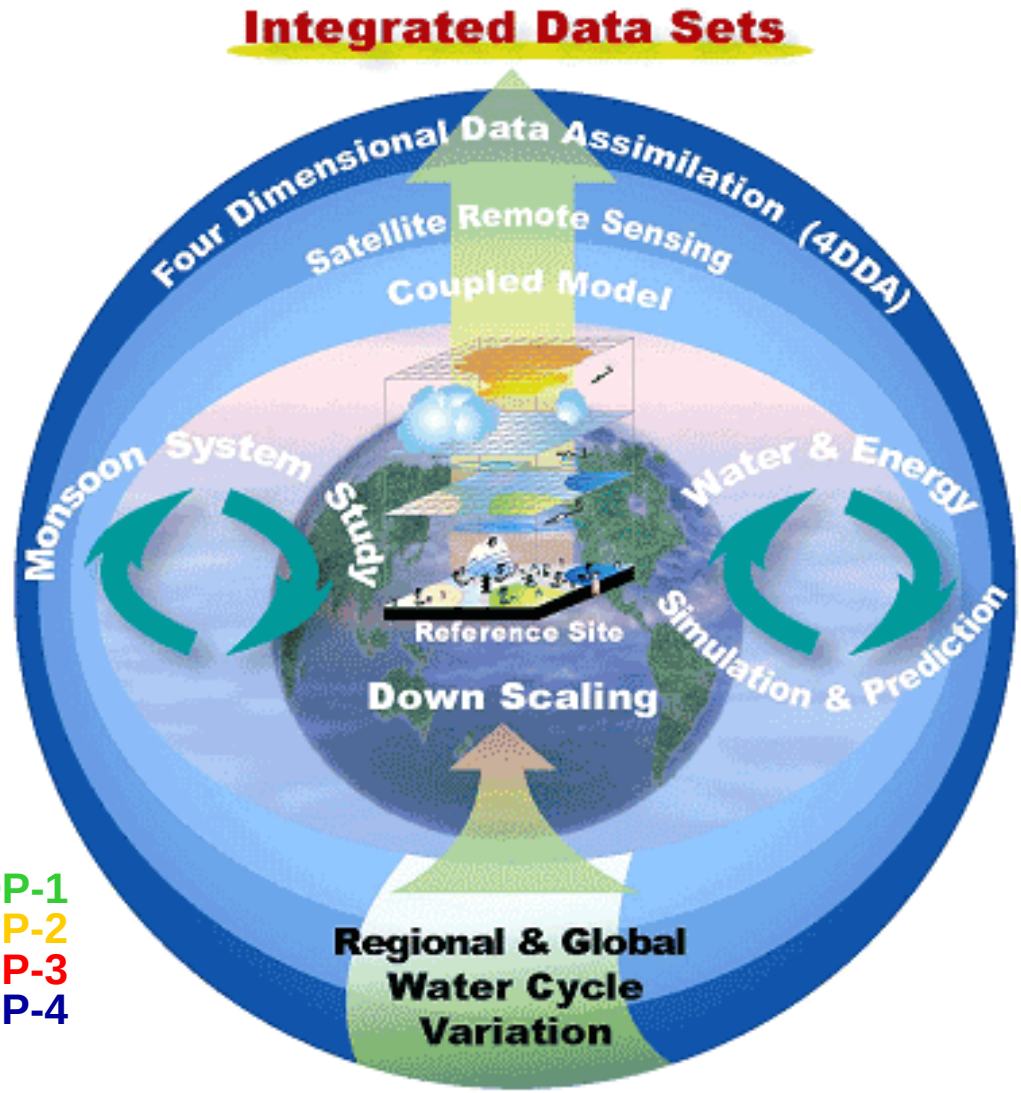
1. The first global integrated data sets of the water cycle with spatial consistency and climate variability, through
   (i) the ground-based observations from the 36 CEOP reference sites
   (ii) the satellite observations of the entire water cycle
   (iii) the simulations of numerical models with physical consistency
2. Challenges to inter-connection of regional water cycles and Down-scaling applications to water resources

CEOP Schedule:



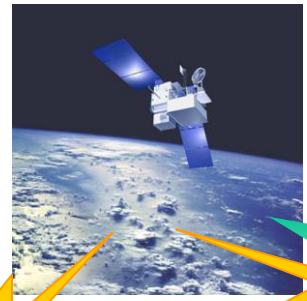
EOP-1
EOP-2
EOP-3
EOP-4

Data Collection:2001-2004 / 2005-2007: Research



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.



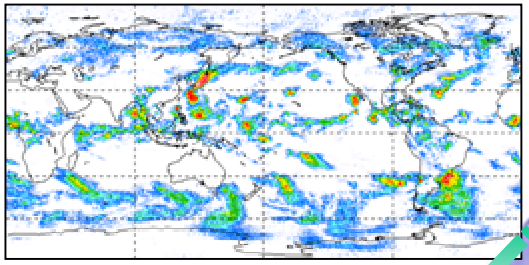
GPM
(Global Precipitation Measurement)

Raw Data

Precipitation Information around the Upstream

Ground Stations (NASA, JAXA)

On-Line



Data Processing System (NASA, JAXA)

Real-time 3-hourly Precipitation Data

On-Line

IFNet
International Flood Network

Estimation of precipitation probability

Present Precipitation > Estimated Precipitation Probability

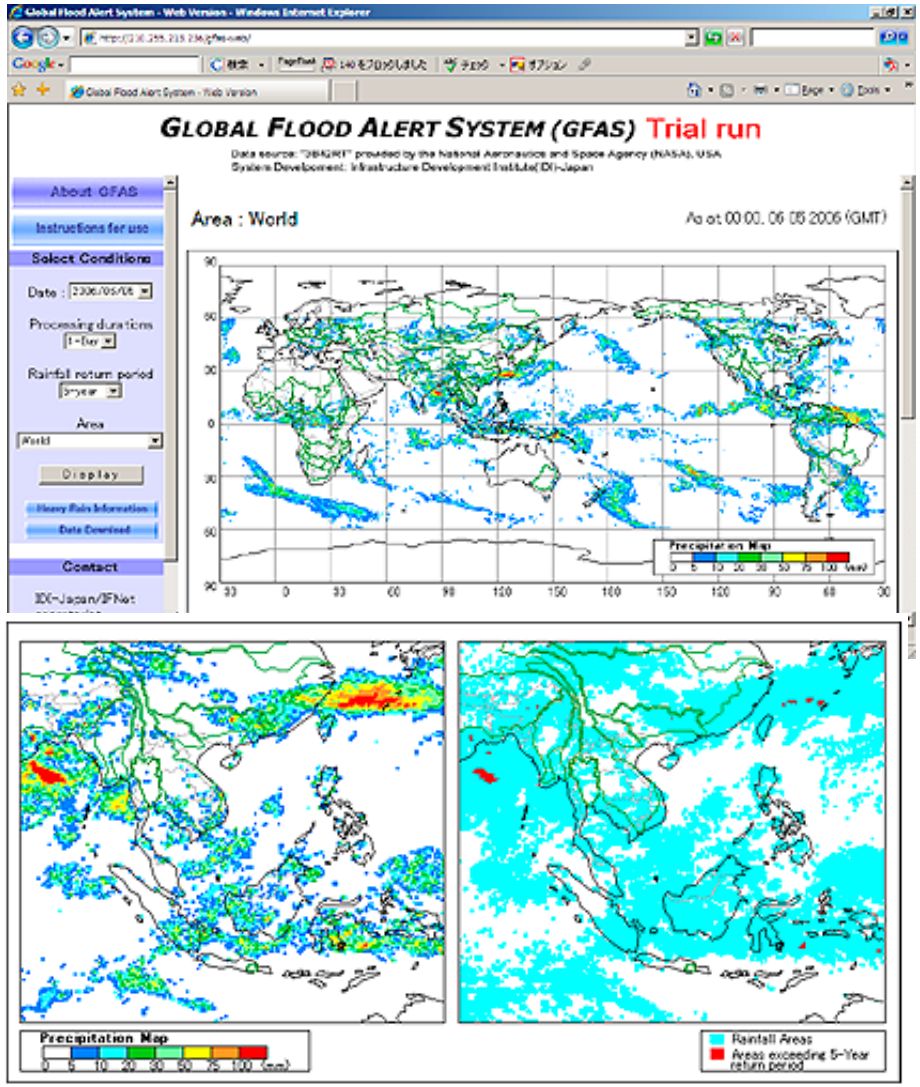
E-mail

Disaster Prevention Organizations of the concerned countries

Flood Alert !

GFAS trial run on IFNet's website

- The internet-based system is being developed by the Infrastructure Development Institute (IDI)-Japan
- The GFAS displays global/regional daily and 3-day rainfall maps, precipitation data in text form, and provides heavy rain information by precipitation probability estimates.
- Currently running on a trial basis at IFNet's website.



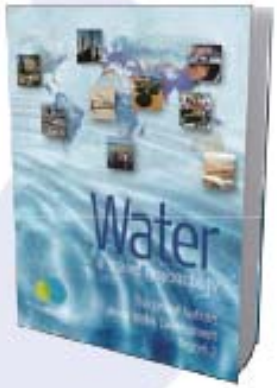
I D I

IFNet International Flood Network

http://gfas.internationalfloodnetwork.org/gfas-web/

Outline of International Centre for Water Hazard and Risk Management (ICHARM)

under the auspices of UNESCO



UN WWDR II (2006)

- Flood risk analyses in diverse localities in developing countries
- Development of flood warning systems that use satellite observations and other advanced technology
- Development of flood hazard mapping procedures able to meet various environmental and social conditions
- Development of community water hazards risk aversion systems with advanced flood warning and flood hazard maps as available means
- Promotion of basic research on hydrological measurement, analysis, and forecast to support ICHARM activities
- Participation in international research programs such as World Water Assessment Programme, International Flood Initiative, Group of Earth Observations and Predictions in Ungaged Basins

Research

Data

Curriculum

Results

Participation

Knowledge

Network

Information networking

- Creation of a worldwide and inter-disciplinary network of practitioners, researchers and course graduates in the field of integrated water risk management
- Collection, analysis and dissemination of information and experiences regarding water-related disasters worldwide
- Timely organization of investigation teams when catastrophic water hazards occur
- Organizing and sponsoring workshops and symposia

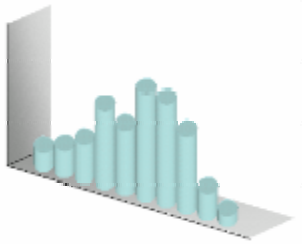
Training

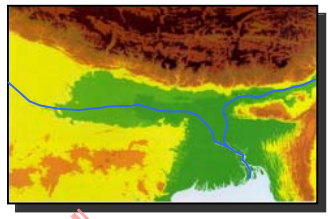
- Training courses on practical risk reduction systems incorporating existing social diversities, for public officers and decision makers
- Human resources development for integrated flood risk management in cooperation with universities and related institutes worldwide
- Training courses of flood hazard mapping and river and dam engineering for researchers and engineers
- Providing follow-up activities for course graduates in their home countries

Flood Hazard Mapping Training

Application to world-wide flood disaster mitigation (Cooperative Research at PWRI-ICHARM)

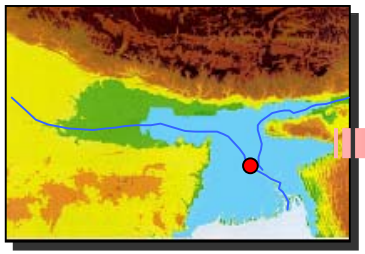
Satellite-derived precipitation

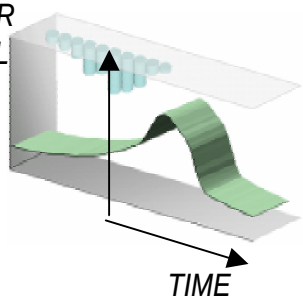




Globally available database:
- DEM,
- Land use, etc.

Runoff modeling &calculation





Probable inundated area

Joint researches at ICHARM to make flood forecasting information based on satellites:

1) Improvement of real-time satellite product of rainfall <with JAXA>

2) Development of Integrated Flood Analysis System (IFAS) <with private sectors>

The forecasting result obtained through the runoff calculation based on satellite-based rainfall and/or ground-based one could be used for flood warning in ungauged basins in developing countries.

Flood Control Management

Flood Warning System

Water Resources Management

Capacity Building Workshop in Asia

organized by IGWCO and JAXA with support of AIT

- The Workshop will be held in 26-28 Sep. 2006, Bangkok, Thailand, to address the uses and applications of Earth observations for sustainable water management.
- The workshop aims to:
  - exchange information on best practices for applications of Earth observations for water resource management in Asia and other regions.
  - exchange information on available data and tools for applications of Earth observations for water resource management in Asia.
  - consolidate a statement of regional requirements based upon existing needs for Earth observations and capacity building activities for water resource management in Asia.
  - discuss and propose a next step of the regional capacity building projects for applications of Earth observations for water resource management in Asia.

Workshop website: http://www.a-a-r-s.org/ws-eowm/

JAXA

Conclusion

- The satellite observation is extremely effective to obtain not only water information on the Earth but also disaster damage information.
- Satellite information is also significant for scientific issues, such as extreme rainfall events, sea ice variations in polar regions, and variation of water cycle related to global change.
- End-to-end systems linked data providers and users are explored, such as IFNet/GFAS, ICHARM, etc., toward future operational systems.