

Asia-Rice team Update

Shinichi Sobue, Kei Oyoshi and Tsugito Nagano
On behalf of Asia Rice crop team (Asia-RiCE)

February 27, 2014



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]

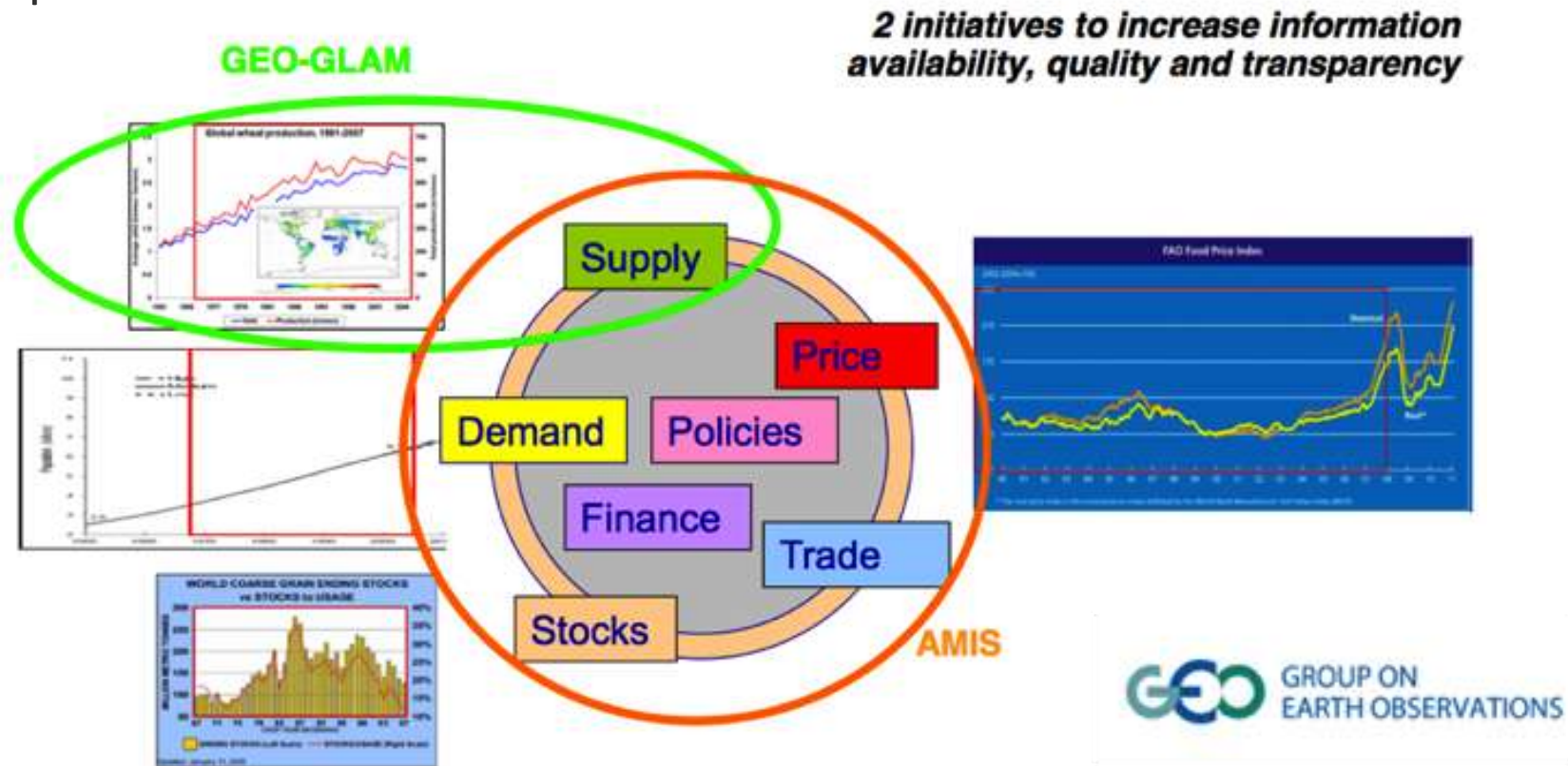
[G20 France 2011 Summit final declaration, 2011]



Contributions of Remote Sensing to GLAM

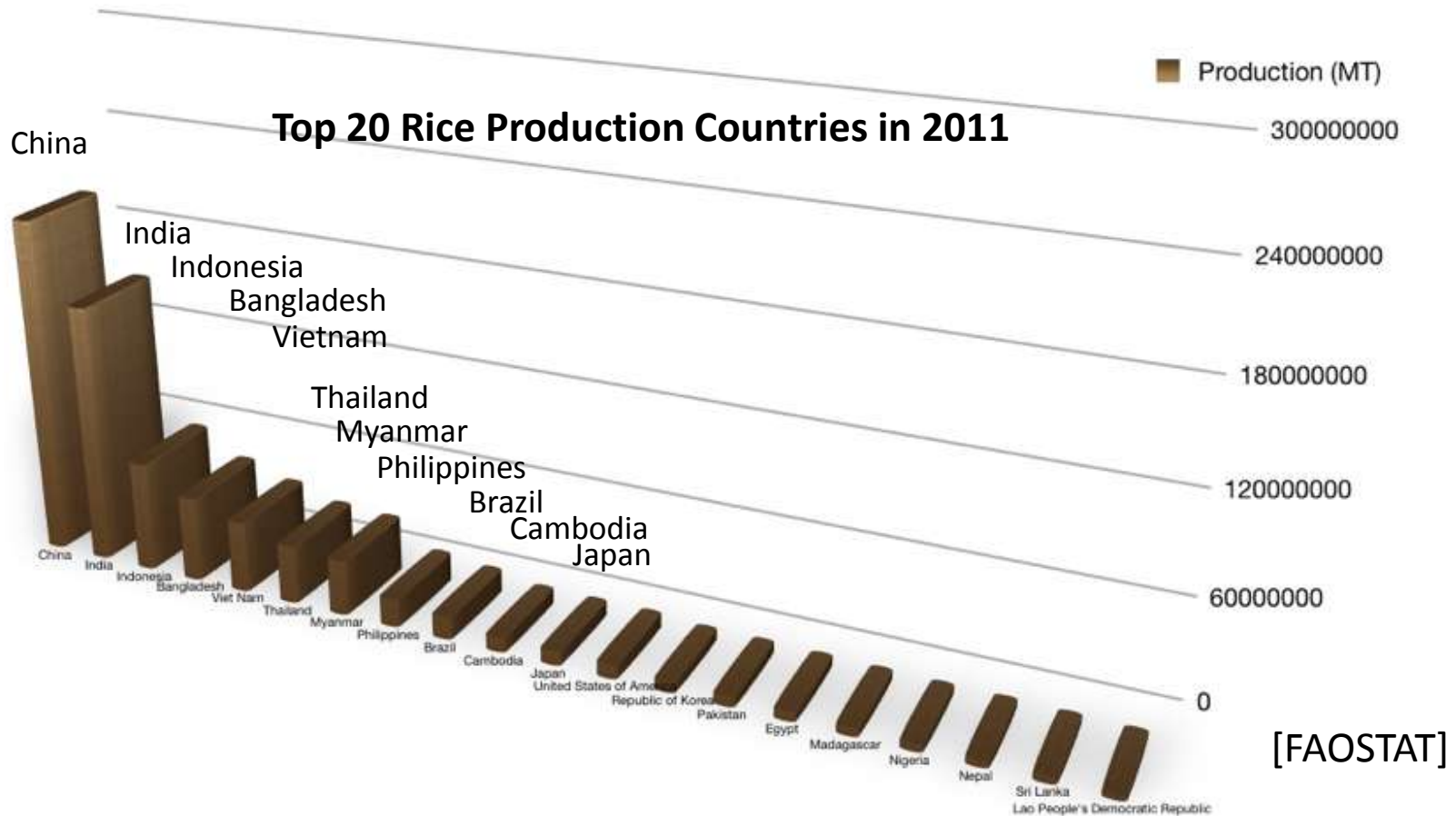
❖ Global Agricultural Geo-monitoring Initiative (GLAM)

- 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.



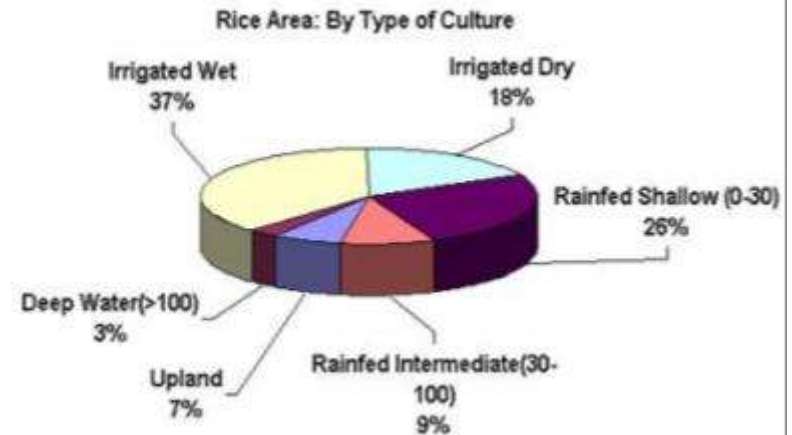
Importance of Rice in Asia

- ❖ Asian countries are responsible for **approximately 90% of the world rice production and consumptions.**
- ❖ Rice is not just a food, but closely related to culture.



Rice related statics or information are imperative for decision making.

- Multi-season crops
- Variable crop calendars within a season
- Diverse growing practices
- Water resource dependency (Water stress – irrigated, rain-fed)
- Rainy season growth (cloud)





- Asia-Rice is an Asian Rice Crop Estimation & Monitoring (Asia-RiCE) component for the GEO Global Agricultural Monitoring (GEOGLAM) initiative since 2012

- 2012: Publish Asia rice crop team work plan version 1.0

- 2013/9 - Define technical demonstration sites with 100km x 100km area in each country in members and implement phase 1A with Indonesia, Thailand and Vietnam to estimate rice crop area and production using available SAR and other satellite data with ground observation data and statistical information

- 2013/10 – Provide rice outlook information to FAO AMIS using agro-meteorological data derived from EO satellites including MODIS, GCOM-W, TRMM and others with ASEAN+3 (AFSIS)

- 2014 – Will start phase 1B implementation and develop phase 2



Product	Description
P1: Rice Crop Area Estimates/Maps	<p>Cultivated area (every year)</p> <p>Inventory of agricultural facilities</p>
P2: Crop Calendars/Crop Growth Status	<p>Timing of sowing, planting, growing and harvesting/growing status.</p> <p>Identification of growth stages</p> <p>Planted area progress (every month) per season.</p> <p>Crop growth anomaly</p>
P3: Crop Damage Assessment	<p>Detection of flooding and other disaster impacted area</p> <p>Detection of drought or inundated area</p> <p>Detection of diseased plants, pests and diseased infestation</p>
P4: Agro-meteorological Information Products	<p>Early warning</p> <p>Anomaly detection (drought, extreme temperatures)</p> <p>Crop growth anomaly</p>
P5: Yield Estimation and Forecasting	<p>Empirical-statistical model estimate</p> <p>Crop-growth simulation model estimates</p>

Data Integration

- Only one sensor / satellite can not solve application requirements
 - Multi-satellite observation including international constellation is definitely needed.

Satellites/Sensors

SAR



Microwave Radiometer



RADAR



Optical Sensor (Global Imager)

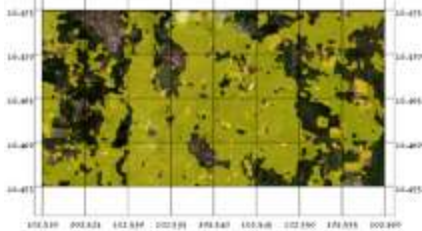


Optical Sensor (High Res.)

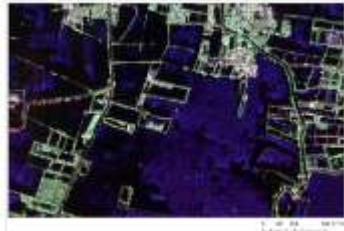


Products from satellite data

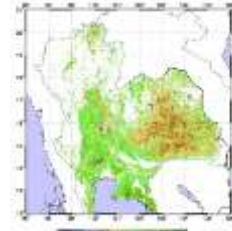
Paddy Field Mapping



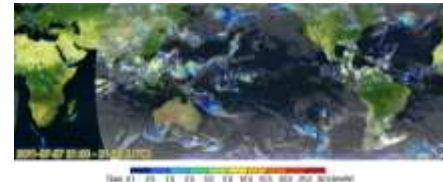
Flood Monitoring



Crop Growth



Agro-meteorological Monitoring



Topography



Agricultural Applications

Agricultural Stat

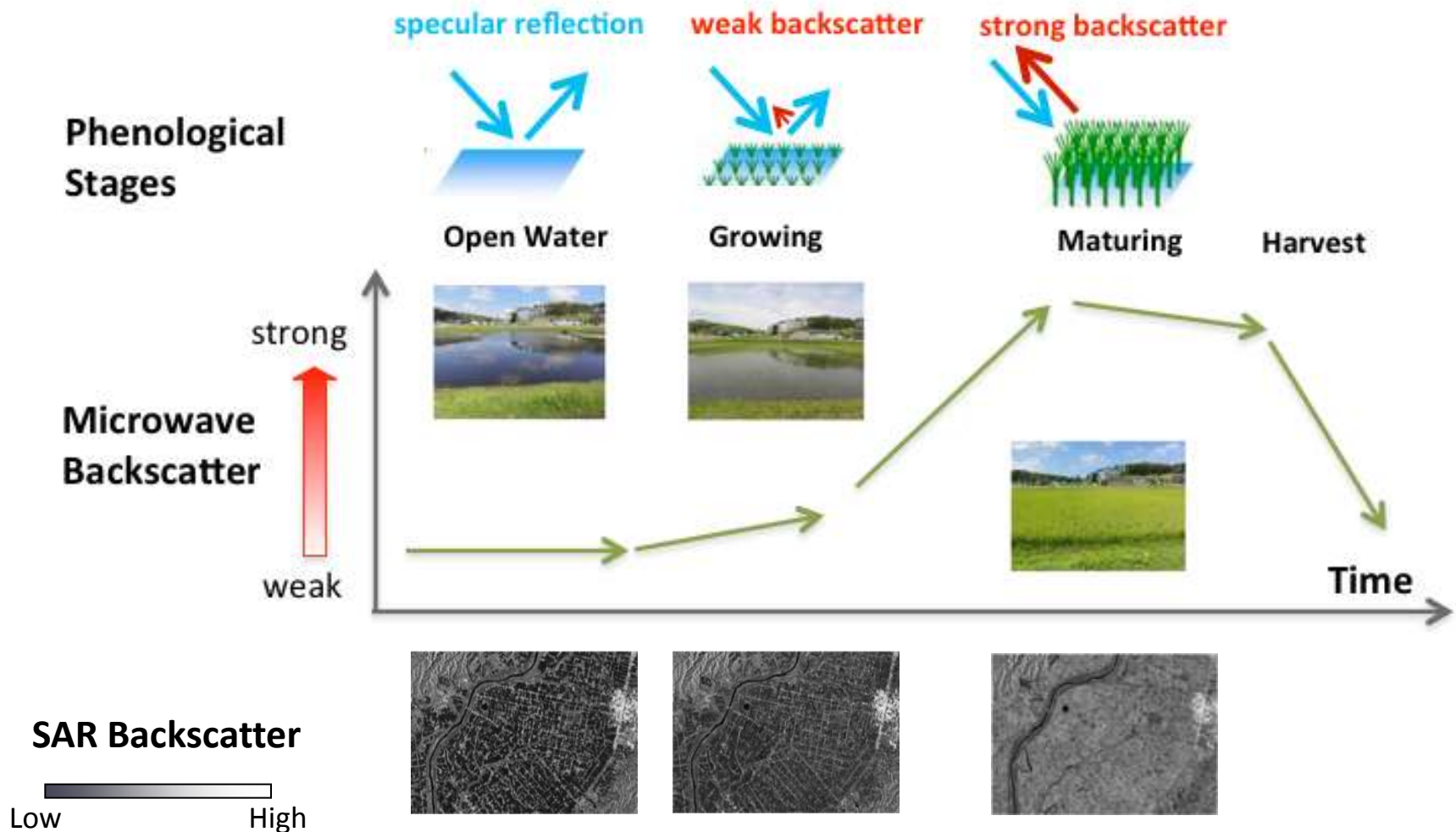
Early Warning

Damage Assessment

Land Resource Management

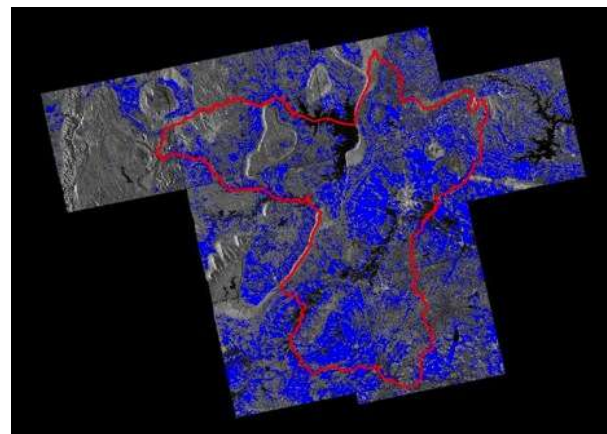
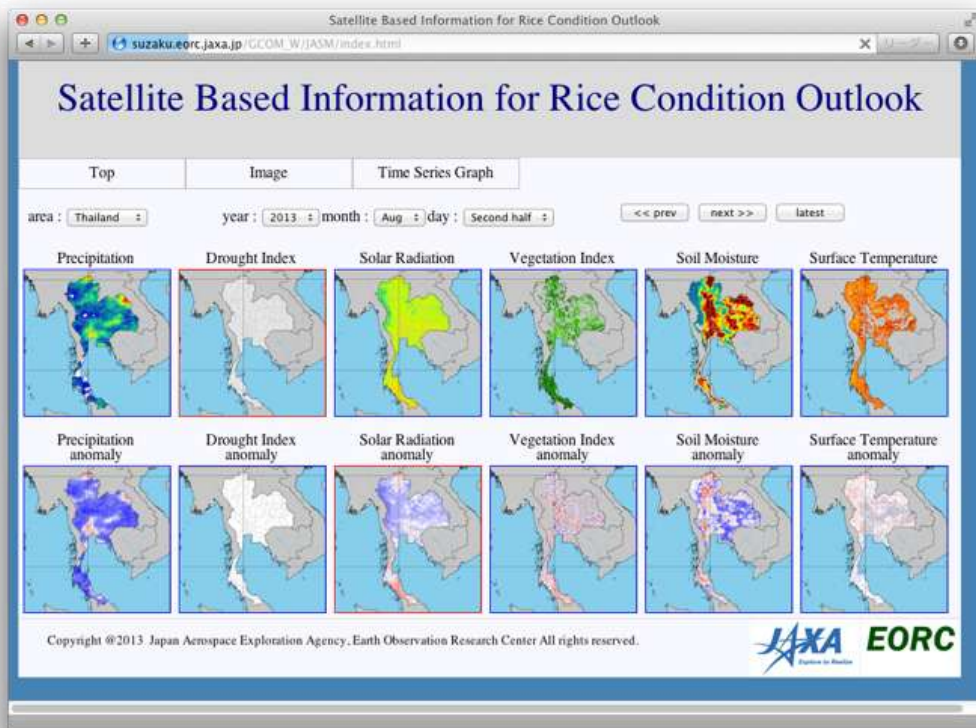
Seasonal Backscatter Characteristics of Paddy Field

- ❖ Seasonal changes in microwave backscatter is useful information to detect paddy field area.



Agro-meteorological information for rice crop outlook

Rice crop area estimation using SAR in Thailand and Vietnam



Asia Rice crop team meeting in Bali, ACRS2013 co-hosted by MOA and JAXA



Agenda and Topics

- **Asia rice crop team homepage update**
 - **Agree to post today's PPTs to home page**
- **Work plan update**
 - **Need to update with outlook activity with linking JAXA's outlook homepage (JASMIN) and UMD homepage**
- **Joint publishment**
 - **Agree to think to submit joint research paper for TDSs phase 1A sites with Japan**
- **Next face-to-face meeting (APRSAF EOWG@Hanoi and SAFE WS@TBD, next May)**
 - **Agree to hold phase 1A sites face-to-face meeting and compile phase 1A study early result to present at GEO plenary by Shinichi on behalf of Asia rice crop team**
 - **Propose to hold SAFE workshop with Asia rice crop team meeting in conjunction with The Institution of Geospatial & Remote Sensing Malaysia (IGRSM) (<http://www.igrsm.com>) will be organising the 7th IGRSM International Remote Sensing & GIS Conference and Exhibition in Kuala Lumpur, Malaysia, on 22-23 April 2014**

- Phase 1A of Asia-RiCE will consist of four technical demonstration sites in three countries
- Each of these will focus on the development of developing provincial-level rice crop area estimations.
- Phase 1B, and/or Phase 2, additional technical demonstrators will be added, and/or the scope may be increased to produce whole country estimates.
 - Thailand will likely be used as a demonstration of whole-country “wall-to-wall” rice crop area estimation capability, using ScanSAR and other data.

Phase-1A

- Indonesia (Subang, West Java Island);
- Thailand (Suphan Buri province);
- Vietnam (Thai Binh (North));
- Vietnam (An Giang (South));

Phase-1B

- Lao P.D.R. (Savannakhet province);
- Philippines (Nueva Ecija for RIICE project, TBD for BAS);
- China (Taishan, Guangdong Province);
- India (West Bengal state);
- Japan (Tsuruoka, Yamagata Prefecture);
- Malaysia (IADA Barat Laut Selangor Province).
- Chinese Taipei (Taiwan) (Chang Hua, Yun Lin, and Chiayi Counties)
- South Korea (Location, TBD)

- Myanmar, Bangladesh and Cambodia

Support to GEOGLAM Phase 1

- Definition of observational requirements for Asian Rice Crops for GEOGLAM Phase 1 – 2013-2014
 - Rice crop requirements distinct from other cereal crops
 - Input to CEOS acquisition planning process
- Coordination of key data streams, including SAR
 - Radarsat-2, RISAT-1, ALOS/ALOS-2, TerraSAR-X, Cosmo-Skymed
- Development of Technical Demonstrator Sites for Phase 1A and 1B

Status of Satellite observation plan and TDS phase 1 activity

Result from Asia rice crop team face-to-face meeting in rice crop workshop in ACRS at Bali co-hosted by Indonesian MOA and JAXA

1. Radarsat-2 JECAM-SOAR proposal by TDSs phase 1

- Submitted: Chinese Taipei, Indonesia, Japan, Malaysia, Philippine, Vietnam, Thailand
- Preparation: China, India, LaoPDR,
- Loan data agreement submitted; Indonesia, Thailand, Vietnam and Japan

2. RISAT-1 – ISRO: Coordinate with ISRO

3. ALOS/ALOS-2

- Completed: ALOS archive to phase 1A TDSs
- ALOS-2 observation planning is underway
- Asia rice crop team plans to submit team JAXA's K&C RA proposal this spring (TBD)

4. TerraSAR-X

- Tandem-X science proposal was accepted but there was very few chance to receive Balistic mode of SAR data
- New TerraSAR-X proposal was accepted but there was limitation of amount of data (target to two countries from April)

5. Cosmo-Skymed

- Thai and south Vietnam have some data under their own frameworks

6. Sentinel-1

- Coordinate with ESA

Revised our requirement document of Asia RiCE with adding Indian TDS

Institutional Arrangement for Phase 1A and...

1. Asian Development Bank - ADB funded project 2013-4 (- Japan Fund for Poverty Reduction)

“R-CDTA 8369: Innovative Data Collection Methods for Agricultural and Rural Statistics”

Aims to assist the selected pilot countries (Lao PDR, Philippines, Thailand, and Viet Nam (North)) in developing and adopting space-based technology (SBT) and similar tool application methods in estimating rice crop area and production.

Under JAXA-ADB agreement (LOI) using JAXA’s satellite data and application

2. APRSAF SAFE projects 2013-4 (Supported by JAXA)

Asia Pacific Regional Space Agency Forum – Space Application for Environment

Aims to encourage environmental monitoring for climate change mitigation and adaptation studies, as well as studies on other forms of practical application, using space applications.

Open to every agency in Asia-Pacific Region for submitting new proposal.

Two prototyping for rice crop monitoring are on-going in Indonesia and South Vietnam

3. IFC, World Bank and JICA

Some discussion with donors about crop insurance to insurance company using space based observation data

4. Other on-going and/or operational activities

FASAL-India, CropWatch-China, RIICE-IRRI and other R&D in Asia-RiCE team

Phase 1A discussion topic with CEOS

- Complicated procedure to get free data from CEOS agencies
 - Each country PI selection, paper works
 - No allow to share data within our Asia team
 - Ground based observation and other statistical data sharing obligation
 - Request to publish scientific research paper even if GEOGLAM is to promote practical data use to SBA
- Resource availability to do data processing, sharing, etc.
 - Major issue is to get data from CEOS agencies to respected country by using Internet (too big data transfer to Asia by Internet !!!) and share data among CO-Is
 - SDMS test bed?

GEO GLAM Outlook to FAO AMIS

Agro-met information using satellites

Collaboration with AFSIS for phase 1A - Rice Growth Outlook

GEOGLAM Consultation Meeting co-hosted by ASEAN+3 Food Security Information System (AFSIS) project and JAXA

- ▶ Phase1A Country: Indonesia, Thailand, Vietnam
- ▶ Submit outlook description to phase 1A countries statistic organizations through AFSIS (20th), then share in Asia-RiCE (23rd) , and submit to GEOGLAM
 - Outlook is not directly connected with official statistic information from statistic organizations because of temporal requirement and administrative issue
- ▶ Satellite derived agro-met information will serve as supporting evidence & data



RESTEC

18 October 2013

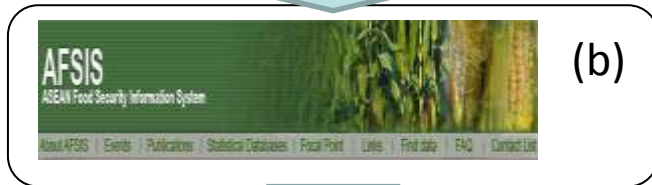
@OAE, Bangkok, Thailand

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

Asia-RiCE phase 1A crop outlook flow to FAOAMIS



(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



(b) Interpret agro-met information to a rice outlook information by rice crop experts in Asia in cooperation with AFSIS project (for phase 1A, three countries (Indonesia, Thai, Vietnam) are targeted



(b1) Review and add some outlook information with provision of additional agro-met information and rice crop growth information derived from Asia rice crop team



(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, ...)



(d) Submit monthly outlook report using EO satellites information to FAO AMIS from September, 2013

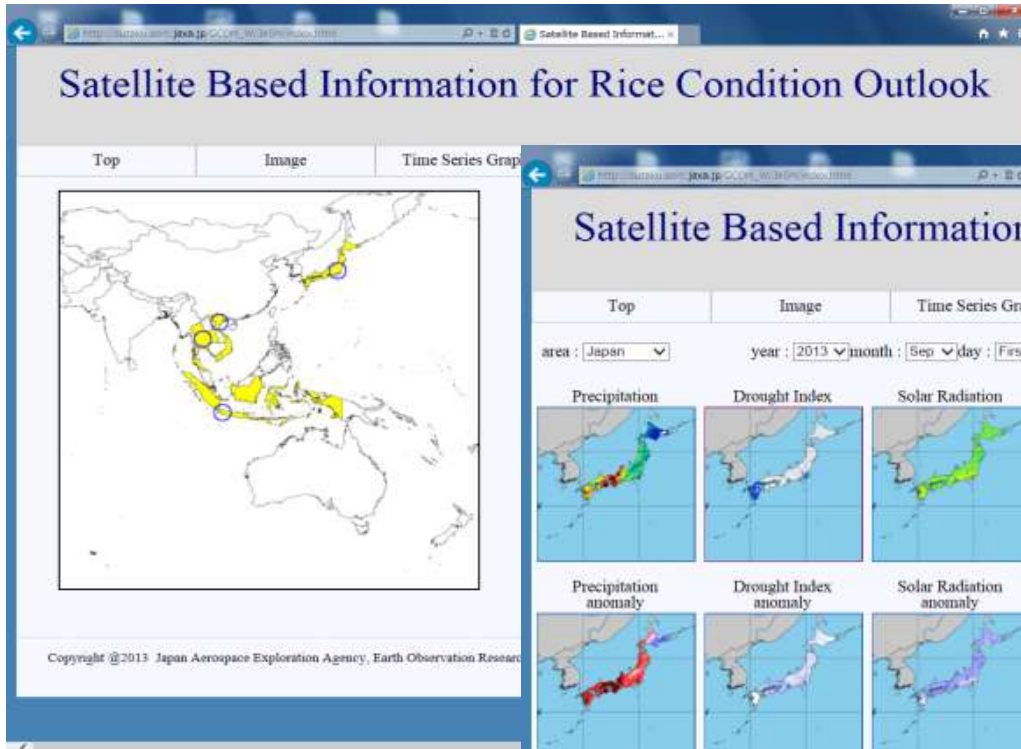
Assessment Source for Rice Growth Outlook

- ❖ Satellite observation provides “Current Condition” and “Anomaly” information and they are updated every 15 days (twice a month).

Parameters	Interval	Spatial Resolution	Data Period (anomaly calc.)	Satellite Data Source
Precipitation	Cumulative (15-day)	10 km	2002- (2002-2012)	GSMaP (GCOM-W1, TRMM, MTSAT etc.)
Solar Radiation	15-day Average	5 km	2007- (2007-2012)	MODIS
Land Surface Temperature	15-day Average	5 km	2002- (2002-2012)	MODIS
Soil Moisture	15-day Average	50 km	2009- (2002-2012)	AMSR-E, WINDSAT
Drought Index	15th /31[30]th day of month	10 km	2003- (2003-2012)	GSMaP, MTSAT
Vegetation Index	15th /31[30]th day of month	5 km	2002- (2009-2012)	MODIS

JASMIN - Data-distribution System for Rice Outlook

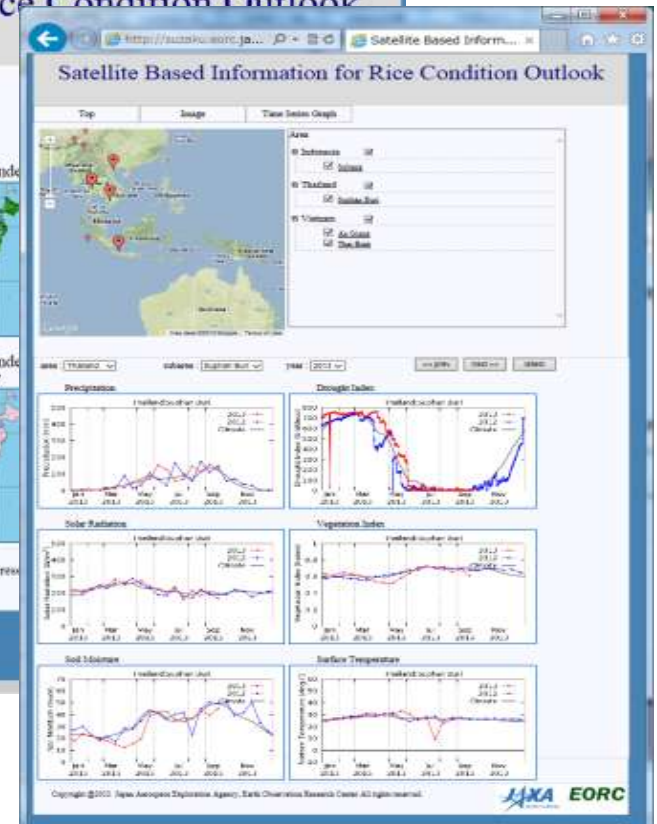
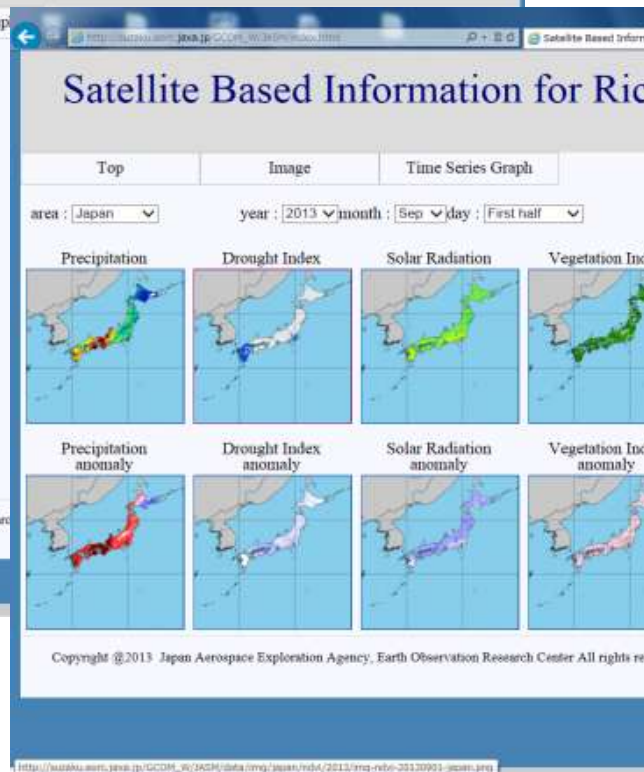
- ❖ Each data will be updated twice a month (15th, 31th day of month).
- ❖ Users can access and get latest data any time.



Top

Spatial Distribution

Time-Series

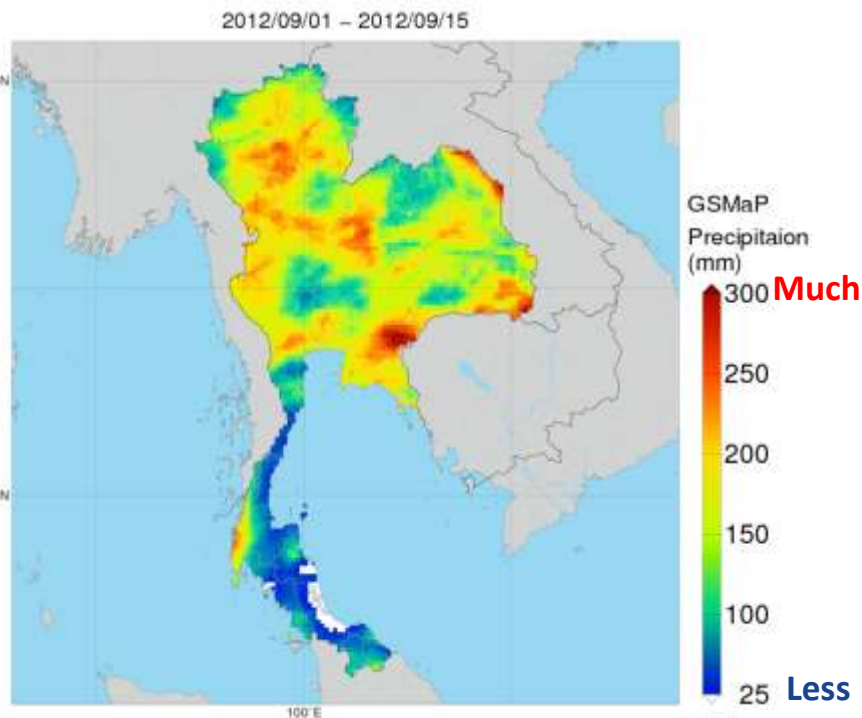


http://suzaku.eorc.jaxa.jp/GCOM_W/JASM/index.html

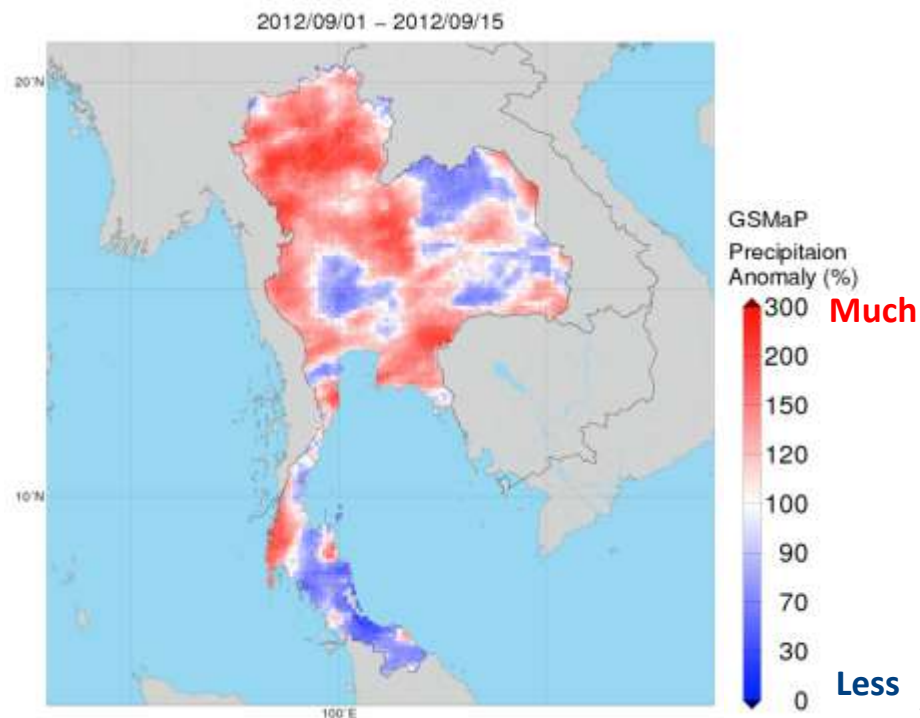
Precipitation

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

Current Condition



Anomaly



Data requirement for outlook

- ❖ Improve existing agro-met data
 - Precipitation, LST: GPM and new generation of geostationary weather satellites
 - PAR, LST, NDVI: NPP, Sentinel-2 and GCOM-C
 - Soil moisture, drought : SMOS, SMAP,
 - Flood and water related disaster: MODIS, AMSR-2, NPP, Sentinel-2 and GCOM-C as well as ScanSAR of SARs
- ❖ Adding countries for outlook to AMIS and ASEAN
 - Cambodia, LaoPDR, Philippine, Myanmar with Indonesia, Thailand, Vietnam
- ❖ Need collaborative work to apply agro-met information derived from satellites to outlook text through holding capacity building under institutional support since agro experts don't think they need those agro-met information for their outlook work



Asia-RiCE

Crop Estimation and Monitoring

APPENDIX – PHASE 1A REQUIREMENTS

Phase 1A Space Data Requirements

Optical

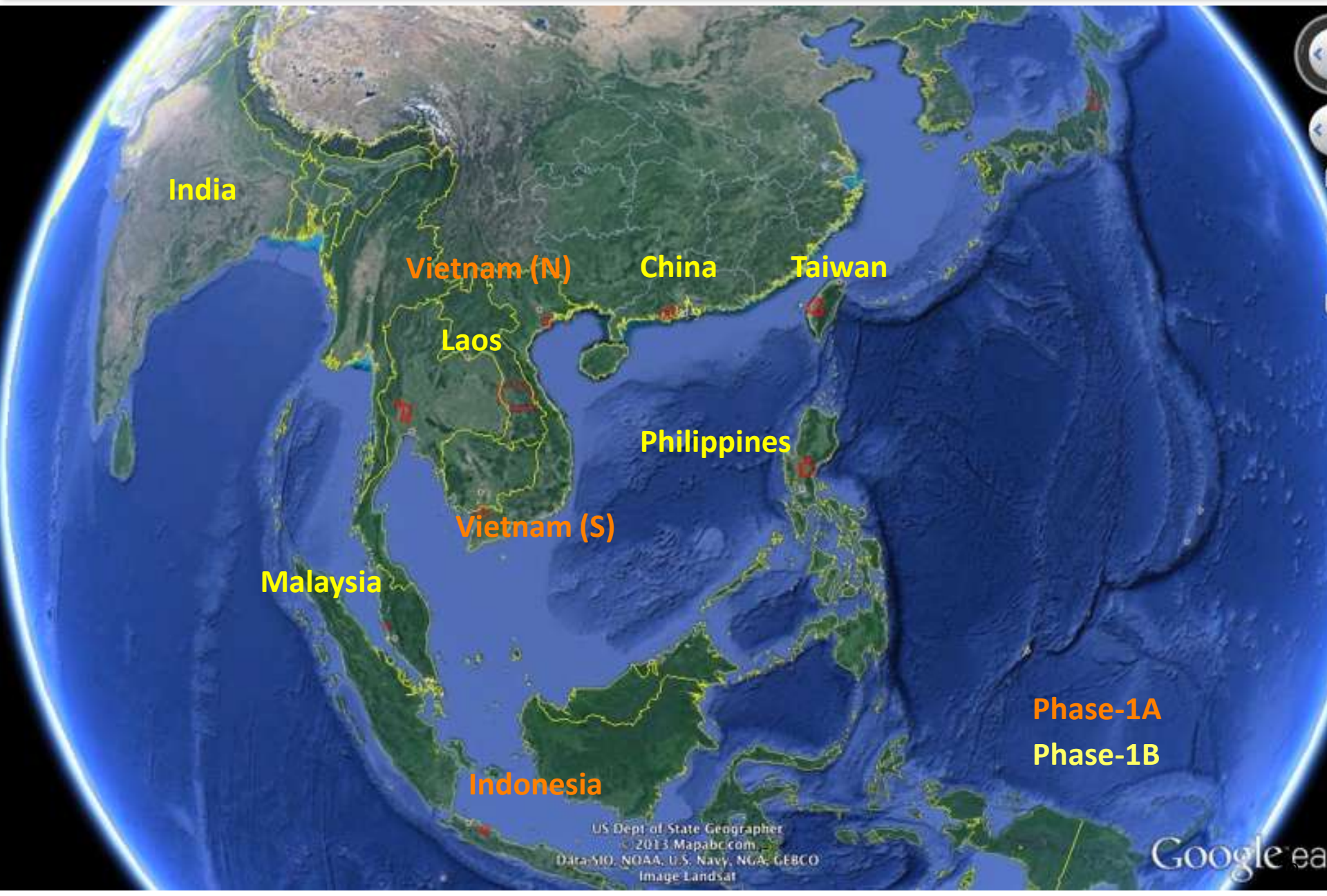
Type	Mission/Instrument/Agency	Product(s)
Optical >100m	Aqua / MODIS / NASA	P2, P4, P5
	SPOT / VGT / CNES	P2, P4, P5
	Terra / MODIS / NASA	P2, P4, P5
	Suomi NPP / VIIRS / NOAA	P2, P4, P5
Optical 10-30m	Landsat-7 / ETM+ / USGS, NASA	P2, P3, P5
	Landsat-8 / OLI / USGS, NASA	P2, P3, P5
	THEOS / MS, PAN / GISTDA	P2, P3, P5
Optical <10m	ALOS / AVNIR-2 / JAXA	P2, P3, P5
	SPOT-5/6 / HRG, HRS / CNES	P2, P3, P5

Phase 1A Space Data Requirements

SAR

Type	Mission/Instrument/Agency	Product(s)
C-Band SAR	Envisat / ASAR / ESA	P1, P2, P3, P5
	RADARSAT / SAR (RADARSAT) / CSA	P1, P2, P3, P5
	RADARSAT-2 / SAR (RADARSAT-2) / CSA	P1, P2, P3, P5
	RISAT-1 / SAR (RISAT) / ISRO	P1, P2, P3, P5
	Sentinel-1 / C-Band SAR / ESA	P1, P2, P3, P4, P5
L-Band SAR	ALOS / PALSAR / JAXA	P1, P2, P3, P4, P5
	ALOS-2* / PALSAR-2 / JAXA	P1, P2, P3, P4, P5
X-Band SAR	COSMO-SkyMed / SAR 2000 / ASI	P3, P5
	TerraSAR-X / X-Band SAR / DLR	P3, P5

Technical Demonstrator Sites (TDS) for Asia-RiCE



Phase 1A: Indonesia

Indonesia – Subang, West Java Island

Aim: To develop and use the rice crop yield estimation model (with a focus on Western Java Island) to provide comprehensive and accurate information to the BPS and Ministry of Agriculture.

Responsible Agency: Indonesian National Institute of Aeronautics and Space (LAPAN).

Technical/Implementation Agency:

LAPAN, Indonesian Center for Agricultural Land Resources Research and Development (ICALRD), Indonesian Agency of Agricultural Research and Development (IAARD), Ministry of Agriculture (MoA) of Republic of Indonesia, Bogor Agricultural Institute (IPB)

Links to Existing Agricultural Authorities: Ministry of Agriculture (MoA).



Subang Region, West Java Island.

Bounding Box	Coordinates
Top-left	-6.22,107.56
Bottom-right	-6.45,108.21

Phase 1A: Thailand

Thailand – Suphan Buri Province

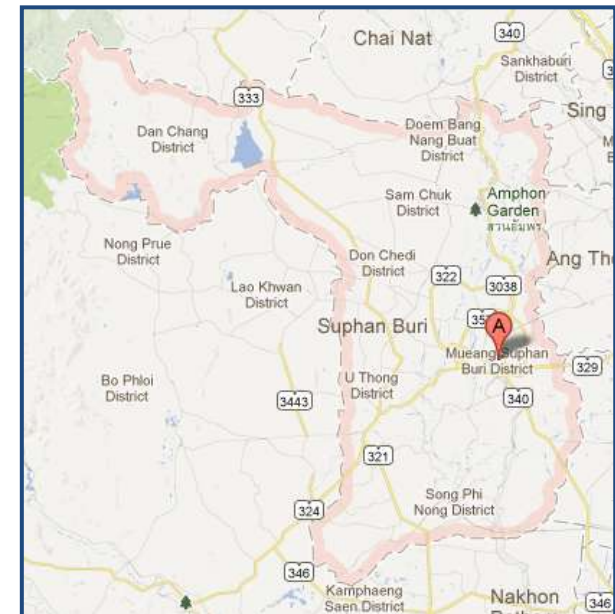
Aim: To produce a rice crop area and yield prediction algorithm.

Responsible Agency: Office of Agricultural Economics (OAE), Rice Department (RD).

Technical/Implementation Agency: Office of Agricultural Economics (OAE), GISTDA.

Links to Existing Agricultural Authorities: Ministry for Agricultural and Cooperatives (MOAC).

Bounding Box	Coordinates
Top-left	15.117204,99.247284
Bottom-right	14.016691,100.323944



Suphan Buri Province.

Phase 1A: Vietnam (North) – Thai Binh

Vietnam – Thai Binh (North)

Aim: To improve the accuracy of rice mapping and to refine yield estimation models.

Responsible Agency: Centre for Informatics and Statistics (CIS),
Ministry of Agriculture and Rural Development (MARD)

Technical/Implementation Agency: Vietnam Academy of Science
and Technology (VAST), Space Technology Institute (STI), GIC

Links to Existing Agricultural Authorities: NIAP, Agriculture and
Rural Development Department of Thai Binh Province



Thai Binh Region

Bounding Box	Coordinates
Top-left	20.753546,106.060638
Bottom-right	20.242871,106.648407

Phase 1A: Vietnam (South) – An Giang

Vietnam – An Giang (South)

Aim: To produce more accurate and reliable remote sensing methods for operational rice crop monitoring. More accurate rice area and rice production estimates are desired to supplement current in-situ measurements to support agricultural managers and planners at local to national level to enhance rice monitoring capability and yield forecast accuracy.

Responsible and Technical/Implementation Agency:
Vietnam Academy of Science and Technology (VAST), Ho Chi Minh Institute of Resources Geography (HCMIRG).

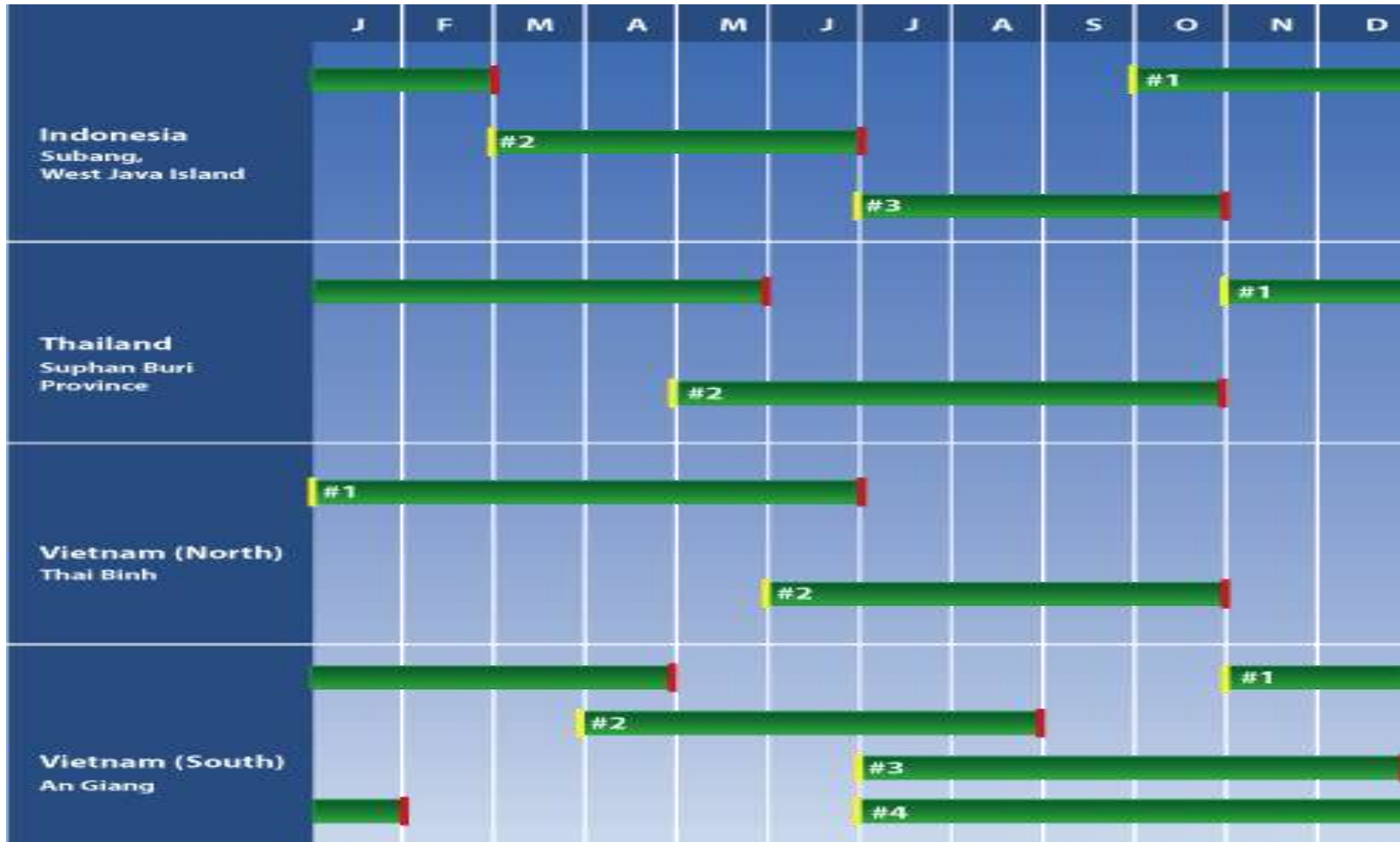
Links to Existing Agricultural Authorities: Ministry of Agriculture and Rural Development (MARD), Center for Informatics and Statistics (CIS), Department of Agriculture and Rural Development (DARD) in An Giang Province.



An Giang Region

Bounding Box	Coordinates
Top-left	10.979828,104.744308
Bottom-right	10.090181,105.670933

Phase 1A Crop Calendars

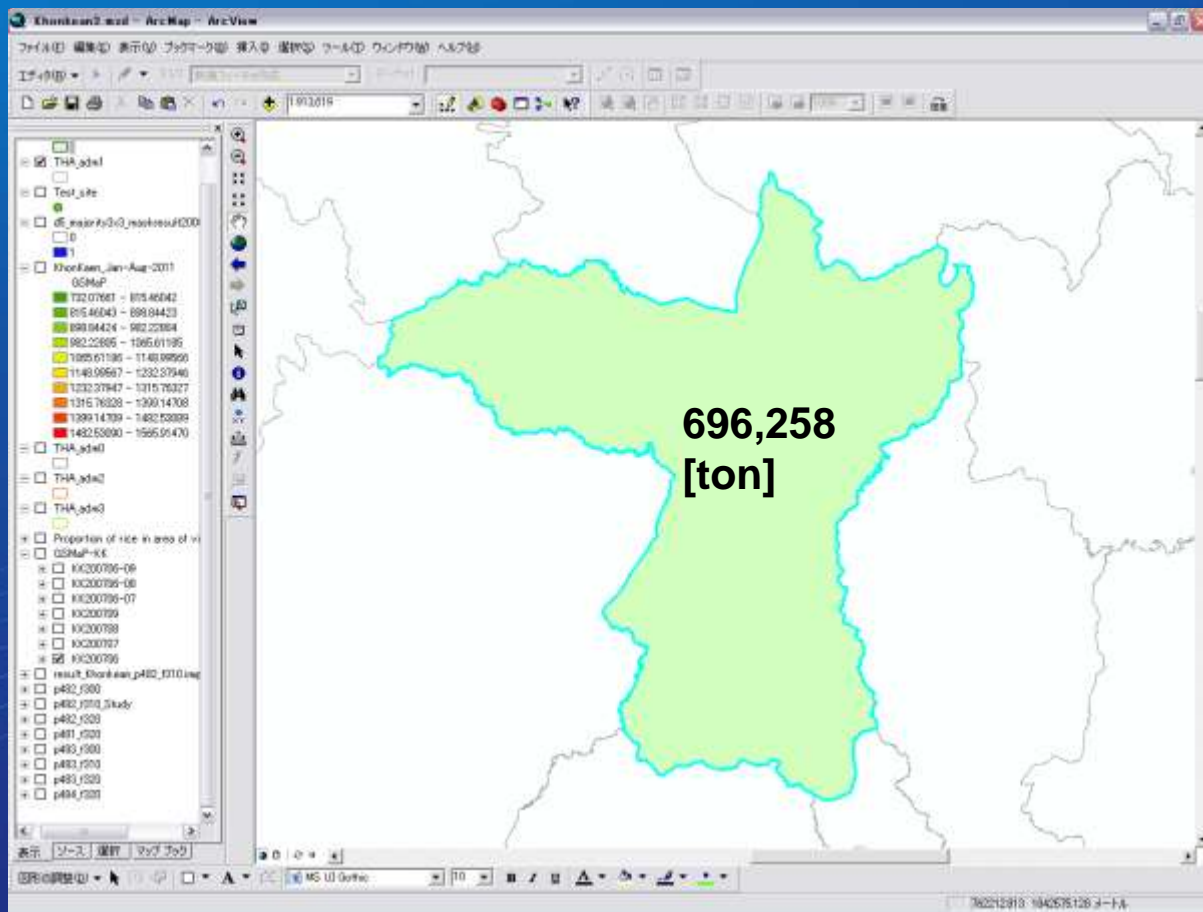


Indonesia (Subang, West Java Island);
Thailand (Suphan Buri province);
Vietnam (Thai Binh (North)), (An Giang (South));

APPENDIX – PHASE 1A COUNTRIES



Rice crop production estimation



Acreage

*

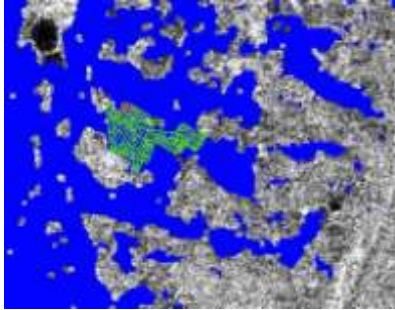
Yield



Production



Validation

	Acreage [m ²]	Yield [g/m ²]	Production [ton]
Result of estimation		Statistic Information*	Acreage x Yield
	164,405.99	203.96	33.53
Validation data by field survey	166,766.39	2.47 – 750.08	40.96
Accuracy	98.58%	–	81.87%

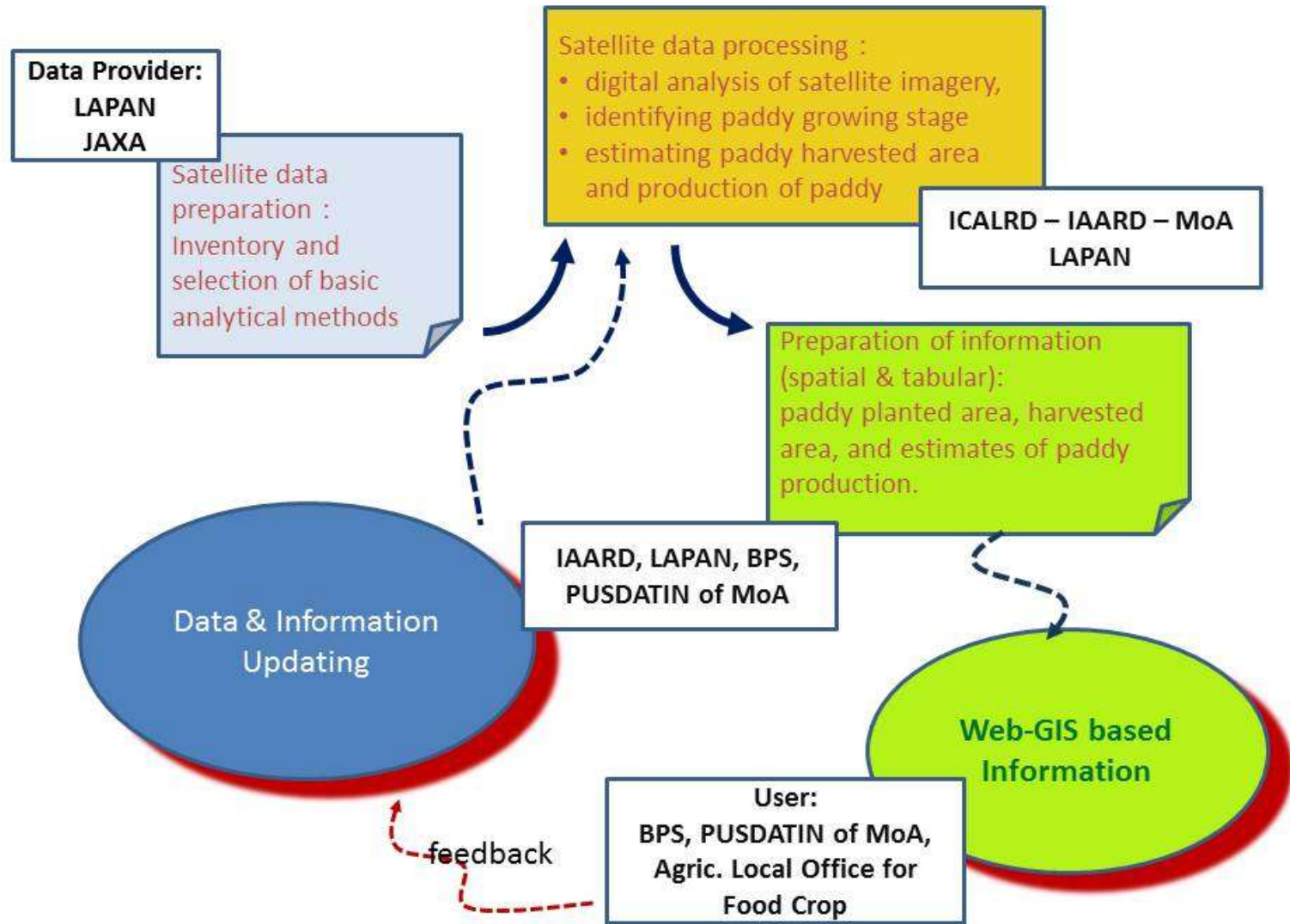
*Statistic information : Average of the past five years.

- Estimating acreage is good.
- Estimating production depends on yield by statistic information.

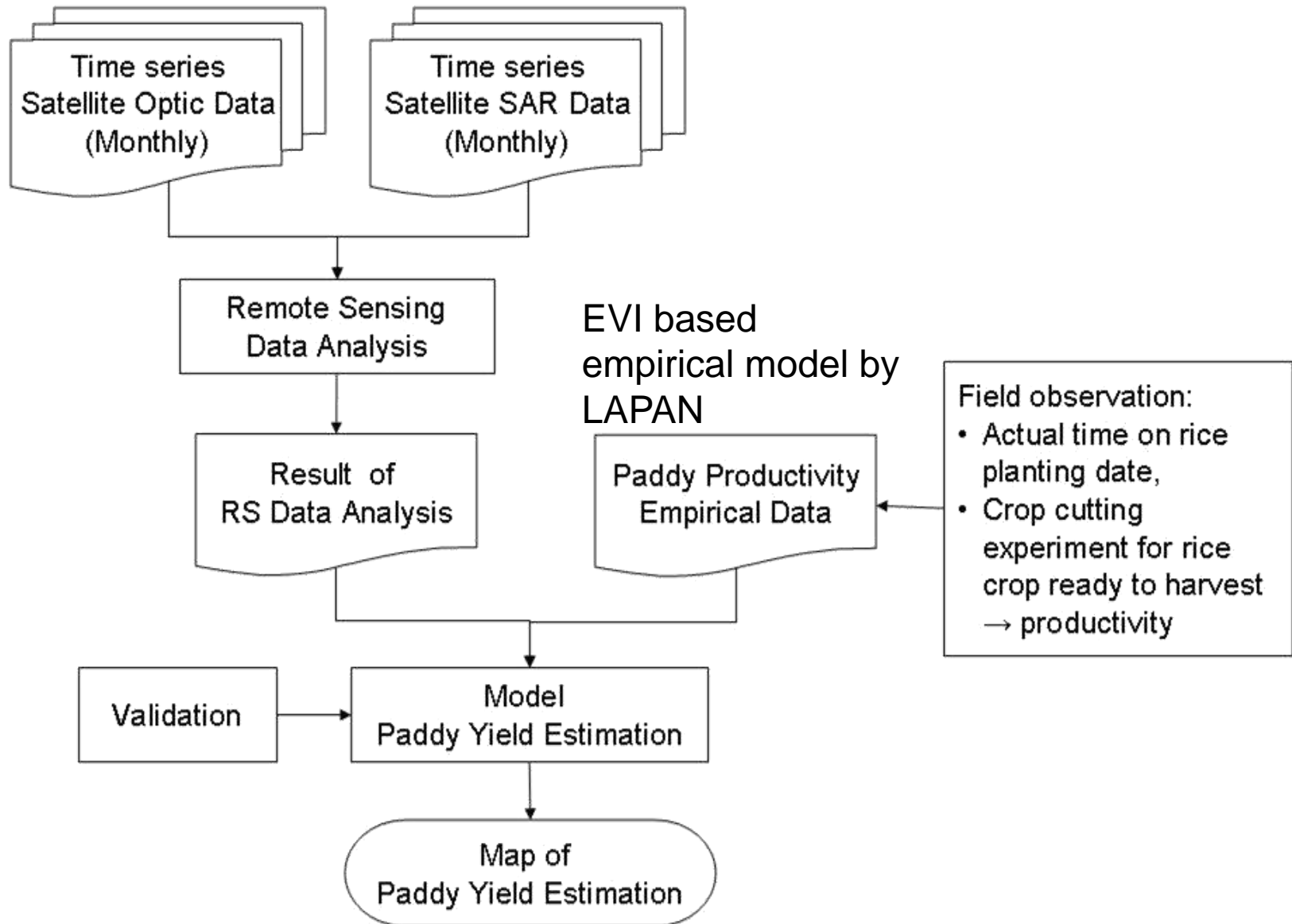
Indonesia TDS - framework of operational use after this prototyping

Engagement between space organization, Ministry of Agriculture, university and statistic office with successful prototyping to proof of concept

Framework of operational use after this prototyping



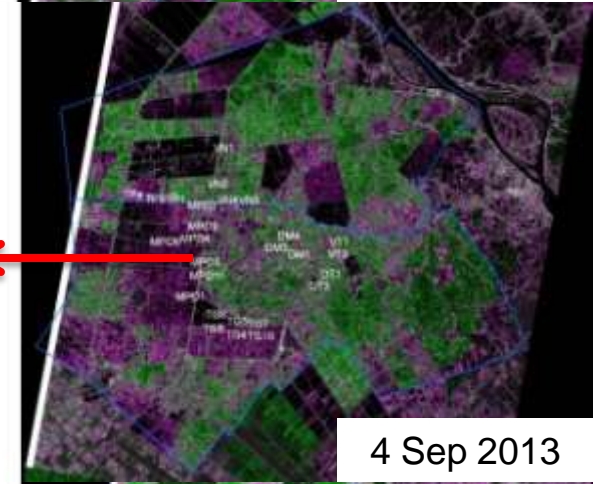
Indonesia TDS - Methodology and Data Used



South Vietnam TDS



Sample rice field MPD3 sown on 17 Aug 2013



Cosmo SkyMed data:
StripMap Pingpong: HHVV
10 dates (19 Aug – 23 Nov)

An Giang (Thoai Son &
Chau Thanh districts):
40 samples in red.

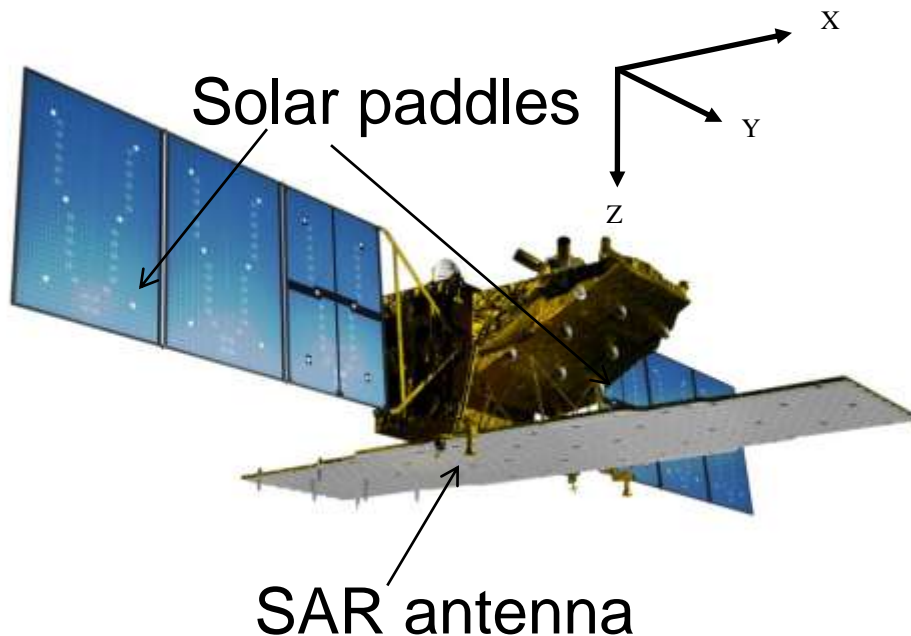


APPENDIX – JAXA'S NEW MISSION FOR GEO GLAM

ALOS-2 Specifications

ALOS-2 satellite

- **Launch** : 2014
- Orbit type : Sun-synchronous
- Altitude : 628 km +/- 500 m (for reference orbit)
- Revisit time : 14 days
- LSDN : 12:00 +/- 15 min



ALOS-2

PALSAR-2

- L-band Synthetic Aperture Radar
- Active Phased Array Antenna type
- two dimensions scan (range and azimuth)
- Antenna size : 3m(EI) x 10m(Az)
- Bandwidth : 14 – 84MHz
- Peak transmit Power : 5100W
- Observation swath : 25 – 490km
- Resolution : Range: 3 m to 100 m
Azimuth: 1 m to 100 m

Observation pattern for annual acquisitions*

Season	N:Winter/S:Summer				N:Spring/S:Autum				N:Summer/S:Winter				N:Autum/S:Spring													
Week of year	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50	51-52
Desc	D+W+F		Arctic	D+W+F	14-day InSAR	D+W+F	14-day InSAR	D+W+F	14-day InSAR	D+W+F	Arctic	D+W+F	Glacier Antarctica	D+W+F	Glac. Antarc	Arctic	D+W+F	Global (1/3)	D+W+F	Global (1/3)						
	WB 350km		WB490	WB 350km	DP(5) 10m	DP(5) 10m	WB 350km	DP(6) 10m	DP(6) 10m	WB 350km	DP(7) 10m	DP(7) 10m	WB 350km	WB490	WB 350km	DP(6)L 10m	DP(6)L 10m	WB 350km	DP(6)L 10m	WB490	WB 350km	SP(6) 3m	SP(7) 3m	WB 350km	SP(8) 3m	SP(9) 3m
Asc	North Pole	World 1			Glacier Greenland	Global (1/5)					World 2			South Pole	N + S Pole	World 1					World 2			N + S Pole		
	WB350	DP(7) 10m	DP(6) 10m	DP(5) 10m	DP(6) 10m	DP(6) 6m	QP(5) 6m	QP(4) 6m	QP(3) 6m	QP(7) 6m		DP(7) 10m	DP(5) 10m	DP(6) 10m	WB350	DP(7) 10m	DP(5) 10m	DP(6) 10m			DP(7) 10m	DP(5) 10m	DP(6) 10m	WB350	WB350L	



10m(HH+HV)28MHz Right



ScanSAR350km(HH+HV)14MHz Right



3m(HH)84MHz Right



ScanSAR350km(HH+HV)14MHz Left



6m(HH+HV+VH+VV)42MHz Right



ScanSAR490km(HH+HV)14MHz Right

(*) *Beam No.



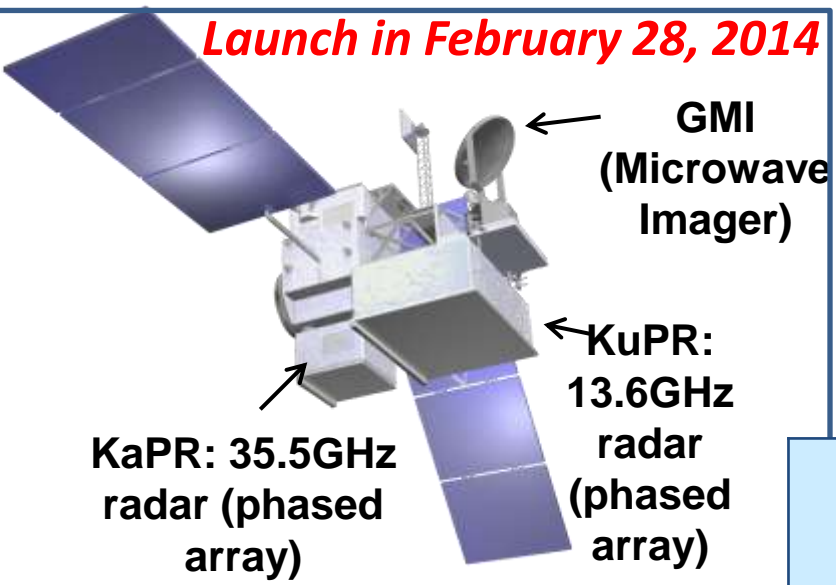
10m(HH+HV)28MHz Left

Super sites (TBD)

* 3m SP and 6m QP modes require 3 and 5 years for global coverage

Global Precipitation Measurement

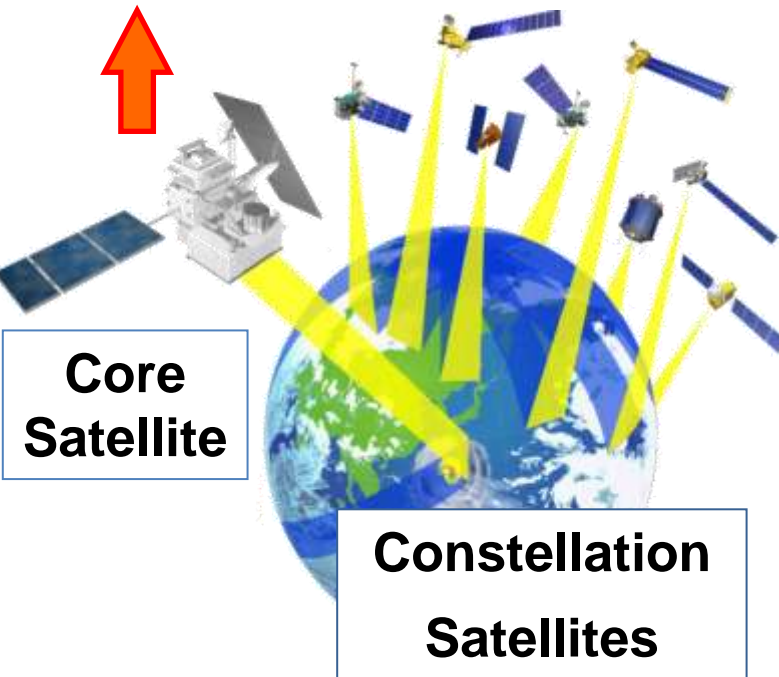
(GPM)



Core Satellite (JAXA, NASA)

- **Dual-frequency Precipitation Radar (DPR)**
- **GPM Microwave Imager (GMI)**

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



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