Outline of GEOGLAM Asia Rice crop team activity - Rice crop monitoring and outlook

Shin-ichi Sobue

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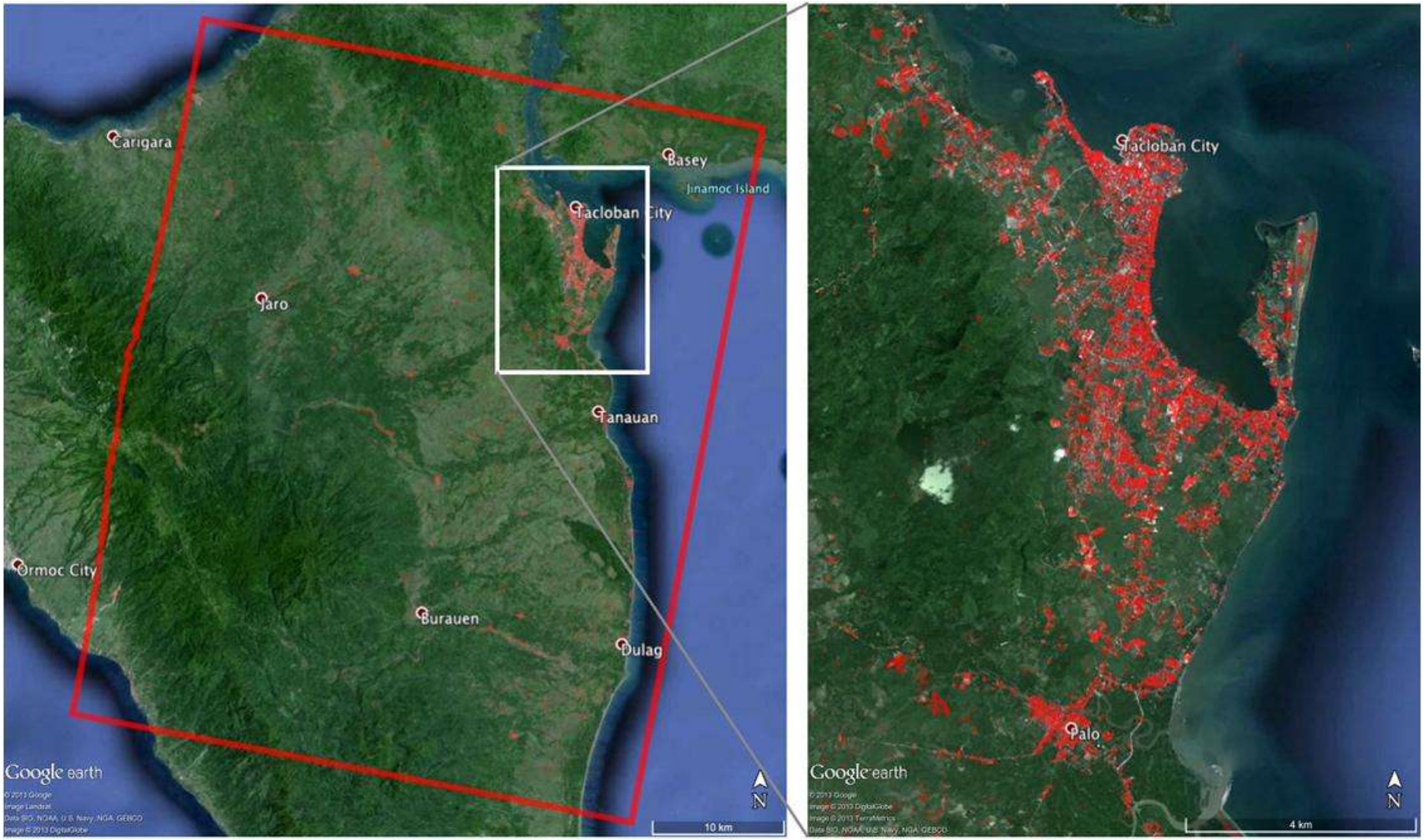
On behalf of the Asian rice crop estimation and monitoring team

NASA-Generated Damage Map To Assist With Typhoon Haiyan Disaster Response

http://www.jpl.nasa.gov/spaceimages/details.php?id=PIA17687



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).

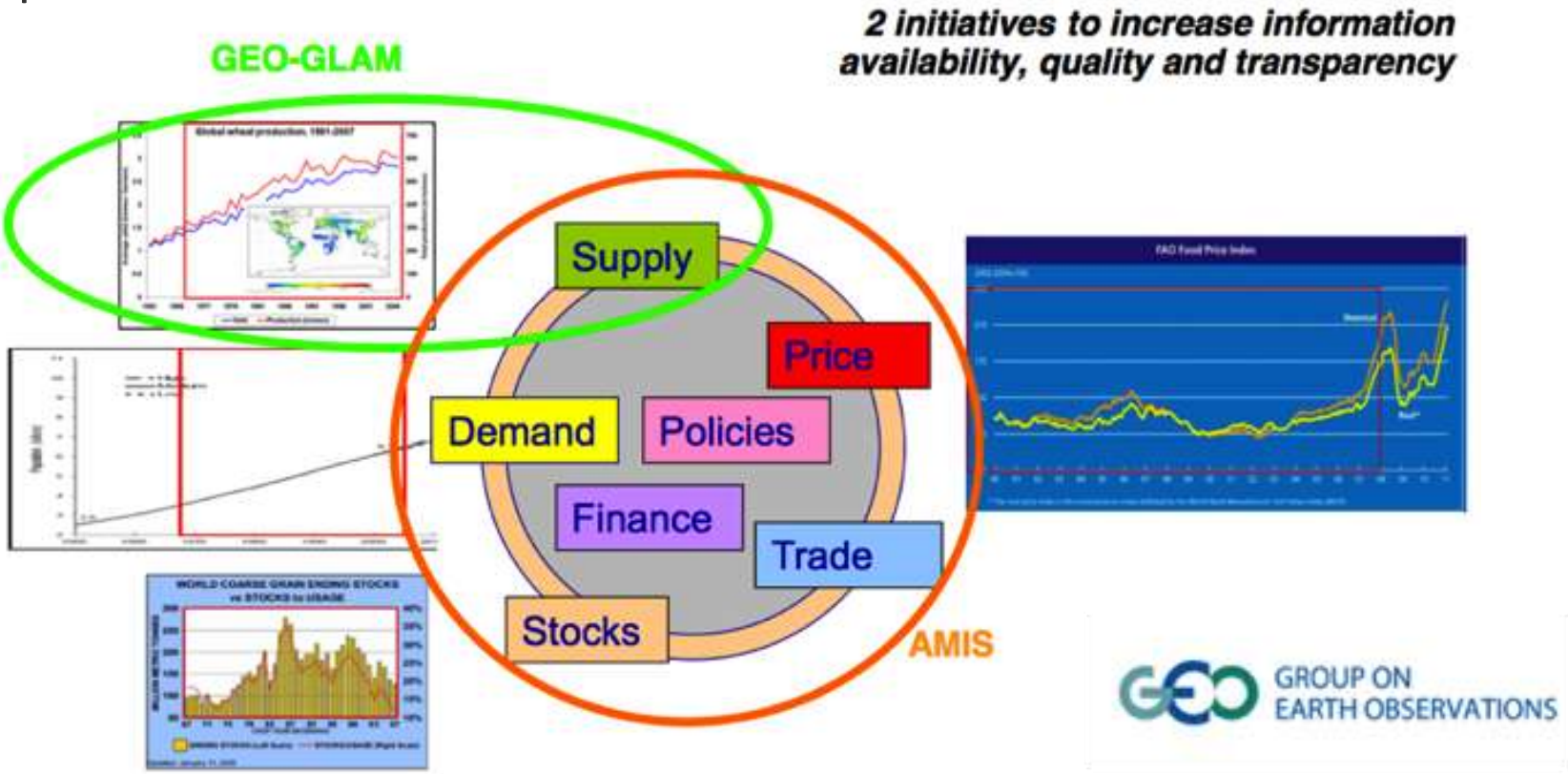
[Meeting of G20 Agriculture Ministers, 2011]
[G20 France 2011 Summit final declaration, 2011]

GEO GROUP ON EARTH OBSERVATIONS

G20 FRANCE 2011

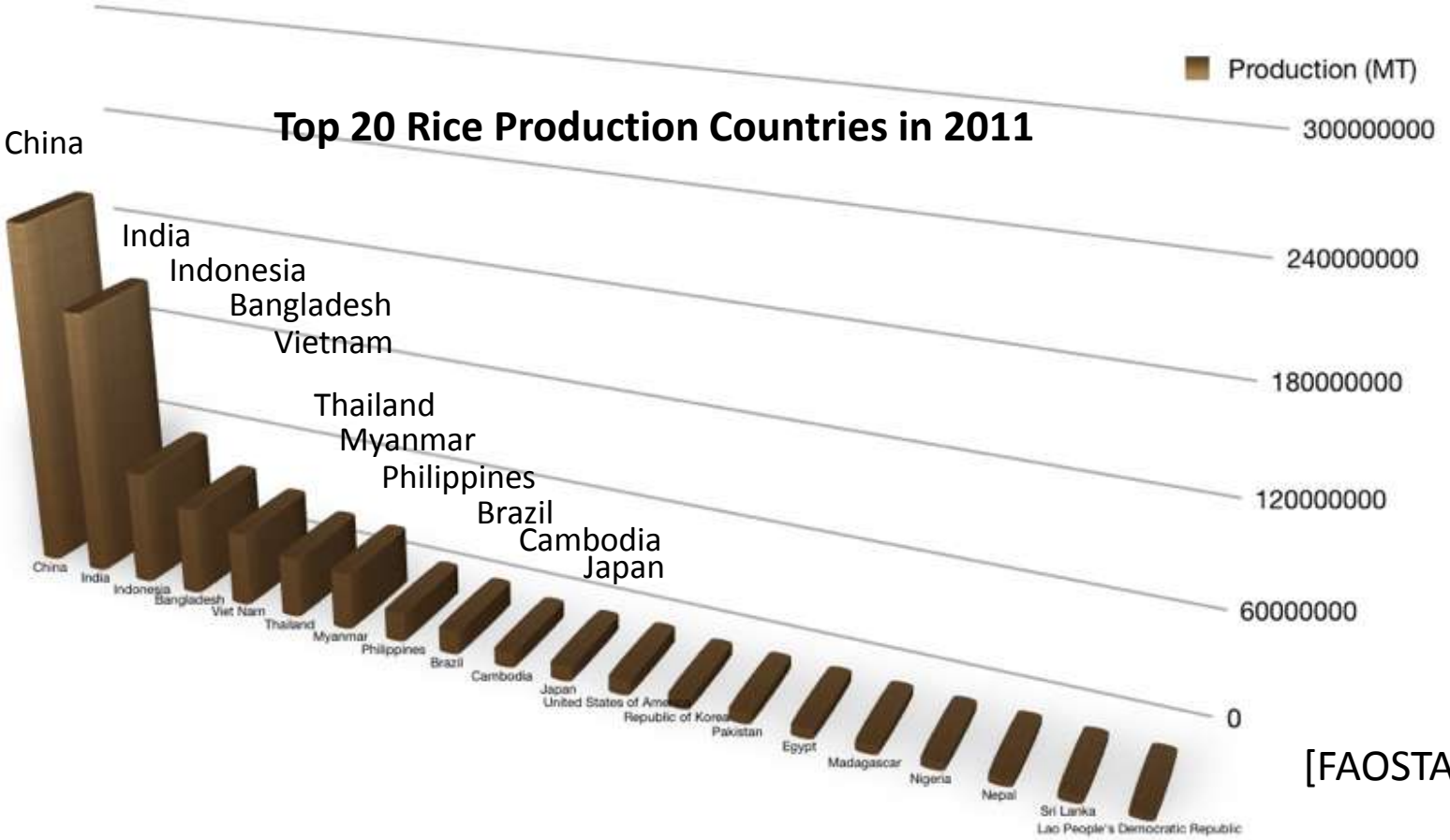
Contributions of Remote Sensing to GLAM

- **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.

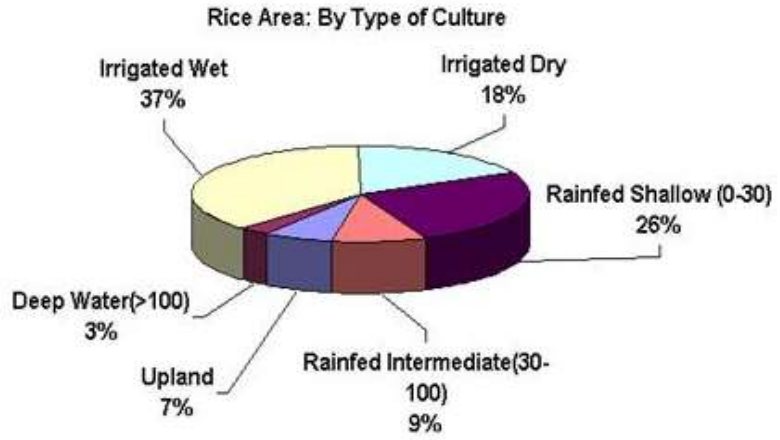


[FAOSTAT]

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)



Asia-RiCE Work Plan

- 2012/7: Report about Asia rice crop monitoring requirement to CEOS UR meeting at Montreal (by Shinichi)
- 2012/9: Develop draft Asia rice crop monitoring work plan
- 2012/11: Review the work plan at ACRS2012 hosted by GISTDA, Thailand with AARS
- 2012/12: Approve the work plan version 1.0 at APRSAF-19 hosted by ANGASA and Japan and submit it to GEO secretariat
- 2013/2 : Revise the work plan version 2.0 with technical demonstration sites at GEOSS-AP
- Monthly Asia rice crop monitoring teleconferences

http://www.asia-rice.org/files/workplan.pdf

Asia-RiCE Home Page

http://www.asia-rice.org

Scope of Phase 1

- 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.

Country Phasing

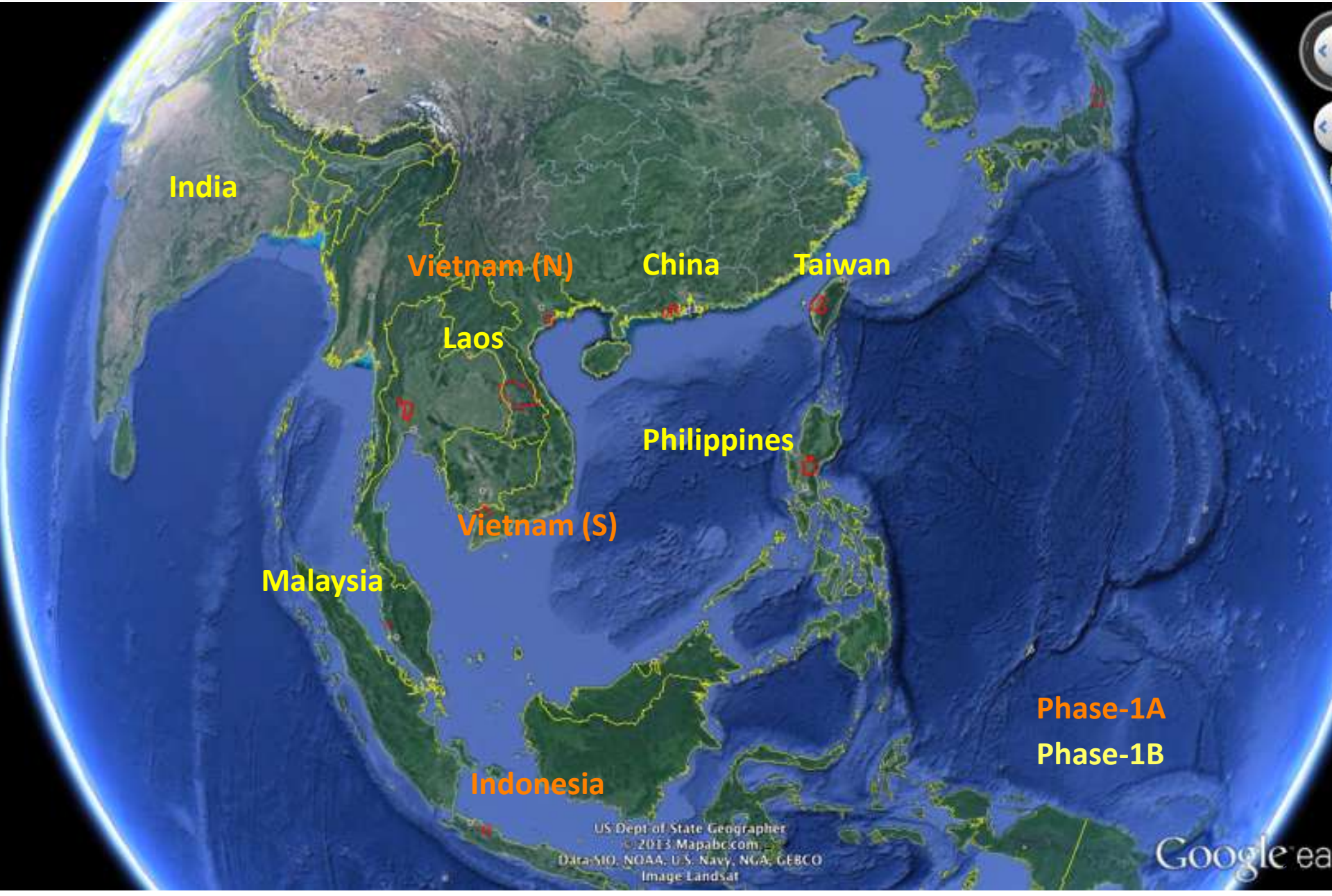
Phase-1A

- 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 (Location TBD);
- Japan (Tsuruoka, Yamagata Prefecture);
- Malaysia (IADA Barat Laut Selangor Province).
- Chinese Taipei (Taiwan) (Chang Hua, Yun Lin, and Chiayi Counties)

Technical Demonstrator Sites (TDS) for Asia-RiCE



Target Crop/Agricultural Products

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

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

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

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

1. Radarsat-2 JECAM-SOAR proposal by TDSs phase 1
- Submitted: Chinese Taipei, Indonesia, Japan, Malaysia, Philippine, Vietnam
- Preparation: China, India, LaoPDR, Thailand

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 next year (TBD)
- ALOS-2 basic observation plan is at least 7 times a year using ScanSAR

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 under-review

5. Cosmo-Skymed
- Thai and south Vietnam have some data under their own frameworks
- Need Indonesia data

6. Sentinel-1
- Coordinate with ESA

Revised our requirement document of Asia RiCE with adding Indian TDS

ALOS-2 observation plan draft

Deforestation

【伐採監視】 年9回（右9回）

・広域観測[350km]、2偏波（HH+HV）、14MHz

Wet land monitoring

【湿地観測】 年9回（右9回）

・広域観測[350km]、2偏波（HH+HV）、14MHz

Asia rice crop observation area of TDSs are almost same as tropical rainforest deforestation monitoring area using ScanSAR mode with HH+HV

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

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

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).

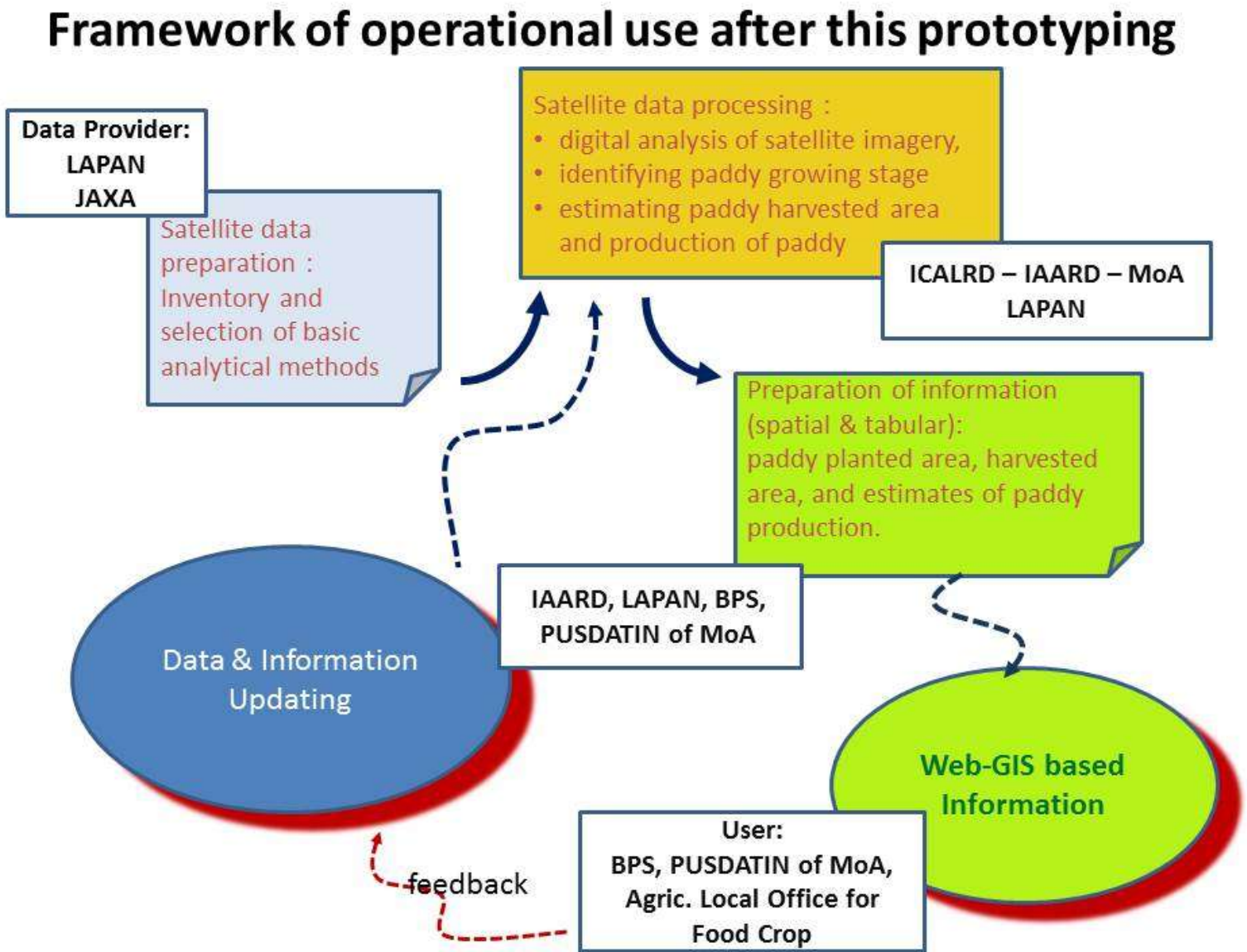
Technical/Implementation Agency:
LAPAN, Indonesian Center for Agricultural Land Resources Research and Development (ICALRD), Indonesian Agency of Agricultural Research and Development (IAARD), Ministry of Agriculture (MoA) of Republic of Indonesia, Bogor Agricultural Institute (IPB)

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

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

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

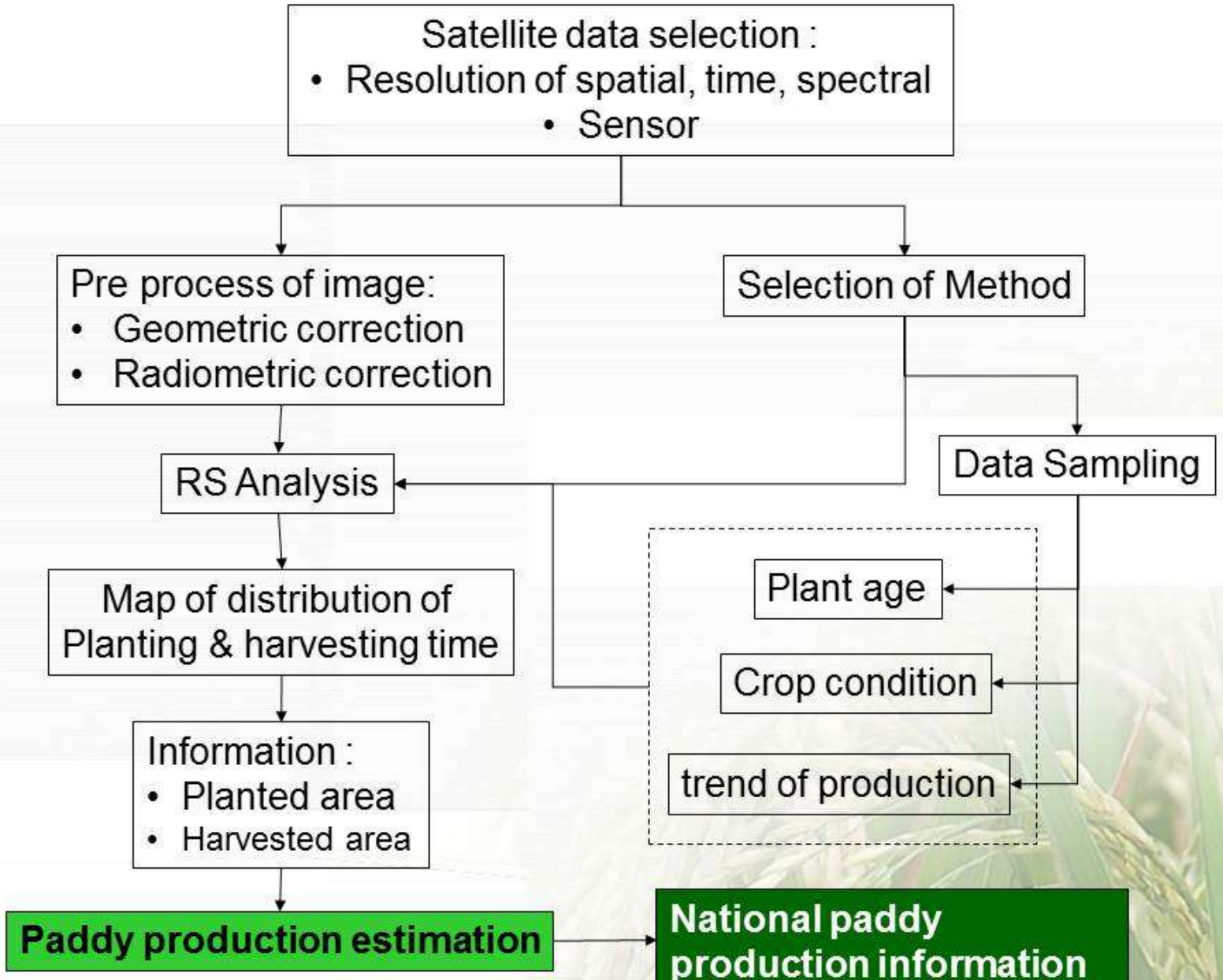


Indonesia TDS - Methodology and Data Used

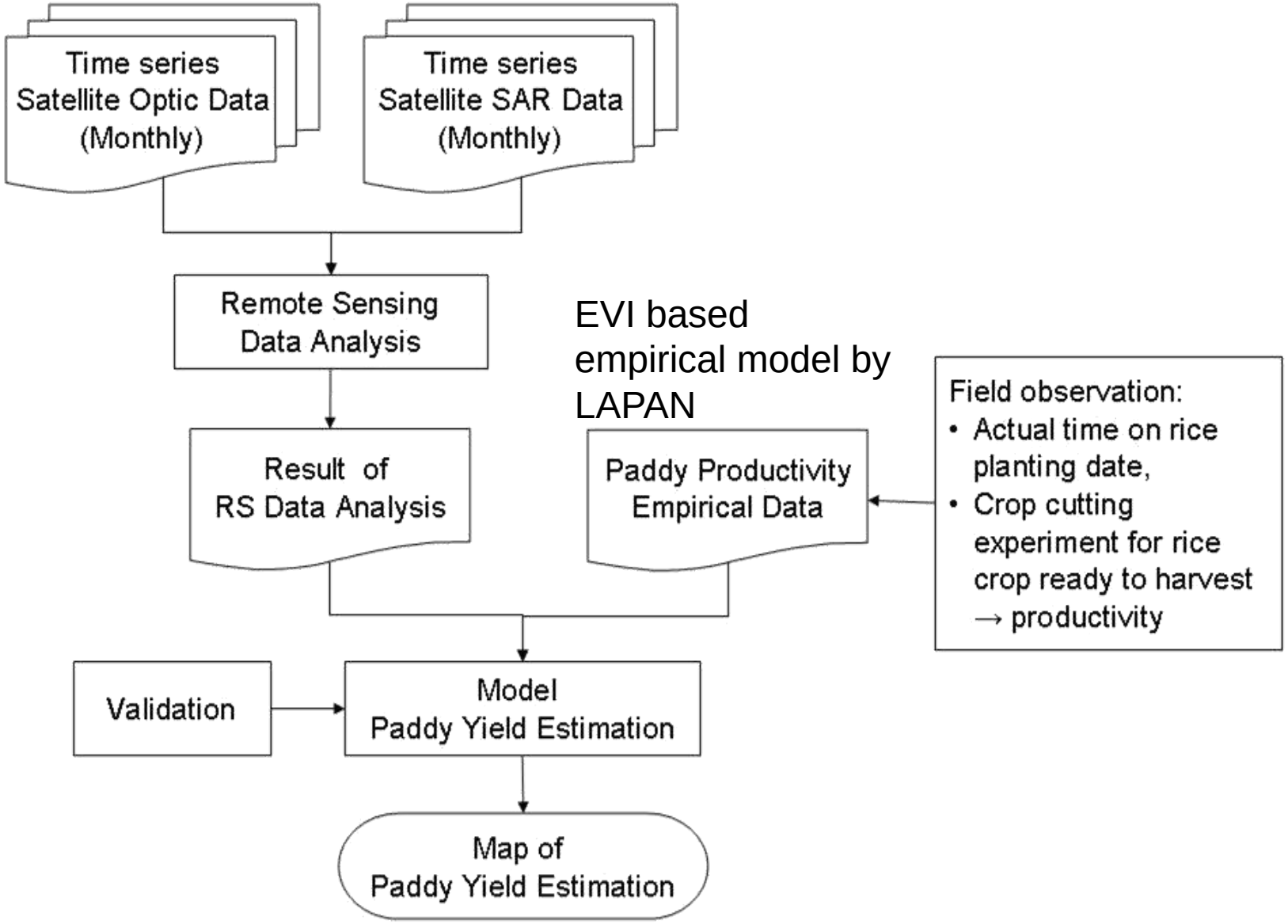
- **Study Area** : Subang of West Java (Asia Rice TDS phase 1A), South Sulawesi and South Kalimantan.

- **Data Used** :
  - ALOS (2007 – 2011)
  - Pi-SAR-L2 (2012)
  - Radarsat-2 for Subang in Asia rice (2013-2014)
  - ALOS-2, Sentinel, etc. (2014 – Future)

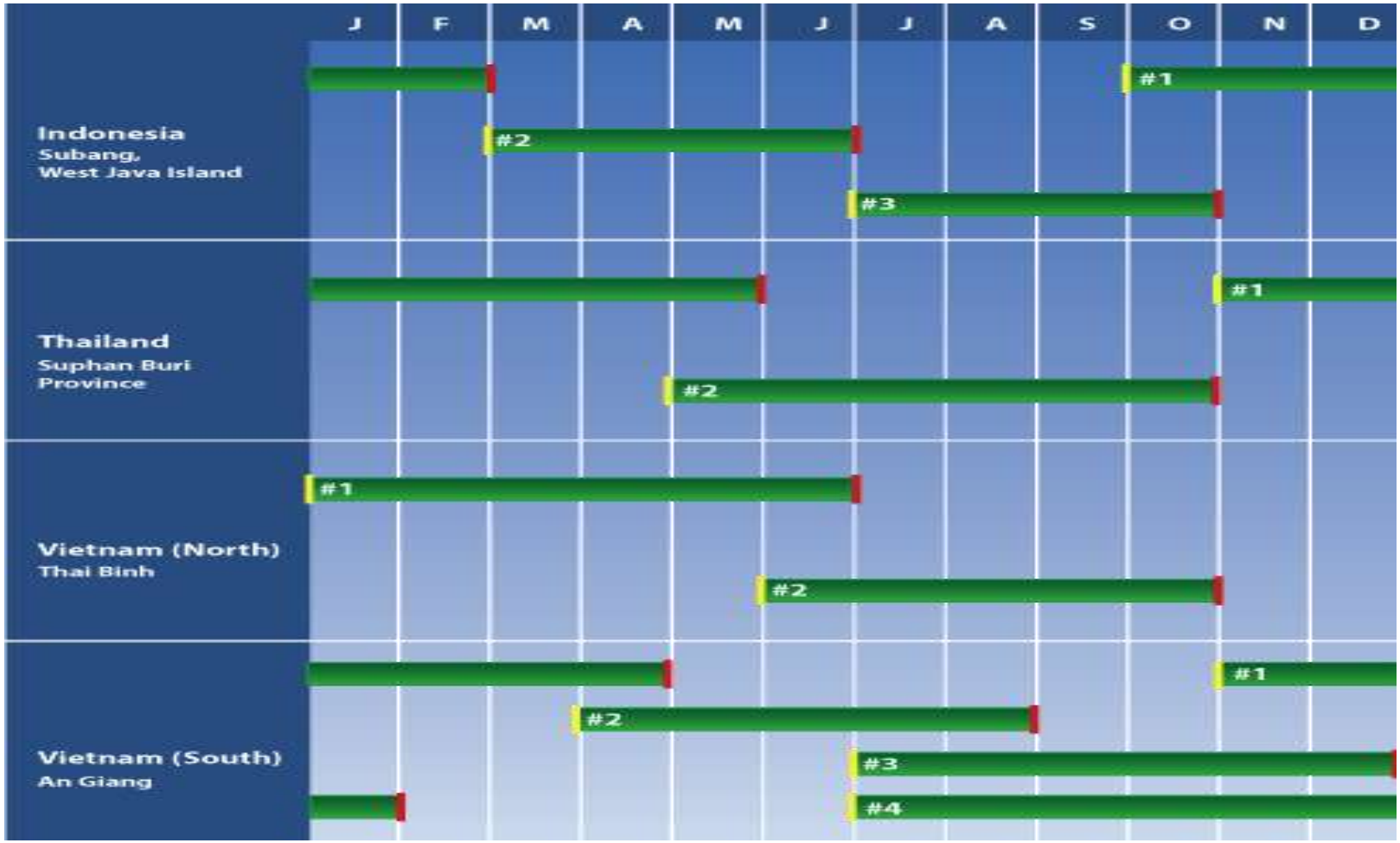
Indonesia TDS - Methodology and Data Used



Indonesia TDS - Methodology and Data Used



Phase 1A Crop Calendars



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

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

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)

Asia-RiCE Crop Estimation and Monitoring

Agro-met information by JAXA using EO and by other team members

(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)

(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

(b1)

Asia-RiCE Crop Estimation and Monitoring

(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)

GEOGLAM Global Agricultural Monitoring

(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)

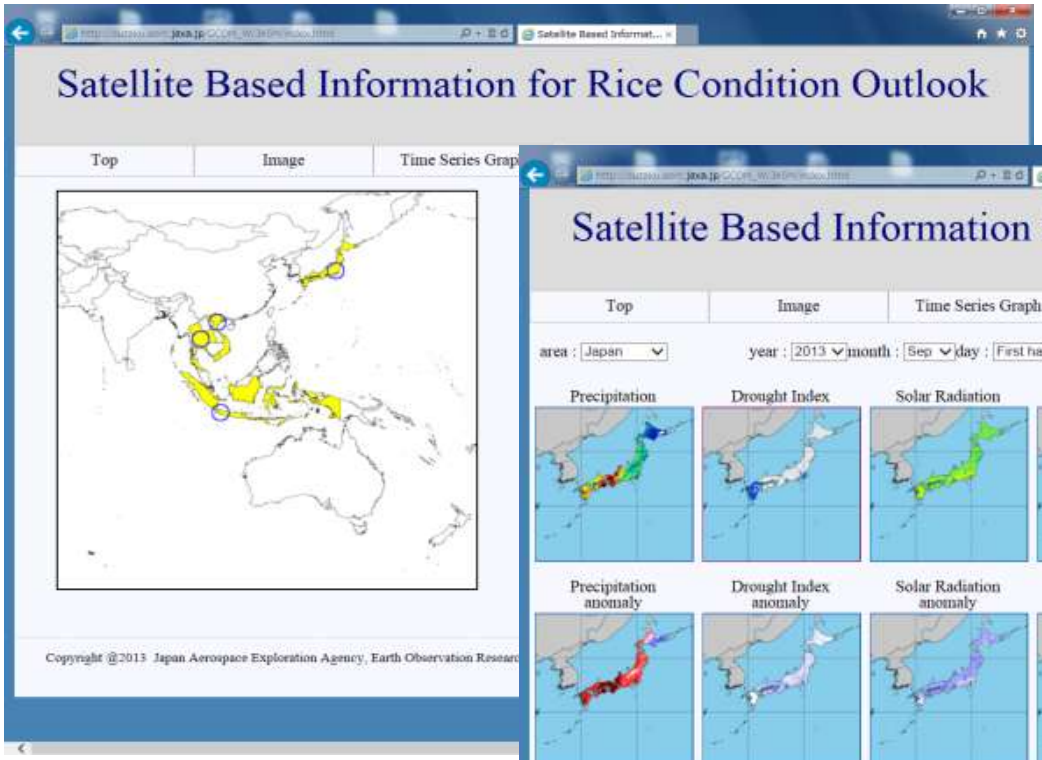
FAO

AMIS Agricultural Market Information System

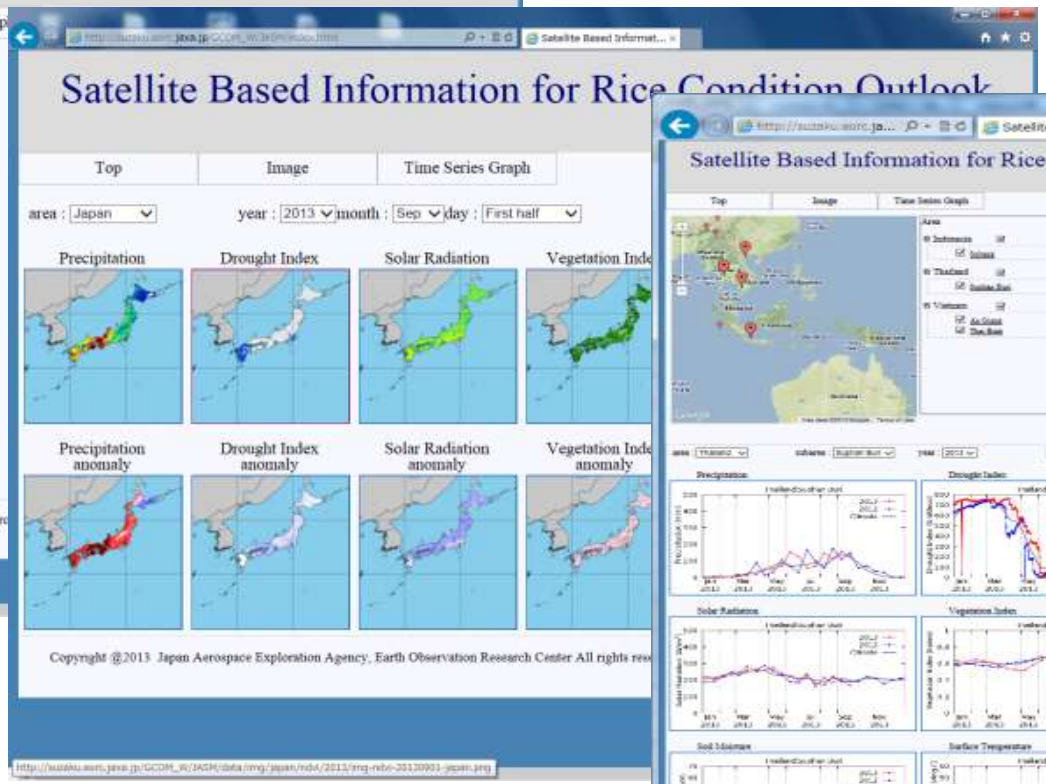
(d) Submit monthly outlook report using EO satellites information to FAO AMIS from this September

JASMIN – Agro-met. data-distribution system for Asia-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

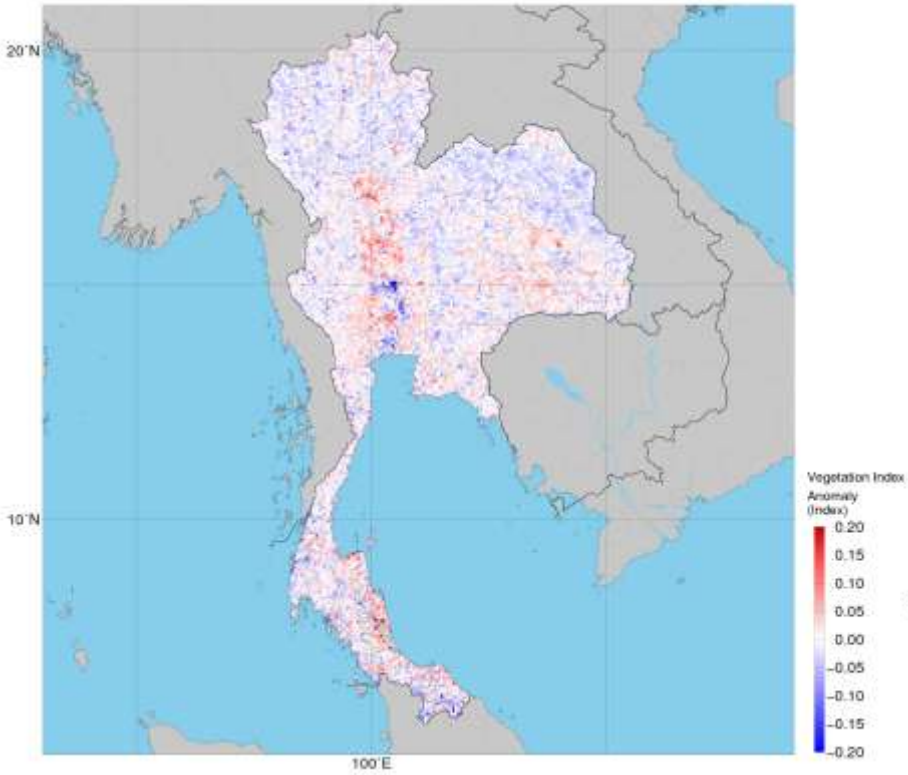
Time-Series

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

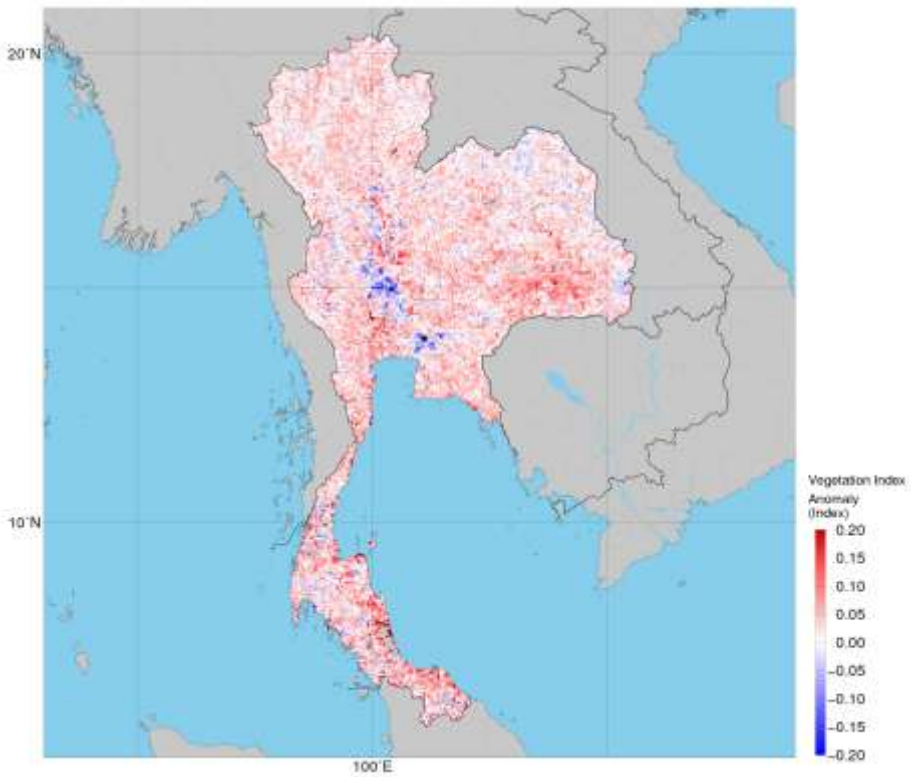
Thailand’s rice growing report for November 2013

In November, mostly of rice are in the harvesting stage especially, in the Northern and North-Eastern region. The yield is increased slightly from last year due to sufficient rainfall and favorable weather. Although there are some damage caused by flooding in the North-Eastern and Central region. The areas were affected by flood, now are recovered and there is enough water for the next crop cultivation.

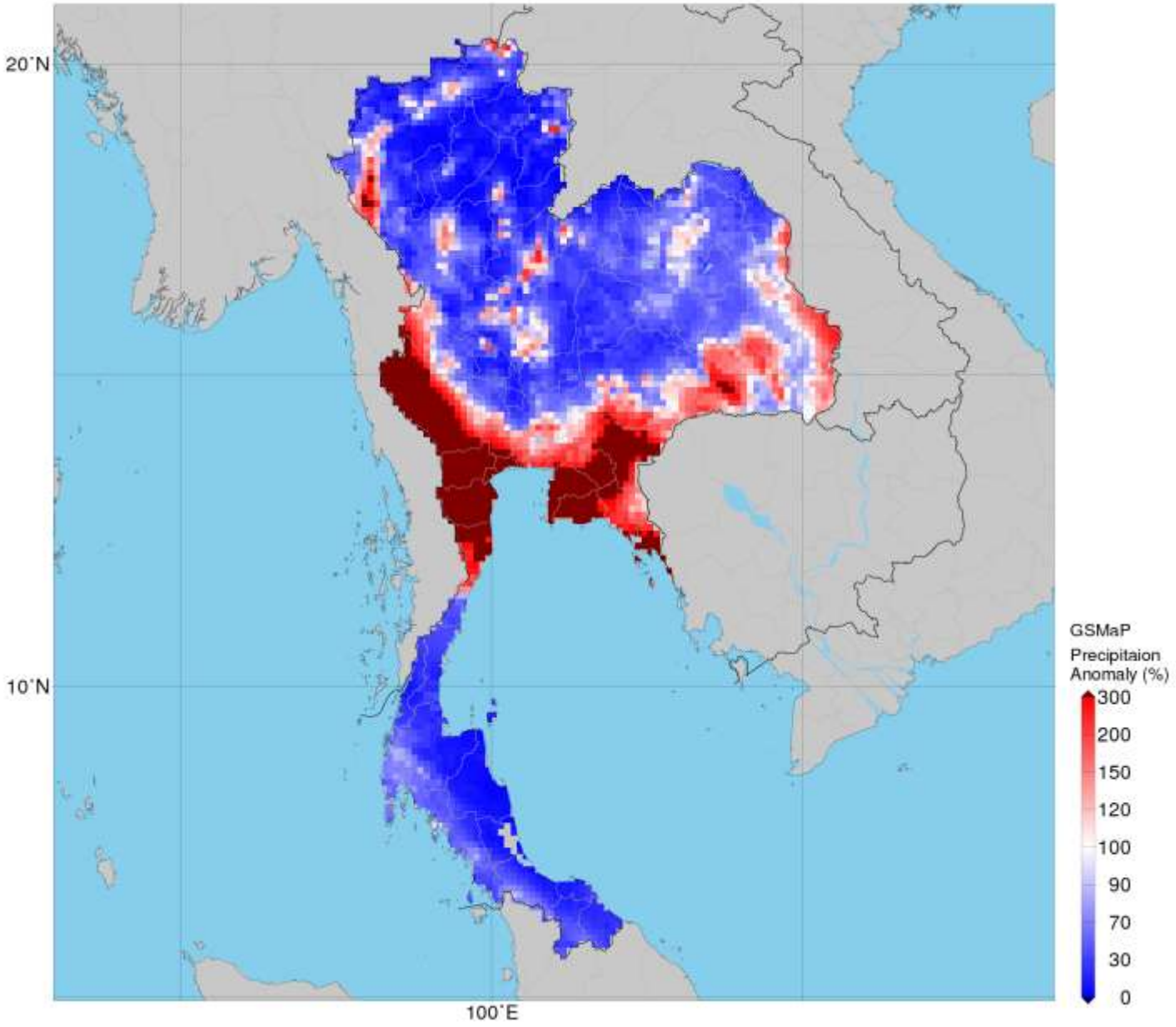
2012/11/01 – 2012/11/15

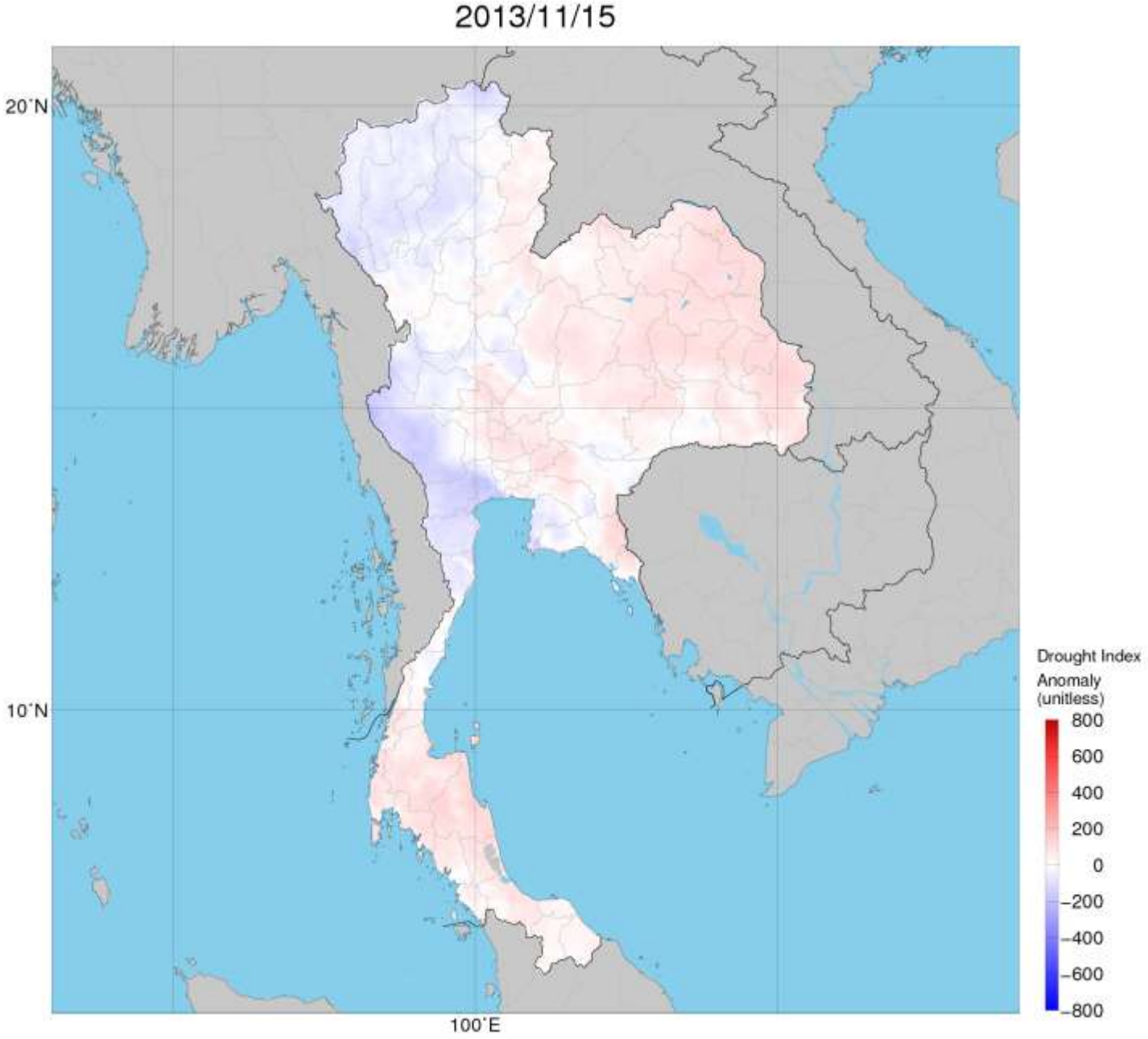


2013/11/01 – 2013/11/15



2013/11/01 – 2013/11/15

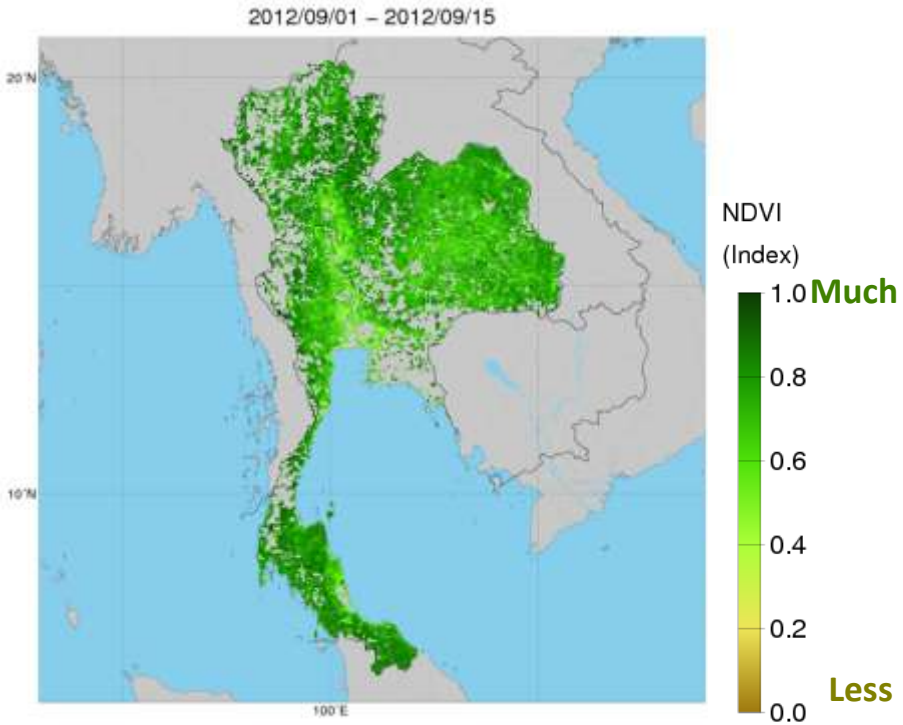



2013/11/15
20°N
10°N
100°E
Drought Index
Anomaly
(unitless)
800
600
400
200
0
−200
−400
−600
−800

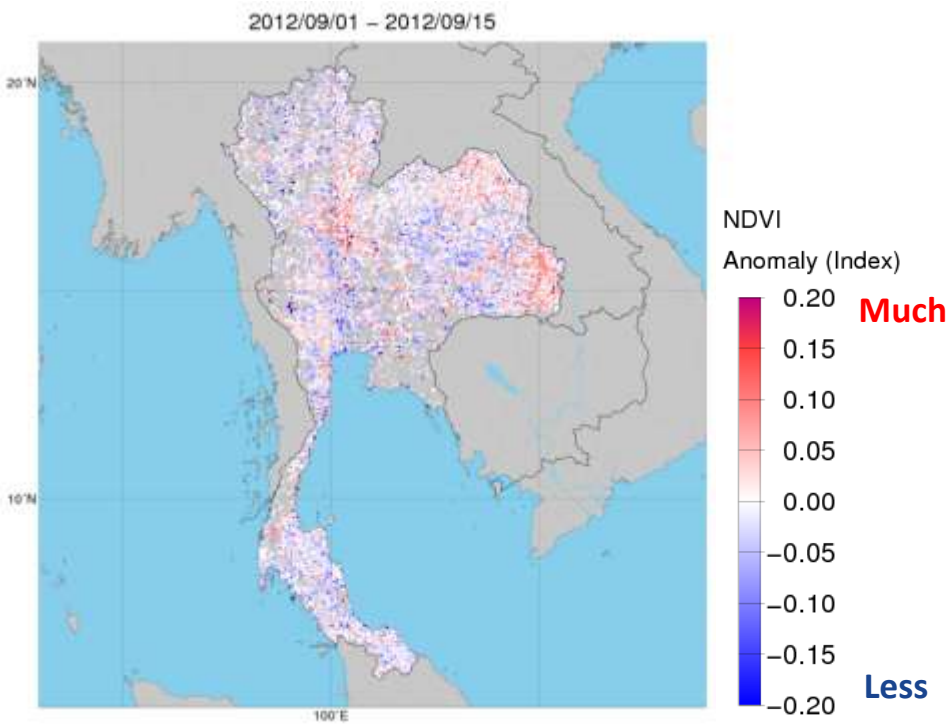
Vegetation Index

- 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



Anomaly



Assessment Source for Rice Growth Outlook

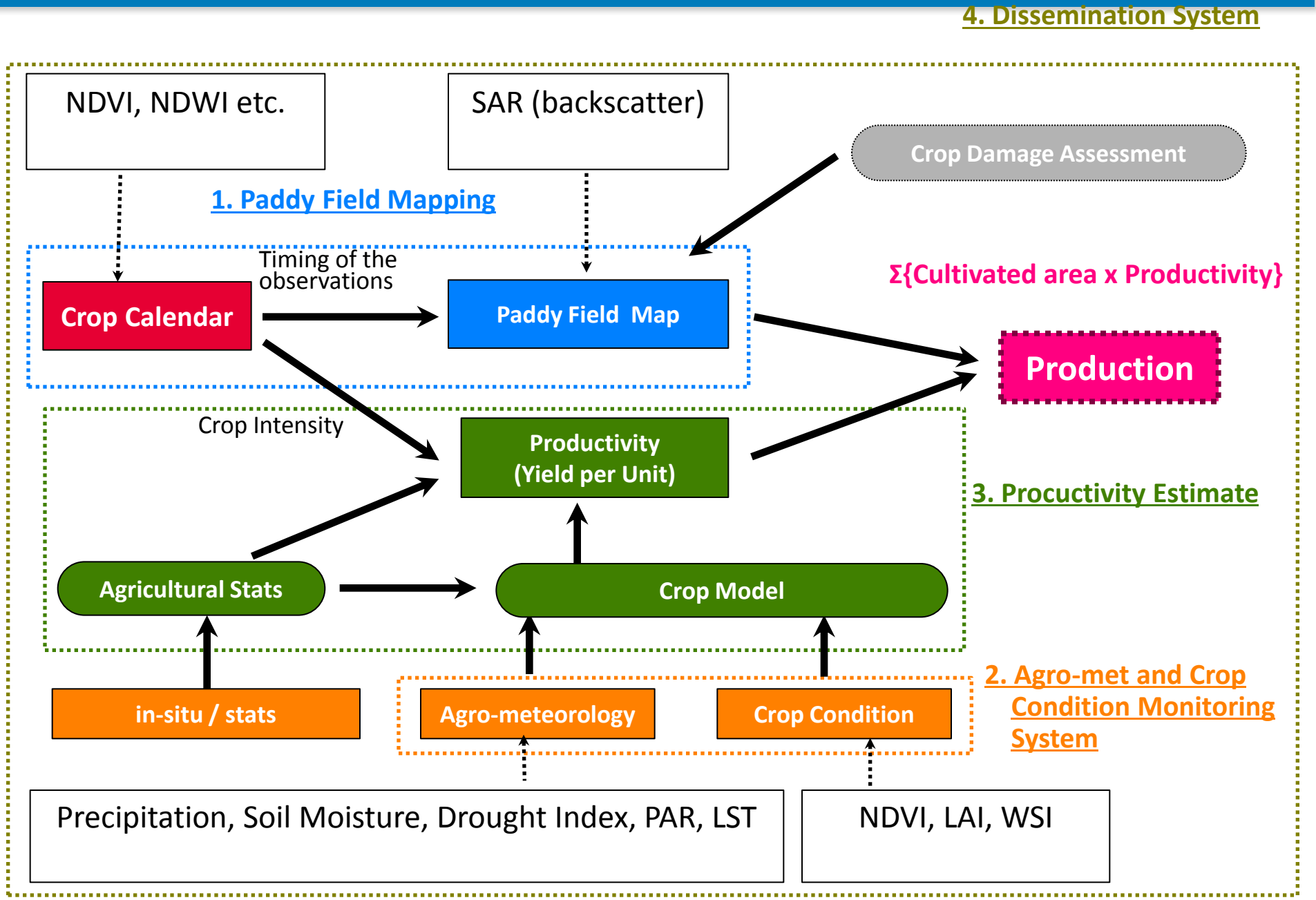
❖ Satellite observation provides "Current Condition" and "Anomaly" information and they are updated every 15 days (twice a month).

-> Add more available data to validate and/or extend parameters DB

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	2002- (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	2009- (2009-2012)	MODIS

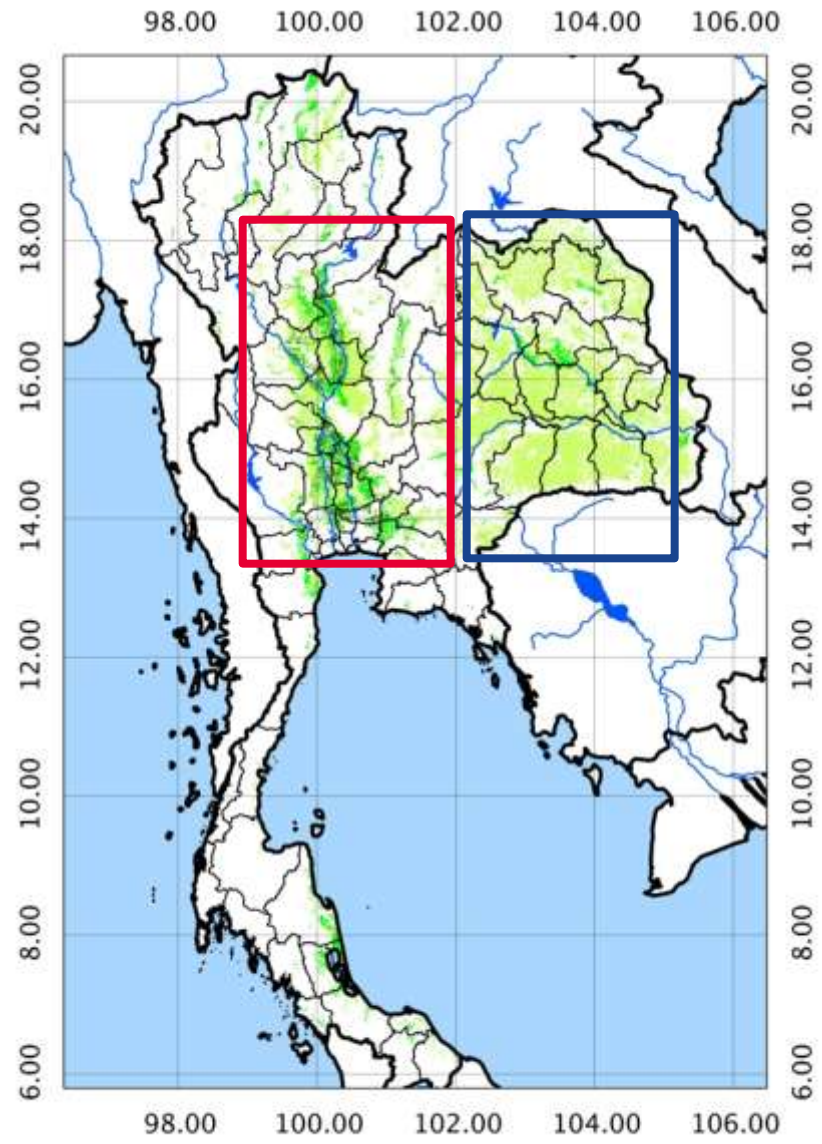
Example of rice crop area estimation using SAR under the cooperation of Japan and Thailand

Framework for Rice Crop Monitoring System

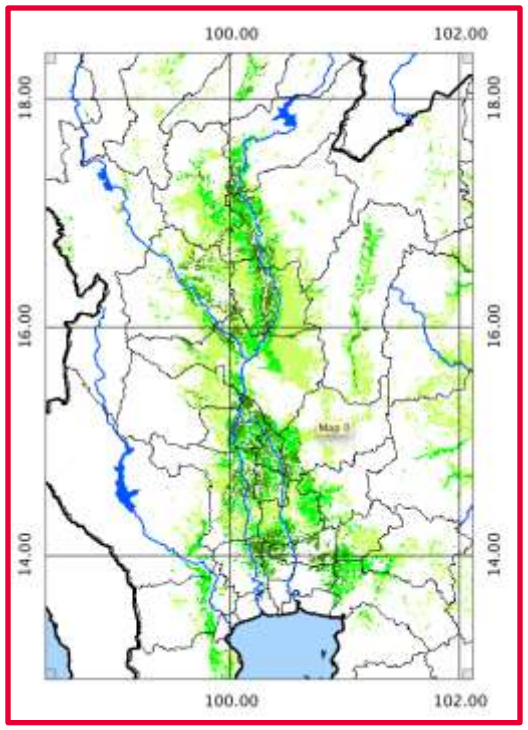


Rice Crop Calendar from time-series MODIS Data by Oyoshi

Crop Intensity Map

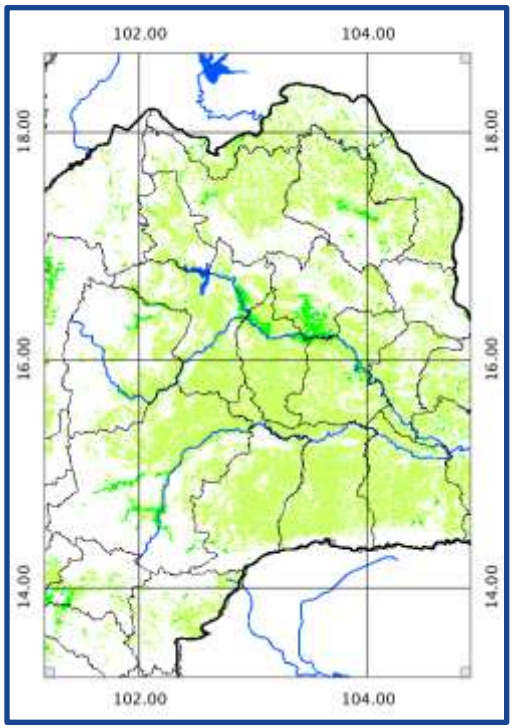


Along the Chao Phraya River



Irrigated Area

Northeastern

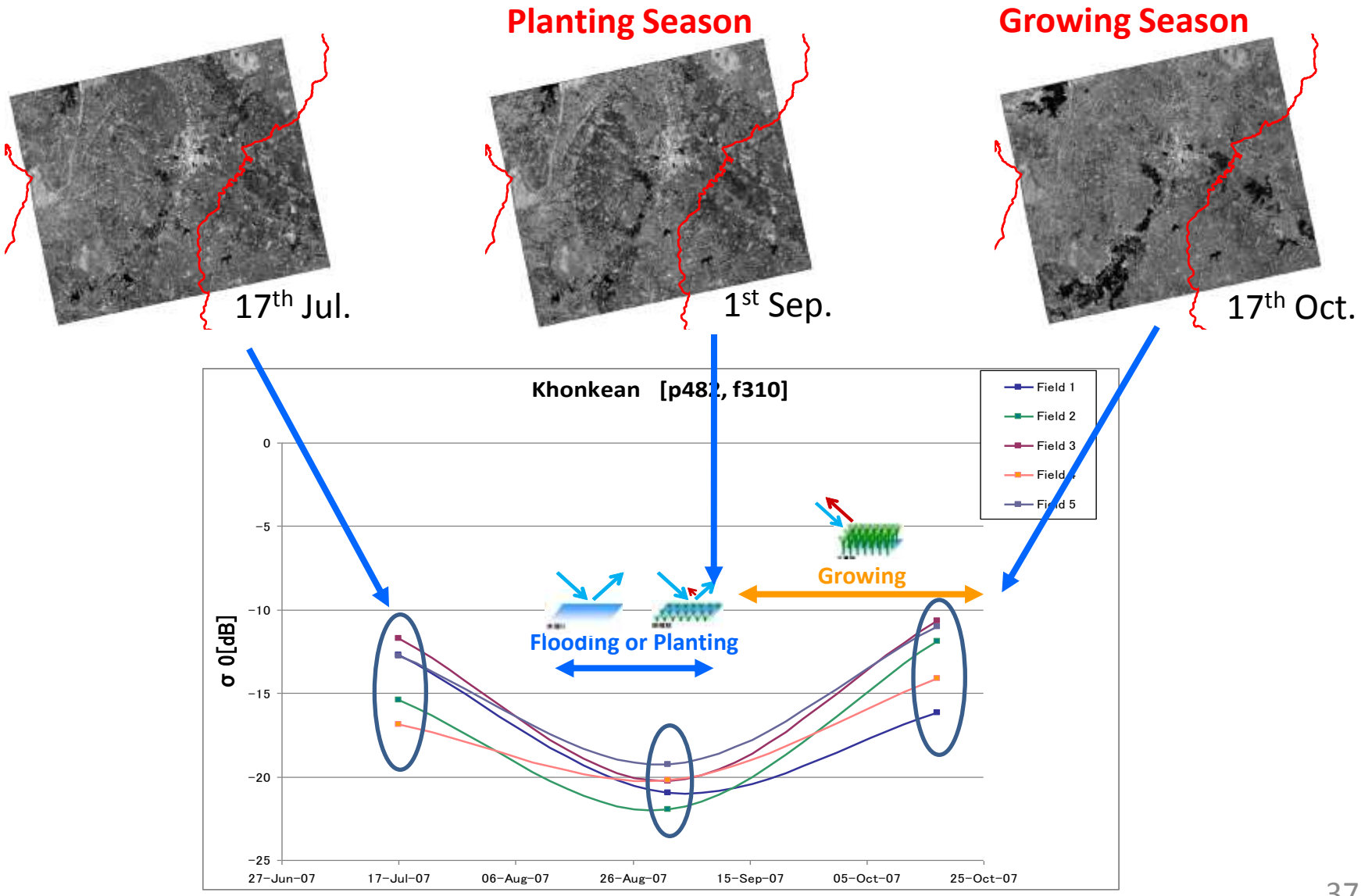


Rein-fed Area

Crop Intensity (times/year)

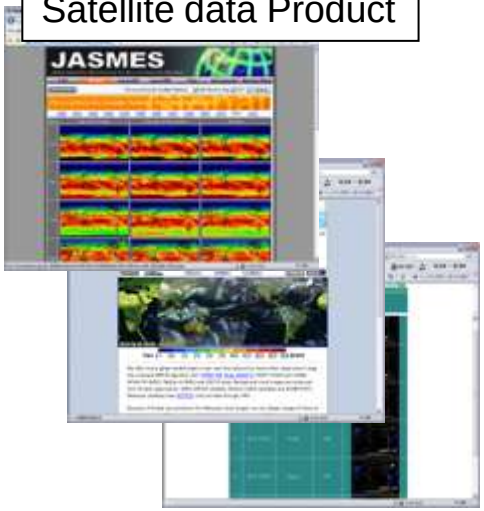
1 2 3

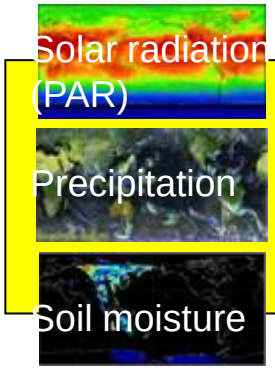
Basic Concept of crop area detection



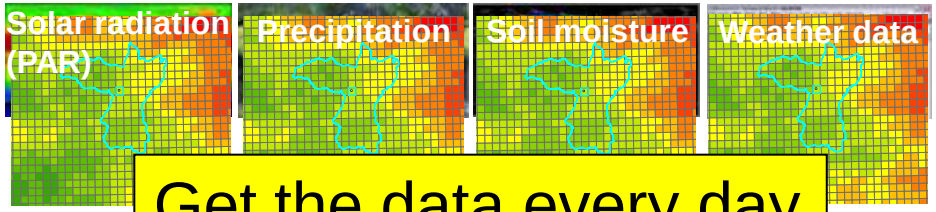
Procedure of Yield per Unit Estimation by Crop Model

JAXA
Satellite data Product



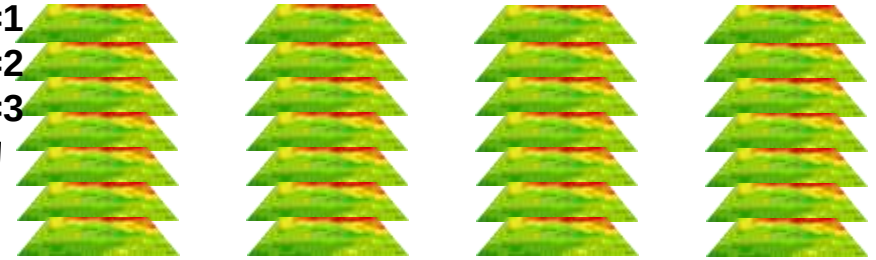


Interpolate to the mesh

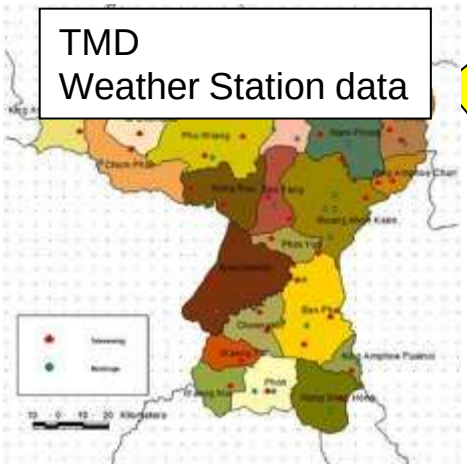


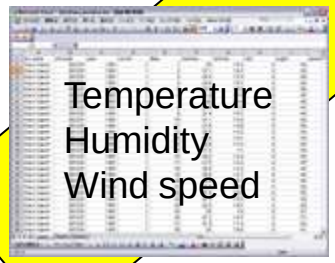
Get the data every day

Day=1
Day=2
Day=3
:
:

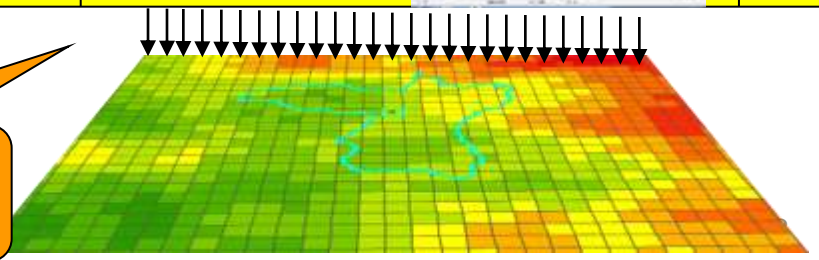


TMD
Weather Station data





KKU model



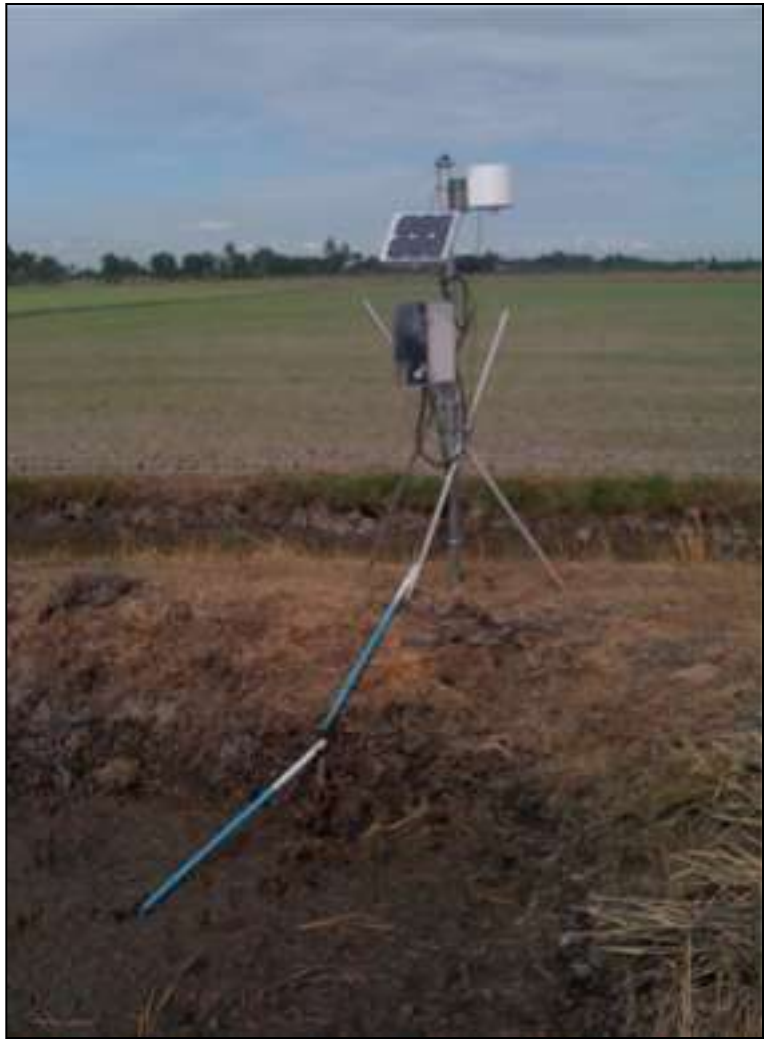
Calculate the yield
per unit each mesh

Automatic Wether Station (AWS) with Camera

❖ **Functions**
- Automatic data collection
- Wireless communication (daily)
- Powered by solar panel

❖ **Meteorological sensor**
- Air Temperature
- Precipitation (rain gauge)
- Radiation
- Wind direction and velocity

❖ **Image sensor**
- CMOS camera (120 M pix)



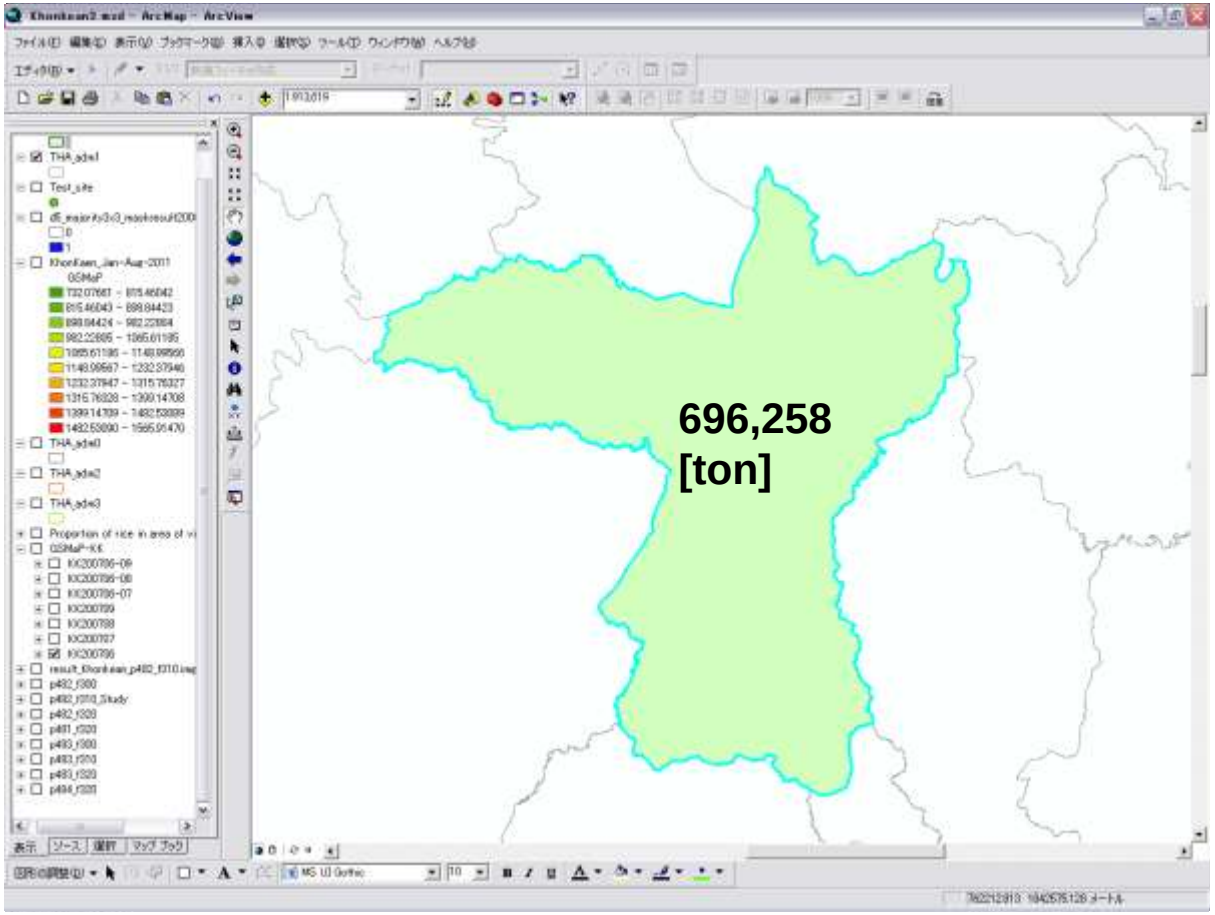
[Prof. Mizoguchi, U.Tokyo]

Paddy Fields for the Validation in Asia-RiCE

AWS in Tsuruoka, Yamagata, Japan

http://www.x-ability.jp/FieldRouter/vbox0098/

Procedure of rice crop yield estimation by acreage and yield per unit



Acreage

*

Yield per unit

Yield

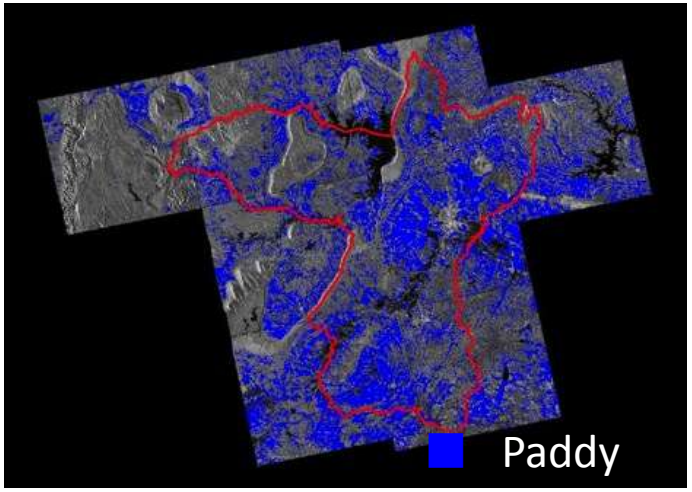
42

Rice Yield Estimation in Khon Kaen, Thailand

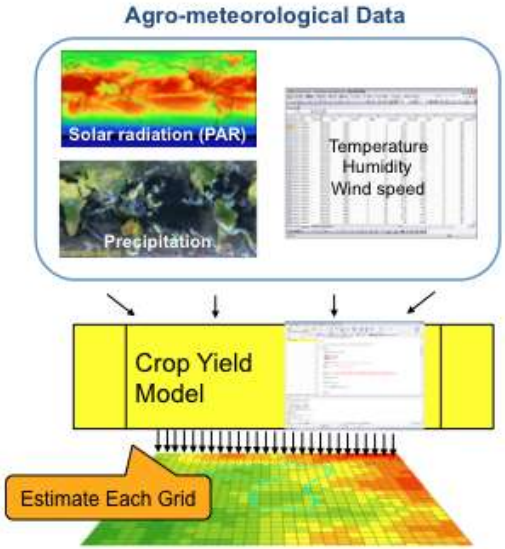
Yield = (Paddy Area) x (YPU : Yield per Unit)

Khon Kaen
Rain-fed cultivation

Paddy Field Map



YPU Estimation by Crop Model



Result of Yield Estimation

	Acreage [m2]	Yield per unit [g/m2]	Yield [ton]
Result of estimation	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%

The results are highly consistent with the validation data with the accuracy of 80%.

INAHOR : Rice Production Estimate Software

❖ **INternational Asian Harvest mOnitoring system for Rice**

- Run on Linux (Ubuntu, CentOS etc.)
- GUI based user-friendly software

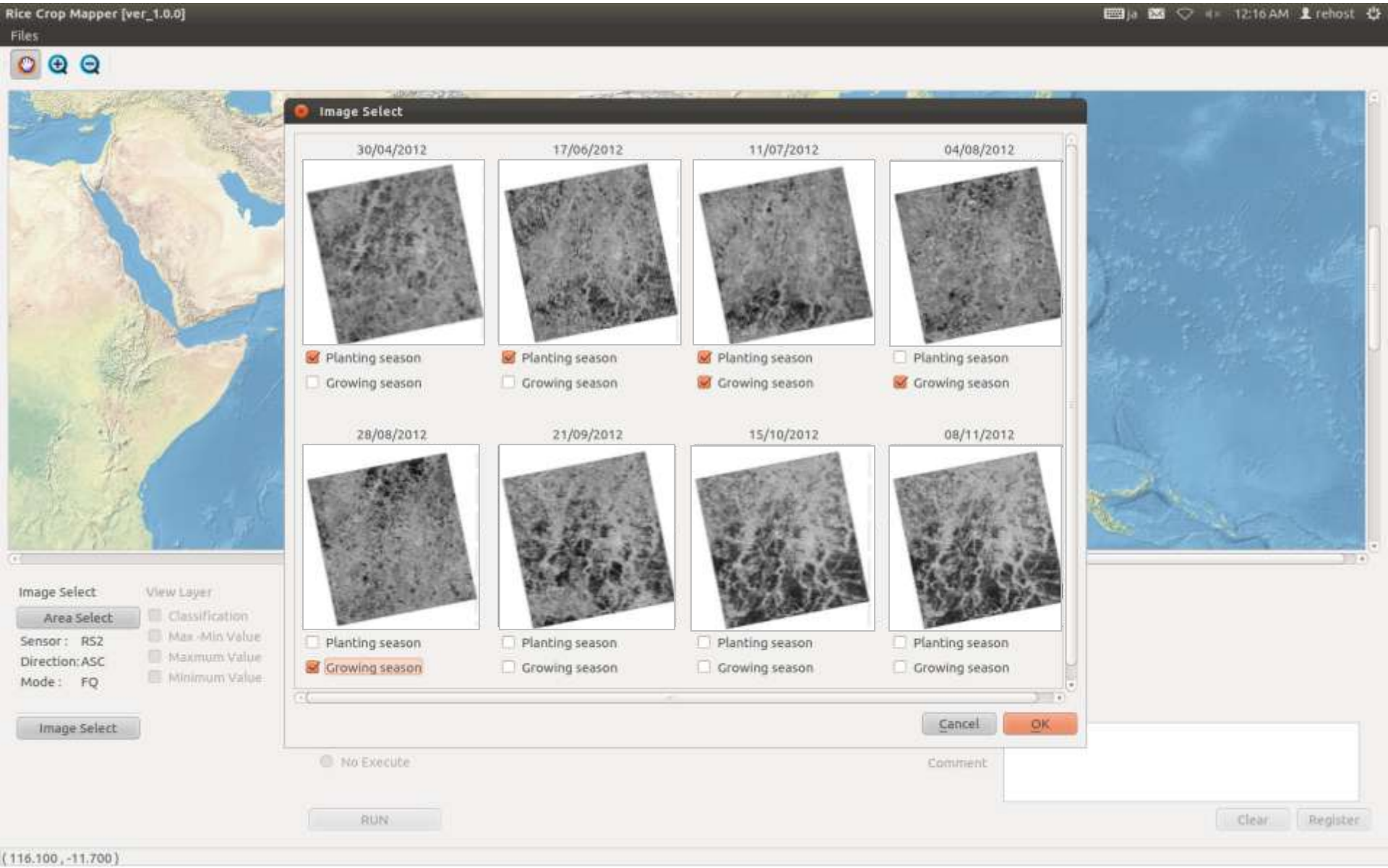
❖ **Input Data**

- **SAR data** (Planting/Vegetative season)
- GeoTiff Format

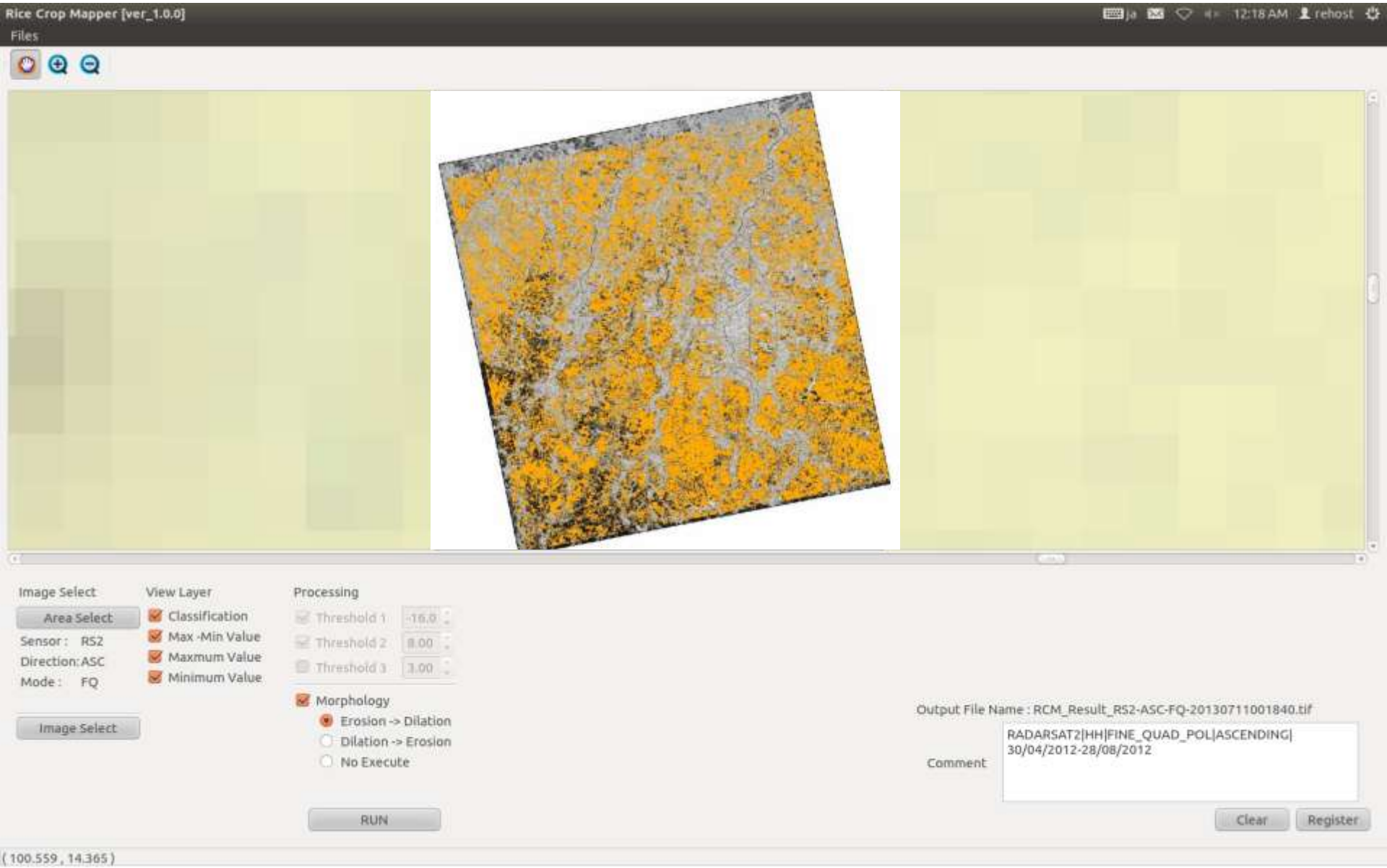
❖ **Basic Functions**

- Mapping of rice planted area
- Calculation of rice planted area (provincial)
- Calculation of rice production with yield data (provincial)

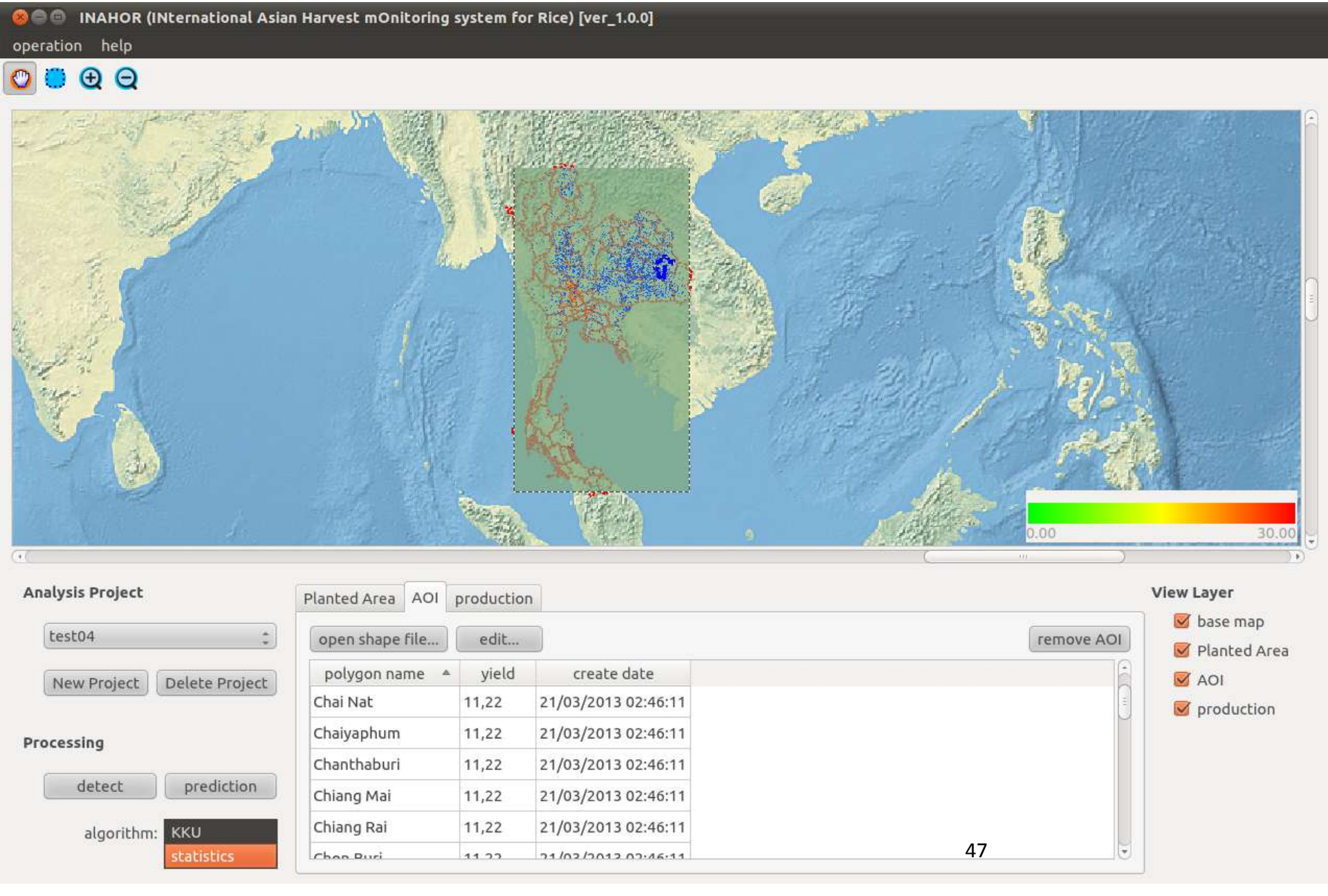
INAHOR rice crop area and yield estimation system using SAR



INAHOR paddy field estimation using temporal series SAR data



INAHOR paddy field estimation result



Next Steps

- Face-to-face meeting at APRSAF in Hanoi in Dec. 2013
- Next SAFE workshop in KL in next Apr. (with AFSIS meeting with adding new countries for outlook) and ACRS in Myanmar in next Oct. (face-to-face meeting)
- Address resource support for AMIS rice outlook/ forecasting and crop area and yield estimation to sustainable operation
- Publication of Technical Demonstrator results
  - Refinement of requirements
- Submit RAs to space agencies including JAXA, ASI, …
- Update to Asia-RiCE Work Plan for 2014
  - New Technical Demonstrators?
  - New sensors? - including Himawari 8-9
  - Integration of new activities


Asia-RiCE
Crop Estimation and Monitoring