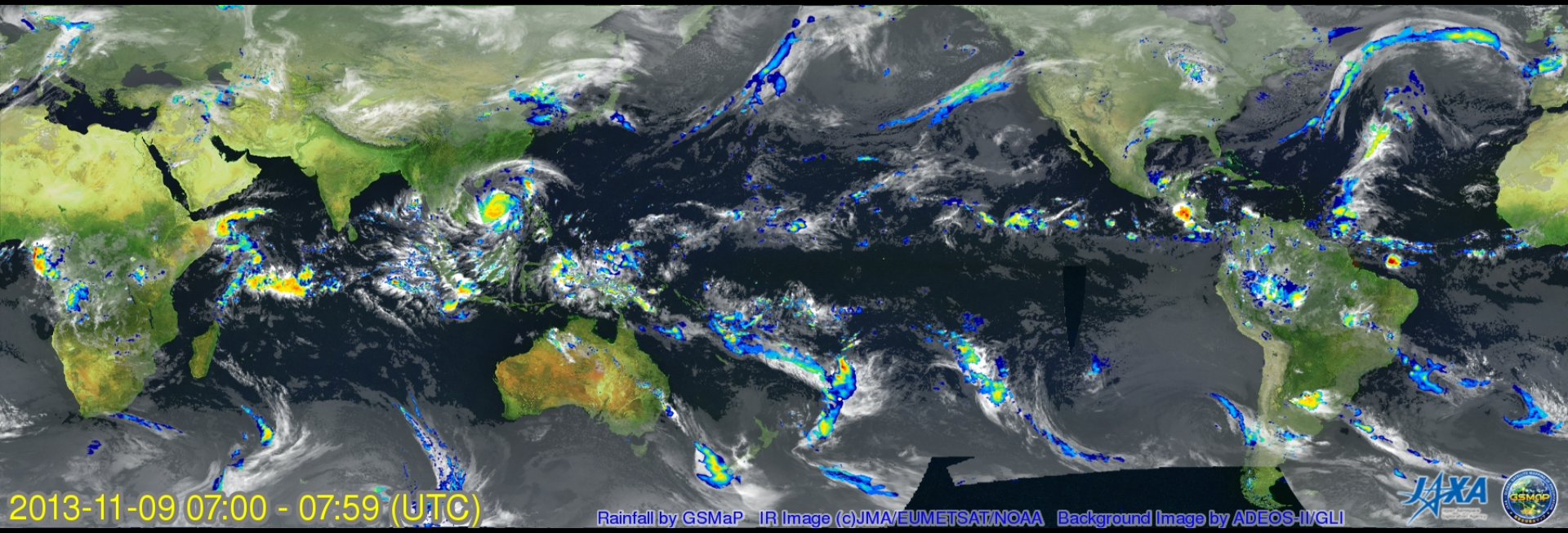
Drought Monitoring Using Japan's Space Technology
APEC Climate Symposium 2013



Shin-ichi Sobue, PhD.
Sobue.shinichi@jaxa.jp
Remote Sensing Center of Japan (RESTEC)
on behalf of Japan Aerospace Exploration Agency (JAXA)
http://sharaku.eorc.jaxa.jp/GSMaP/index_j.htm

RESTEC Activities

Shin-ichi Sobue
General Manager of Planning Department
Remote Sensing Technology Center of Japan

Mission of RESTEC (Newly Defined)

Business Strategy and Development Office
Formed in Nov 1st,2011

Global Service Development Office
Formed in Nov 1st,2011

GEO Intelligence Office
Formed in Oct 23th,2012

Think Tank/ Consulting

Solution Businesses

Capacity Building

5 Core Activities

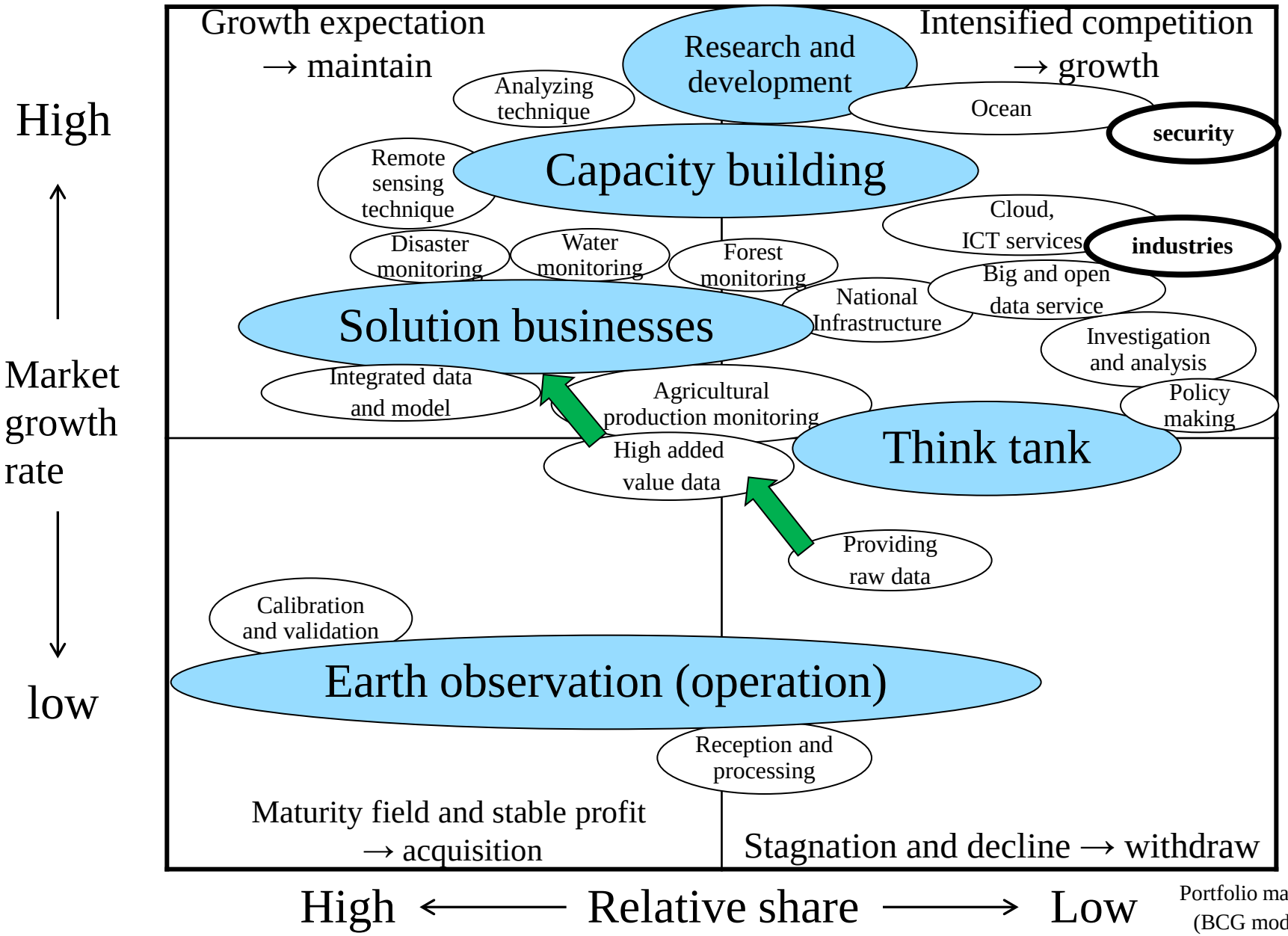
Research and Development

Earth Observation

Core Competence

- Advanced and comprehensive techniques relating to Remote Sensing.
  - ➢ Experiences and R&D capability relating to the satellite data and SAR etc.（including calibration and validation)
- Overall capability from the data acquisition to providing solutions.
  - ➢ Providing the observation data received, processing and analysis for the wide range of users.
- Organizing capability of overseas projects, in Asia and others.
  - ➢ Participated to the projects of JAXA, JICA, World Bank and ADB.
- Mobilization capability of human network inside and outside the country which has been built up as a public corporation.
  - ➢ JICA programs and other training programs for general users.

Portfolio



Portfolio matrics (BCG model)

Overview of JAXA

Japan Aerospace Exploration Agency (JAXA)

- On October 1, 2003, the Institute of Space and Astronautical Science (ISAS), the National Aerospace Laboratory of Japan (NAL) and the National Space Development Agency of Japan (NASDA) were merged into JAXA.
- From basic research and development to utilization related to space science and technology.
- Building a secure and prosperous society through the utilization of aerospace technology is an important mission.

JAXA
Japan Aerospace Exploration Agency

13 offices
(incl. communication station, research field, campus and center)

Tsukuba Space Center

Tanegashima Space Center

JAXA organization

Dr. Naoki Okumura

President

Vice-President

Mr. Kiyoshi Higuchi

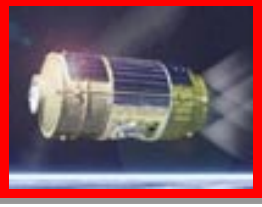
Staff: 1,526 (FY2013)
Budget: 162.5Byen

Policy Coordination

Admin. Management

Technical Management

<Rocket> Space Transportation Mission Directorate



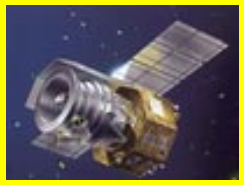
<Satellite> Satellite Applications Mission Directorate I

<Space Station> Human Spaceflight Mission Directorate

<R & D> Aerospace Research & Development Directorate

<Airplanes> Institute of Aeronautical Technology

<Space Science> Institute of Space & Astronautical Science

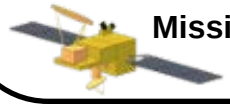


<Space Exploration> Lunar & Planetary Exploration Program Group

JAXA's Mission

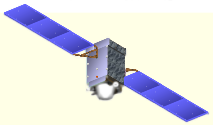
Contributions toward a Secure and Prosperous Society

Earth Observation Satellites



Global Change Observation Mission-Water（GCOM-W）"SHIZUKU"

Communication & NavigationSatellites

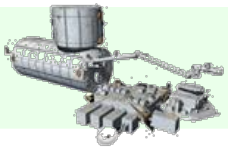


1st Quasi-Zenith Satellite "MICHIBIKI"

Expansion of Human Frontiers

International Space Station（ISS）

H-II transfer Vehicle（HTV）

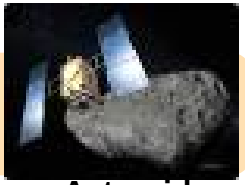


ISS/Japanese Experiment Module (JEM) Kibo

Space Science

SELenological and Engineering Explorer (SELENE) "KAGUYA"

Space Exploration



Asteroid Explorer "HAYABUSA"

Space Transportation

H-IIA Rocket

Aeronautics

Research on Clean Engine Technology

History & Current Mid-term Plan (JAXA EO)

Target	Sensors	JFY 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Disaster/ Resource	SAR	PALSAR								ALOS-2 (SAR)					Next Generation Optical)
	Optical	ALOS													
		PRISM, AVNIR2 (Optical)													
Climate Change/ Water Cycle	Precipitation Radar	TRMM/PR								GPM/DPR					
	Microwave Radiometer	Aqua/AMSR-E								GCOM-W/ AMSR2					
Global Warming	Optical Sensor												GCOM-C/ SGLI		
	Cloud Radar												EarthCARE/CPR		
	Spectrometer					GOSAT								GOSAT-2	
Communi -cation	Mobile Communication	ETS-VIII													Next-generation
	Wideband Internetworking	WINDS													
	Data Relay	DRTS													DRTS Follow-on
Navigation	Quasi-zenith							QZSS							

Operation Development Research

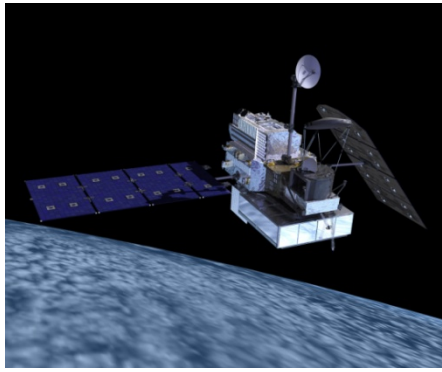
Recent Topics of JAXA Earth Observation

- GCOM-W1 “SHIZUKU” with AMSR2 was launched from the Tanegashima Space Center on May 18, 2012 by the H-IIA Launch Vehicle.

  - Brightness temperature products and eight kinds of geophysical parameters of AMSR2 have been released since January 25, and May 17, 2013, respectively through the JAXA web site.

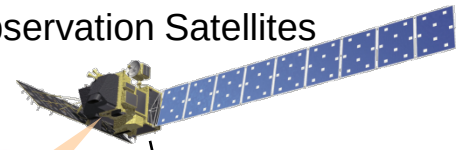
https://gcom-w1.jaxa.jp/

- ALOS-2 with PALSAR-2 and GPM Core Observatory with DPR will be launched from the Tanegashima Space Center in this Japanese Fiscal Year.



Activities of EORC

Earth Observation Satellites



Data Relay Test Satellite

Ground Stations

Receiving

Mission (Sensor) data

Level 1 processing

Domestic/ Foreign Partners

Radiometric/Geometric correction

Map projection

Processing

Archiving

All Raw data Certain of processed data

Total 644TB
as of 2008 end

Users

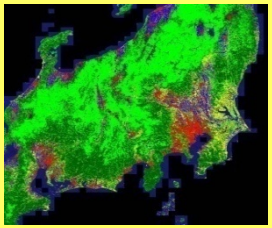
Government, Local authorities, Universities, Research institutes, Private enterprises

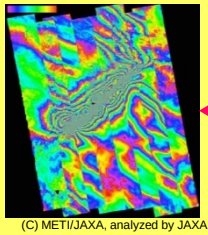
Distribution

Non-commercial /Commercial products

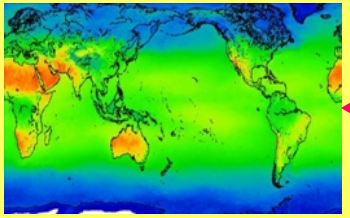
High level processing

Value-added





(C) METI/JAXA, analyzed by JAXA

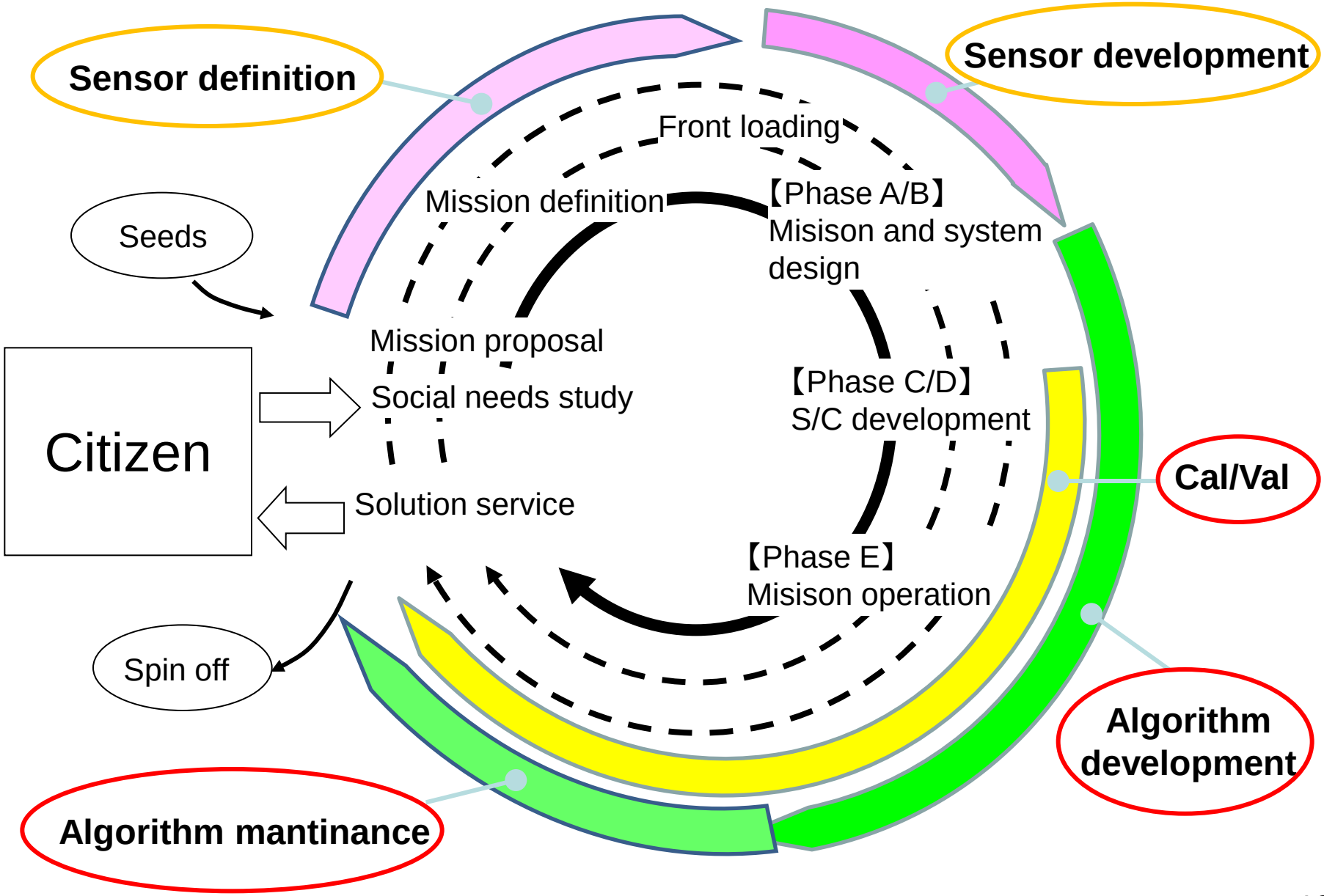


Calibration/Validation Applications Research

Accuracy improvement Processing algorithm/ technique development

Collaboration with ground-based research and modeling research

Sensor development and operation cycle



What's happening now ?

Global Climate change is seriously affecting water cycle, which causes..

Damage to Agricultural productivity, and Human Health.

Space-born observation will help to make countermeasure strategy.

What we can observe by satellites.

- CO2 observation
- precipitation observation
- Meteorological observation
- vegetation observation
- Biomass observation
- Soil moisture Land water
- cropping, etc.

Satellite Derived Information Useful for Outlook

JASMES
JAXA Satellite Monitoring for Environmental Studies

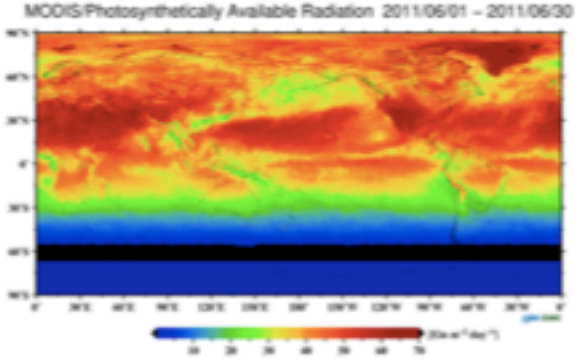
GSMaP

JAXA
Japan Aerospace Exploration Agency

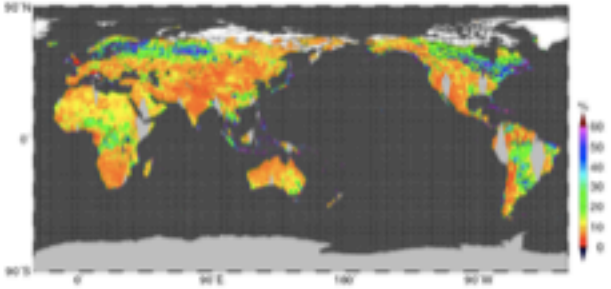
http://kuroshio.eorc.jaxa.jp/JASMES/

http://sharaku.eorc.jaxa.jp/GSMaP_crest/index_j.html

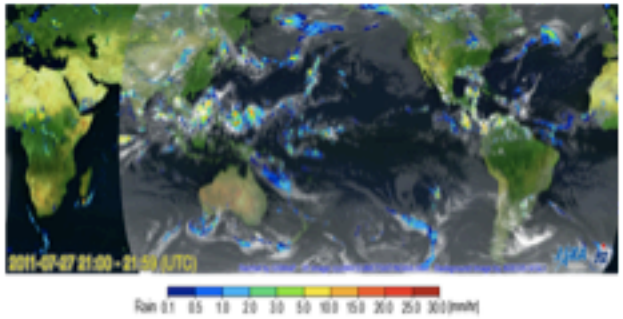
Solar Radiation



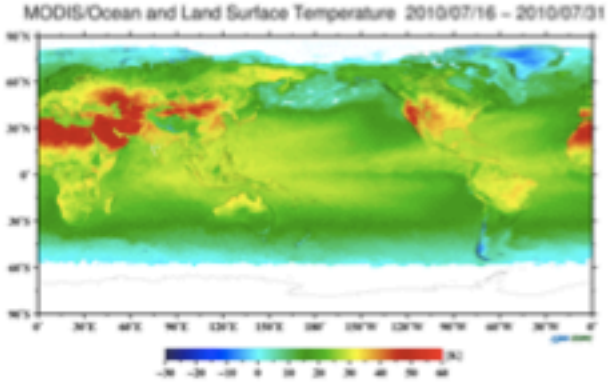
Soil Moisture



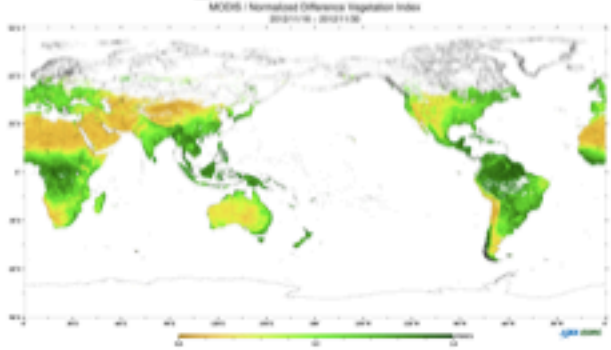
Precipitation



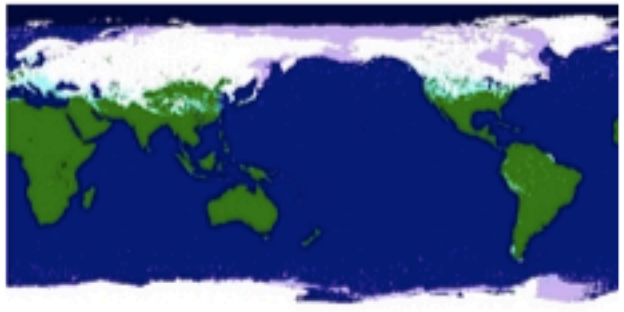
LST/SST



Vegetation Index



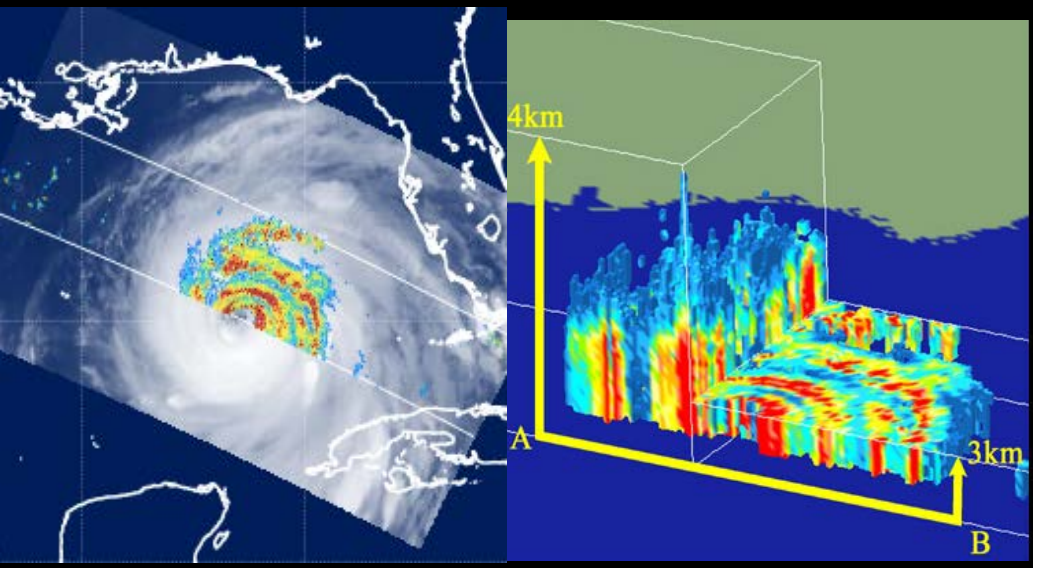
Snow Cover Extent



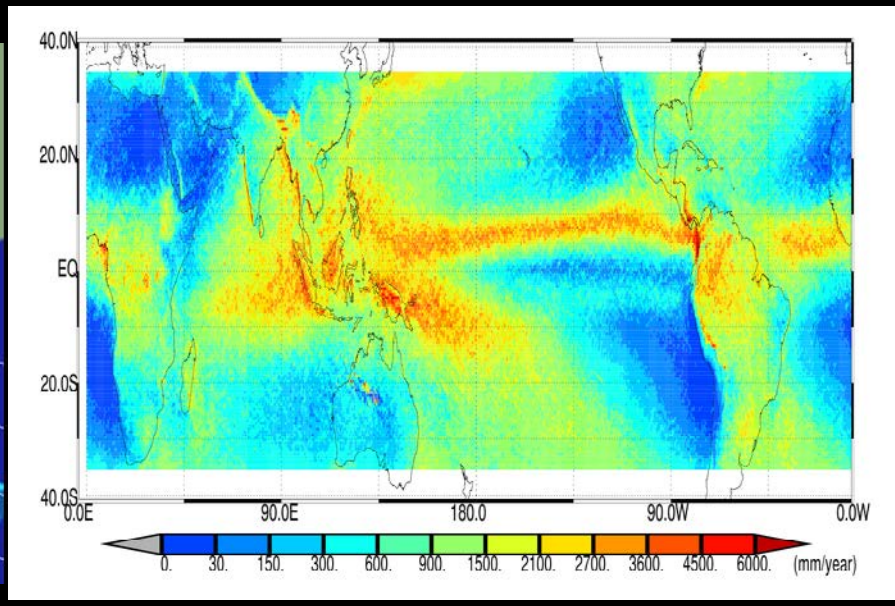
Tropical Rainfall Measuring Mission (TRMM)

US-Japan joint mission

- Focused on rainfall observation by three different sensors (Precipitation Radar (PR), TMI, VIRS).
- Nearly 16 years rain observation by PR
- Homogeneous 3-D rain observation over ocean and land
- Detailed structures of tropical cyclones
- Diurnal cycle and Seasonal variation of rain
- Observation of El Nino and La Nina, etc.

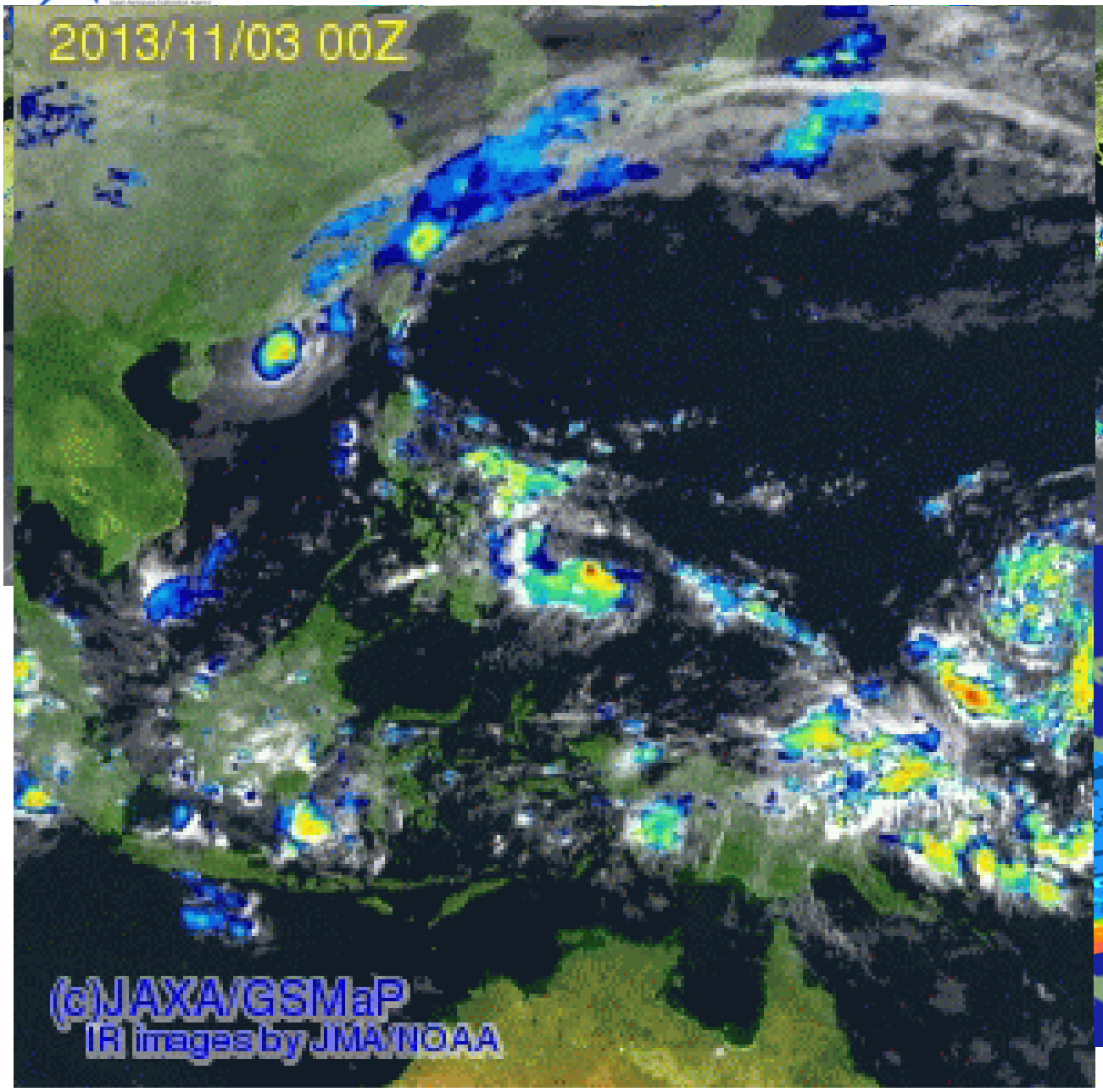


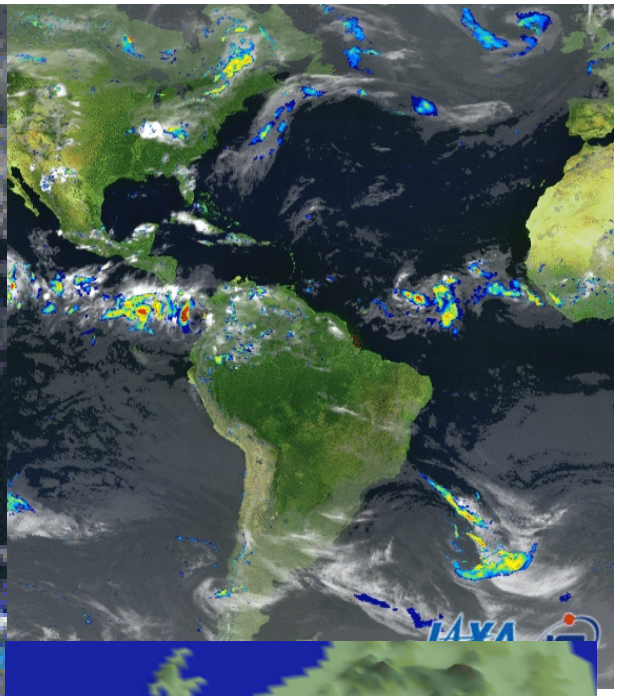
Hurricane KATRINA (2005)

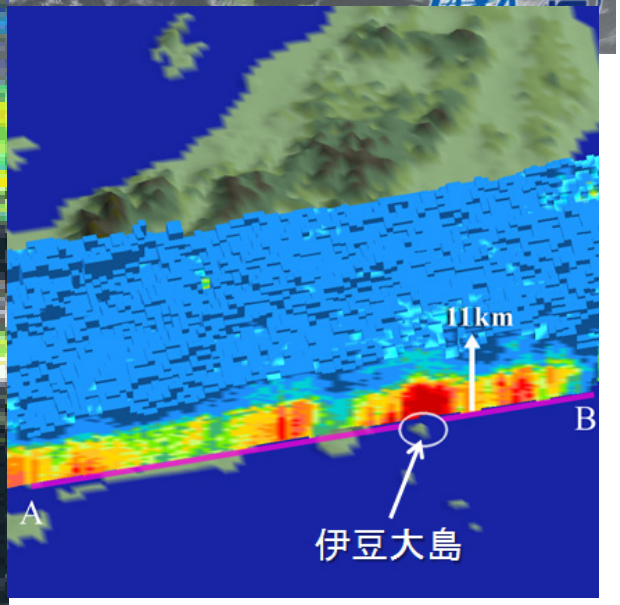


Global Precipitation in 14 years

GSMaP (Global Satellite Mapping of Precipitation)

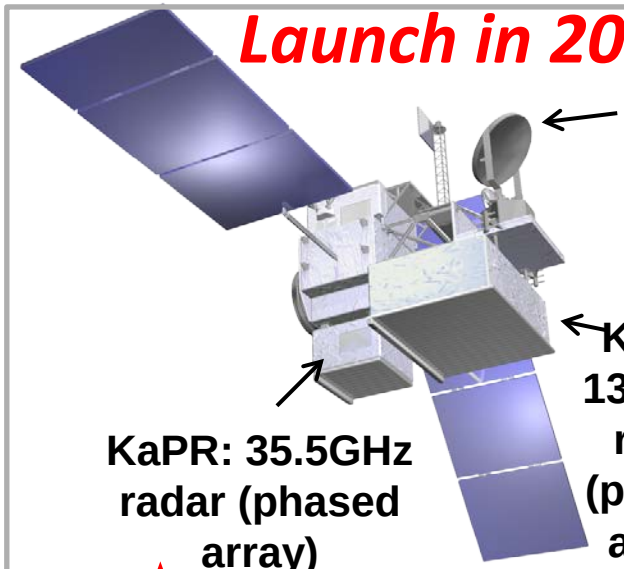






Global Precipitation Measurement (GPM)/ Dual-frequency Precipitation Radar (DPR), coming soon

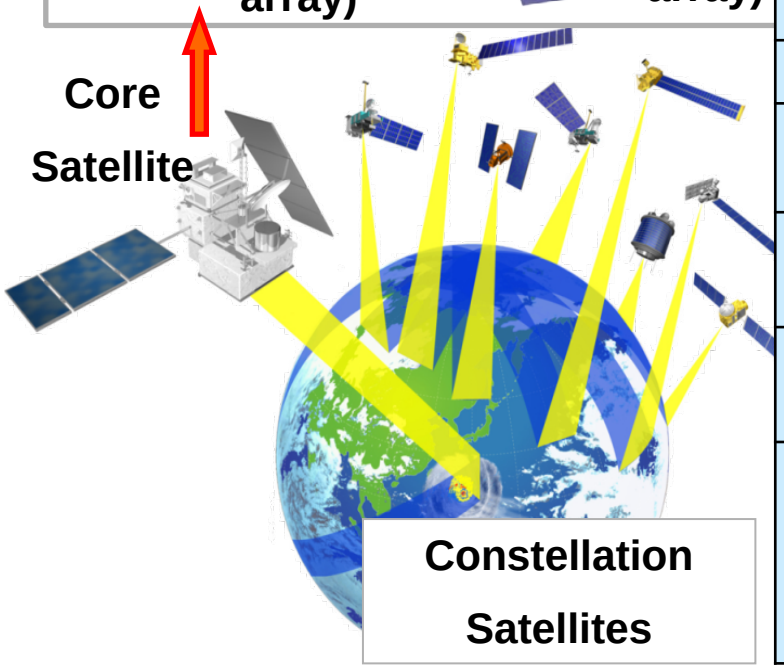
Launch in 2014



Core Satellite (JAXA, NASA)

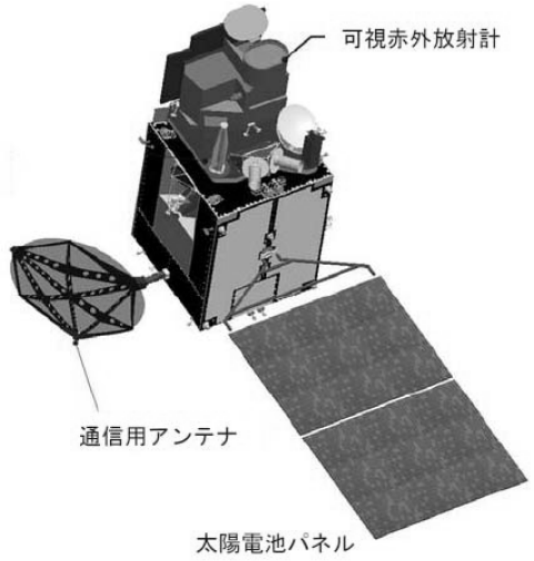
GPM Microwave Imager (GMI)

- Improve the accuracy of weather forecasts
- Improve water resource management



Item	GPM Dual-frequency Precipitation (DPR)		TRMM Precipitation Radar
Abbreviation	KuPR	KaPR	PR
Swath Width	245 km	120 km	245 km
Horizontal Resolution	5 km		5 km
Observation Range	Upto 19km		Upto 15km
Min Detect Ze (Rainfall Rate)	< 18 dBZ (< 0.5 mm/hr)	< 12 dBZ (< 0.2 mm/hr)	< 23 dBZ (0.7 mm/hr)

Next generation Himawari-8/9 by JMA



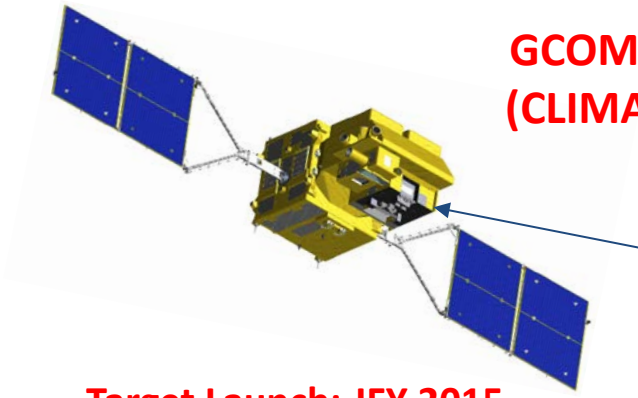
Band	Wavelength (μm)	Spatial resolution
1	0.43-0.46	1km
2	0.50-0.52	1km
3	0.63-0.66	0.5km
4	0.85-0.87	1km
5	1.60-1.62	2km
6	2.25-2.27	2km
7	3.74-3.96	2km
8	6.60-6.43	2km
9	6.89-7.01	2km
10	7.26-7.43	2km
11	8.44-8.76	2km
12	9.64-9.72	2km
13	10.3-10.6	2km
14	11.1-11.3	2km
15	12.2-12.5	2km
16	13.2-13.4	2km

Global Change Observation Mission (GCOM)

- Long-term observation (over 10 years) for global climate change and water cycle.
- Two satellite series;
  - ✓ **GCOM-W :** Microwave observation using AMSR2 (AMSR-E follow on) for observing water circulation
    (water vapor, precipitation, soil moisture, sea surface temp., wind speed, etc)
  - ✓ **GCOM-C :** Optical multi-channel observation using SGLI (GLI follow on)- MODIS type instrument for radiation budget and carbon cycle
    (aerosol, clouds, ocean color, vegetation, snow ice, etc)

GCOM-W1 (WATER) or SHIZUKU"

Launched: 18 May 2012 (Regular observation operation from 10 August 2012)



GCOM-C1 (CLIMATE)

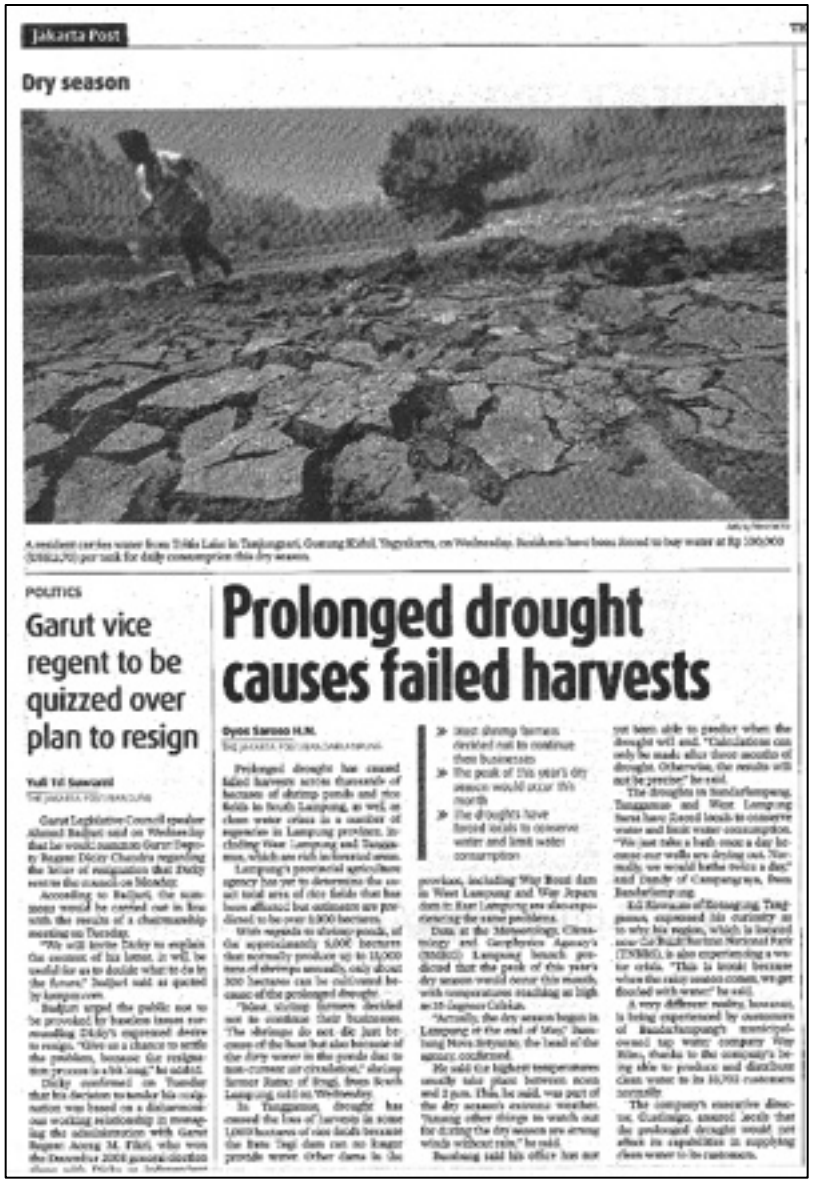
Target Launch: JFY 2015

Sensor	Advanced Microwave Scanning Radiometer 2 (AMSR2)
Design Life	5 years

Sensor	Second generation GLobal Imager (SGLI)
Design Life	5 years

Drought Damages in Indonesia

Jakarta Post : 2011/09/08



Jakarta Post

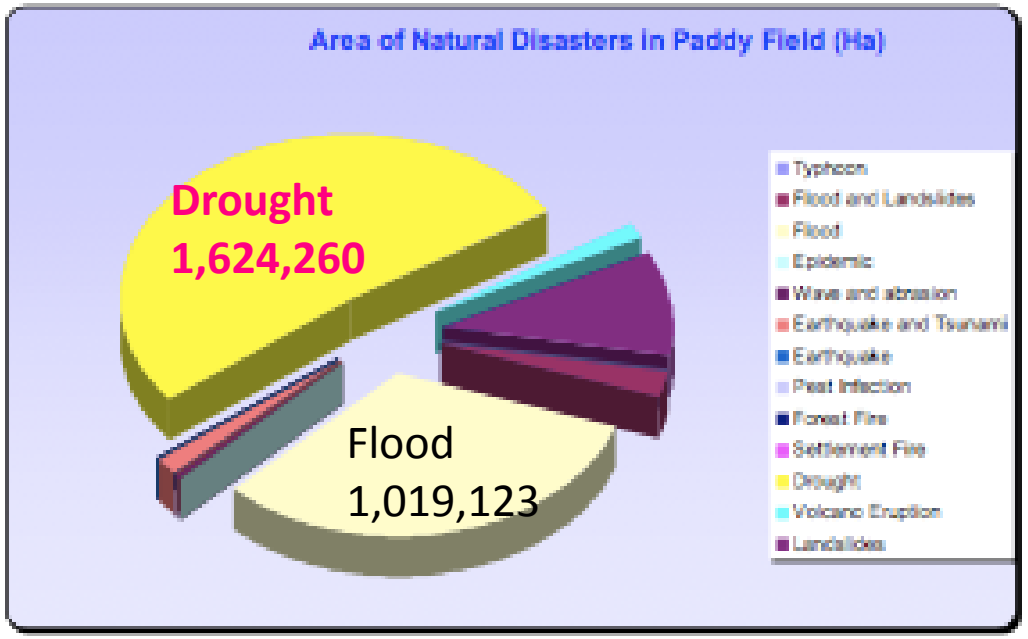
Dry season

POLITICS

Garut vice regent to be quizzed over plan to resign

Prolonged drought causes failed harvests

Area of Natural Disaster in Paddy Field



Source: http://www.bnpb.go.id

Agricultural area that suffered disasters :

- **Drought : 1,624,260 ha**
- **Flood : 1,019,123 ha**
- **Landslides : 323,658 ha**

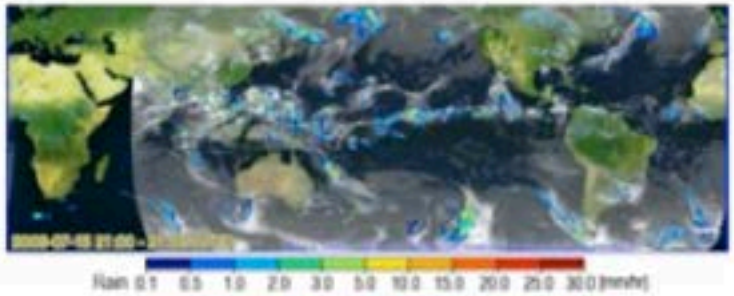
Drought Monitoring in Indonesia

❖ Drought Index from satellite-based precipitation and temperature

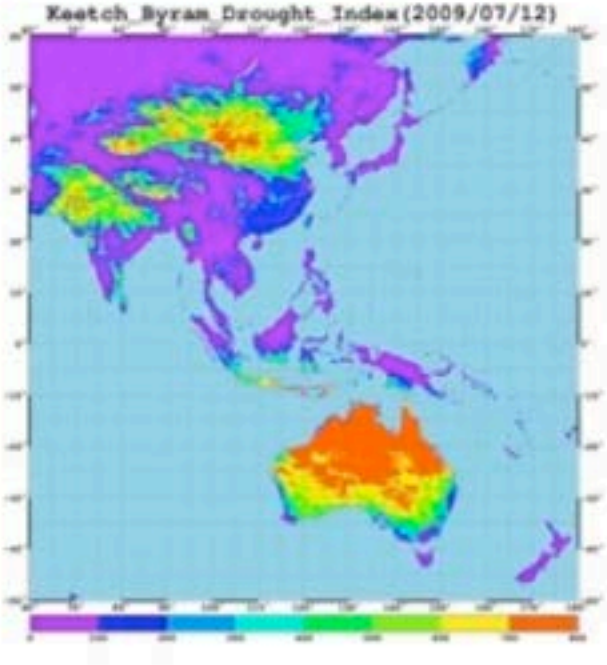
- KBDI is a soil/duff drought index based on 20 cm soil capacity of water.

  Factors in the index are to compute the balance between evapotranspiration (land surface temperature) and precipitation. [Keetch *et. al*, 1965]

- Presently, this index is derived from satellite observation:
  - land surface temperature (LST) from MTSAT received at IIS/U-Tokyo
  - precipitation derived from global satellite mapping (GSMaP) provided by JAXA EROC.



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



http://webgms.iis.u-tokyo.ac.jp/KBDI/

[Prof. Takeuchi, U.Tokyo]

Project Overview

❖ Objective:

- To enhance the understanding on climate change-related drought in Indonesia.
- To develop the methods/techniques of drought monitoring over the agriculture areas in Java island accessible for users and public.

❖ Data and Application Creator:

- LAPAN (Indonesia)
- JAXA, Univ.Tokyo (Japan)

❖ User Agency:

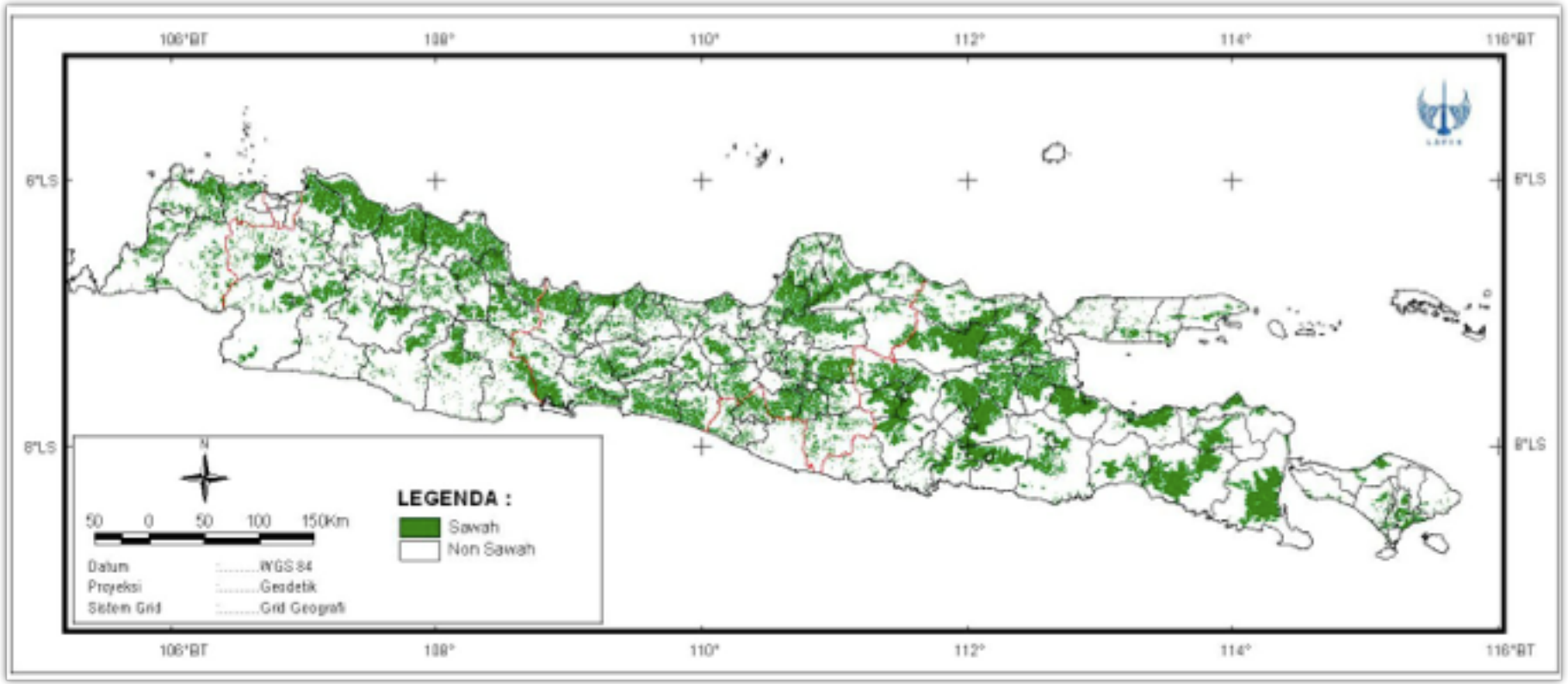
- Min. of Agriculture (Indonesisa)

❖ Technical Supporter:

- GIC AIT(Thailand), Univ.Tokyo (Japan)

Study Area : Paddy Rice Field in Java Island

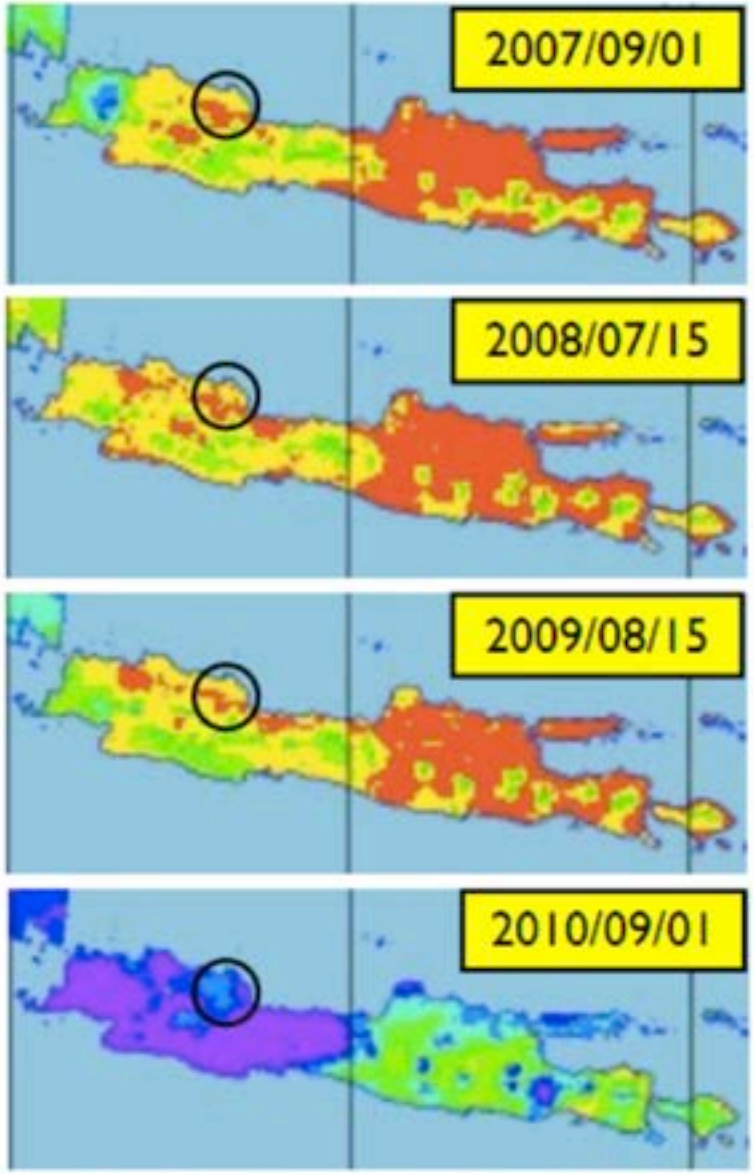
Paddy Field Based on Landsat data 2009

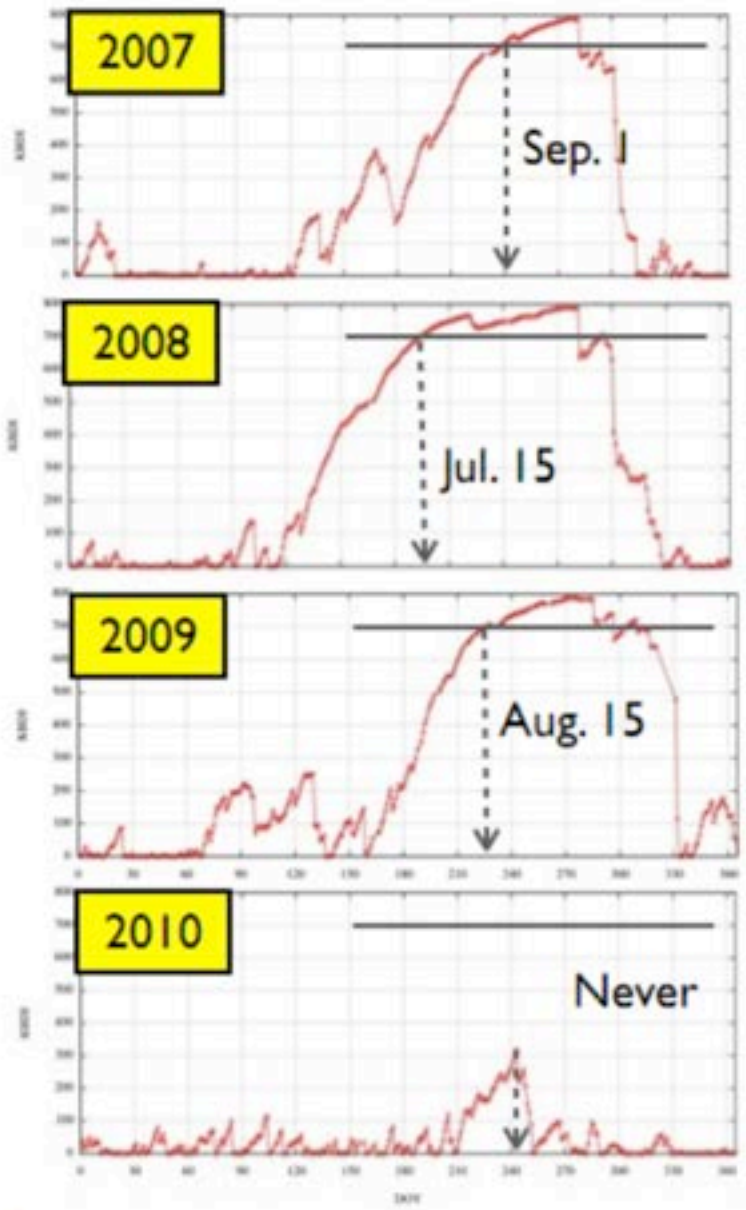


Source: Landsat-7/EM+ data (2009)

Drought Monitoring over Java Island

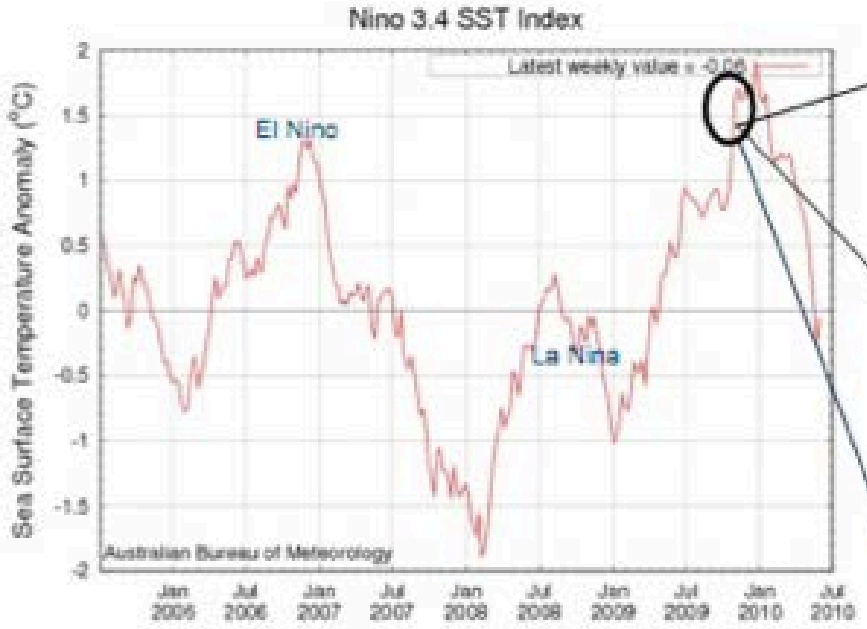
KBDI based drought (Drying Soil) onset in Indramayu



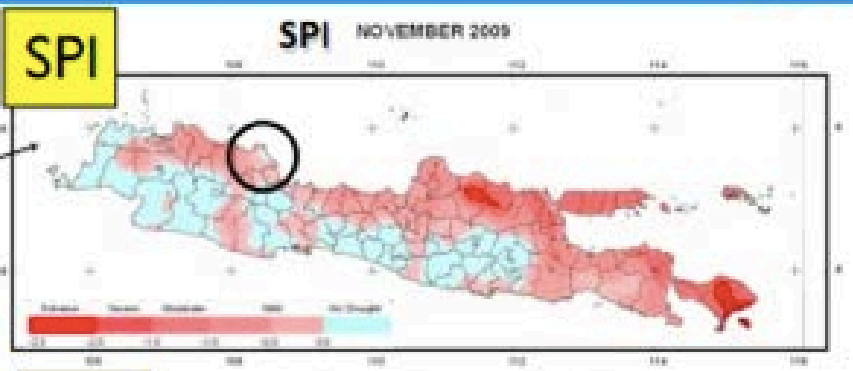


[Prof. Takeuchi, U.Tokyo]

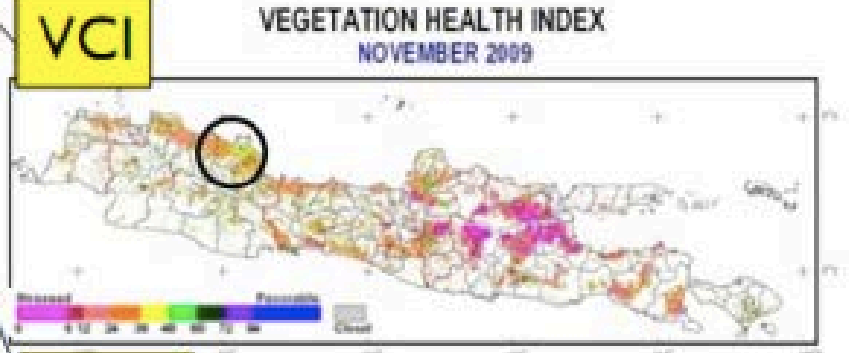
El Nino (2009)



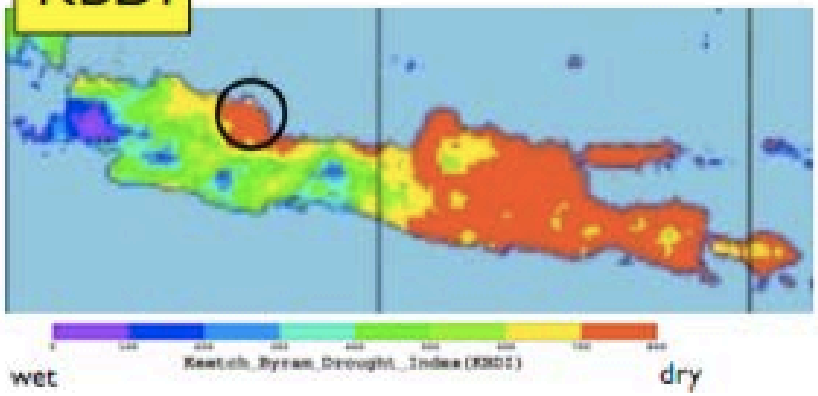
SPI



VCI



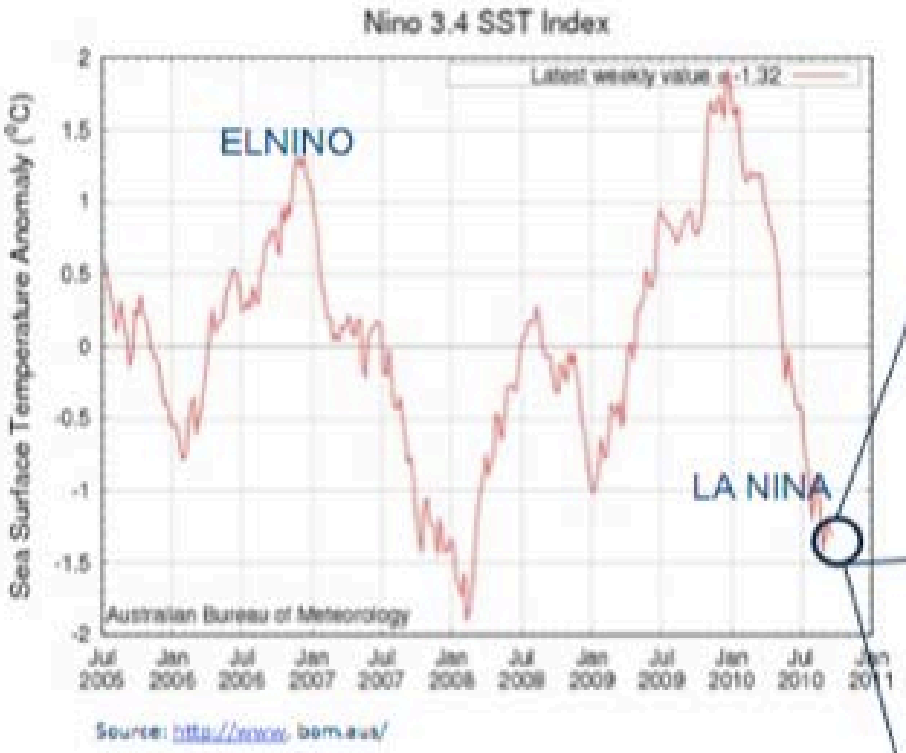
KBDI



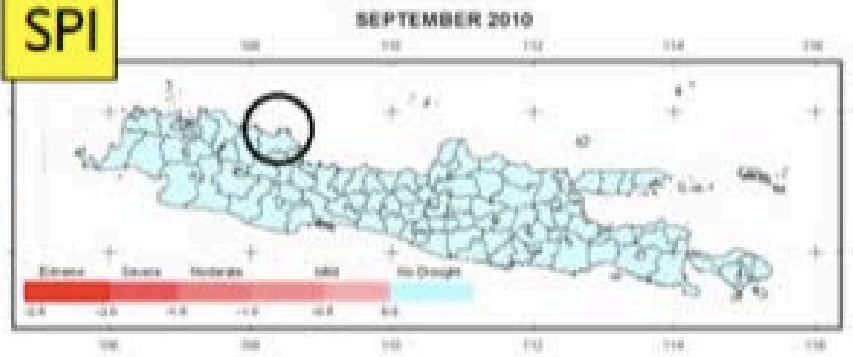
Both SPI, VHI and KBDI indices can also represent the El Nino Condition during 2009

[Prof. Takeuchi, U.Tokyo]

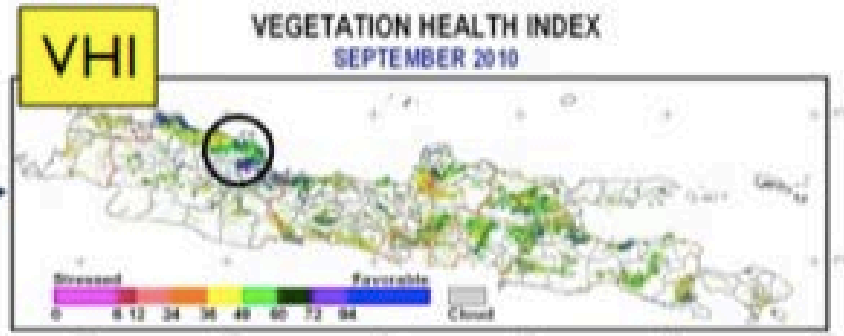
La Nina (2010)



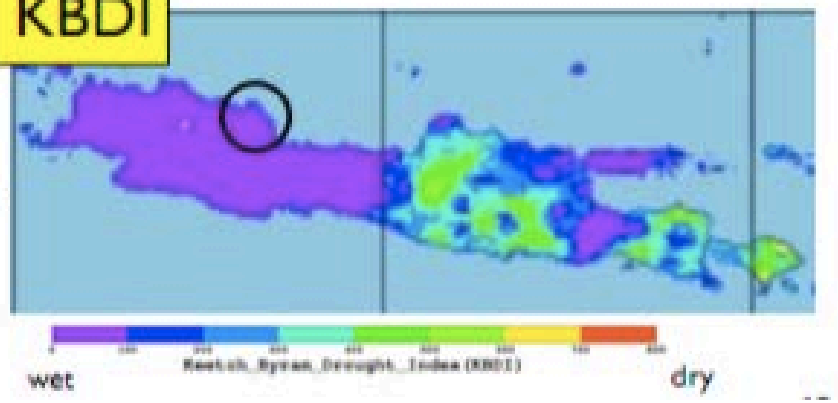
SPI



VHI



KBDI



Both SPI, VHI and KBDI indices can also represent the La Nina Condition during 2010

[Prof. Takeuchi, U.Tokyo]

G20 France 2011 Summit Final Declaration

- **Action Plan on food price volatility and agriculture**

  26. We recognize the importance of timely, accurate and transparent information in helping to address food price volatility, and agree on the need to improve the quality, reliability, accuracy, timeliness and comparability of data on agricultural markets (production, consumption and stocks). We decide to launch:

  - Agricultural Market Information System (AMIS),
  - Global Agricultural Geo-Monitoring Initiative (GLAM).

[Meeting of G20 Agriculture Ministers, 2011]
[G20 France 2011 Summit final declaration, 2011]

GEO GROUP ON EARTH OBSERVATIONS

G20 FRANCE 2011

G20 France 2011 Summit Final Declaration Contd.

- Annex 2

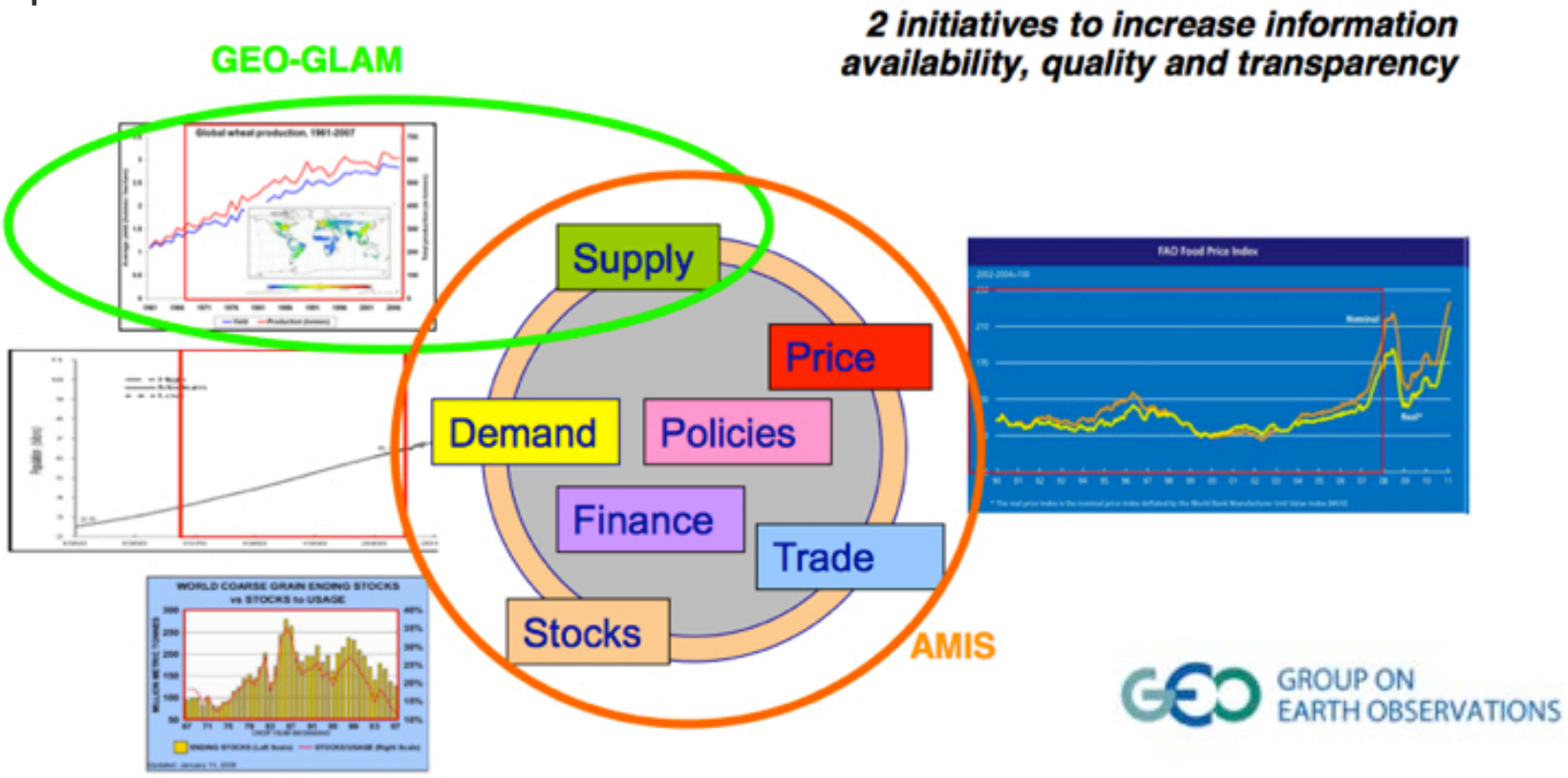
  We decide to launch an Agricultural Market Information System (AMIS) in order to enhance the quality, reliability, accuracy, timeliness and comparability of food market outlook information through strengthening the collaboration and dialogue among main producing, exporting and importing countries, commercial enterprises and international organizations.

- Annex 3

  We decide to launch a Global Agricultural Geo-Monitoring Initiative. This initiative will strengthen global agricultural monitoring by improving the use of remote sensing tools for crop production projections and weather forecasting. We agree on the objectives and next steps for this initiative that were proposed by the intergovernmental Group on Earth Observation (GEO) and several research centers from G20 countries.

Contributions of Remote Sensing to GLAM

- **Global Agricultural Geo-monitoring Initiative (GLAM)**
  - Strengthen global agricultural monitoring by improving the use of **remote sensing tools**.
  - To enhance crop production projections and weather forecasting.
  - Useful input for AMIS concerning the provision of more accurate crop forecasts data.



Collaboration with AFSIS for Rice Growth Outlook

- GEOGLAM Consultation Meeting by AFSIS
  - Phase1 Country: Indonesia, Thailand, Vietnam
  - Submit Outlook description to AFSIS (20th), then share Asia-RiCE (23rd) , and submit to GEOGLAM
  - Satellite derived information is serve as supporting evidence & data.

18 October 2013
@OAE, Bangkok, Thailand

AFSIS : ASEAN+3 Food Security Information System (Office in Bangkok)

Outlook information for AMIS

AMIS

Market Monitor

No.11 – September 2013 www.amis-outlook.org

*The **Market Monitor** is a product of the Agricultural Market Information System (AMIS), a G20 initiative to provide information, analysis and short-term supply and demand forecasts. It covers the international markets for wheat, maize, rice and soybeans, giving a synopsis of major market developments and the policy and other market drivers behind them. The analysis is a collective assessment of the market situation and outlook by the ten international organizations that form the AMIS Secretariat. Ultimately, the report aims at improving market transparency and detecting emerging problems that might warrant the attention of policy makers.*

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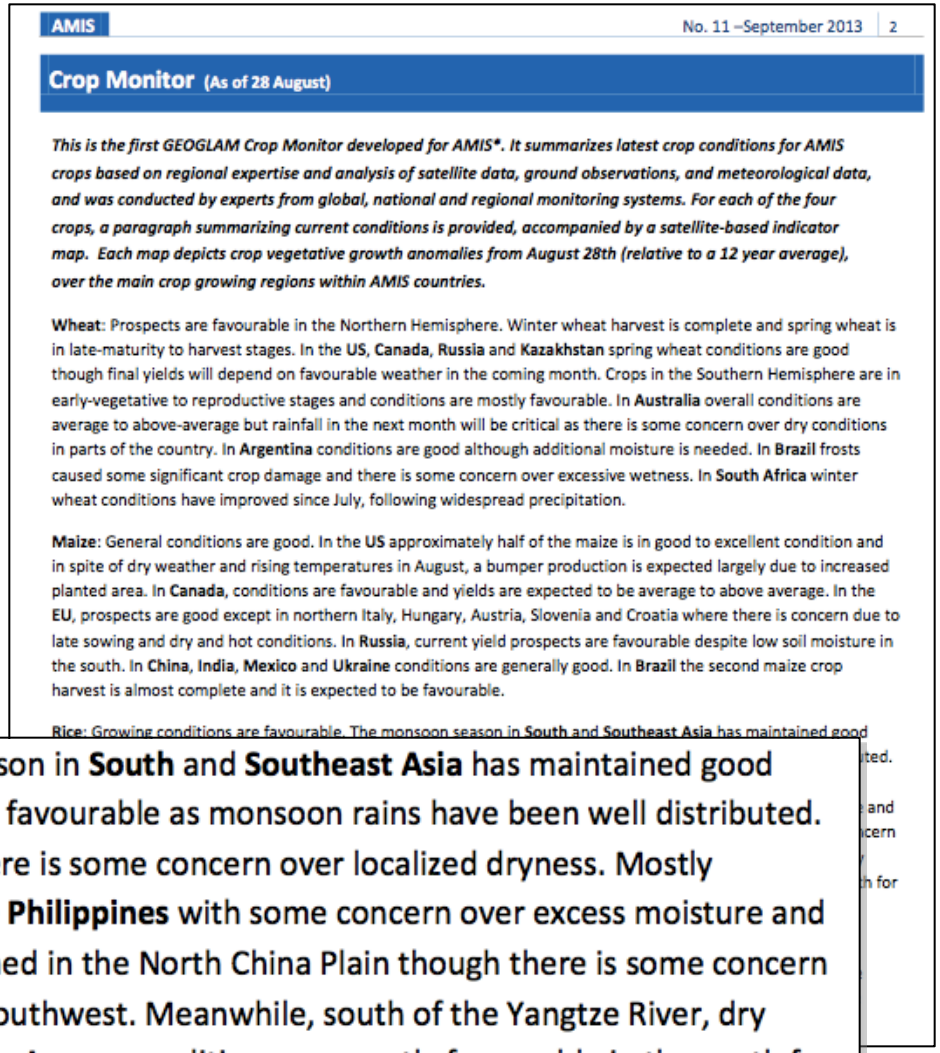
World Supply-Demand Outlook 1
Crop Monitor *NEW* 2
International Prices 4
Futures Markets 6
Policy Developments 7
Market Indicators 8
Explanatory Notes 10



Crop Monitor (As of 28 August)

This is the first GEOGLAM Crop Monitor developed for AMIS*. It summarizes latest crop conditions for AMIS crops based on regional expertise and analysis of satellite data, ground observations, and meteorological data, and was conducted by experts from global, national and regional monitoring systems. For each of the four crops, a paragraph summarizing current conditions is provided, accompanied by a satellite-based indicator map. Each map depicts crop vegetative growth anomalies from August 28th (relative to a 12 year average), over the main crop growing regions within AMIS countries.

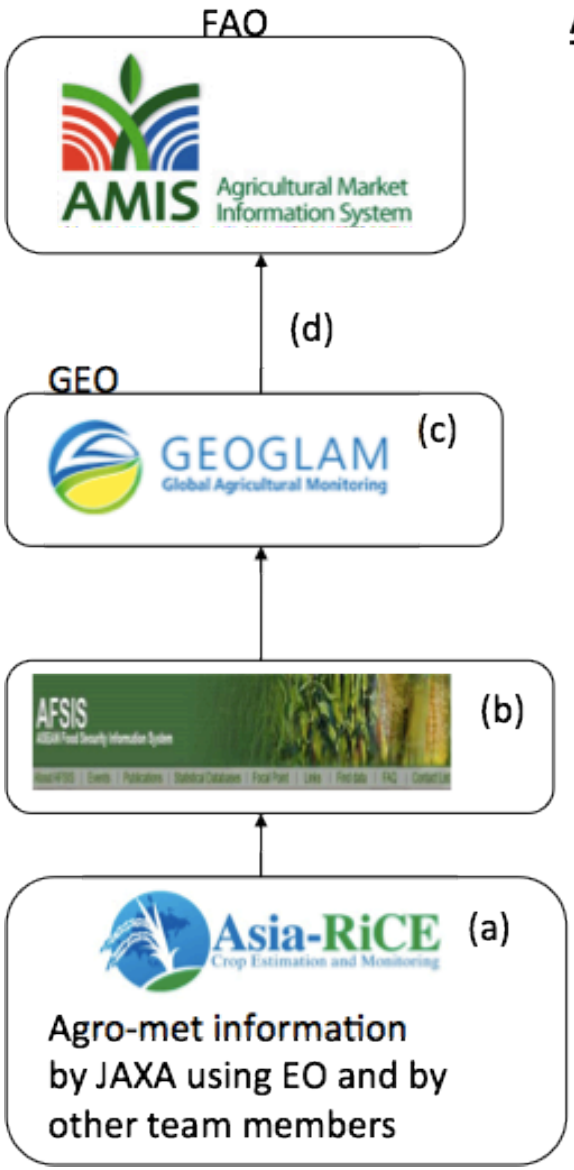
Wheat: Prospects are favourable in the Northern Hemisphere. Winter wheat harvest is complete and spring wheat is in late-maturity to harvest stages. In the **US**, **Canada**, **Russia** and **Kazakhstan** spring wheat conditions are good though final yields will depend on favourable weather in the coming month. Crops in the Southern Hemisphere are in early-vegetative to reproductive stages and conditions are mostly favourable. In **Australia** overall conditions are average to above-average but rainfall in the next month will be critical as there is some concern over dry conditions in parts of the country. In **Argentina** conditions are good although additional moisture is needed. In **Brazil** frosts caused some significant crop damage and there is some concern over excessive wetness. In **South Africa** winter wheat conditions have improved since July, following widespread precipitation.

Maize: General conditions are good. In the **US** approximately half of the maize is in good to excellent condition and in spite of dry weather and rising temperatures in August, a bumper production is expected largely due to increased planted area. In **Canada**, conditions are favourable and yields are expected to be average to above average. In the **EU**, prospects are good except in northern Italy, Hungary, Austria, Slovenia and Croatia where there is concern due to late sowing and dry and hot conditions. In **Russia**, current yield prospects are favourable despite low soil moisture in the south. In **China**, **India**, **Mexico** and **Ukraine** conditions are generally good. In **Brazil** the second maize crop harvest is almost complete and it is expected to be favourable.

Rice: Growing conditions are favourable. The monsoon season in **South** and **Southeast Asia** has maintained good moisture across most of the region. In **India**, conditions are favourable as monsoon rains have been well distributed. In **Thailand**, precipitation has been widespread, though there is some concern over localized dryness. Mostly favourable conditions were maintained in **Vietnam** and the **Philippines** with some concern over excess moisture and flooding. In **China**, good moisture conditions were maintained in the North China Plain though there is some concern over flooding in the northeast and excess moisture in the southwest. Meanwhile, south of the Yangtze River, dry conditions and above normal temperatures raise concern. In **Japan**, conditions are mostly favourable in the south for early developing rice.

Started provision of outlook with satellite data in September 2013

Asia Rice crop outlook to FAO AMIS



(d) Submit monthly outlook report using EO satellites information to FAO AMIS from this September

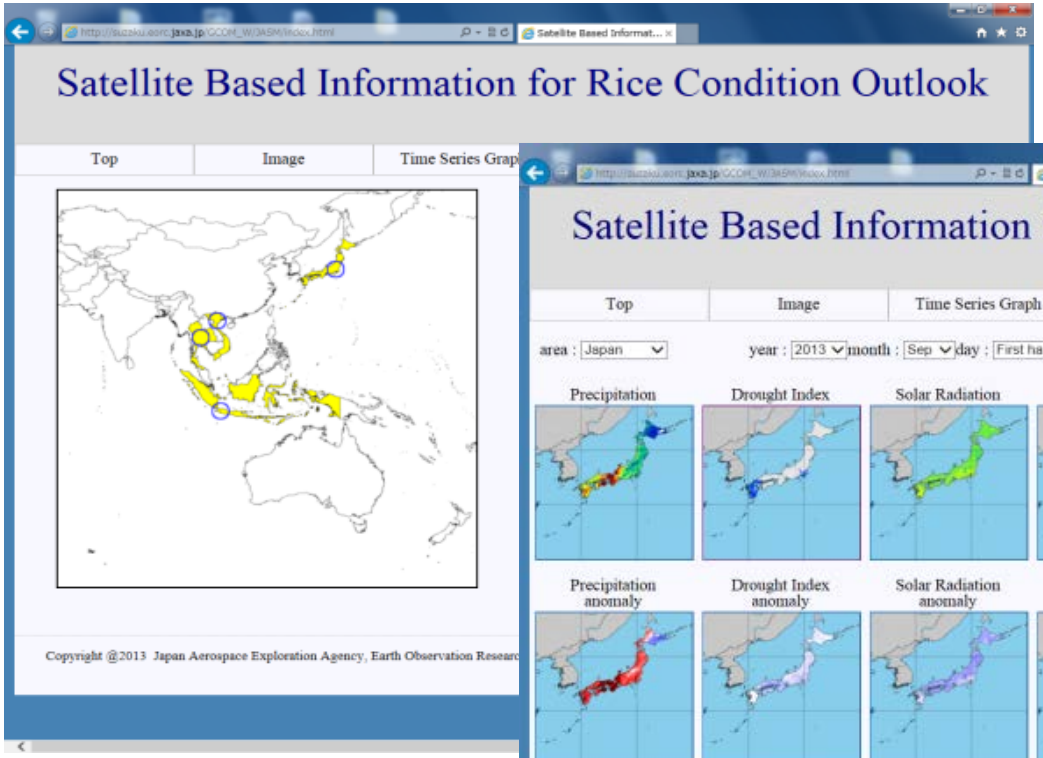
(c) Develop monthly outlook report for corn, wheat, soy bean and rice by GEO GLAM team including Asia rice crop outlook submitted by AFSIS and post on UMD outlook page by USDA and other crop experts with GEO GLAM team (NASA, USDA, CSA, JAXA, EC, …)

(b) Interpret agro-met information to a rice outlook information by rice crop experts in Asia in cooperation with AFSIS project (for phase 1, three countries (Indonesia, Thai, Vietnam are targeted and JAXA/AFSIS will co-host hands on training this October)

(a) Drought index (KBDI), Precipitation, LST, NDVI, Soil moisture (provincial / national / regional) anomaly by GCOM-W, GSMaP, MODIS, etc. by JAXA with UT(contract to RESTEC) and other team members

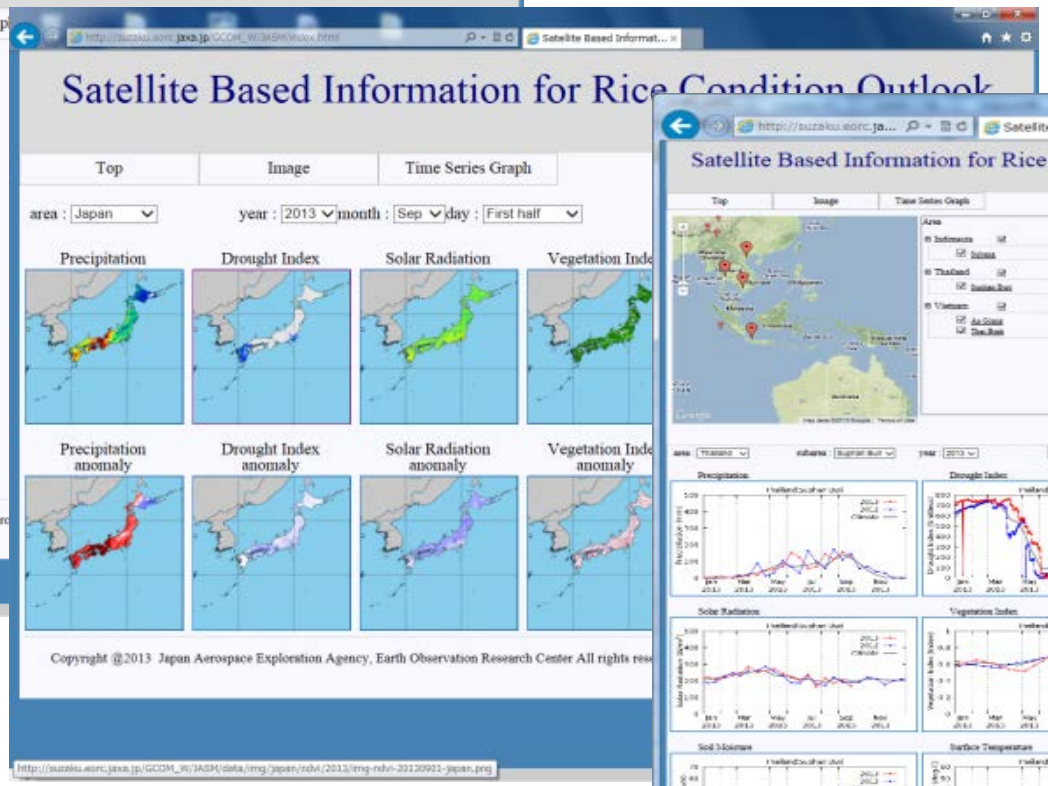
JASMIN - Data-distribution System for Rice Outlook

- Each data will be updated twice a month (15th, 31th day of month).
- Users can access and get latest data any time.



Top

Spatial Distribution



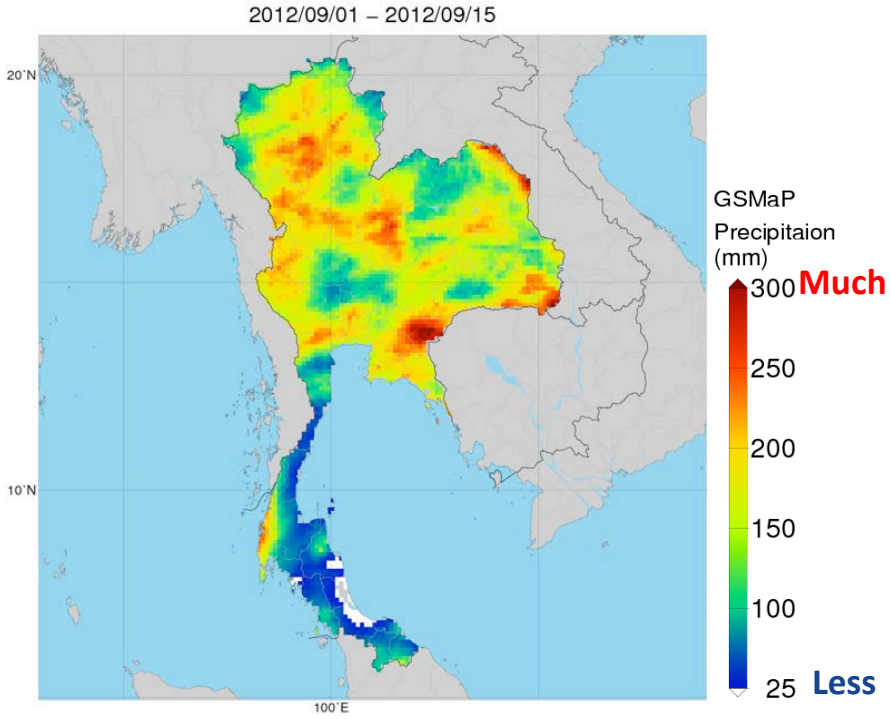
Time-Series

http://suzaku.eorc.jaxa.jp/GCOM_W/JASM/index.html

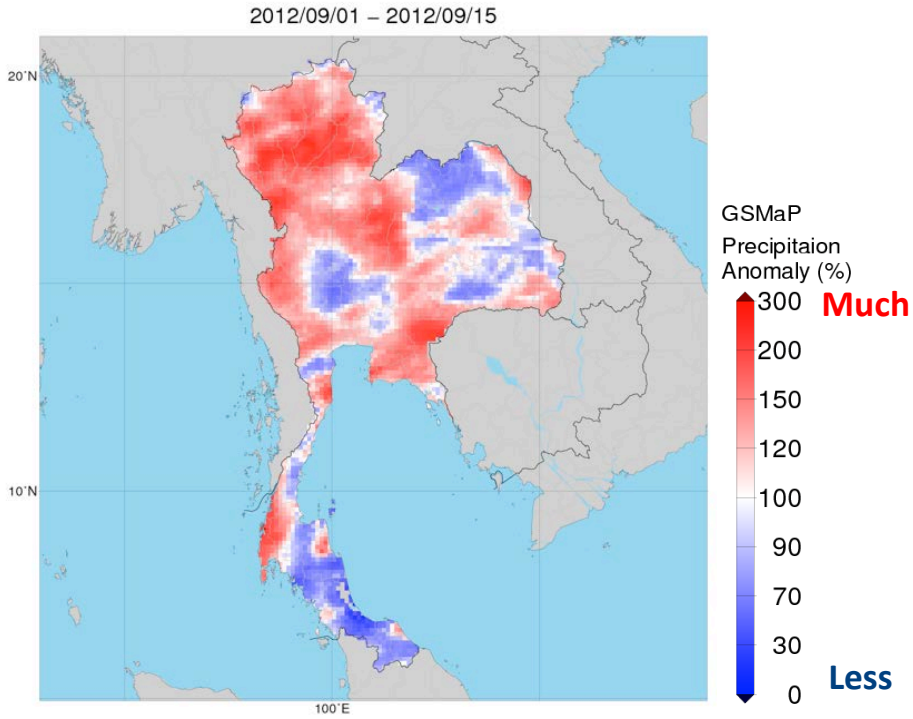
Precipitation

- This system provide “Precipitation” accumulated 15-day precipitation.
- Few precipitation can causes drought and too much precipitation can causes flooding.

Current Condition



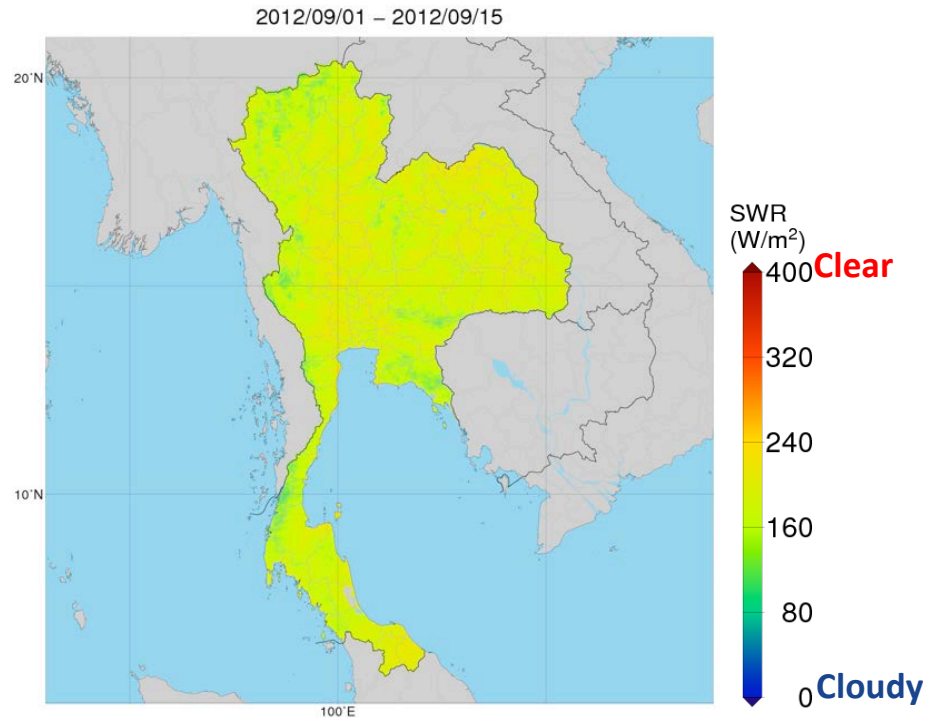
Anomaly



Solar Radiation

- Solar radiation is one of the key factors for rice growth.
- High solar radiation means there is few cloud and a lot of solar radiation comes to land surface.

Current Condition



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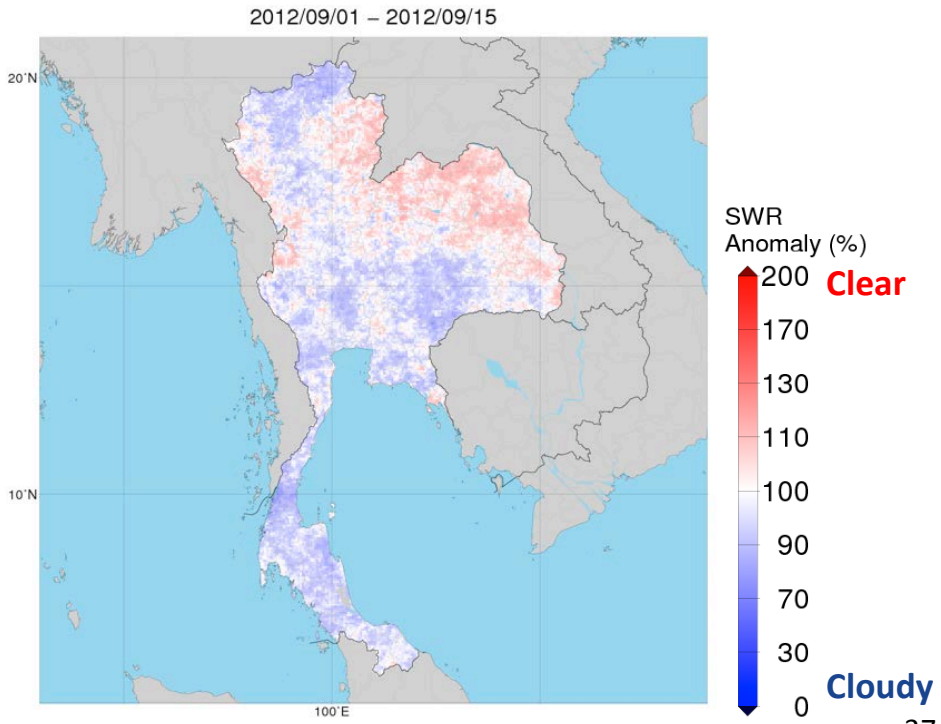
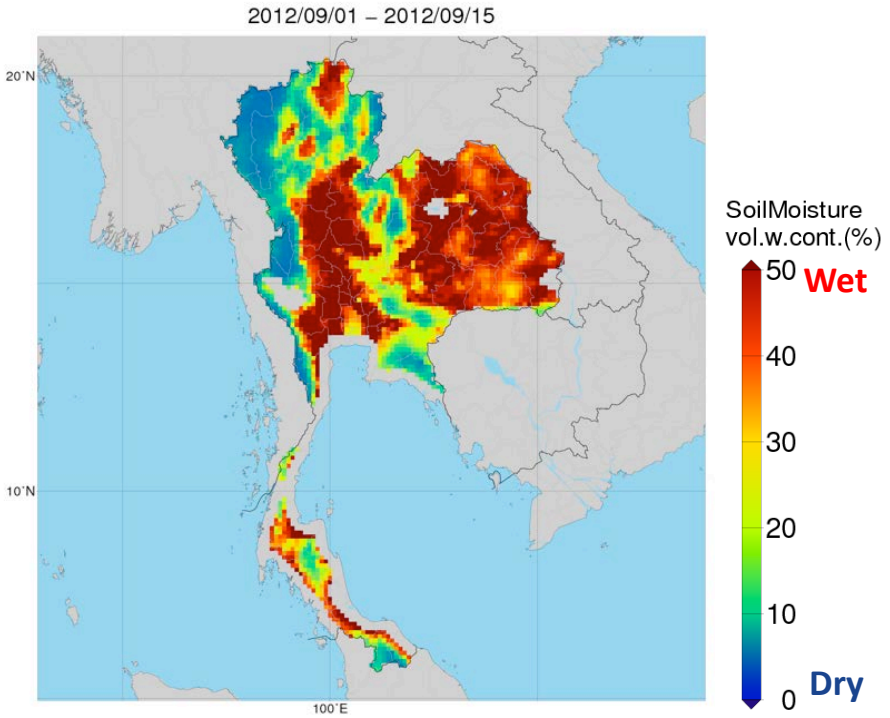


Soil Moisture

- Available water in the soil is a significant factor for rice growth.
- High soil moisture means available water in the soil is enough.
- Low soil moisture means at the risk of drought.

Current Condition



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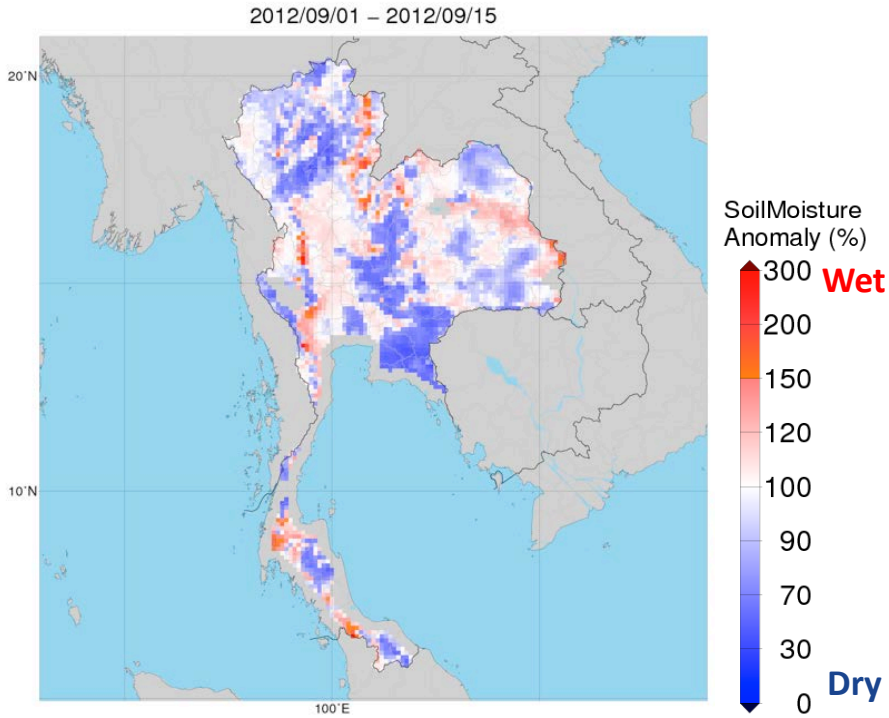
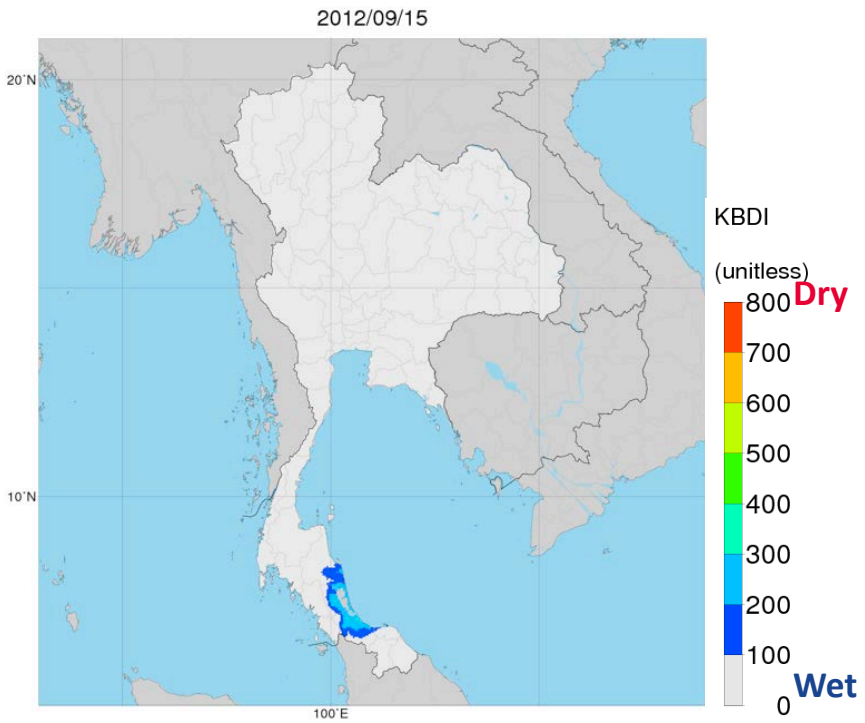


Drought Index

- Drought index shows the degree of drought.
- Drought index is calculated from satellite derived precipitation and land surface temperature.
- High index means that there are few available water (drought).

Current Condition



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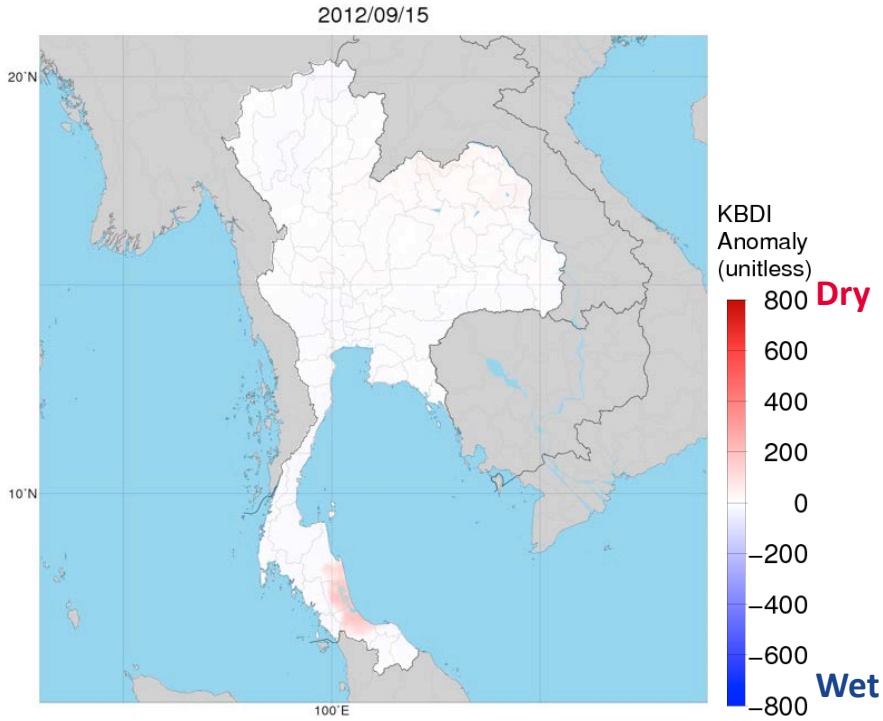
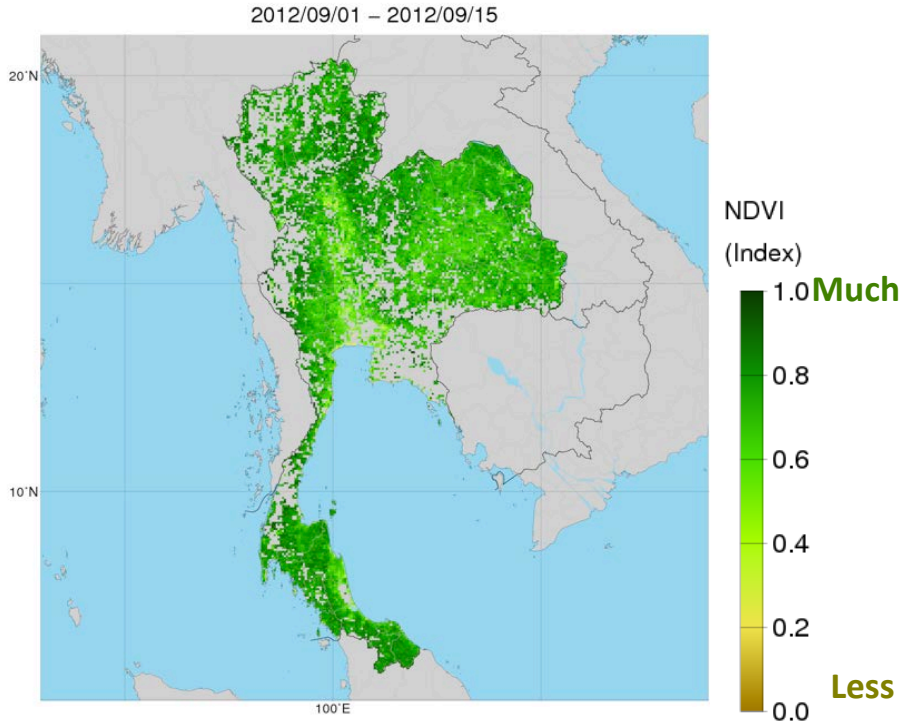


Vegetation Index

- NDVI is not agro-meteorological parameter, but the index to indicate the amount of leaves.
- High NDVI means much vegetative and less NDVI means less vegetative.

Current Condition



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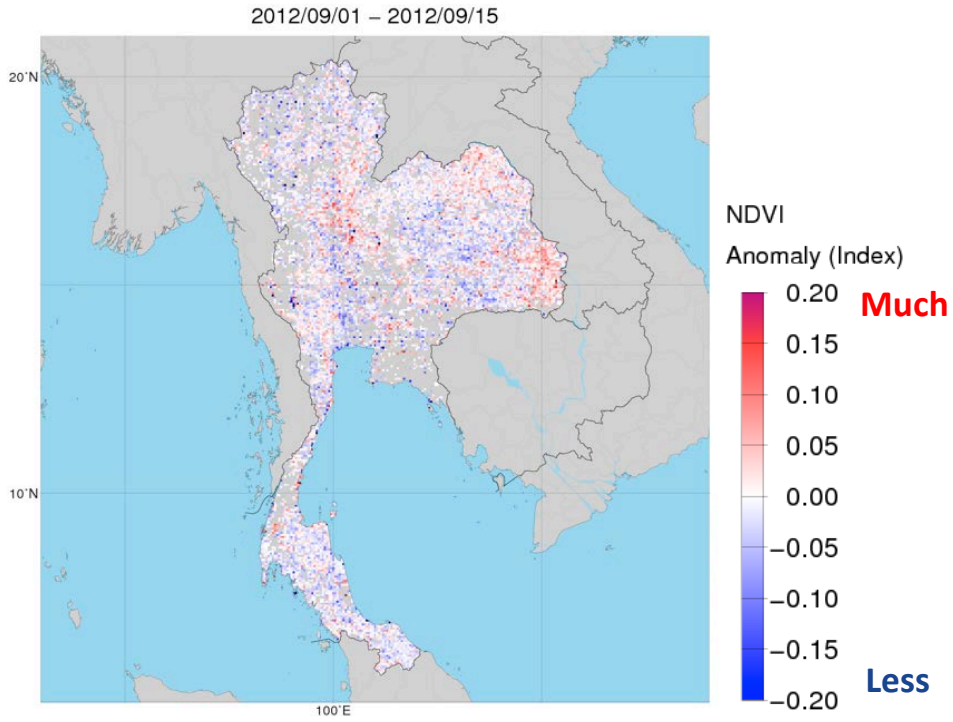
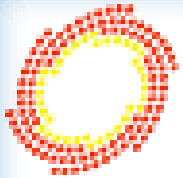
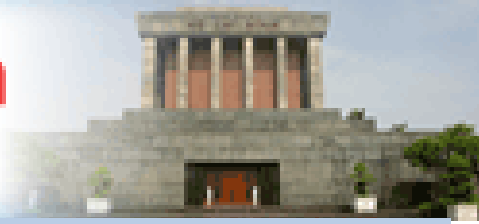


Asia Pacific Regional Space Agency Forum 20



20TH APRSAF
ASIA-PACIFIC REGIONAL SPACE AGENCY FORUM
VIETNAM

ARPSAF-20 in Vietnam
from December 3 to 6, 2013



Need to strengthen the relationship among regional efforts to build strong bridge between supplier sides including space agencies and demander sides including APEC climate center with climate service and research organizations

[Climate R^3 (Regional Readiness Review for Key Climate Missions)]

6. Welcome the progress achieved through Climate R^3 in promoting practical data coordination in an important climate change domain of priority interest to APRSAF participating countries;
7. Agree to explore the establishment of practical relationships in support of organizations such as the APEC Climate Center;
8. Recognize the potential of Australian proposed Continuity of Earth Observation Data for Asia-Pacific (CEOD-AP) study activity to: identify EO data requirements and priorities at the regional and national level; increase the understanding of regional EO data needs; support engagement of key regional and national stakeholder user agencies and frameworks; serve as a focus for EOWG coordination efforts;
9. Facilitate cooperation between Australia and the EOWG co-chairs in 2013 to progress the CEOD-AP activity, with a progress report to be provided to the annual mid-year EOWG meeting in preparation for APRSAF-20;

http://www.isrs.or.kr/

It may be also good opportunity to continue to talk between APEC climate center and remote sensing experts from remote sensing society of S. Korea, Japan and Chinese Taipei.

Conclusion

Be ready to provide satellite based information for drought and water related disaster

Be ready to have a dialogue to establish a cooperation with APEC climate center and other national related organizations