Asia Rice crop team activity for GEO GLAM To improve food security information using Earth observation at national/regional/global scale

Shin-ichi Sobue

Remote Sensing Technology Center of Japan
On behalf of Asia rice crop team

22 July, 2014

GEOGLAM
Global Agricultural Monitoring

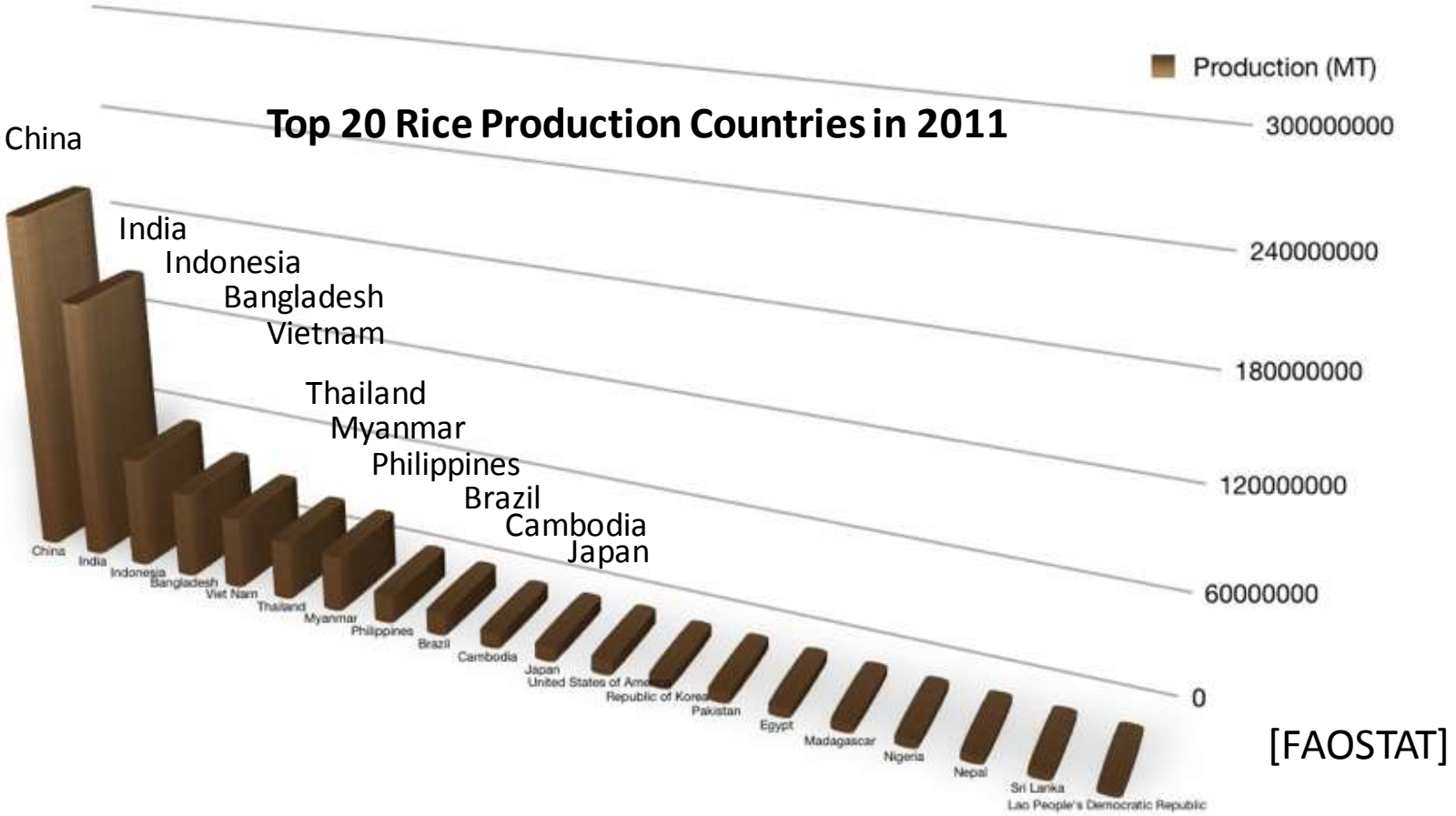
Asia-RiCE
Crop Estimation and Monitoring

Agenda

- Background of Asia rice crop team (AsiaRiCE)
- AsiaRiCE products – rice crop area estimation
- Phase 1 activity with early results of phase 1A using R2
- Overview of ADB project
- AsiaRiCE products – outlook
- Way forward

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.

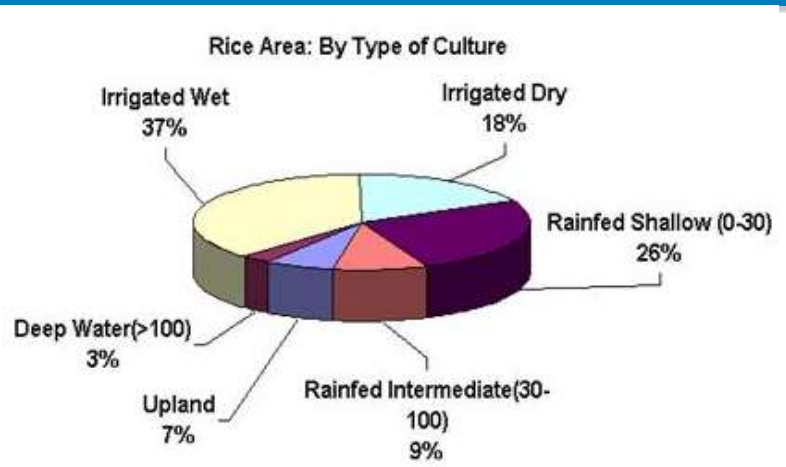


[FAOSTAT]

Rice related statics or information are imperative for decision making.

Special Characteristics of Asian Rice Crop Growing Regions

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



Regional Cooperation for rice crop monitoring using space technology in Asia

http://www.asia-rice.org

Regional Cooperation for rice crop

http://www.asia-rice.org

Multiple source data integration for agriculture

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

Satellites/Sensors

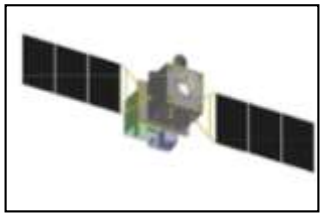
SAR

Microwave Radiometer

Precipitation Radar

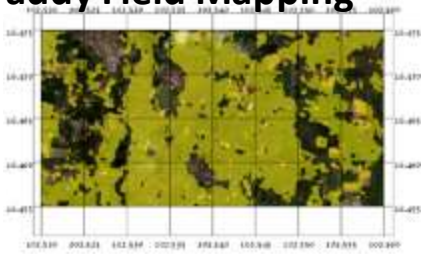
Optical Sensor (Global Imager)

Optical Sensor (High Res.)

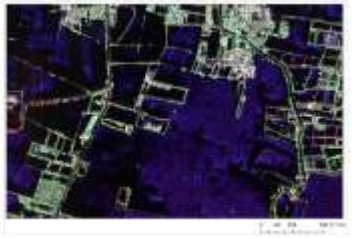


Products from satellite data

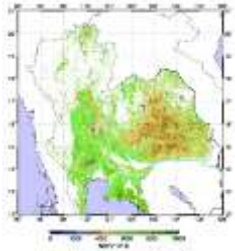
Paddy Field Mapping



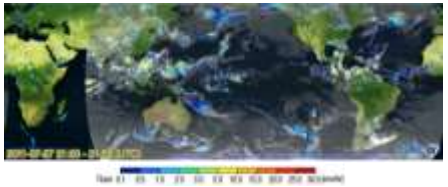
Flood Monitoring



Crop Growth



Agro-meteorological Monitoring



Topography

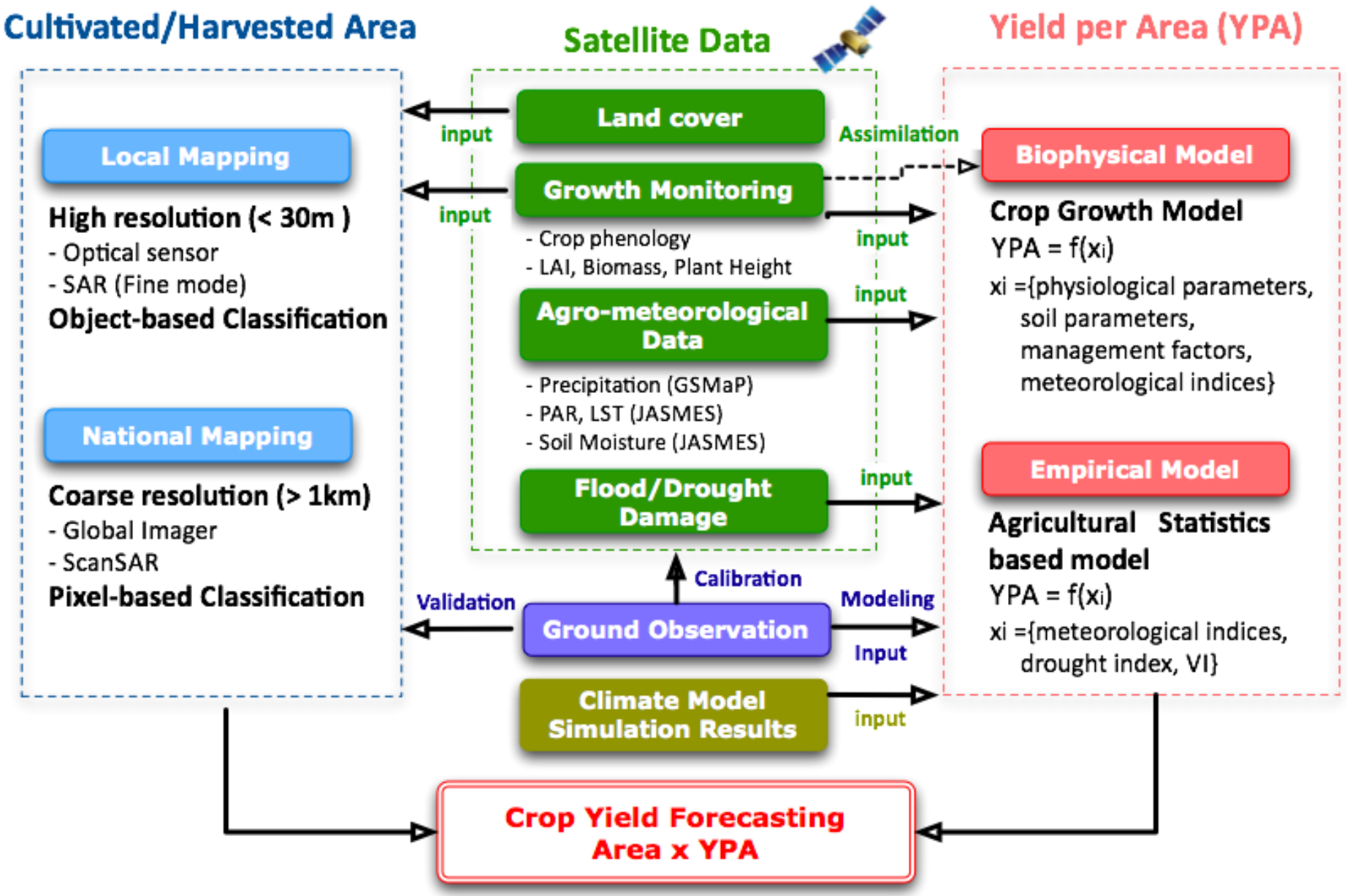
Agricultural Applications

- Agricultural Stat
- Early Warning
- Damage Assessment
- Land Resource Management

Asia-RiCE products – rice corp area estimation

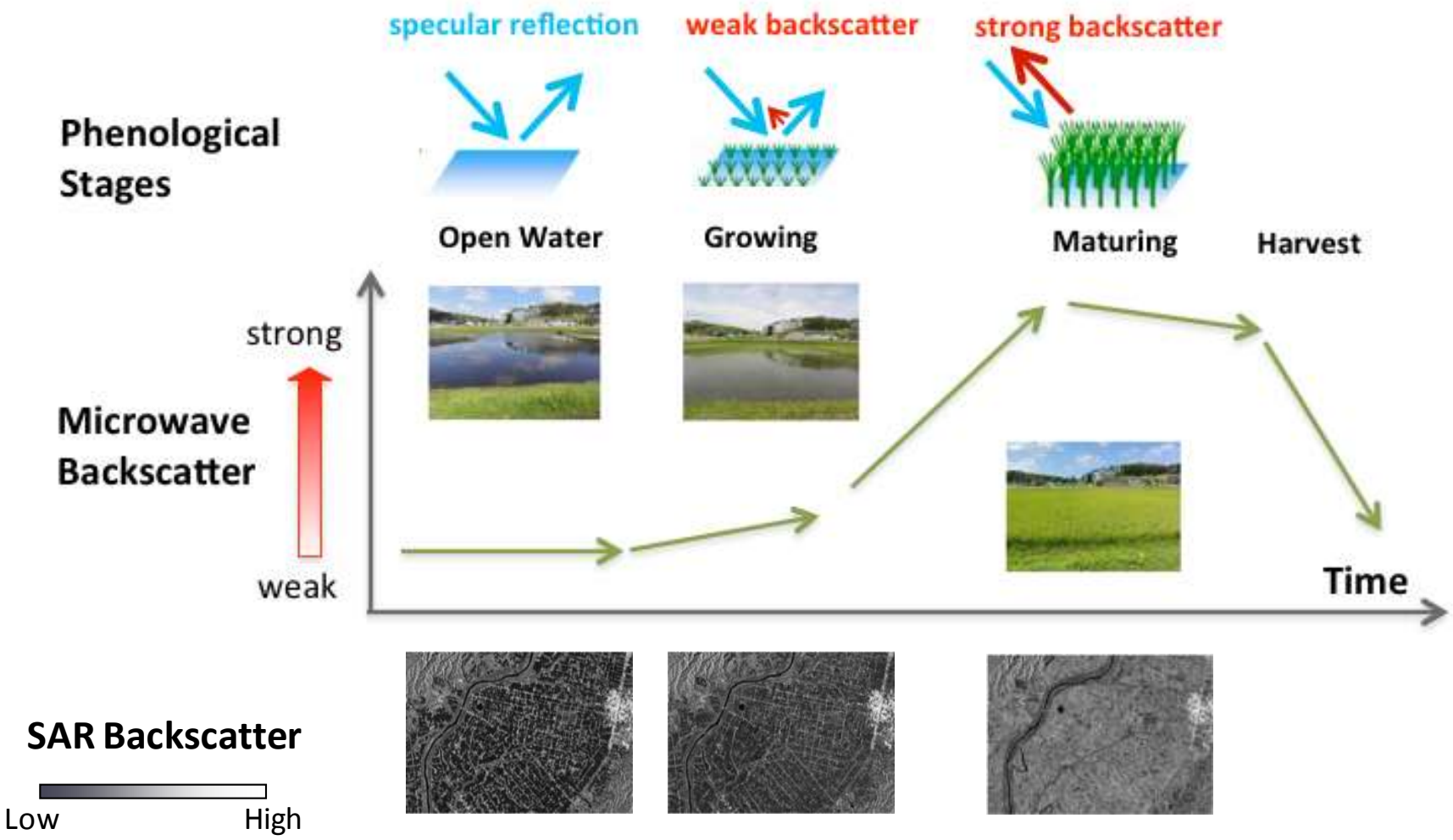
ID	Target Agricultural Products
P1	**Rice Crop Area Estimates/Maps**
P2	**Crop Calendars/Crop Growth Status**
P3	**Crop Damage Assessment**
P4	**Agro-meteorological Information Products**
P5	**Production Estimation (and Forecasting)**

Framework for Crop Yield Estimation



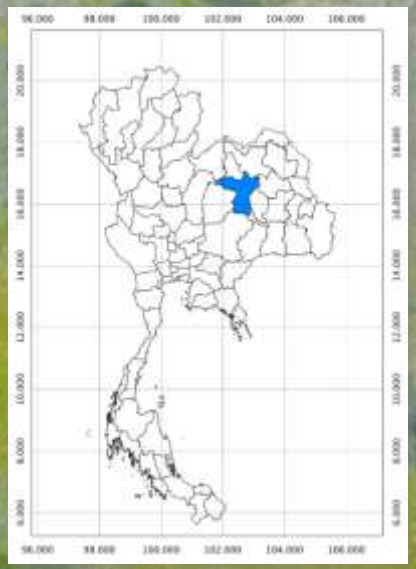
Seasonal Backscatter Characteristics of Paddy Field

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

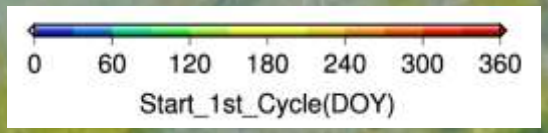


Comparison with in-situ Measurement

Khon Kaen, Thailand, 2011

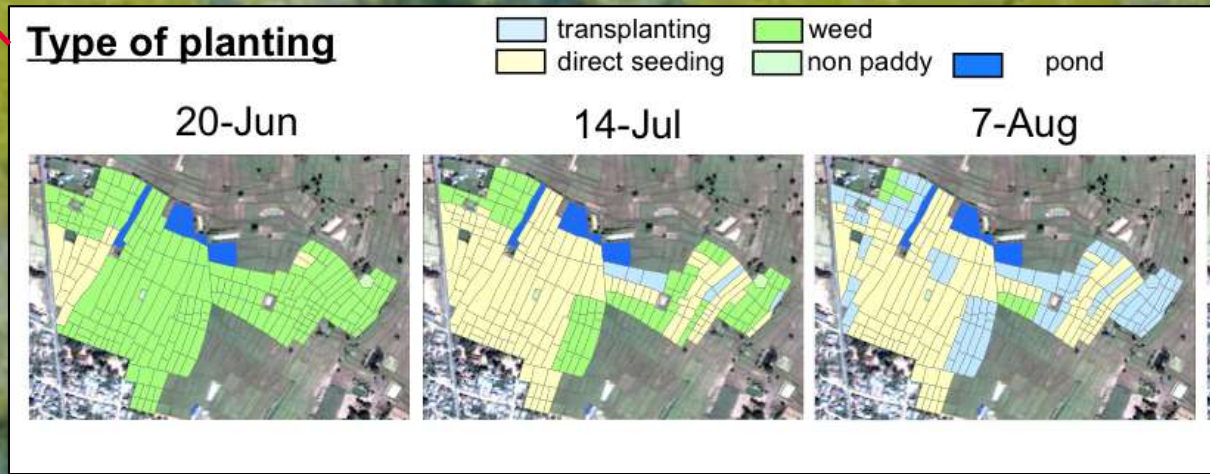


Satellite Measurements
DOY = 180-190

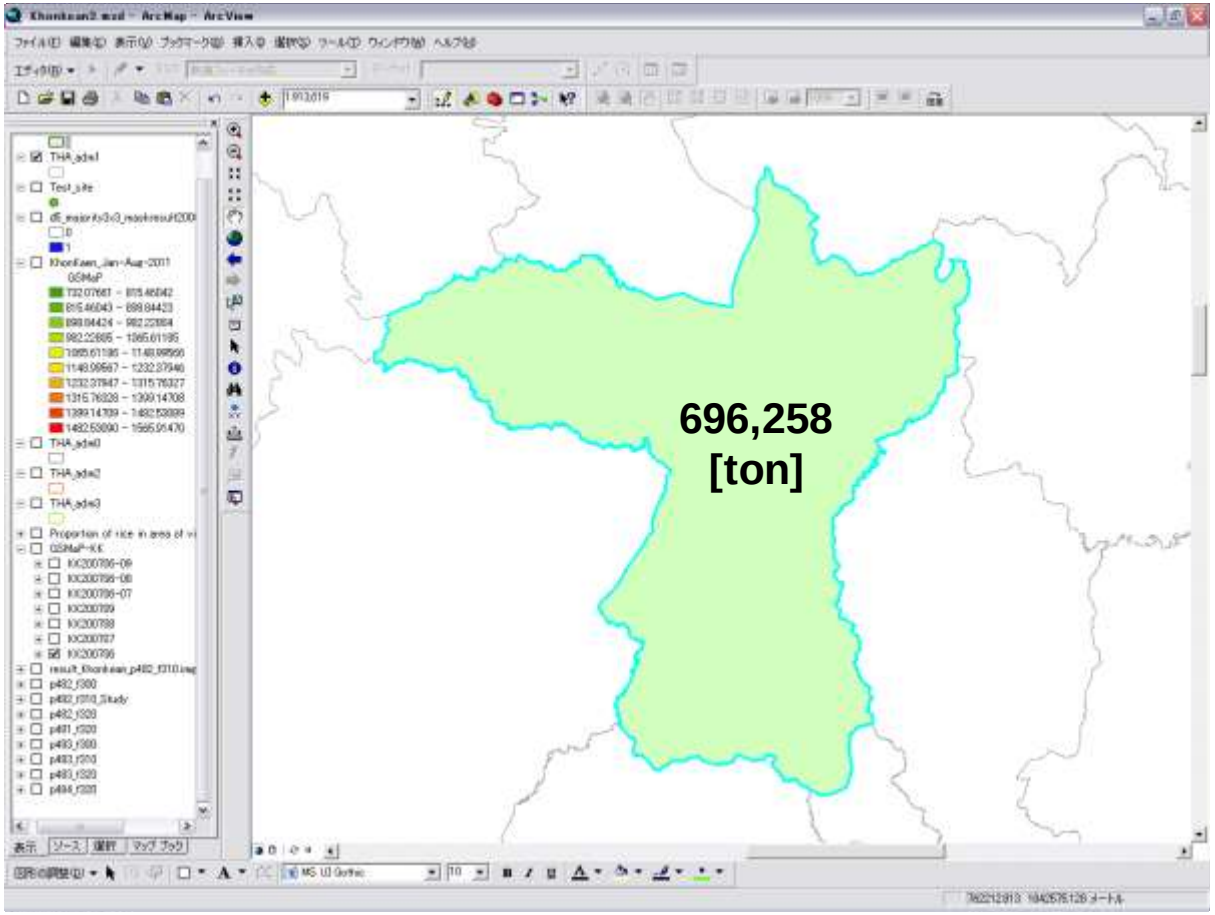


in-situ measurements

- Planting date was during 20th Jun to 7th Aug.
  (DOY: 171-219)



Procedure of rice crop yield estimation by acreage and yield per unit by JAXA and GISTDA&OAE, Thailand



Acreage

*

Yield per unit

Production

12

Scope of Phase 1

Proof of concept and promote the usefulness of EO, especially SAR to rice crop monitoring in provincial level to expand national / regional level

- Phase 1A of Asia-RiCE will consist of four technical demonstration sites in three countries from 6/2013
- 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 (100m res.) and other data.

Asia-RiCE Technical Demonstration Sites

SAR Technology Application for Paddy Crop Monitoring in Center of Paddy Area, in Indonesia

Indonesian Agency for Agricultural Research and Development
Indonesian Center for Agricultural Land Resources Research and Development

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.

Subang Region, West Java Island.

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)

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

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

Phase 1A: Indonesia

Rice Cultivation in Indonesia

Indonesia	Type of rice	Status	Months											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average from 33 Provinces	Wet season	Seeding	1	2	3							10	11	12
		Harvesting	10	11	12	1	2	3						
	Dry season	Seeding				4	5	6	7	8	9			
		Harvesting							4	5	6	7	8	9

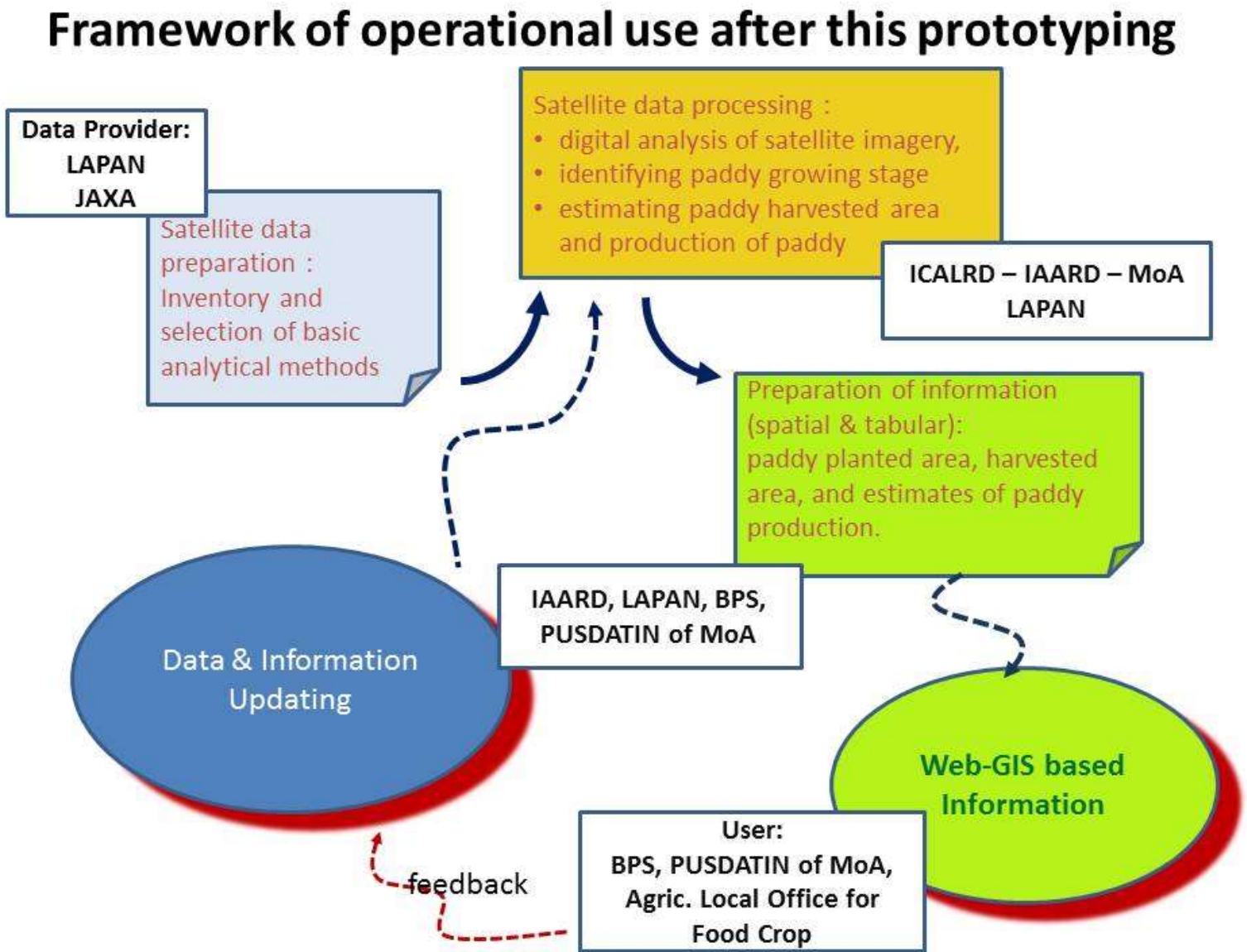
Note:	
Seeding	
Harvesting	

Note :

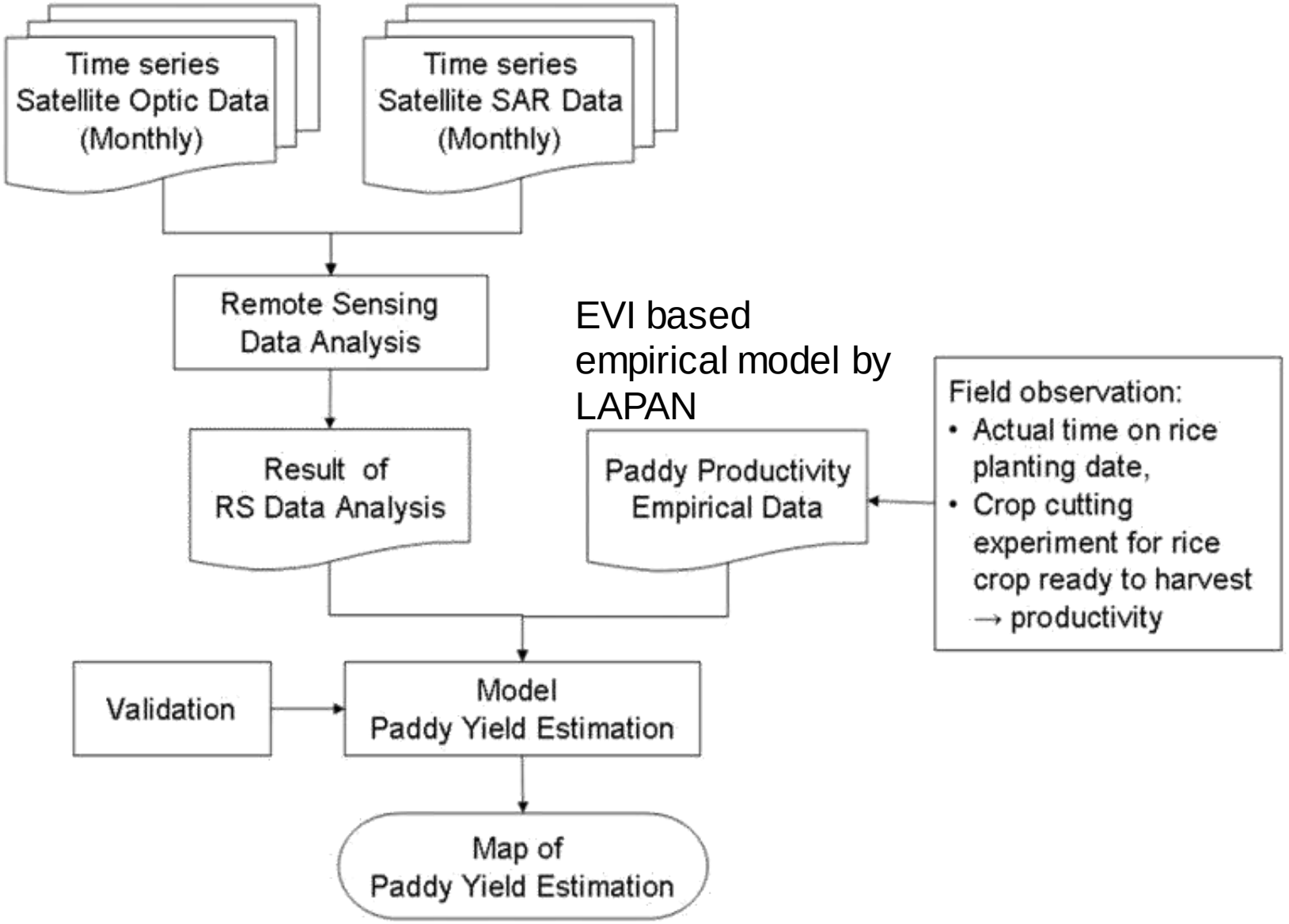
Indonesia have 2 type of season: Wet land (October to March) and dry (April to September) but now tends to shift from the time range.
The habits of most Indonesian farmers are planting when water is available so there is no firm timetable at planting and harvest time, that is mean that planted and harvesting are available every month

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



Indonesia TDS - Methodology and Data Used

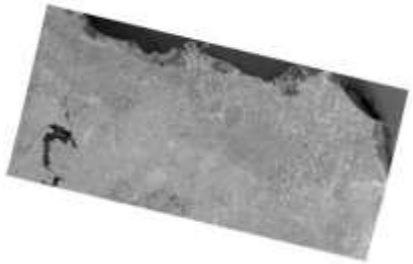


Subang-Indoramayu, Indonesia

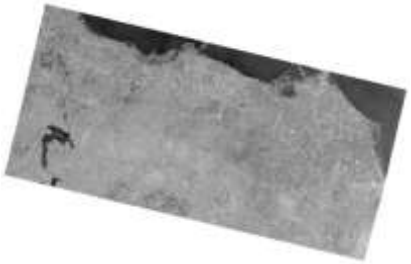
RADARSAT-2 Data List

Descending	Ascending
23-Aug-13	
3-Nov-13	
27-Nov-13	1-Dec-13
21-Dec-13	25-Dec-13
14-Jan-14	18-Jan-14
7-Feb-14	11-Feb-14
27-Mar-14	31-Mar-14
20-Apr-14	24-Apr-14
14-May-14	18-May-14
7-Jun-14	11-Jun-14
1-Jul-14	27-Jun-14

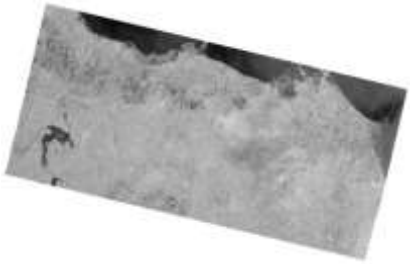
Time series images (VV,Descending)



2013-AUG-23



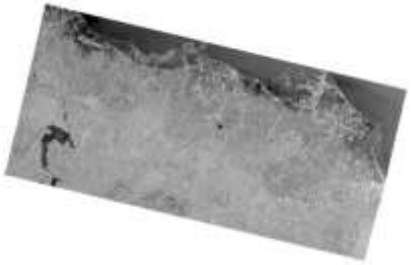
2013-NOV-3



2013-NOV-27

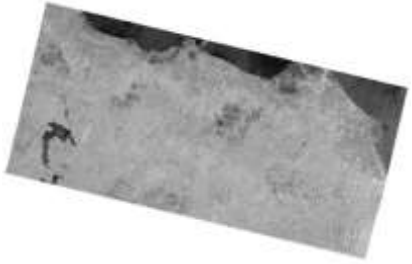
2013-DES-21

2014-JAN-14

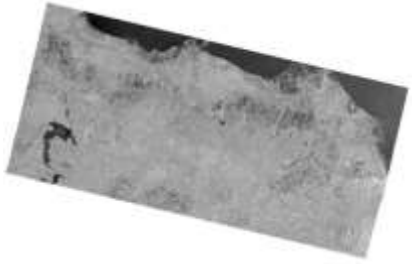


2014-FEB-7

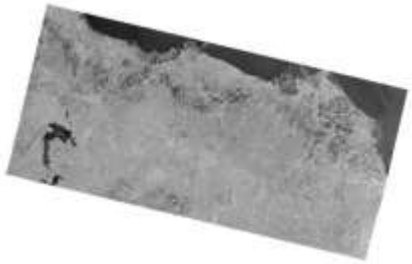
2014-MAR-27



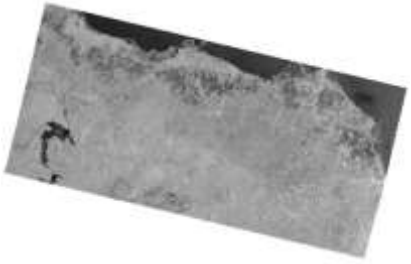
2014-APR-20



2014-MAY-14

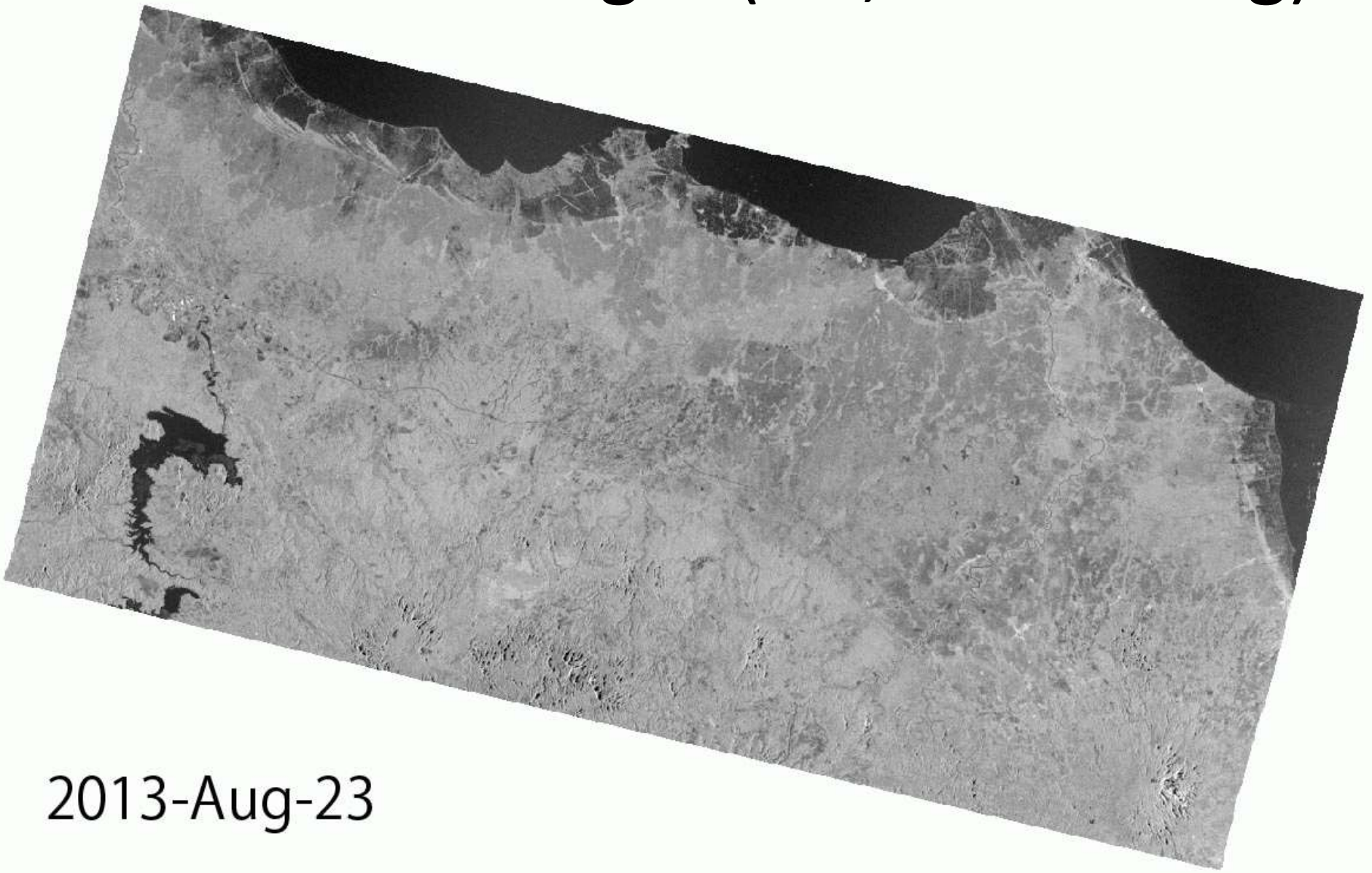


2014-JUN-7



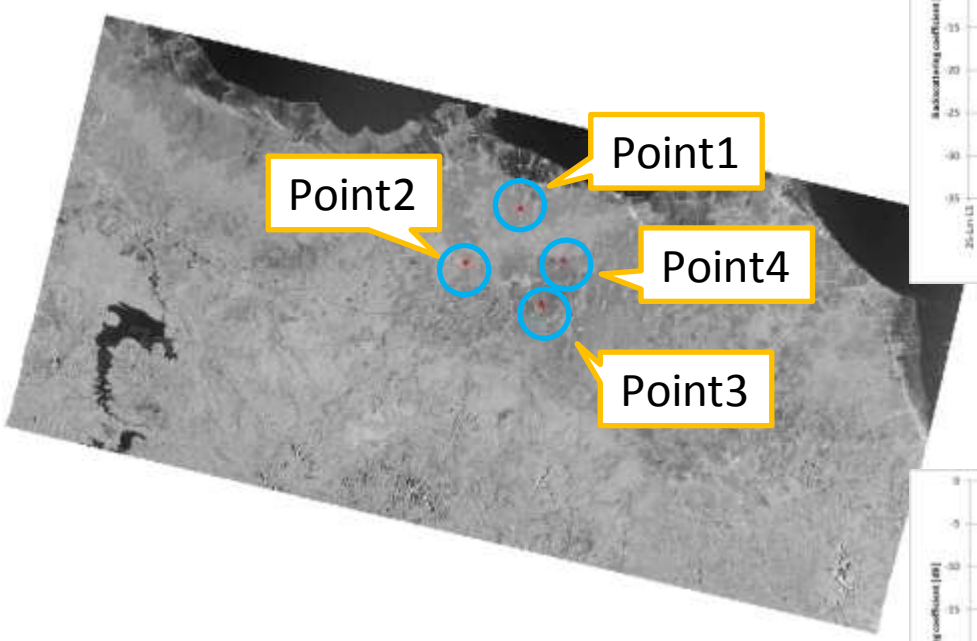
2014-JUL-1

Time series images (VH,Descending)

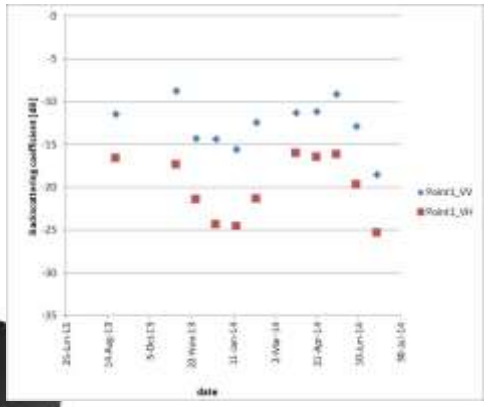


2013-Aug-23

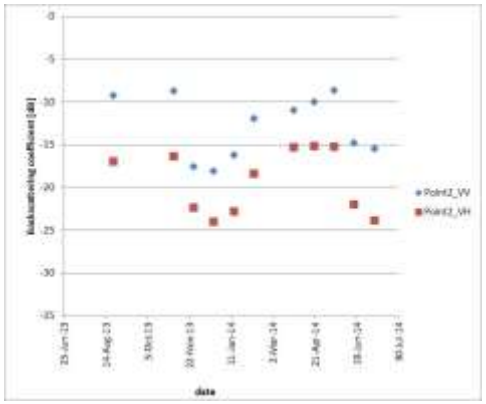
Time series variation of Backscatter



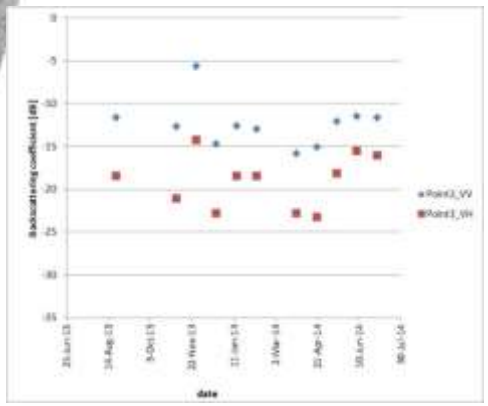
Point1



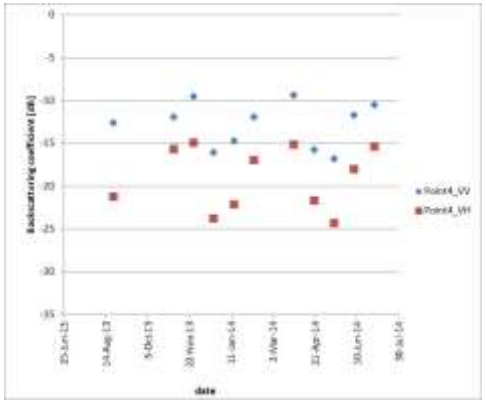
Point2



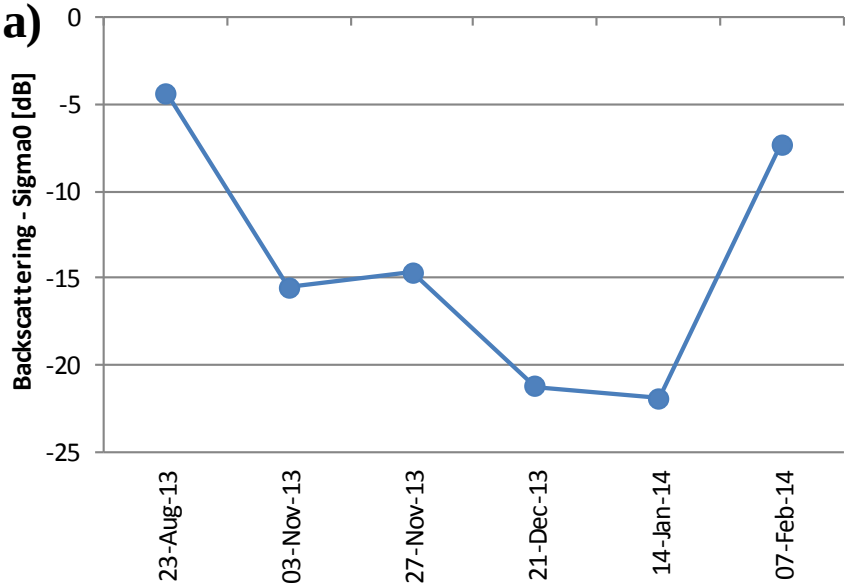
Point3



Point4

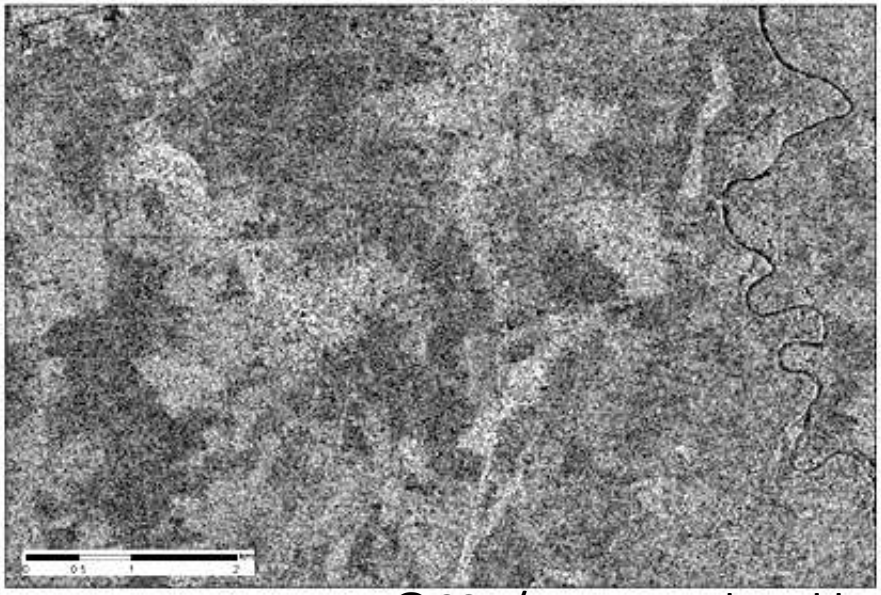


Phase 1A TDS in Indonesia (Observation Area)

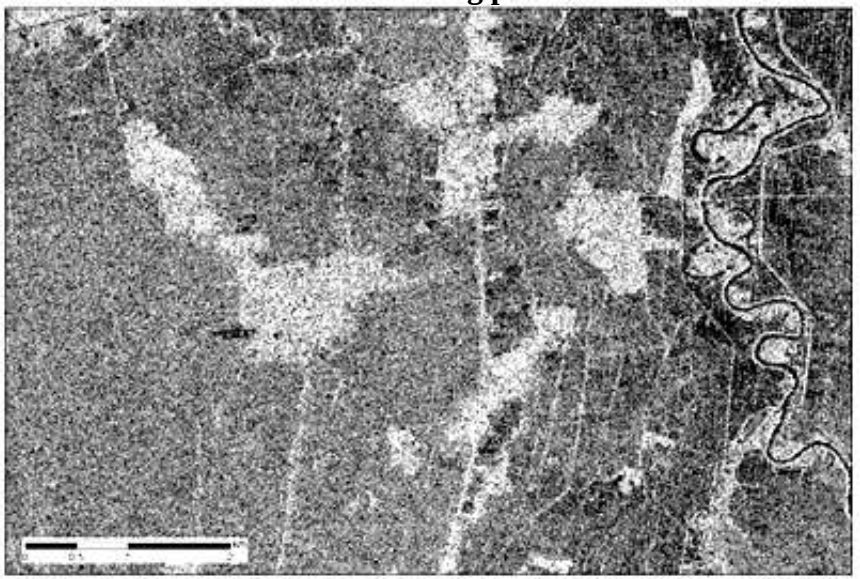


Backscattering change during rice growthing

R2 data - Planting phase: 03-Nov-2013



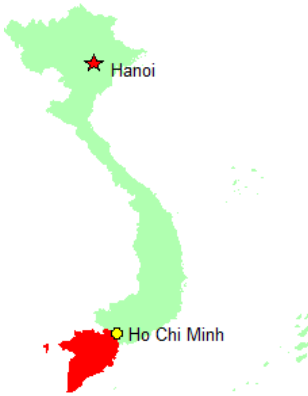
R2 data - Harvesting phase:07-Feb-2014



Rice mapping using Radarsat-2 data
First result

Thuy Toan, Lam Dao Nguyen, Kei Oyoshi and Shin-ichi Sobue

The Mekong Delta, Vietnam



An Giang Province
Asia-Rice technical Demonstrator Site

- 13 provinces and city;
- Population: 17.3 M (20% or 1/5 of VN);
- Area: 40,500 Km^2 (12% or 1/8 of VN)
- Rice production: 23.2 Mton (> 50% or ½ of VN)

Source: GSO, 2011

RADARSAT data over An Giang

- **General objective**: to assess the use of C-band SAR data for
  - Mapping and statistics of rice grown area of the 3 rice seasons
  - Retrieval of rice parameters for rice yield models

- **Methodological objective**
  - To determine the optimum number and dates of SAR data
  - To assess the joint use of ascending and descending mode
  - To assess inter-operability of RASARSAT and Sentinel-1

- **Radarsat-2 data required**
  - Beam Mode: F0W2 (Fine Wide, 150 km x 150 km)
    Incidence angle : 30.6° -39.5°
  - Polarisation: VV VH

  (Close to Sentinel-1 Interferometric Wide Swath IW1)

Technical Demonstrator Site – An Giang Growing Seasons

Rice crop season	Sowing	Harvest
Rainy season	Jul–Sep	Nov–Jan
Winter-Spring	Nov–Dec	Mar-Apr
Summer-Autumn	Apr–May	Jul–Aug
Autumn-Winter	Jul–Sep	Oct–Dec

Crop season	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Winter-Spring crop														
Summer-Autumn crop														
Autumn-Winter crop														

An Giang, Vietnam

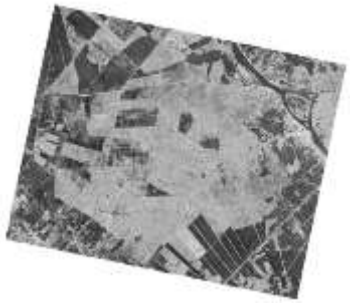
Selected area near “An Giang” from full scene range

RADARSAT-2 Data List

Descending	Ascending
29-Aug-13	
22-Sep-13	
16-Oct-13	
9-Nov-13	
3-Dec-13	8-Dec-13
27-Dec-13	1-Jan-14
20-Jan-14	25-Jan-14
13-Feb-14	
	7-Apr-14
26-Apr-14	1-May-14
20-May-14	25-May-14
13-Jun-14	18-Jun-14

Time series images (VV,Descending)

2013-AUG-29



2013-SEP-22

2013-OCT-16

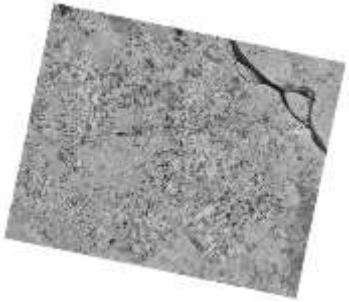
2013-NOV-09

2013-DES-03

2013-DES-27

2014-JAN-20

2014-FEB-13

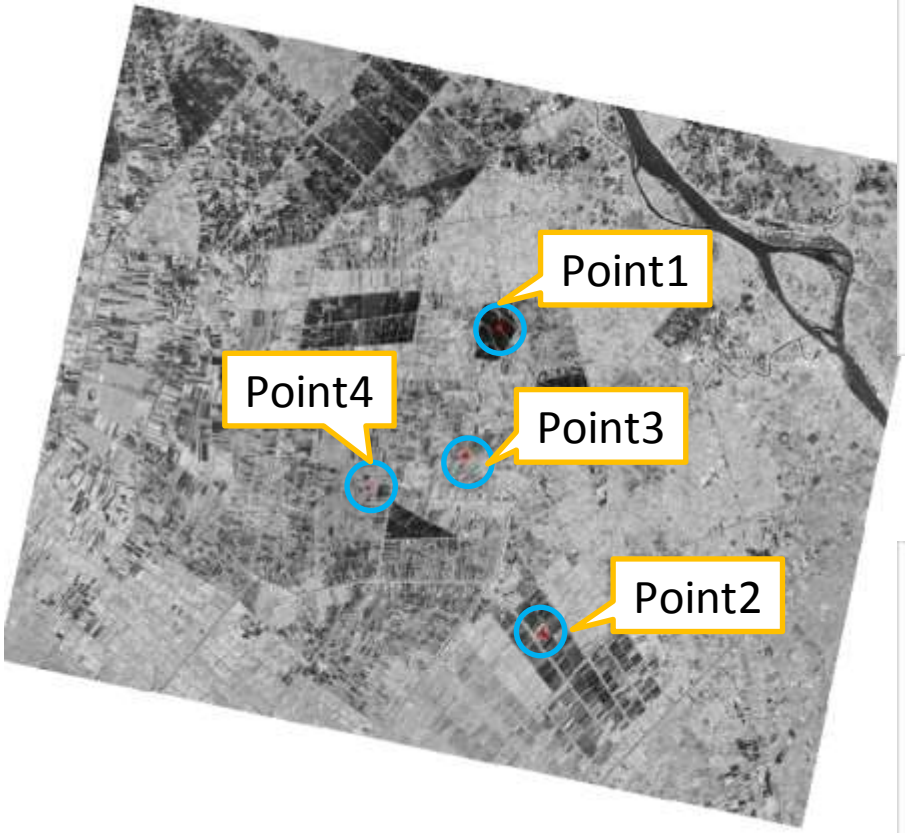


2014-APR-26

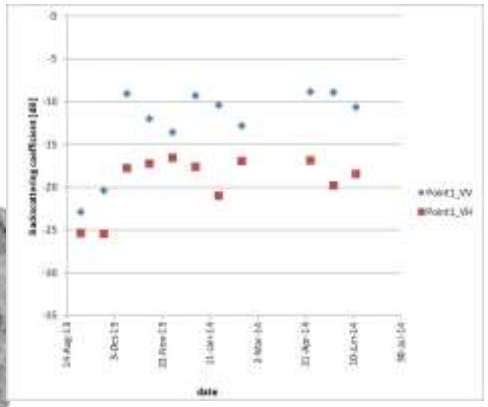
2014-MAY-20

2014-JUN-13

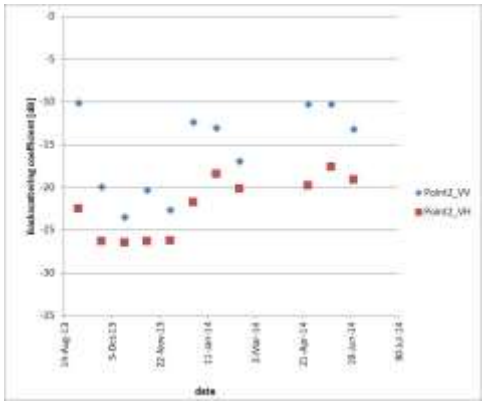
Time series variation of Backscatter



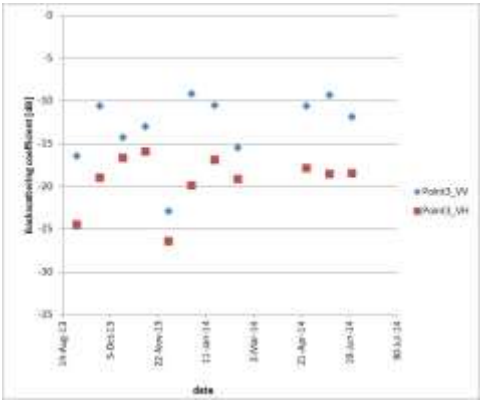
Point1



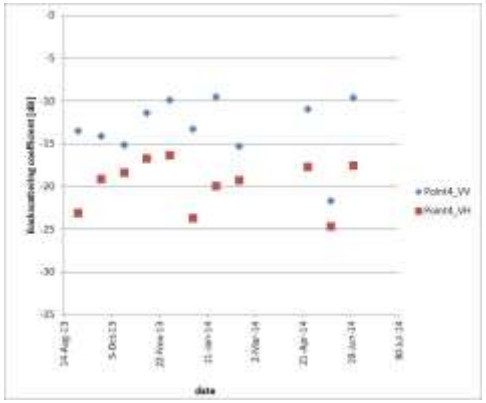
Point2



Point3

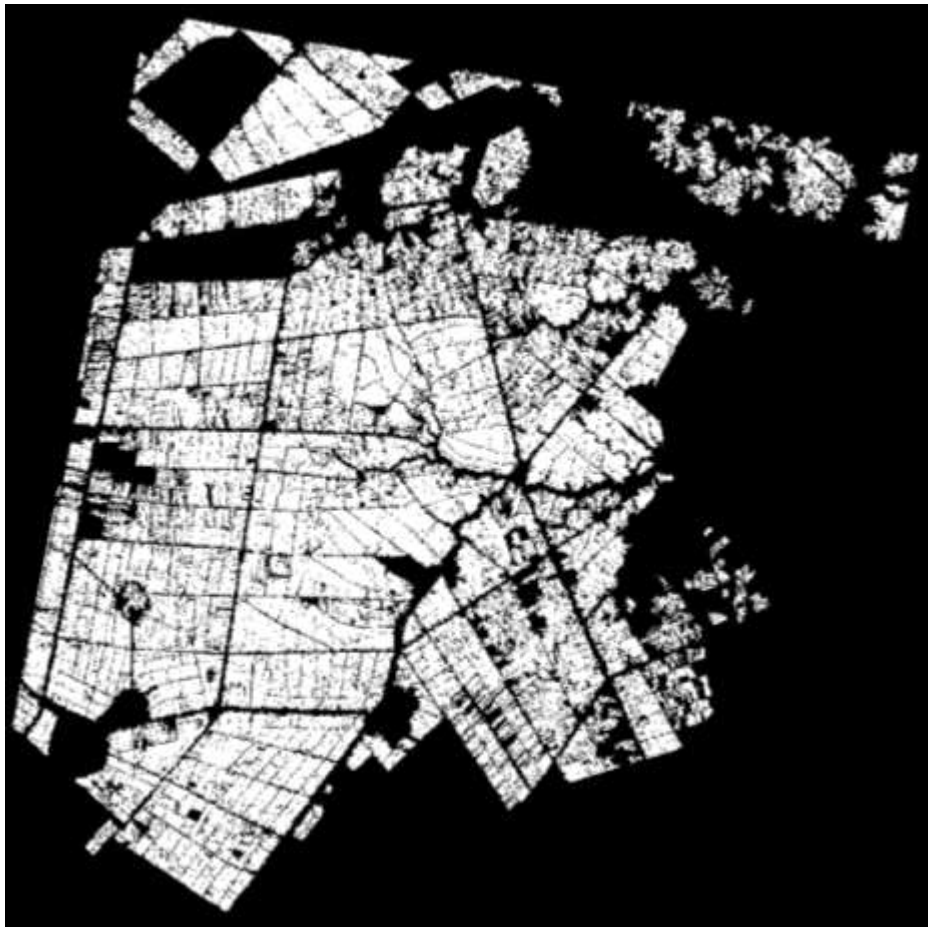


Point4

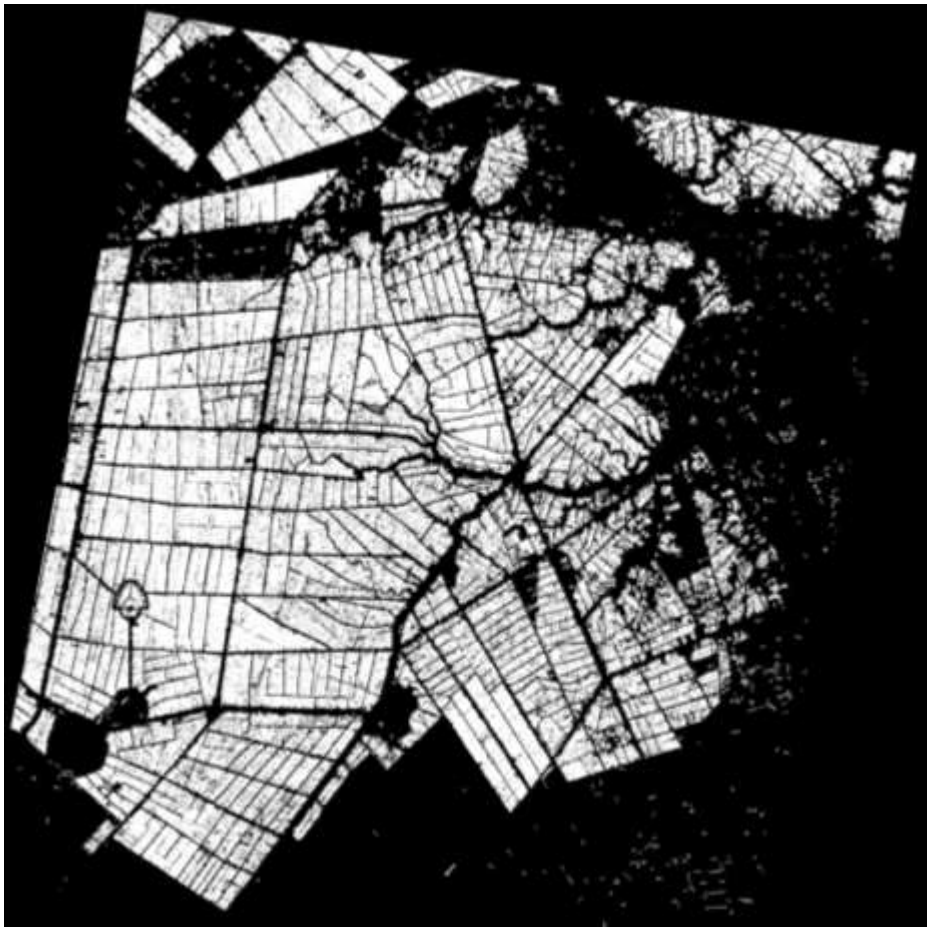


2013 Autumn-Winter rice map

From Radarsat-2, 2 dates



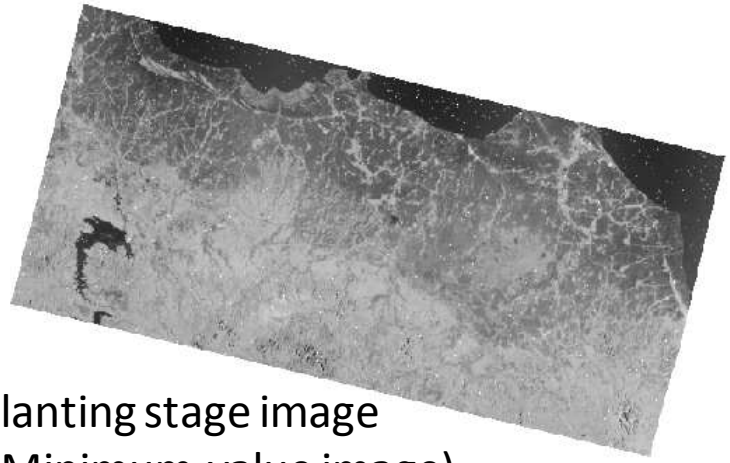
From Cosmo-Skymed, 10 dates



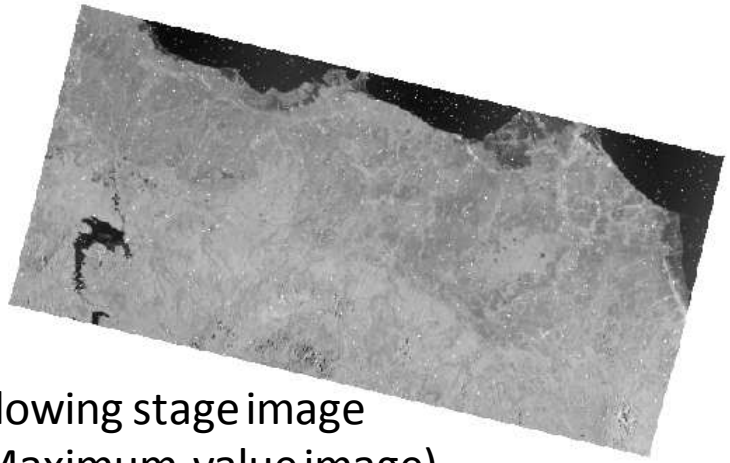
On going:

Improvement of RS2 map and accuracy assessment with ground data

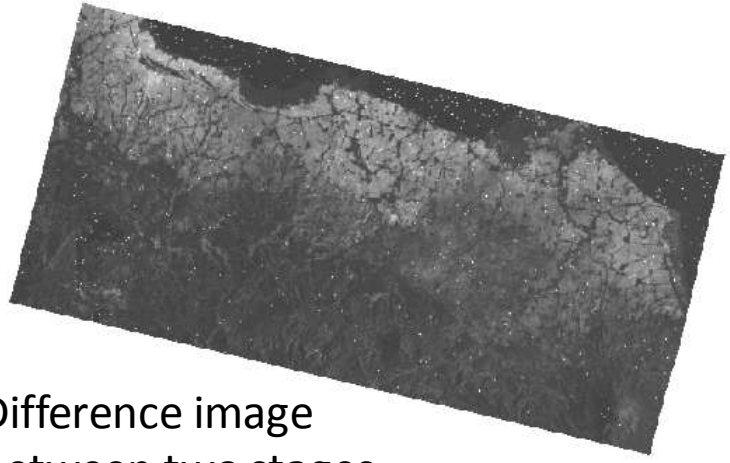
Paddy Field Area Detection



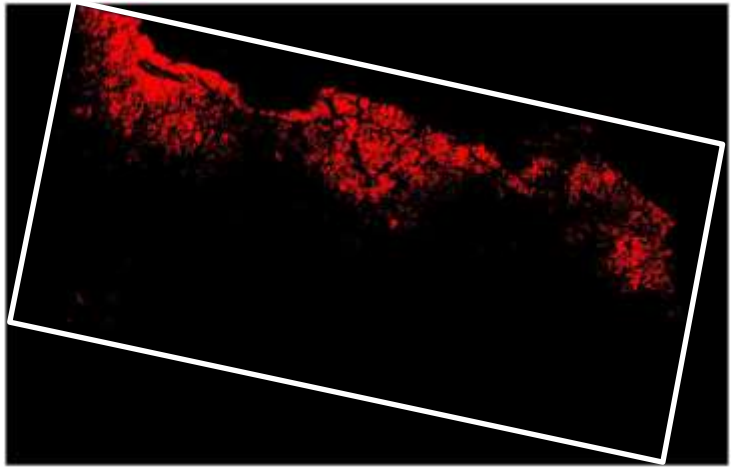
Planting stage image
(Minimum-value image)



Glowing stage image
(Maximum-value image)

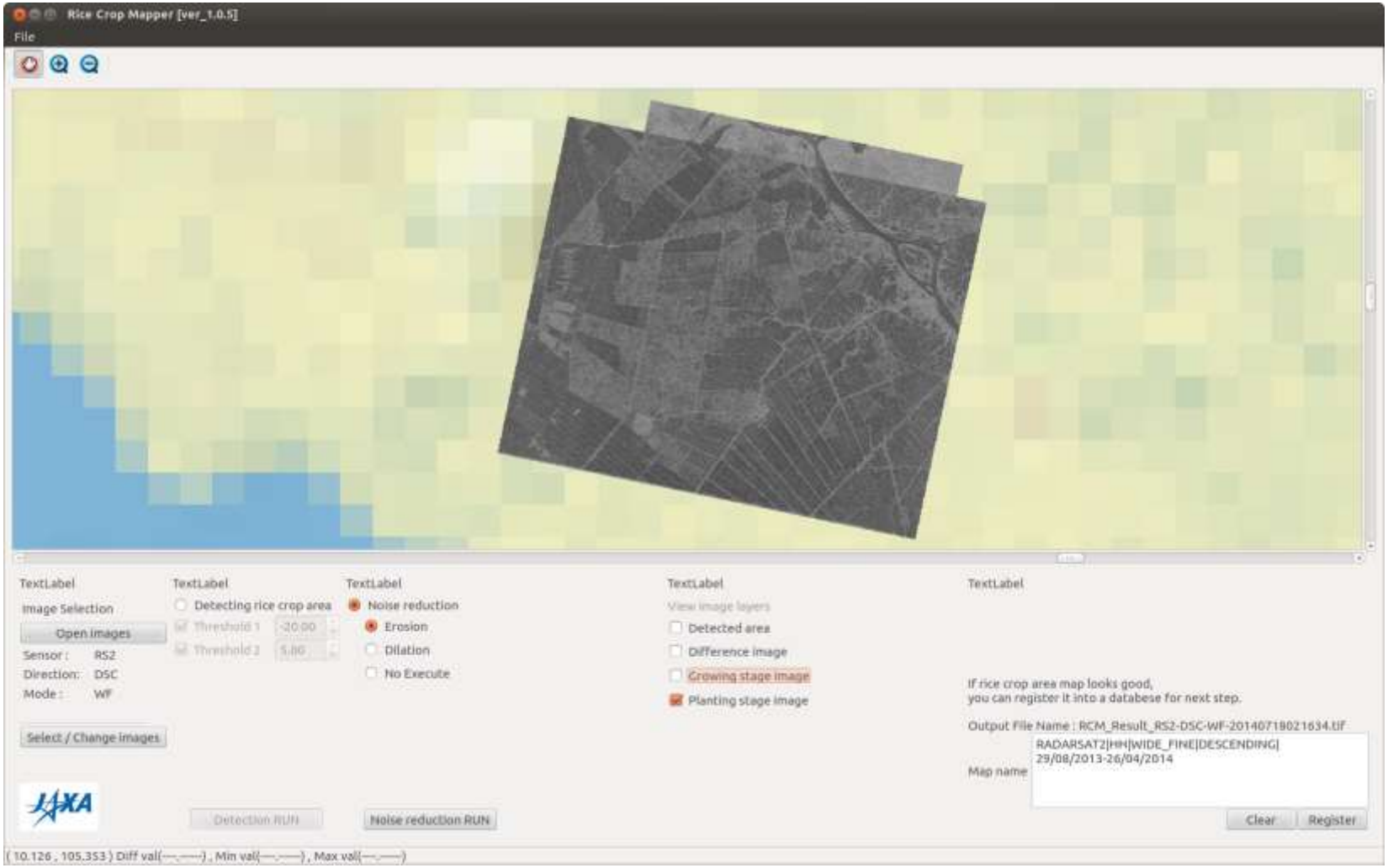


Difference image
between two stages



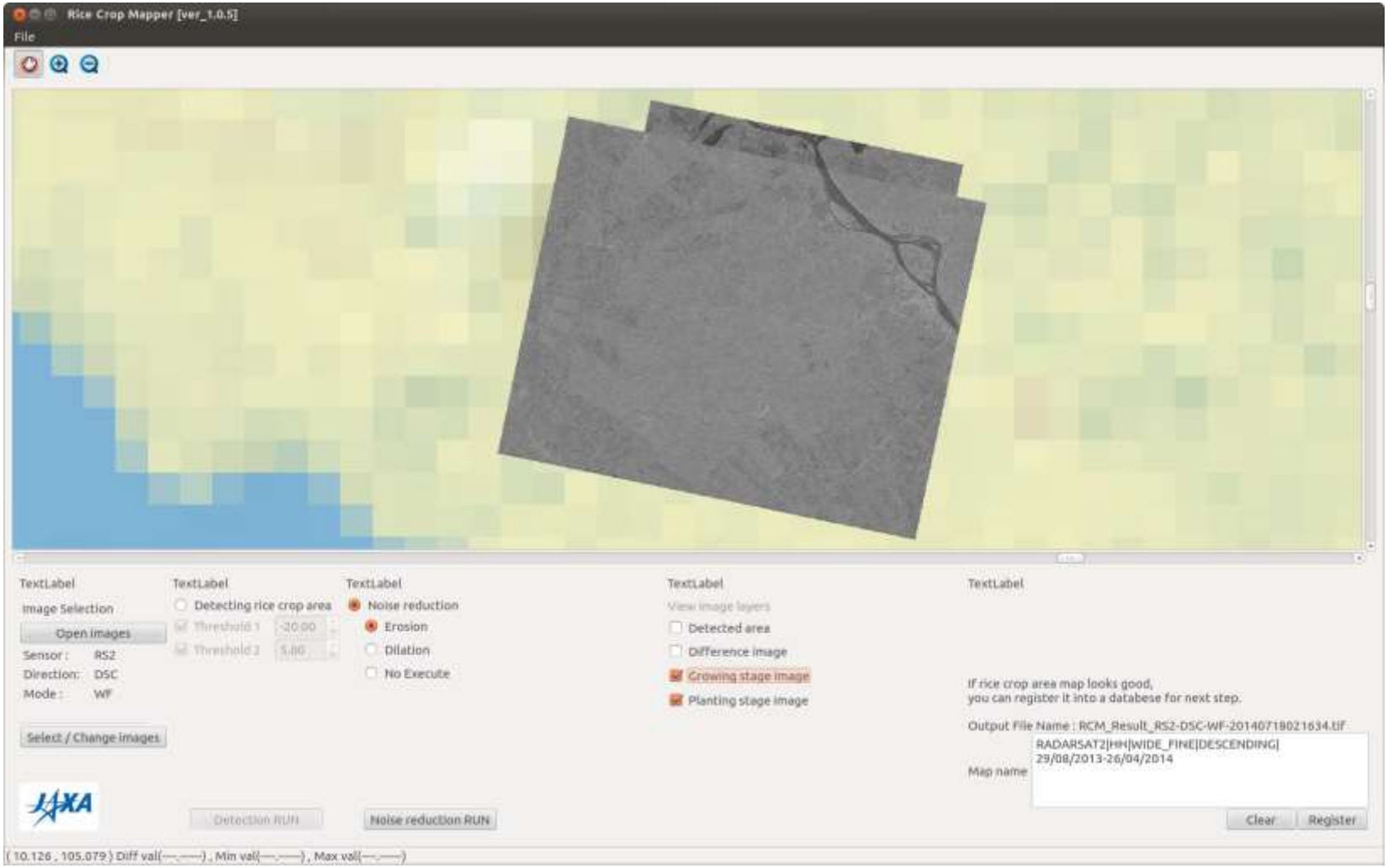
Detected paddy field area

Paddy Field Area Detection by INAHOR



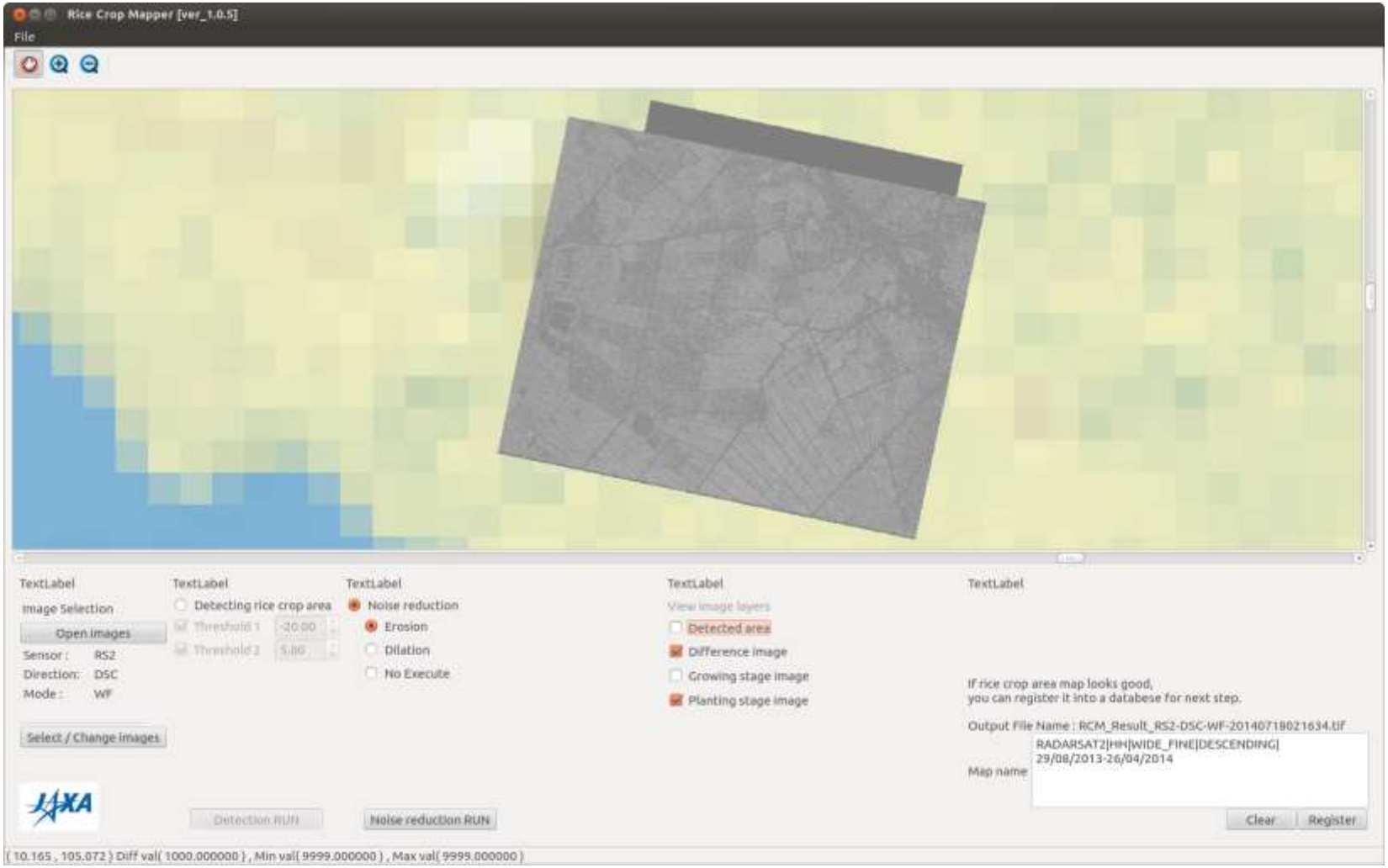
Planting stage image (Minimum-value image)

Paddy Field Area Detection by INAHOR



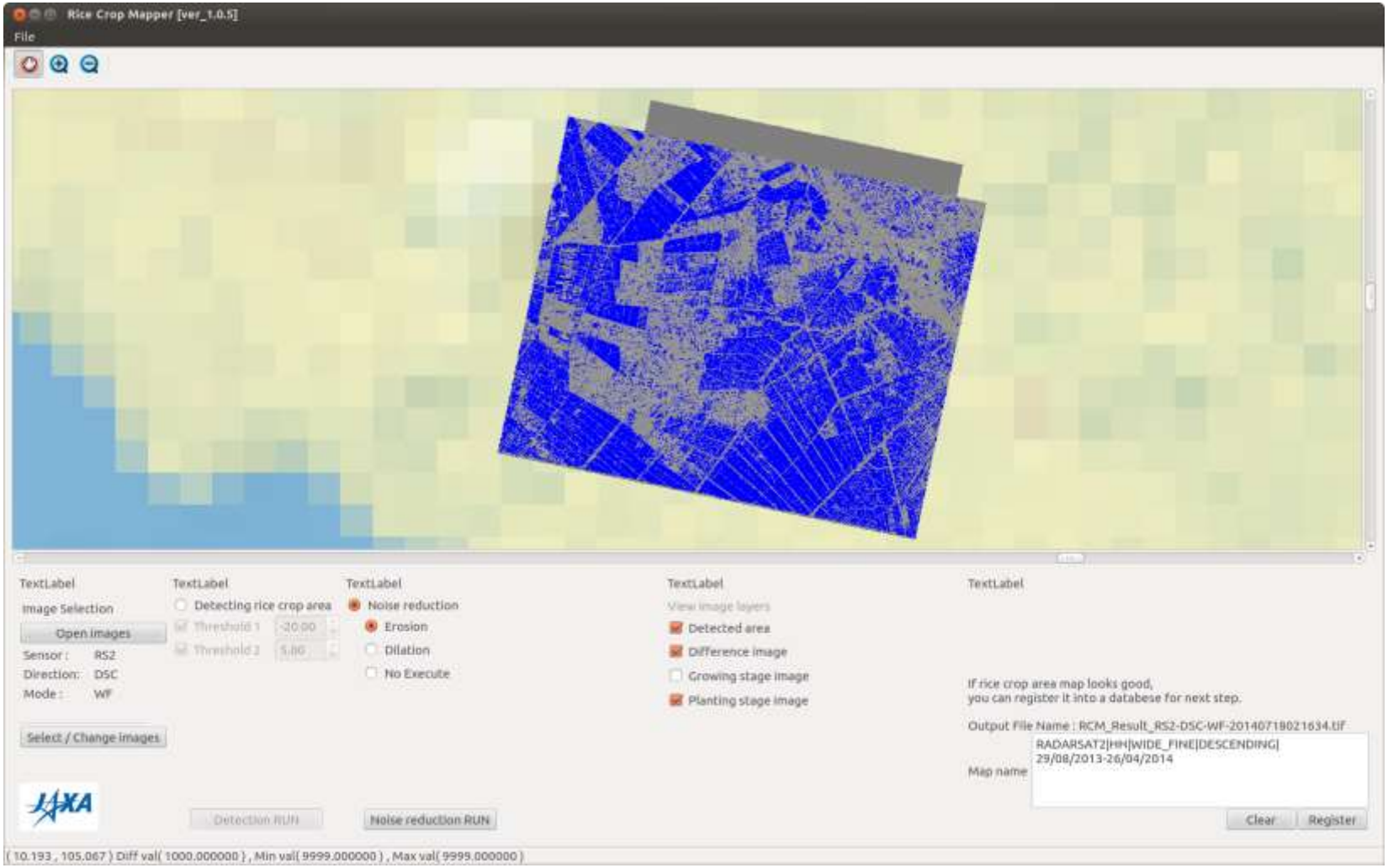
Glowing stage image (Maximum-value image)

Paddy Field Area Detection by INAHOR



Difference image between two stages

Paddy Field Area Detection by INAHOR



Detected paddy field area

Data : Descending images

Overview of Ongoing ADB Projects Applying Earth Observation Technology

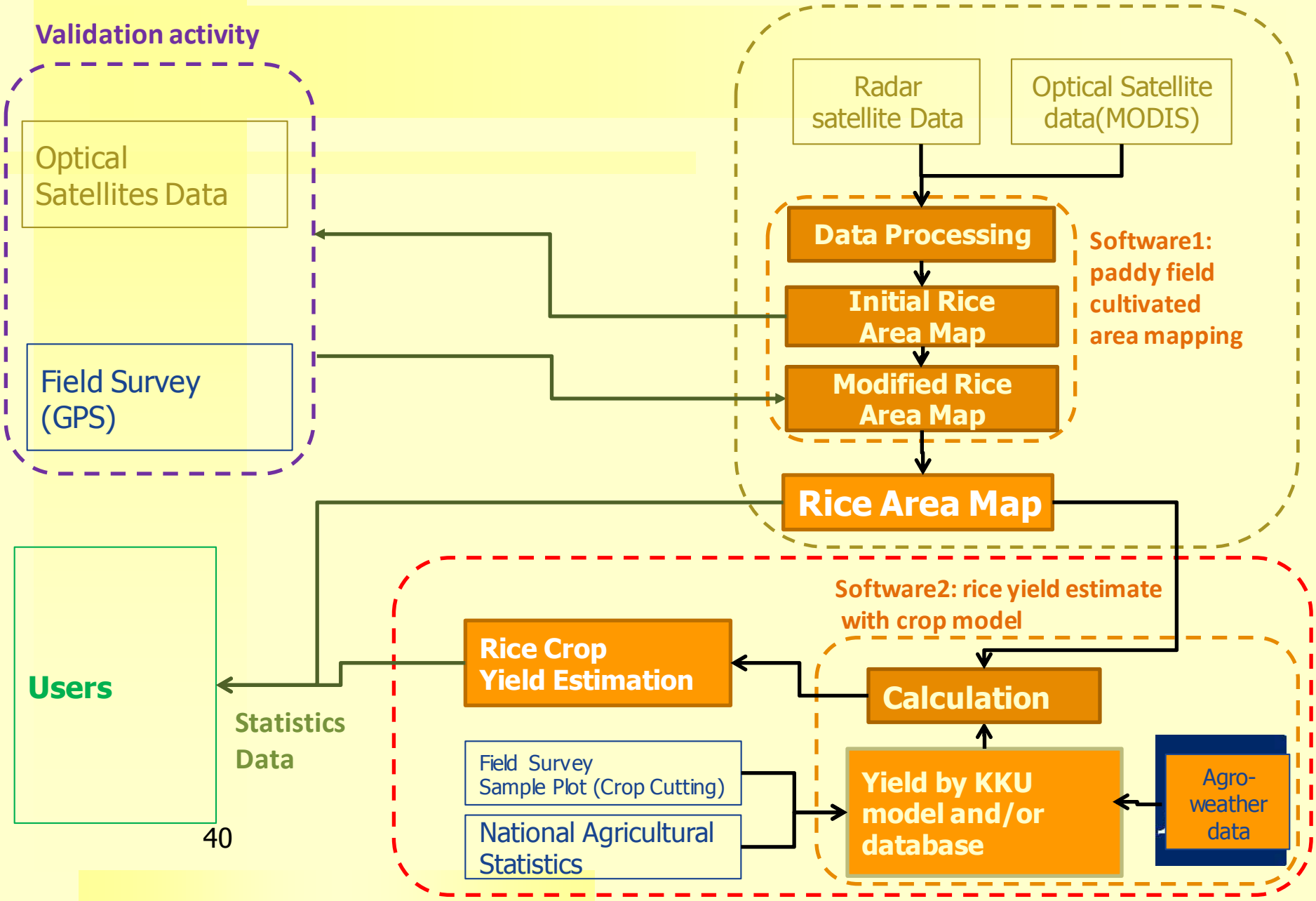
Presentation by
Yusuke Muraki
Space Technology Specialist
Asian Development Bank
December 4 2013

Satellite Radar Application for Rice Statistics

- TA-8369 REG **"Innovative Data Collection Methods for Agricultural and Rural Statistics"**
- JFPR funded, 2 million US$
- Lao PDR, Philippines, Thailand and Viet Nam
- For 2 years (2014/6 to 2016/6)
- Impact: More evidence-based policies and programs on food security
- Outcome: The improved quality and timeliness of rice crop area and production estimates and forecasts.
- Technical advisor: JAXA

ADB

Implementation Arrangement



Asia-RiCE products - outlook

ID	Target Agricultural Products
P1	**Rice Crop Area Estimates/Maps**
P2	**Crop Calendars/Crop Growth Status**
P3	**Crop Damage Assessment**
P4	**Agro-meteorological Information Products**
P5	**Production Estimation (and Forecasting)**

To Enhance Food Market Outlook Information

- AMIS is a G20 initiative and is a global agricultural market information system that concerns itself with matters relating to wheat, maize (corn), rice and soybeans.

Agricultural Market Information System

http://www.amis-outlook.org/home/en/

Provide satellite derived information on the WWW

Develop Rice Outlook by **AFSIS** and **Agricultural Statistician** in each country

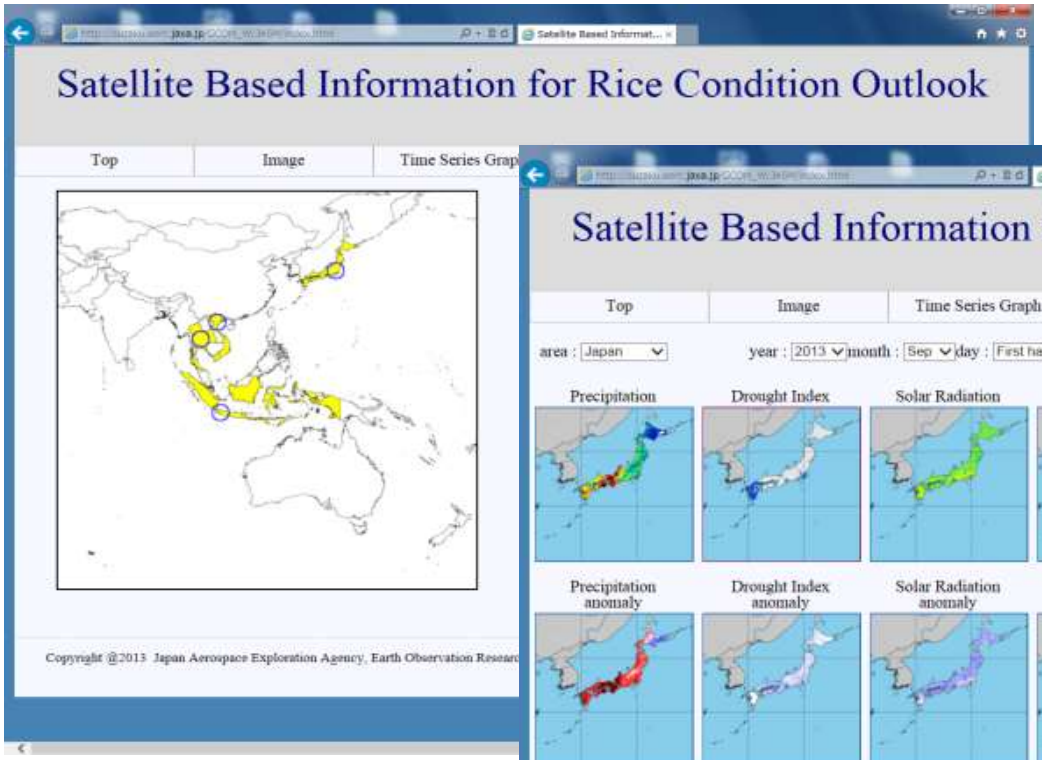
Review and Post **"Asia-RiCE Outlook"**

Develop "**Crop Monitor**" report for AMIS "Market Monitor"

Publish "**Market Monitor**" (Monthly)

JASMIN - Data-distribution System for Rice Outlook

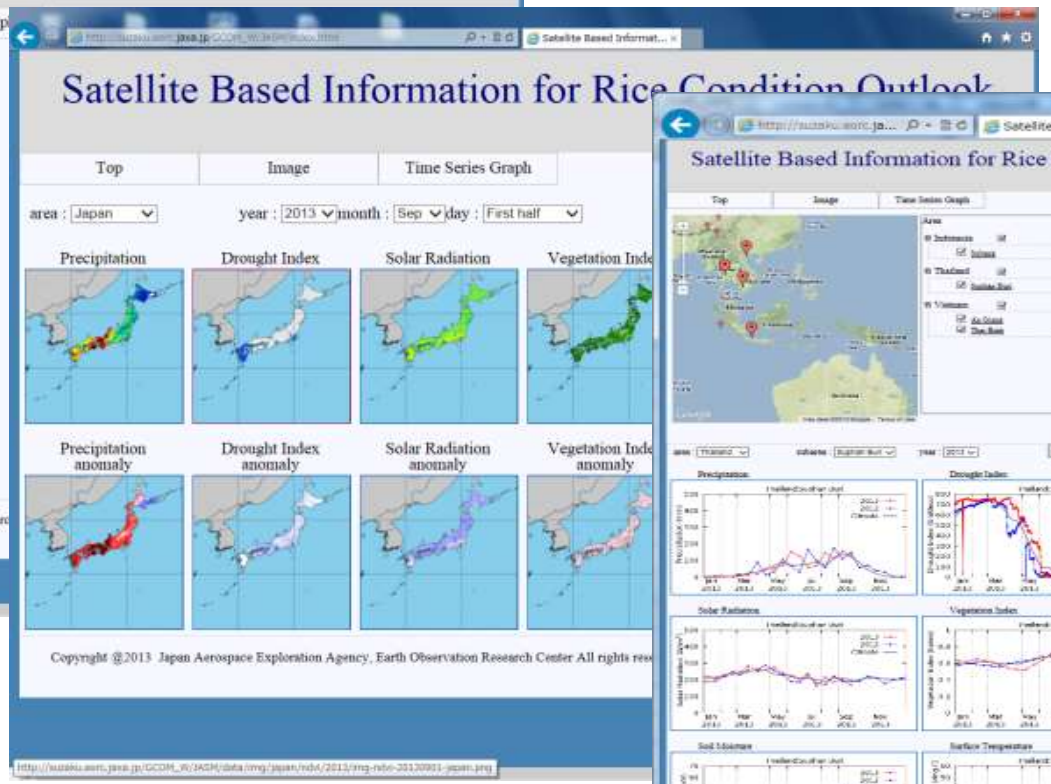
- Each data will be updated twice a month (15th, 31th day of month).
- Users can access and get latest data any time.



Top

Spatial Distribution

Time-Series

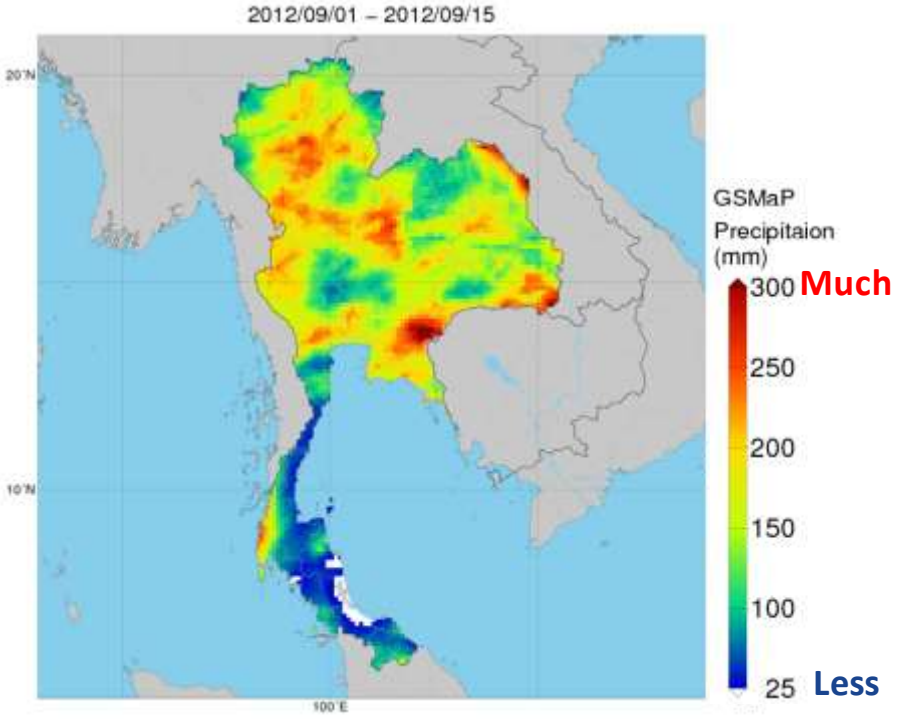


http://suzaku.eorc.jaxa.jp/GCOM_W/JASM/index.html

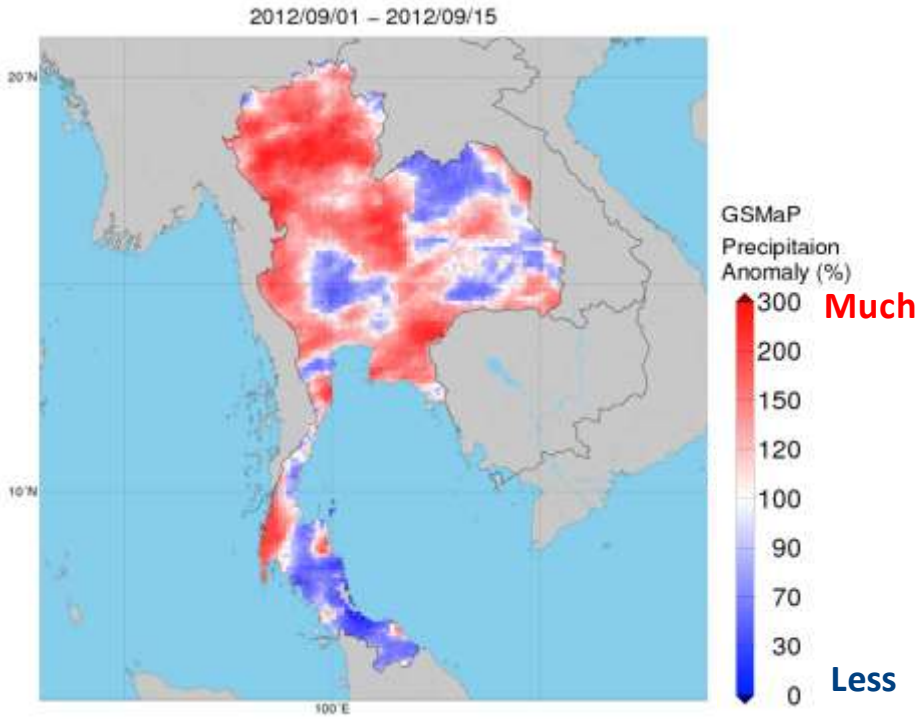
Precipitation

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

Current Condition



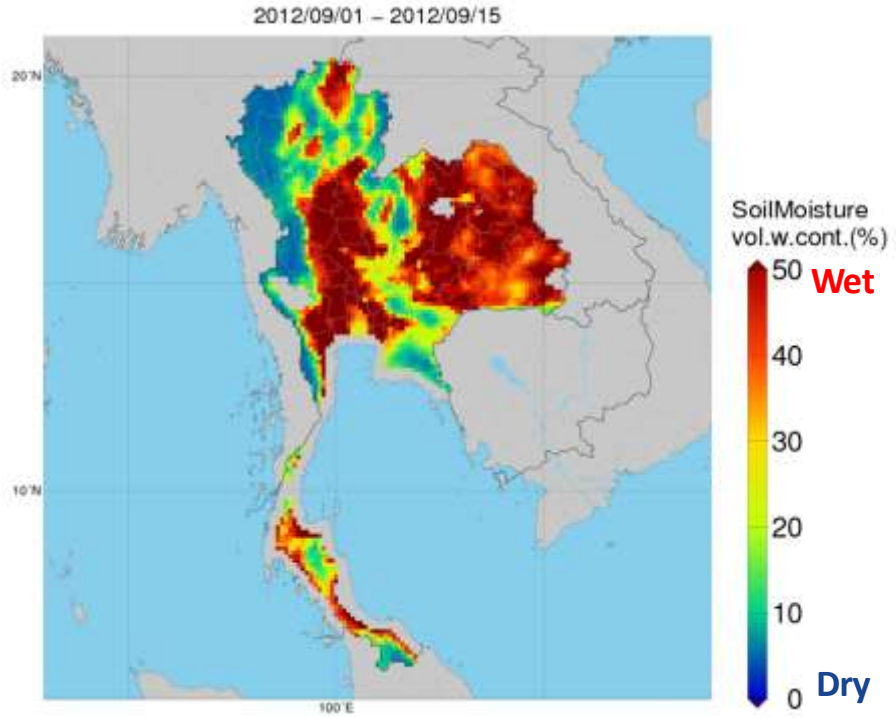
Anomaly



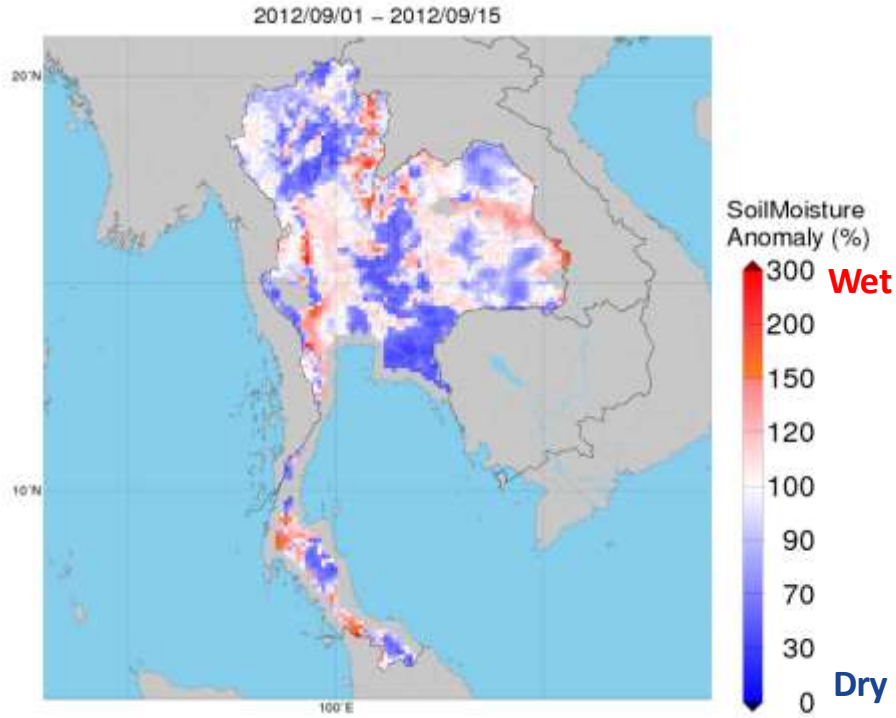
Soil Moisture

- 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



Anomaly



Outlook information for AMIS

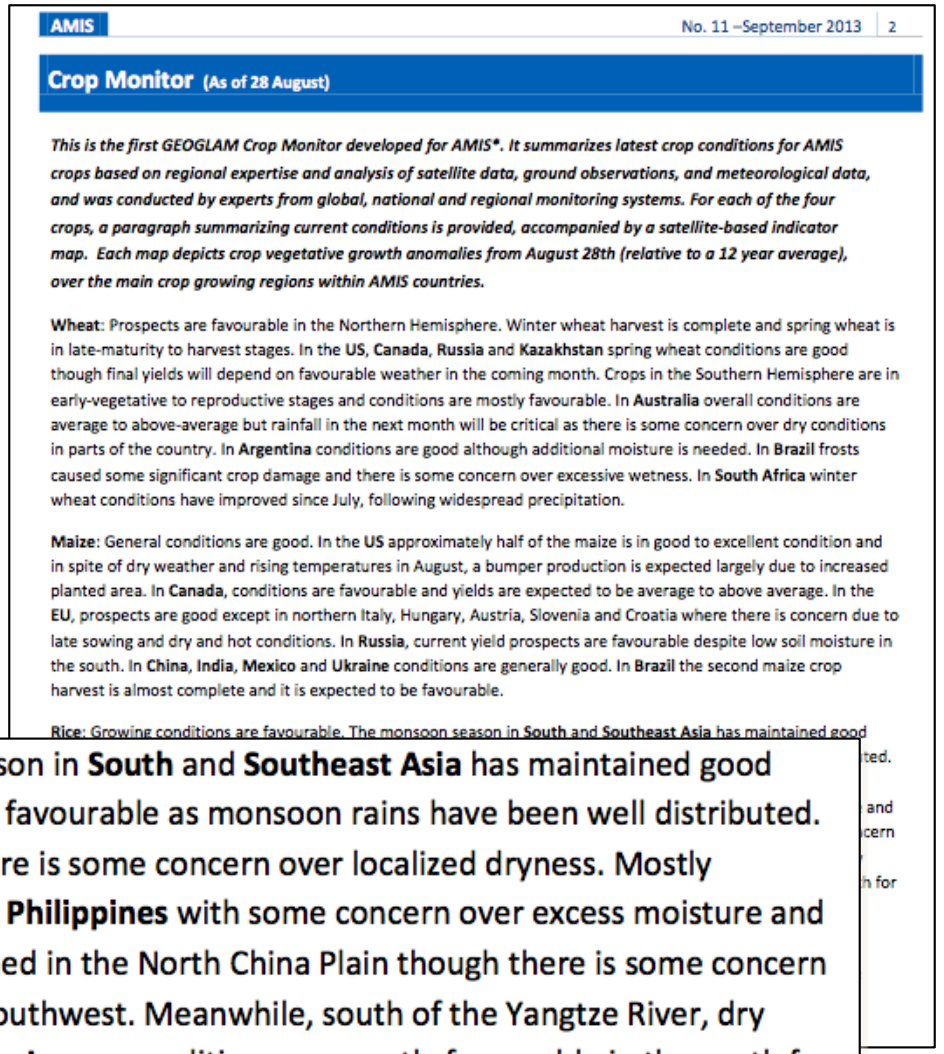
AMIS

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.*

Contents



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

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

Way forward

EO and in-situ observation

1. EO satellites coordination

(1) ALOS/ALOS-2: complete data delivery to phase 1A TDSs, and preparation of K&C phase 4 project proposal for wall-to-wall (7 times per year with ScanSar mode (100m res.)

(2) Radarsat-2: data delivery from last August to phase 1A/1B with Wide fine mode (5m res.) under CEOS contribution

(3) TerraSar-X: for 3 countries (Indonesia, Vietnam and Japan) with strip / scansar mode

(4) Sentinel-1: for phase 1A/1B country under CEOS contribution from the end of June? with a reference site (south Vietnam) biweekly observation

(5) CosmoSkymed: only for south Vietnam and Thailand

-> Cross validation and integrated usage of various SARs with opticals

-> Sharing results / knowledge of our team activity with other GEO GLAM activities such as JECAM

-> Promote a value / usefulness of EO data to rice crop monitoring in practical use

	2013					2014											2015
	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
Indonesia	23			3, 27	1, 21, 25	14, 18	7, 11	3, 7, 27, 31	20, 24,	14, 18,	7, 11,	1, 5, 25, 29,	18, 22,	11, 15,	5, 9, 29,			
An Giang	29	22	16, 23	9	3, 8, 27	1, 20, 25	13, 18	9, 14	2, 7, 26,	1, 20, 25,	13, 18,	7, 12, 31	5, 24, 29,	22,	11, 16,	4, 9, 28,	3, 22, 27	15, 20
Thailand			22		24	2, 21, 26	14, 19	10, 15	3, 8, 27,	2, 21, 26,	14, 19,	8, 13,	1, 6, 25, 30	18, 23,	17,			
Phillipines					29	17, 22		10	6, 11, 30	4, 23, 28,	22,	10, 15,	4, 9, 28,	2, 21, 26,	14, 19,	8, 13,	1, 6, 25, 30	
Japan									16, 23,	17,	3, 27,	4, 21, 28,	14, 21,	7, 14,	1, 8, 25,	1, 18, 25,		
Malaysia							14	7, 16	3, 12, 27	5, 20, 29,	14, 17, 23,	7, 10, 16,	1, 10, 25,	3, 18, 27,	11, 20,	5, 14, 29,	7, 22,	1, 16, 25,	9, 16
Laos																		
Taiwan							1, 17, 25	13, 21	6, 14, 19, 30	8, 24,	1, 15, 17, 25,	11, 19,	4, 12, 28,	5, 21, 29	15, 23,	8, 16,		
Thai Binh						13, 22	6, 15	2, 11, 26	4, 28,	13, 22,	6, 30,	9, 24,	2, 17, 26,	10, 17, 19,	4, 13, 28,			
China																		
India																		

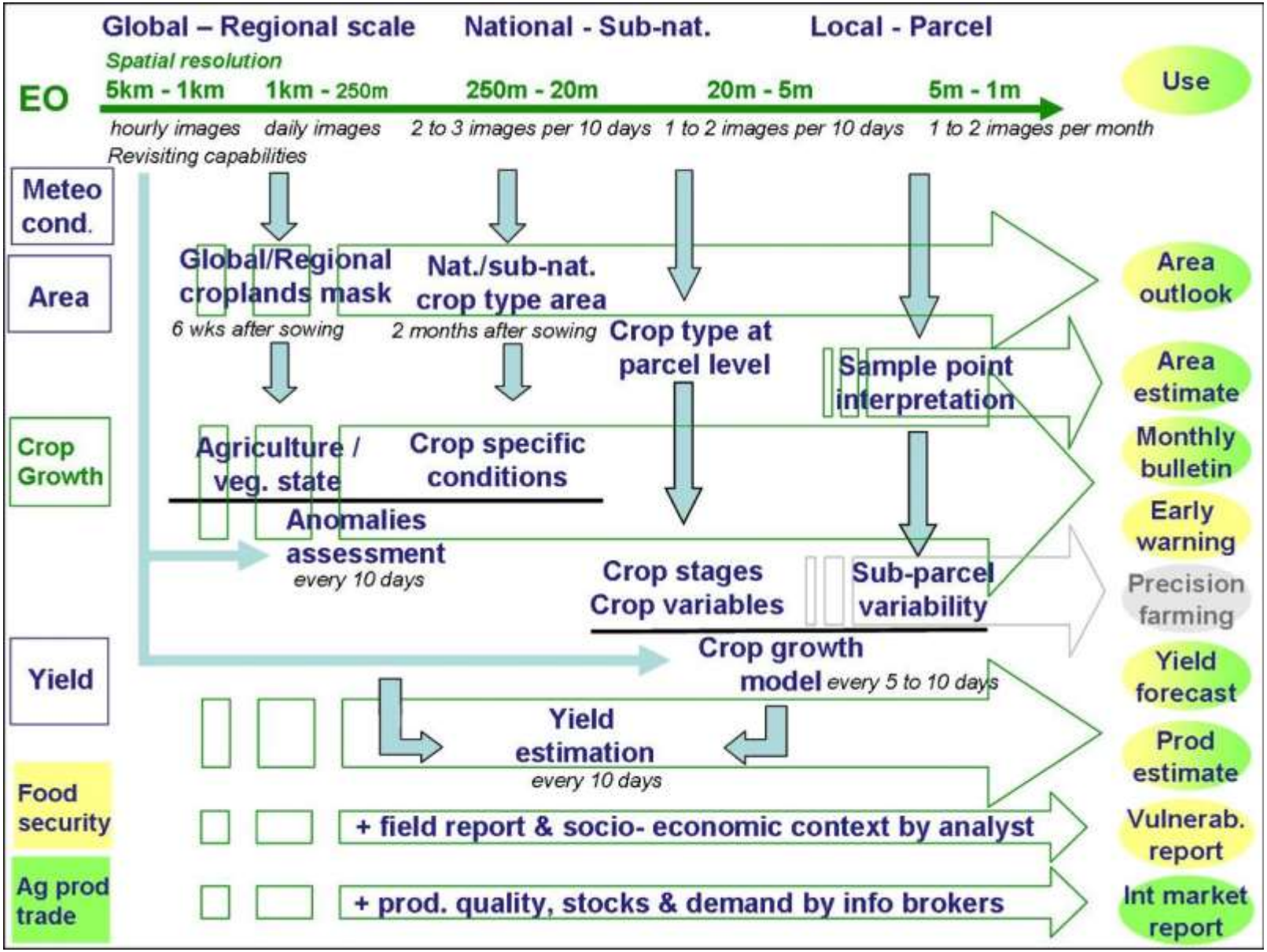
2. Ground observation data coordination

(1) Need to have ground observation data to validate rice crop area and production estimation using EO satellites with crop calendar (how, when)

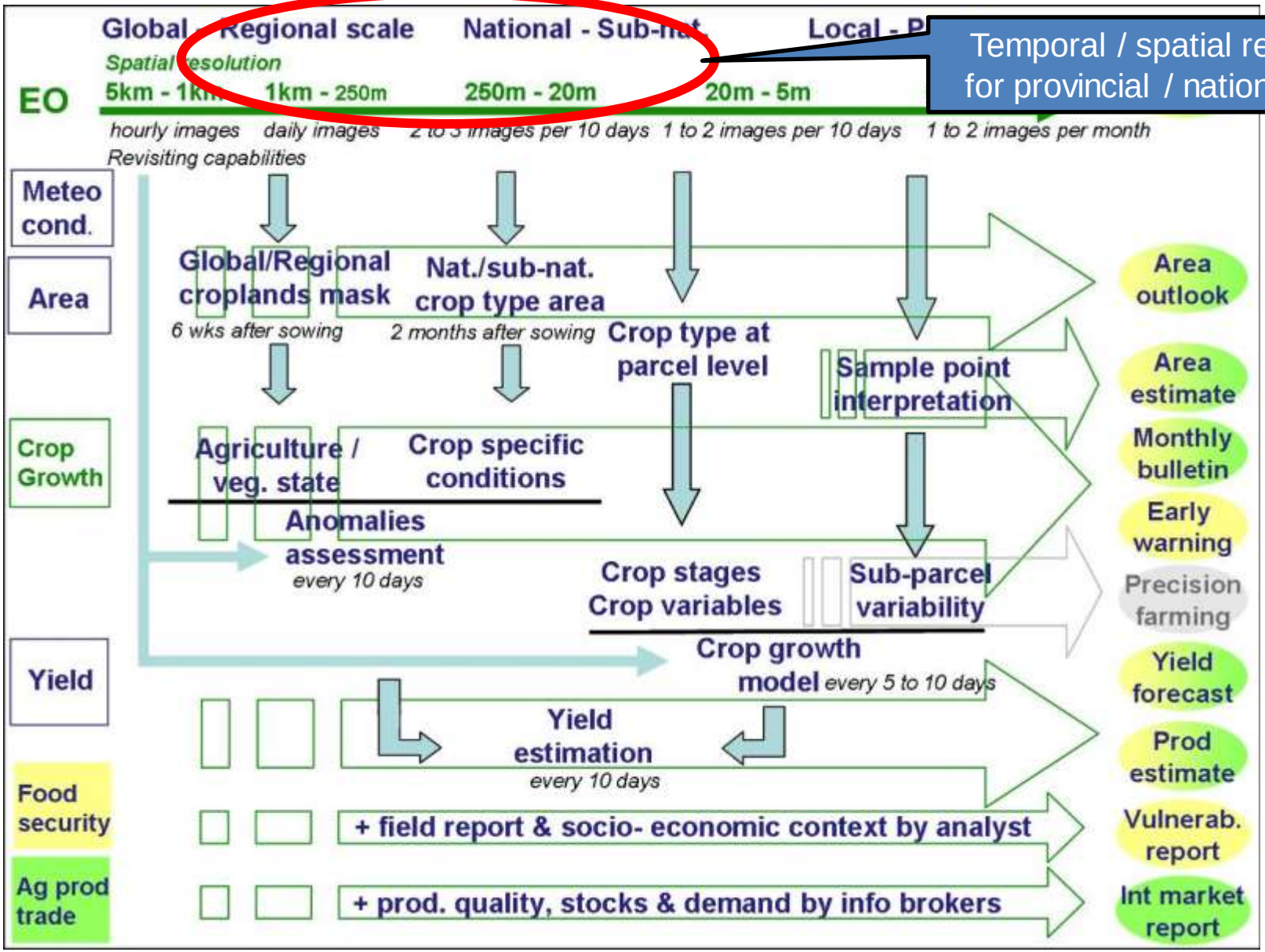
(2) Need to have statistical information of rice crop area and production by countries in provincial level

-> Need to standardize a method to collect ground observation data and promote sharing those data in our team and hopely other GEO GLAM activities such as JECAM

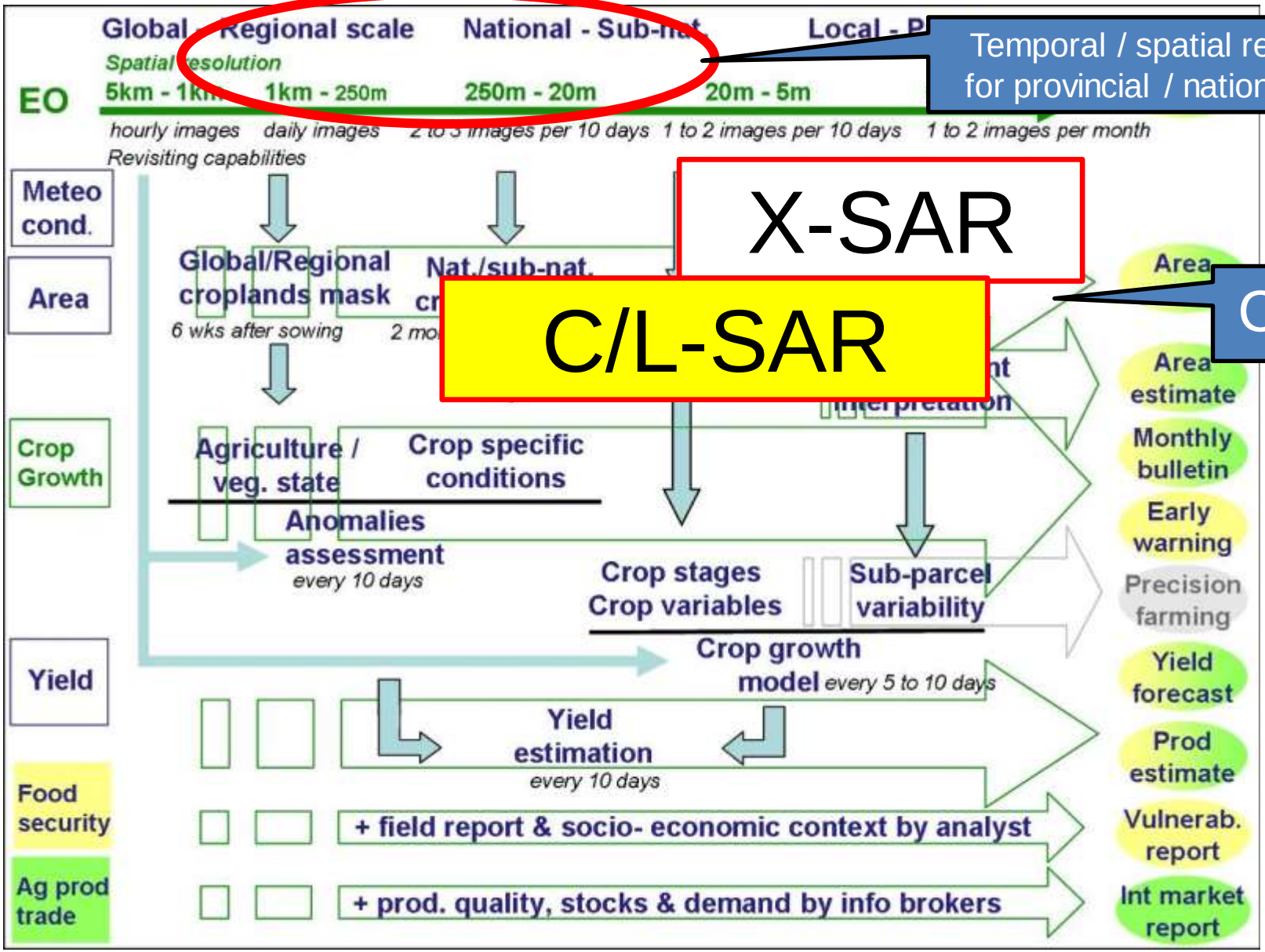
Technical and Institutional Challenge



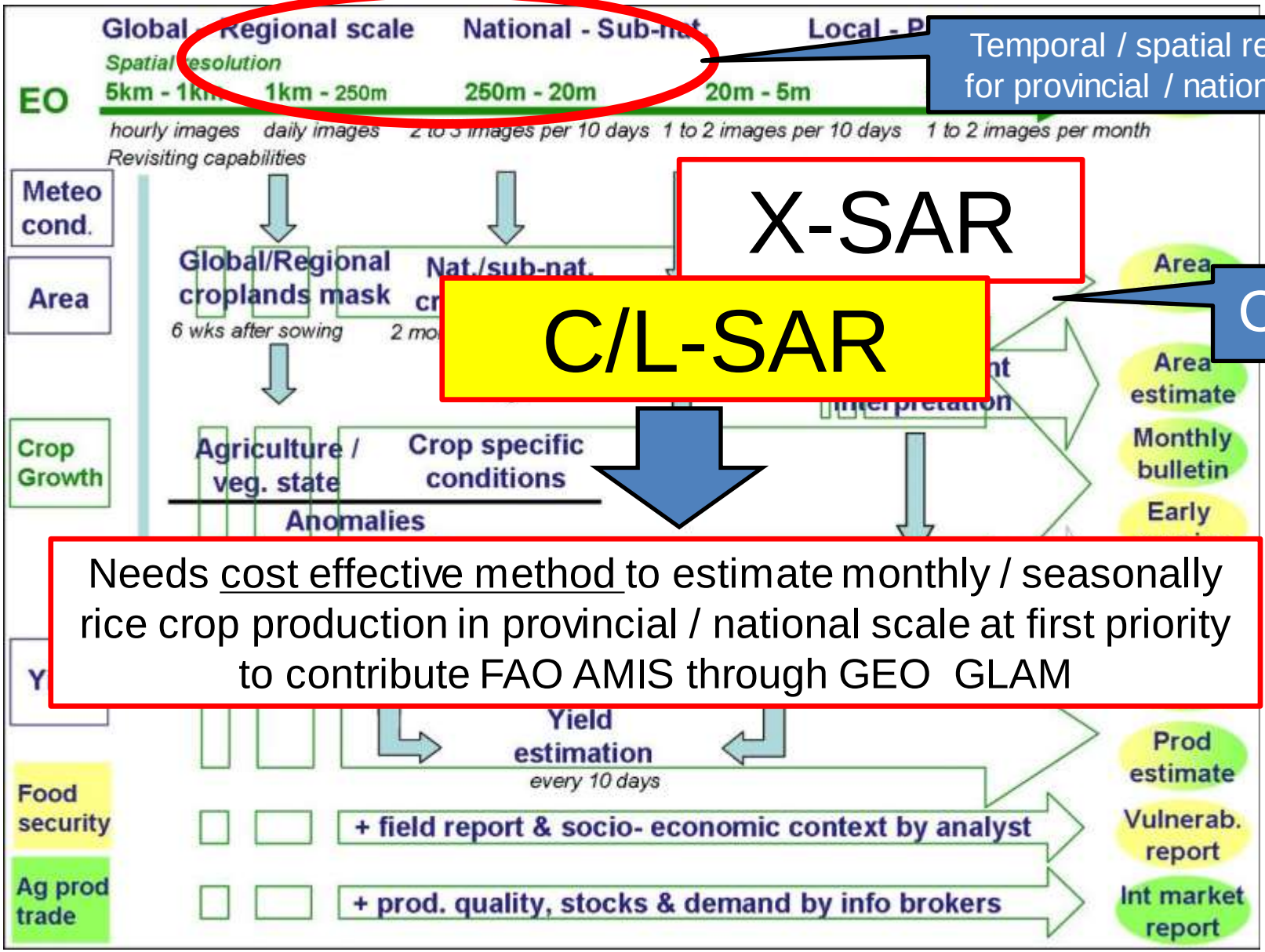
Technical and Institutional Challenge



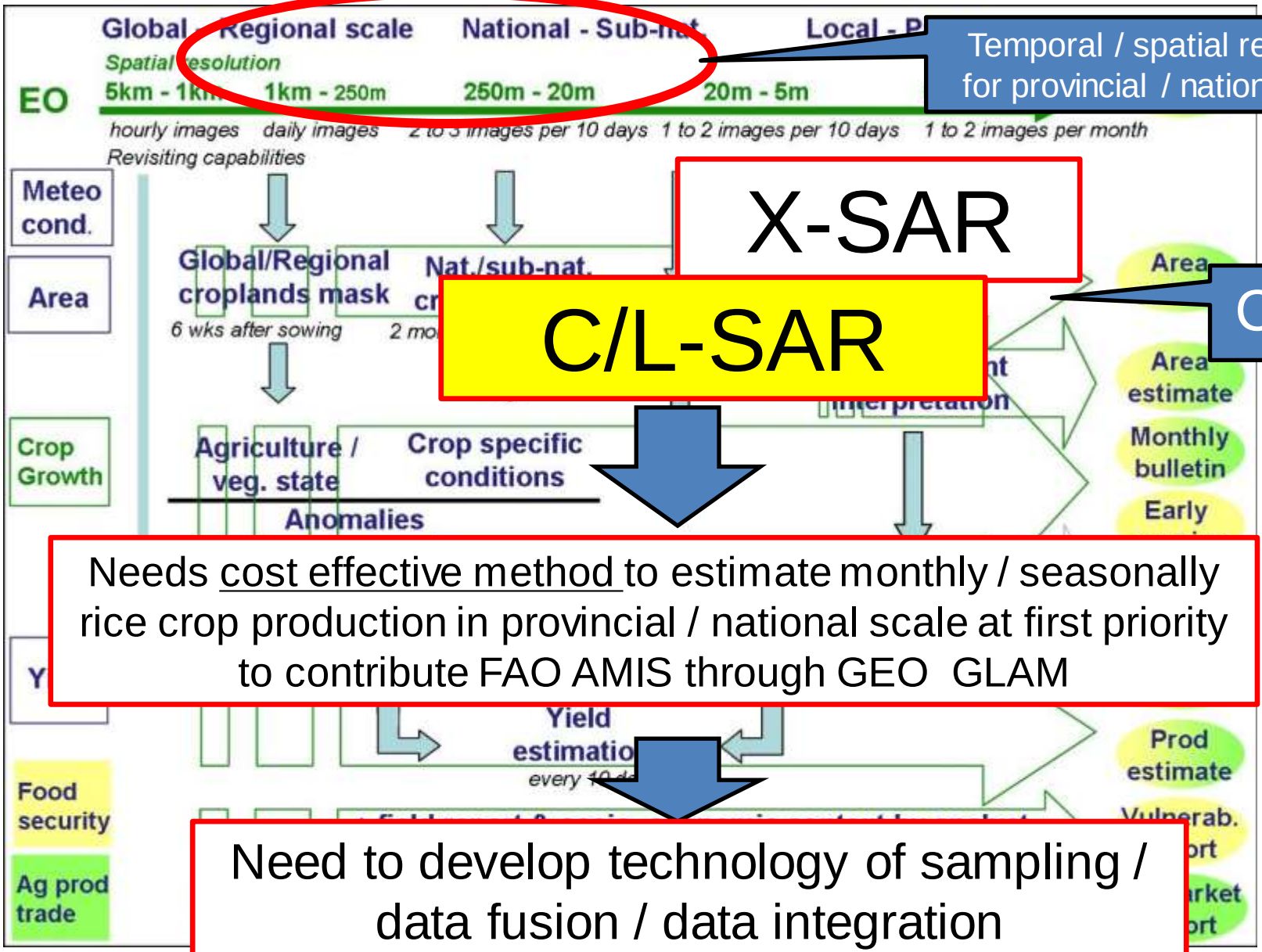
Technical and Institutional Challenge



Technical and Institutional Challenge



Technical and Institutional Challenge



Way Forward – coming events

- Sentinel-1 reference site coordination meeting of low Mekong area of Vietnam in Taichung, Chinese Taipei in August
- Asia rice crop team meeting and outlook coordination meeting at ASEAN+3 food security information system (AFSIS) conference room in Bangkok on October 29th - 30th just before remote sensing session of IRC2014 on October 31th hosted by IRRI

- To summarize phase 1A outcome / accomplishment to submit CEOS / GEO plenary
- To implement phase 1B TDSs using SAR fleets including radarsat-2, TerraSAR-X, CSK, RISAT, Sentinel-1 and ALOS-2
- To implement Asia rice crop monitoring under CEOS SDMS for Indonesian TDS