

ALOS Kyoto & Carbon Initiative 22nd Science Team meeting (KC#22)

Asia-RiCE: Rice Crop Estimation and Monitoring (the role of PALSAR-2)

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On behalf of the GEOGLAM Asia-RiCE team

**Feb 16, 2016
at RESTEC HQ, Tokyo**



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Background of Asia-RiCE

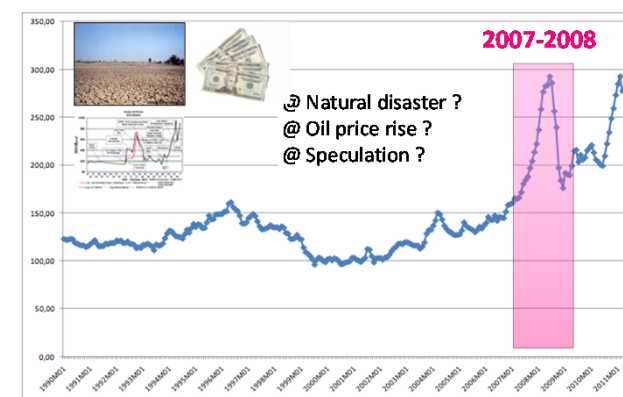
Background of GEOGLAM/Asia-RiCE

G20 FRANCE summit 2011 :

- The G20 Agriculture Ministers agreed on an **“Action Plan on food price volatility and agriculture”** in June 2011.
- The action plan was submitted at a Summit in November 2011.
- In order to improve crop production projections and weather forecasting, the use of modern tools was promoted, **in particular remote sensing**.



Figure 1: Food Price Index, monthly, January 1990–May 2011 (2000 = 100)



Source: World Bank (2011)

Part of the G20 Head of States Declaration:

44. We commit to improve market information and transparency in order to make international markets for agricultural commodities more effective. To that end, **we launched**:

- The **“Agricultural Market Information System” (AMIS)** in Rome on September 15, 2011, **to improve information on markets**. It will enhance the quality,
- The **“Global Agricultural Geo-monitoring Initiative” (GEO GLAM)** in Geneva on September 22-23, 2011. This initiative will **coordinate satellite monitoring observation systems** in different regions of the world in order to enhance crop production projections and weather forecasting data.

Background of GEOGLAM/Asia-RiCE

- The **GEO GLAM** serves as a useful input for the **AMIS**. (four type of commodity crops – wheat, maize, **rice**, and soybeans)
- Since rice is the main commodity crop in Asia, Japan Aerospace Exploration Agency (JAXA) proposes and leads the Asian Rice Crop Estimation & Monitoring project (Asia-RiCE) for GEO GLAM.
- Asia-RiCE is a collaborative effort between a number of Asian organizations.



Asia-RiCE Home Page – www.asia-rice.org



The screenshot shows the Asia-RiCE Home Page. The browser address bar displays www.asia-rice.org/index.php. The page features the Asia-RiCE logo (Crop Estimation and Monitoring) and the GEOGLAM logo (Global Agricultural Monitoring). A navigation menu includes links for Home, About, Work Plan, News/Events, GEOGLAM, Contacts, and Links. A large image of rice stalks is prominently displayed. Below the image, a text box states: "Rice is the staple food for more than half of humanity, with 90% of the world crop grown and consumed in Asia." The "About" section describes the project as an ad hoc team effort for the GEOGLAM initiative. It highlights the importance of rice as a staple food and the need for real-time monitoring due to population growth and climate change. A "Download the latest Work Plan" button is visible. The "Objectives" section lists three goals: ensuring Asian countries receive full benefits of GEOGLAM, prioritizing rice crop monitoring within the GEOGLAM initiative, and establishing a framework for coordination. The footer mentions the website is provided by AXA and is part of the GEO Group on Earth Observations.

Asia-RiCE
Crop Estimation and Monitoring

GEOGLAM
Global Agricultural Monitoring

Home About Work Plan News/Events GEOGLAM Contacts Links

Rice is the staple food for more than half of humanity, with 90% of the world crop grown and consumed in Asia.

About

Asia-Rice is the work of an ad hoc team of stakeholders with an interest in the development of an Asian Rice Crop Estimation & Monitoring (Asia-RICE) component for the GEO Global Agricultural Monitoring (GEOGLAM) initiative.

Rice is the staple food for more than half of humanity - with 90% of the world crop grown and consumed in Asia.

World population, and therefore demand for food, has increased linearly over the last fifty years (+80M/year), and is projected to keep growing until around 2050 up to 9 billion inhabitants (United Nations Department of Economic and Social Affairs, Population Division 2004). This conjuncture is prone to create tensions in food markets that could lead to world food price crises, as in 2008 when the price of rice more than doubled in only seven months. In this context of price instability and threatened food security, tools to monitor rice production in real-time are highly needed by governments, traders and decision makers.

Accurate information is needed on the spatial distribution of rice fields, water resource management, risk occurrence and annual production projections. However, most agricultural surveys rely mainly on statistics based on limited ground samplings at which data are extrapolated on a national scale. Although the census can provide statistical estimates, slow and unsystematic collection of data can limit the ability to make timely decisions.

Moreover, rice agriculture is strongly linked to environmental issues, from water management to climate change. For these reasons, long term inter-annual monitoring is also required in order to study the production and cultural impacts of these factors. Satellite remote sensing can support this long term monitoring requirement at regional and global scales.

Objectives

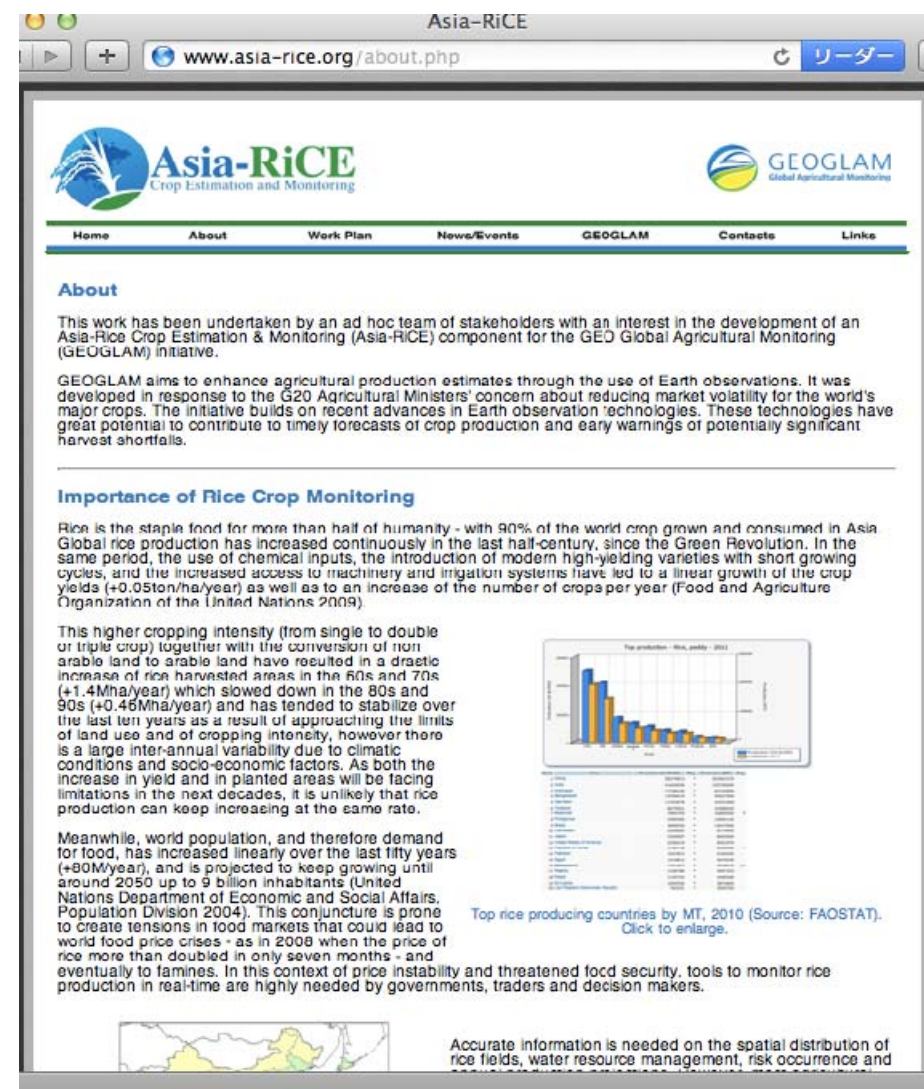
Asia-RICE describes a work plan for the definition and development of the Asia-RICE component for GEOGLAM. The objectives are:

- To ensure that Asian countries receive the full potential benefits of GEOGLAM, and that they are suitably engaged and prepared to do so;
- To ensure that rice crop monitoring issues are given suitable priority and attention within the scope of the full GEOGLAM initiative, including in the development of the observing requirements; and
- To establish a framework for the coordination necessary to engage, manage and support the various stakeholders.

The regional activities suggested by the Asia-RICE Work Plan will be consistent with and undertaken within the broader GEOGLAM Work Plan and there will be a number of interdependencies and interchanges between the two Plans.

Website provided by AXA

GEO GROUP ON EARTH OBSERVATIONS



The screenshot shows the Asia-RiCE About Page. The browser address bar displays www.asia-rice.org/about.php. The page features the Asia-RiCE logo and the GEOGLAM logo. A navigation menu includes links for Home, About, Work Plan, News/Events, GEOGLAM, Contacts, and Links. The "About" section describes the project as an ad hoc team effort for the GEOGLAM initiative. It highlights the importance of rice as a staple food and the need for real-time monitoring due to population growth and climate change. The "Importance of Rice Crop Monitoring" section discusses the historical increase in rice production and the challenges of maintaining growth in the future. A bar chart titled "Top production - rice, paddy - 2011" shows the top rice-producing countries by metric tons (MT) in 2011. The chart lists countries such as China, India, and the United States. The footer mentions the website is provided by AXA and is part of the GEO Group on Earth Observations.

Asia-RiCE
Crop Estimation and Monitoring

GEOGLAM
Global Agricultural Monitoring

Home About Work Plan News/Events GEOGLAM Contacts Links

About

This work has been undertaken by an ad hoc team of stakeholders with an interest in the development of an Asia-Rice Crop Estimation & Monitoring (Asia-RICE) component for the GEO Global Agricultural Monitoring (GEOGLAM) initiative.

GEOGLAM aims to enhance agricultural production estimates through the use of Earth observations. It was developed in response to the G20 Agricultural Ministers' concern about reducing market volatility for the world's major crops. The initiative builds on recent advances in Earth observation technologies. These technologies have great potential to contribute to timely forecasts of crop production and early warnings of potentially significant harvest shortfalls.

Importance of Rice Crop Monitoring

Rice is the staple food for more than half of humanity - with 90% of the world crop grown and consumed in Asia. Global rice production has increased continuously in the last half-century, since the Green Revolution. In the same period, the use of chemical inputs, the introduction of modern high-yielding varieties with short growing cycles, and the increased access to machinery and irrigation systems have led to a linear growth of the crop yields (+0.05ton/ha/year) as well as to an increase of the number of crops per year (Food and Agriculture Organization of the United Nations 2009).

This higher cropping intensity (from single to double or triple crop) together with the conversion of non arable land to arable land have resulted in a drastic increase of rice harvested areas in the 60s and 70s (+1.4Mha/year) which slowed down in the 80s and 90s (+0.46Mha/year) and has tended to stabilize over the last ten years as a result of approaching the limits of land use and of cropping intensity, however there is a large inter-annual variability due to climatic conditions and socio-economic factors. As both the increase in yield and in planted areas will be facing limitations in the next decades, it is unlikely that rice production can keep increasing at the same rate.

Meanwhile, world population, and therefore demand for food, has increased linearly over the last fifty years (+80M/year), and is projected to keep growing until around 2050 up to 9 billion inhabitants (United Nations Department of Economic and Social Affairs, Population Division 2004). This conjuncture is prone to create tensions in food markets that could lead to world food price crises - as in 2008 when the price of rice more than doubled in only seven months - and eventually to famines. In this context of price instability and threatened food security, tools to monitor rice production in real-time are highly needed by governments, traders and decision makers.

Top production - rice, paddy - 2011

Top rice producing countries by MT, 2010 (Source: FAOSTAT).
Click to enlarge.

Accurate information is needed on the spatial distribution of rice fields, water resource management, risk occurrence and

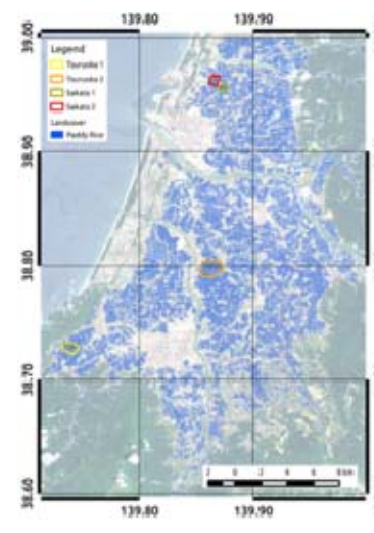
For more information, please visit our home page.

Plan of Asia-RiCE

Asia-RiCE Target Agricultural Products

ID	Product
P1	Rice Planting Area Estimates and Mapping
P2	Crop Calendars/Crop Growth Status
P3	Crop Damage Assessment
P4	Agro-meteorological Information Products
P5	Production Estimation and Forecasting

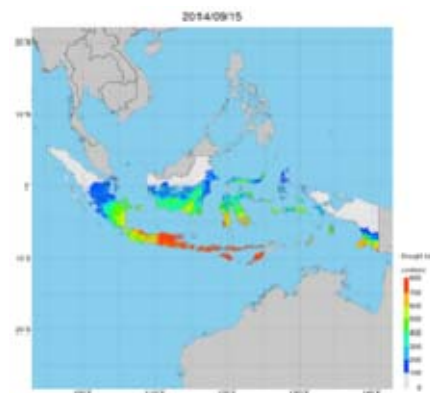
Example of Products



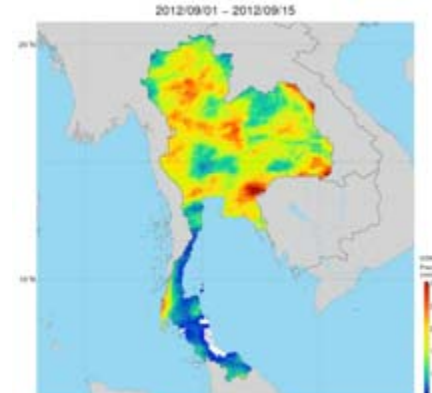
P1: Planted Area



P2: Crop Calendar



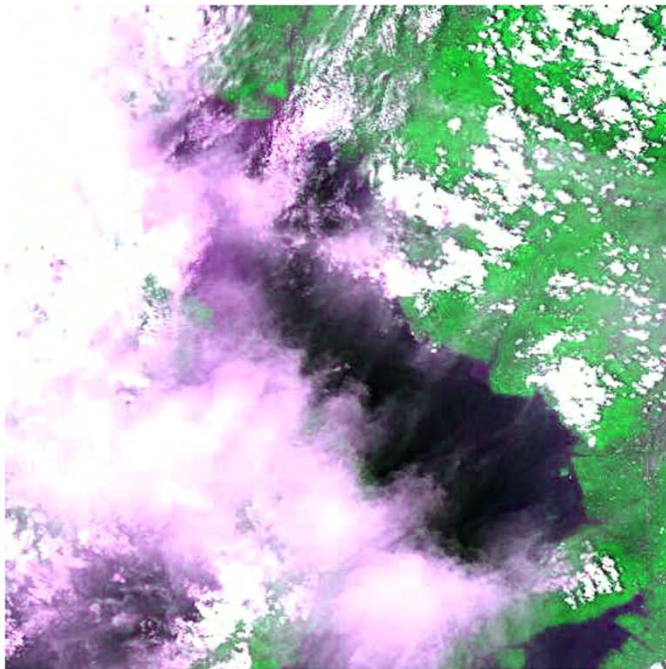
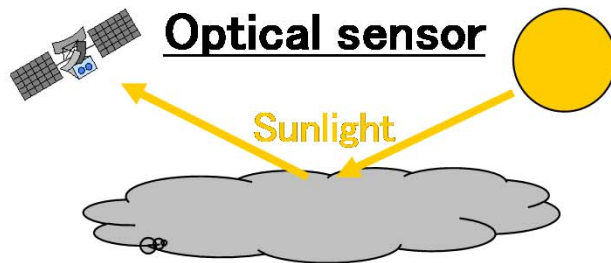
P3: Drought Warning



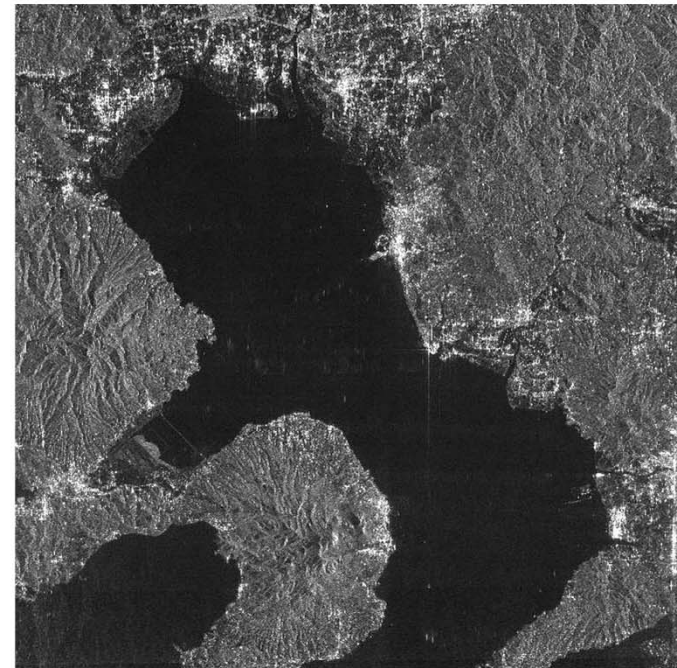
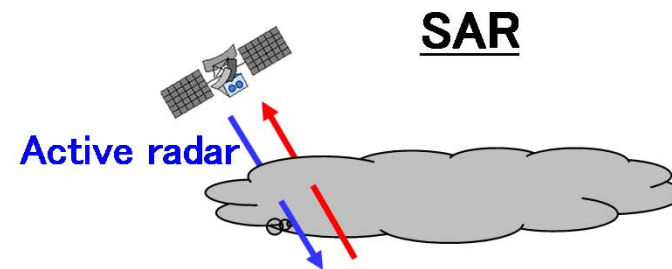
P4: Precipitation

Advantage of synthetic aperture radar (SAR)

SAR is useful in Asian countries which have a lot of cloud, since microwave can penetrate the cloud.



ALOS AVNIR-2 : The cloud covers the ground in the optical sensor image.



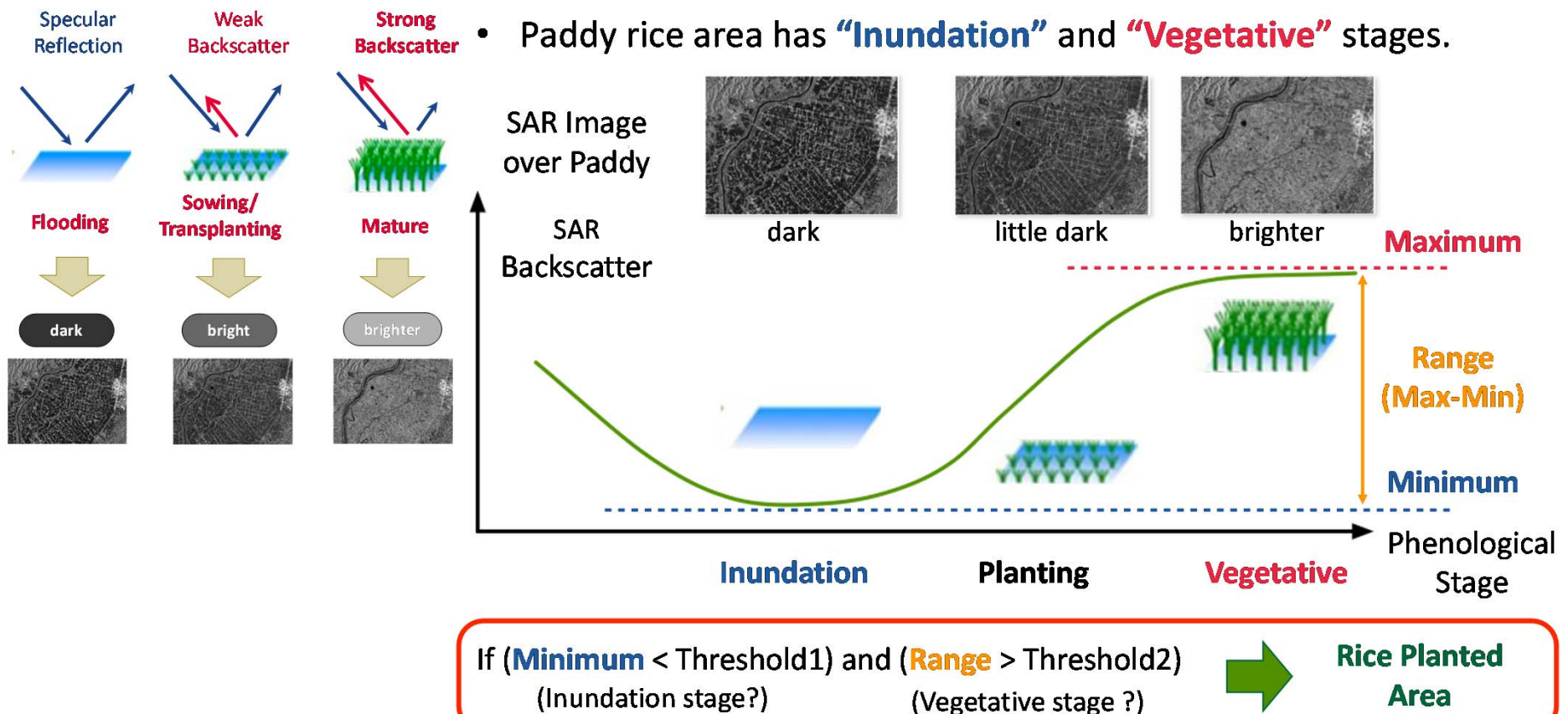
ALOS PALSAR : SAR can observe the ground under the cloud.

Observed
simultaneously





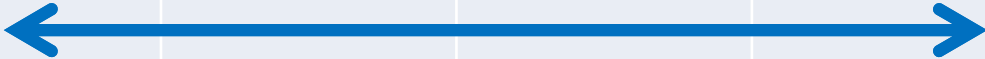

Basic concept for identifying rice planted area

Rice area can be identified by analyzing characteristics which is the change of backscatter at rice field.

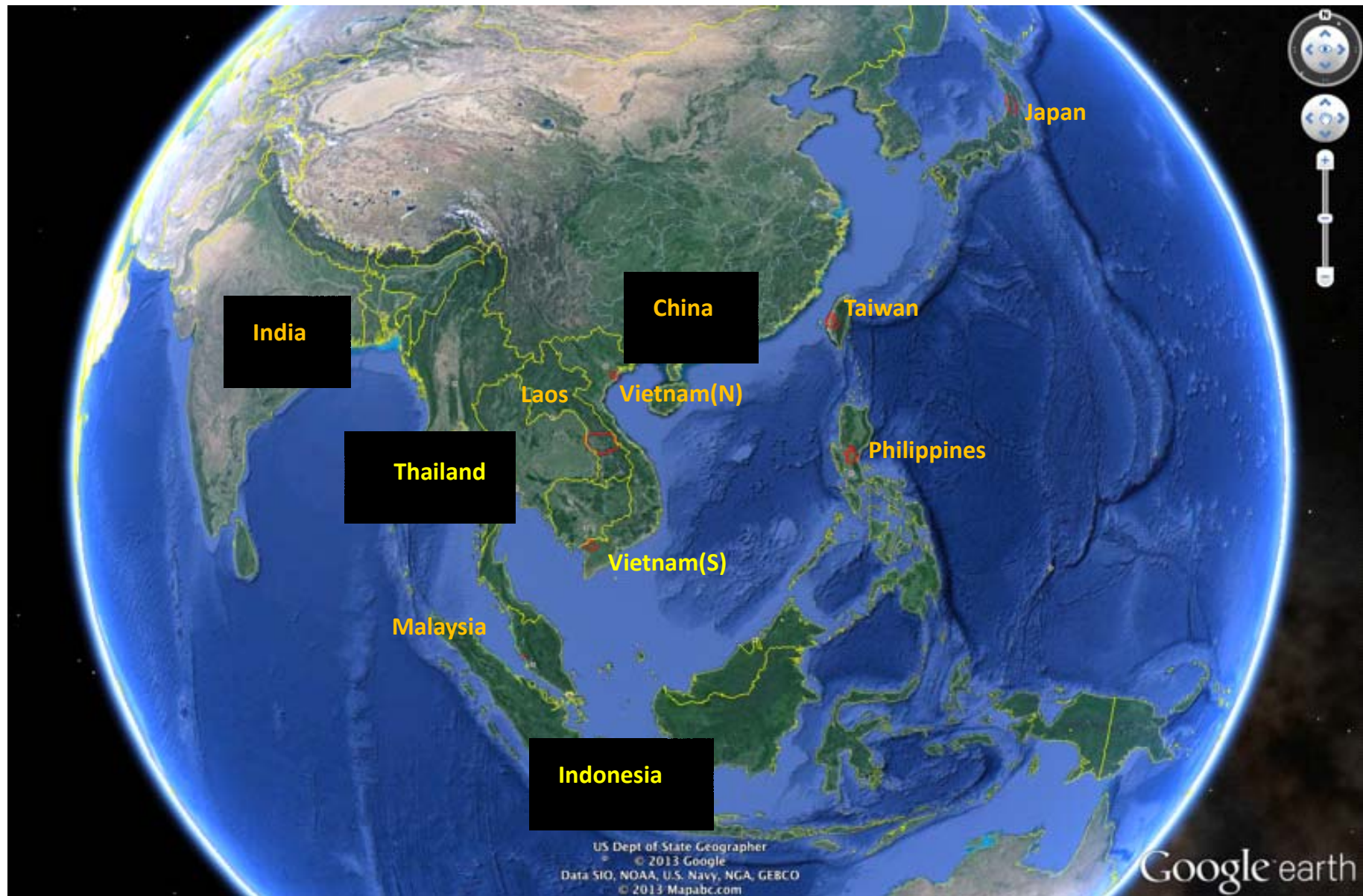
The area where is dark in planting stage and becomes brighter in vegetative stage is paddy field.



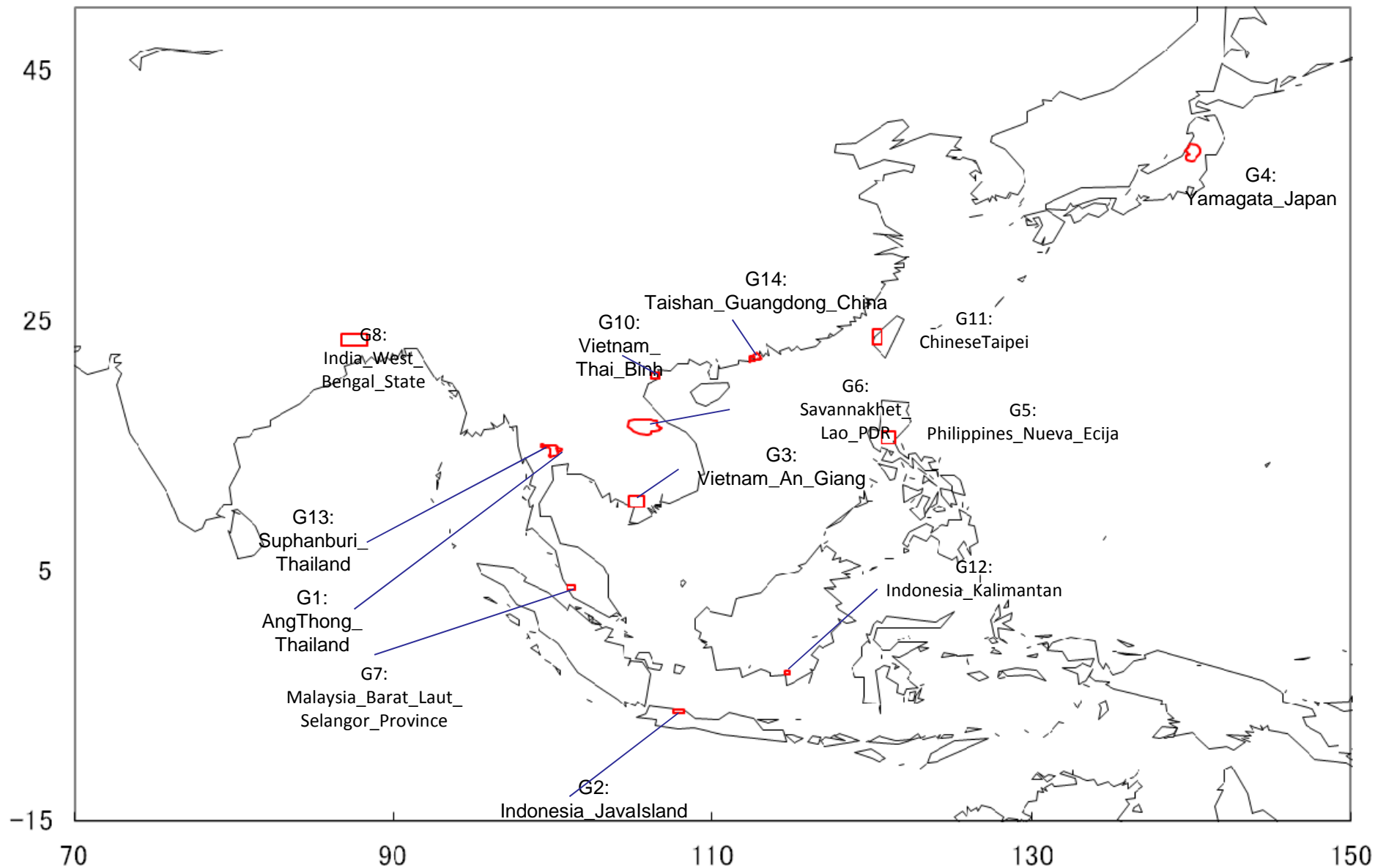
Asia-RiCE Team Phasing

Phase	Target Countries	2013	2014	2015	2016
Phase1A (Province level)	Indonesia, Vietnam(S), Thailand				
Phase1B (Province level)	Japan, Chinese Taipei, Malaysia, Myanmar, Cambodia,...				
					
Phase2 (Country level)	Indonesia, Vietnam(S), ...				
Related activity (ADB)	Philippines, Thailand, Lao PDR, Vietnam(N)				
PALSAR-2 data available					

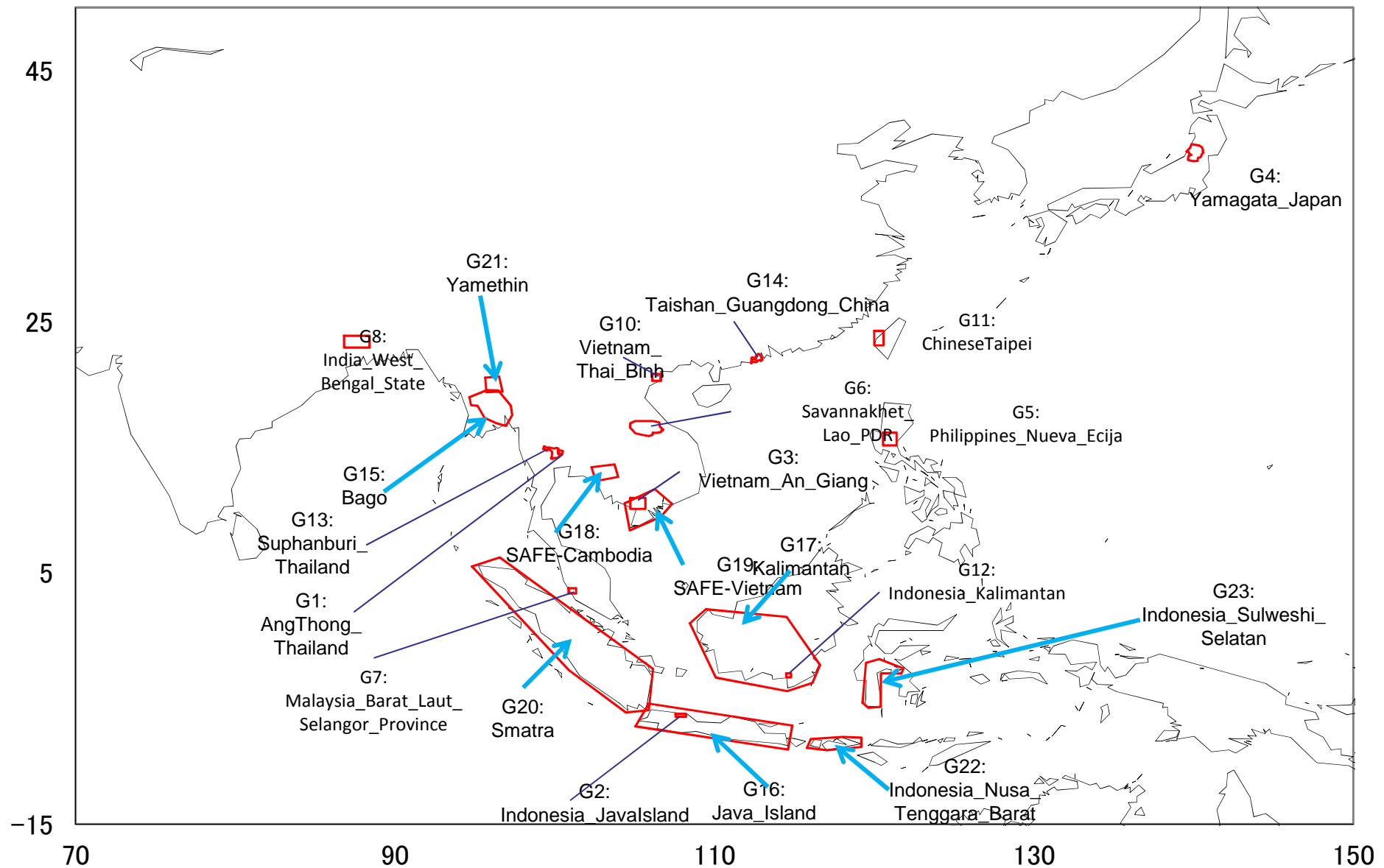
Asia-RiCE Technical Demonstration Sites



PALSAR-2 observation request in 2015 for Asia-RiCE Technical Demonstration Sites

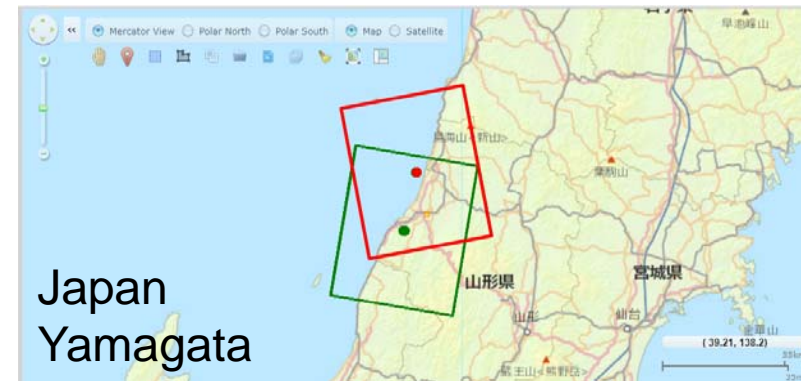


PALSAR-2 observation request in 2016 for Asia-RiCE Technical Demonstration Sites



PALSAR-2 data available status on Asia-RiCE study sites

PALSAR-2 observation area in 2015



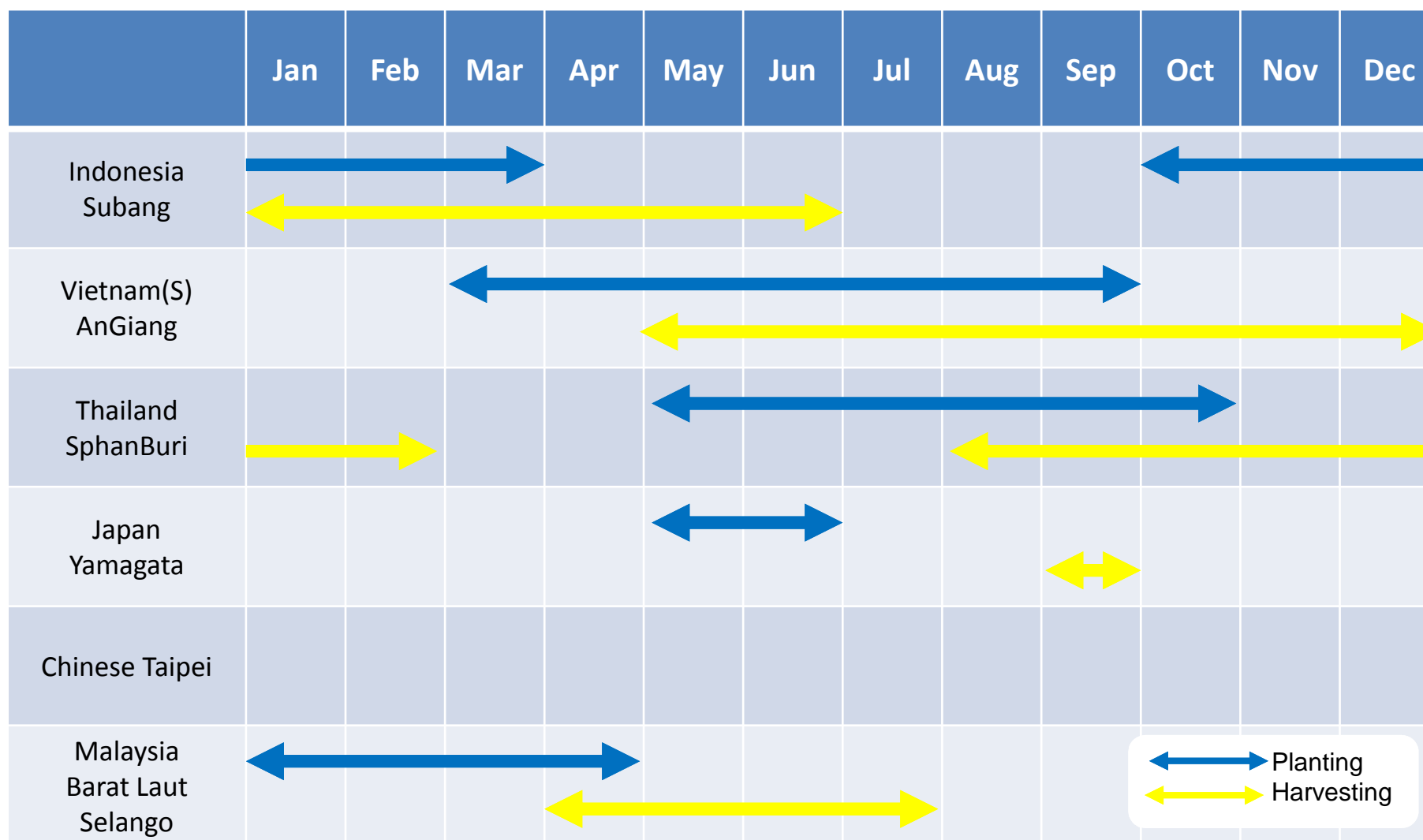
PALSAR-2 observation status

Indonesia	Vietnam(S)	Thailand	Japan	Chinese Taipei	Malaysia
Oct-Jun	Mar-Dec	May-Feb	May-Sep		Jan-Jul
ScanSAR	ScanSAR	ScanSAR	Ultra Fine	ScanSAR	ScanSAR
Path 32	Path 35	Path 38	Path 18	Path 27	Path 37
2014;	2014;	2014;	2014;	2014;	2014;
08/14	12/05	12/06	10/09	09/14	09/08
09/11				10/26	10/20
10/23					
12/04					
2015;	2015;	2015;	2015;	2015;	2015;
01/15	01/16	01/17	05/07	04/12	01/12
02/26	04/10	02/28	05/21	05/10	04/06
04/09	05/22	04/11	06/04	05/24	05/18
GAP> 07/3	07/03	07/04	06/18	08/30	
08/13	08/14	08/01	07/02	10/25	
08/27	08/28	10/24	07/16	12/20	
10/22	10/23	12/05	08/13		GAP>
12/03	GAP>		10/22		
2016;	2016;	2016;	2016;	2016;	2016;
01/14		GAP>	01/14	01/31	

Red color is data available for main rice from planting to harvest in the average year.

There are some GAPS. Ideally, the observations are required at least every month.

Crop Calendar for main rice in rainy season



In ASEAN countries, we have to monitor the situation every month, since planting situation is dramatically changed by depending on water condition.

Data distribution system for Asia-RiCE KC4

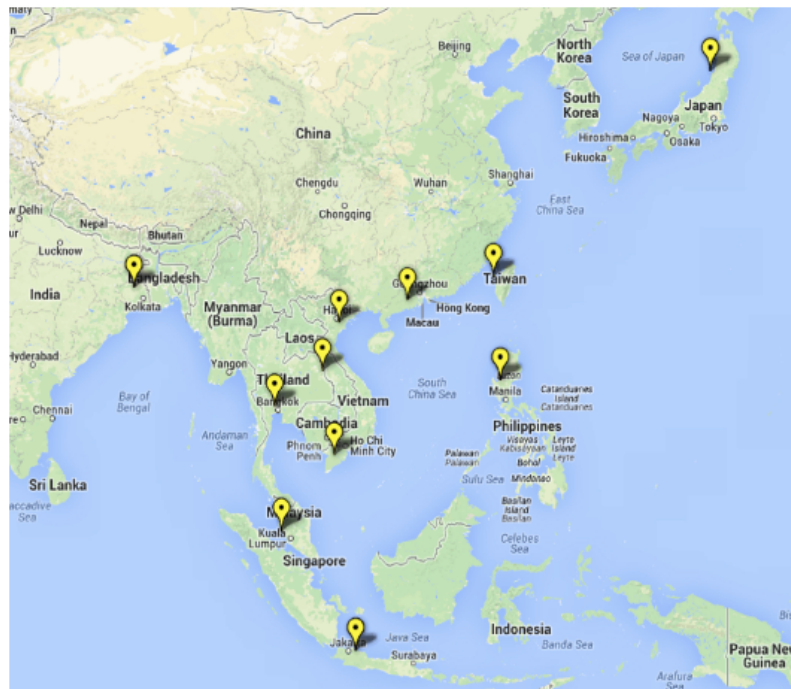
K&C4 ALOS-2 PALSAR2 Data Distribution System for Asia-RiCE



Description

This is an online **ALOS-2 PALSAR-2**, Japanese Synthetic Aperture Radar (SAR), data distribution system for implementing the **Asian Rice Crop Estimation and Monitoring (Asia-RiCE)** as a component of the **GEO Global Agricultural Monitoring (GEOGLAM)**. ALOS-2 data are provided by JAXA under the framework of **Kyoto & Carbon4 (K&C4) Initiative**.

Asia-RiCE Technical Demonstration Sites (Asia-RiCE TDS)



-Chinese Taipei
-India
-Indonesia
-Japan
-Lao P.D.R.
-Malaysia
-Philippines
-Thailand
-Vietnam_North
-Vietnam_South
-Argentina (GEOGLAM JECAM Site)

ALOS-2 Related Links

-ALOS Research and Application Project of JAXA/EORC
-Product/Data Format Info.
-Calibration Info.

Last update : September 03 2015 07:29:34

Managed by Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA)

- Since ALOS-2 account is provided for PI only, we have to distribute data to CI after getting the products by ALOS-2.
- We developed a web system to distribute PALSAR-2 data to CI.
- The system requires ID & password so that CI can't get other country's data.

Data distribution system for Asia-RiCE KC4

K&C4 ALOS-2 PALSAR2 Data Distribution System for Asia-RiCE



Important Notice for ALOS-2 Data Users under the K&C4 Initiative

Data Policy(K&C4 Agreement:Article.7 Provision and Rights of Earth Observation Satellite Data by JAXA)

-With respect to the handling of Earth Observation Satellite Data provided by JAXA, the Research Organization shall comply with the conditions below and instruction of JAXA;

- (1) The Research Organization shall use the provided the Earth Observation Satellite Data solely for the purpose of implementation of the Agreement;
- (2) It is prohibited to disclosure, re-distribution and duplication to a third party of the Earth Observation Satellite Data, except for the PI, CI, and a party agreed by JAXA of such disclosure, re-distribution and duplication. However, RO can duplicate the Earth Observation Satellite Date for creating a backup;
- (3) The RO shall return, dispose, or otherwise appropriately keep the Earth Observation Satellite Data (including the duplicated data) in accordance with the instruction of JAXA upon the termination of this Agreement.

See whole [K&C4 Agreement](#)

See [Application form and Co-Investigators List](#)

Data Description

Product Level: 2.1

- Orthorectified by using digital elevation model (SRTM90)
- Geoid Model: EGM96
- Resampling Method: Nearest Neighbor (NN)
- GeoTIFF Format (16-bit, Unsigned Int)

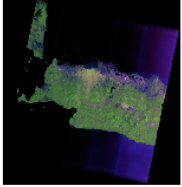
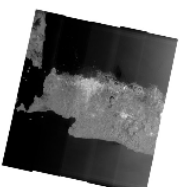
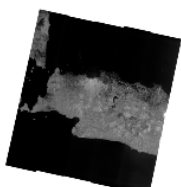
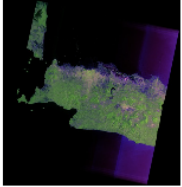
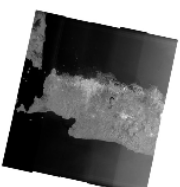
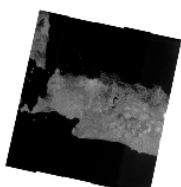
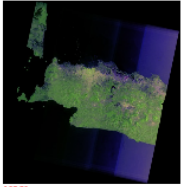
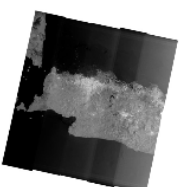
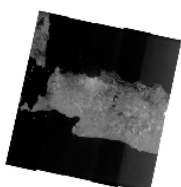
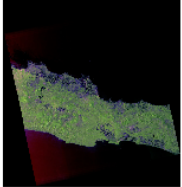
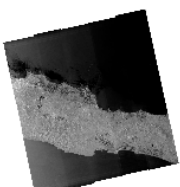
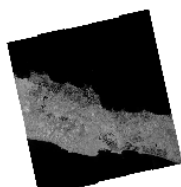

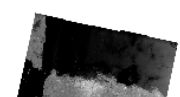
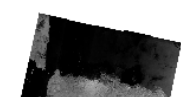
Brightness gaps between the scans of level 2.1 ScanSAR products

Brightness gaps between the scans are currently seen in some WD1 (wide area observation 350km) level 2.1 products. Calibration and pre-processing software development to remove the gaps and refine the ALOS-2 product are underway.

About [Data Processing Levels](#)

About [ALOS-2 Satellite](#)

- CI can download the data with this system.
- CI must observe the data policy according to K&C4 agreement.
- Product level 2.1 is provided.
- The product has brightness gaps between the scans now.

DD/MM/YYYY	Pseud RGB	HH Pol	HV Pol
27/08/2015	 KML	 KML GeoTIFF	 KML GeoTIFF
13/08/2015	 KML	 KML GeoTIFF	 KML GeoTIFF
30/07/2015	 KML	 KML GeoTIFF	 KML GeoTIFF
10/06/2015	 KML	 KML GeoTIFF	 KML GeoTIFF
	 KML	 KML GeoTIFF	 KML GeoTIFF

Rice planted area/production estimation software (INAHOR)

Rice planted area/production estimation software

RESTEC developed a software named INAHOR which can estimate rice planted area and production using SAR data under contract with JAXA, In order to standardize a methodology for monitoring rice using satellite data in Asian countries.

INAHOR :

International **A**siatic **H**arvest m**O**nitoring system for **R**ice
(and “INAHOR” also means “**rice year**” in Japanese)

The main functions :

- Providing a rice planted area map (including the growing stages classification)
- Providing a rice planted area and production (need yield information)

Input satellite data :

Time-series SAR data (ALOS PALSAR,
ALOS-2 PALSAR-2, RADARSAT-2, Sentinel-1)



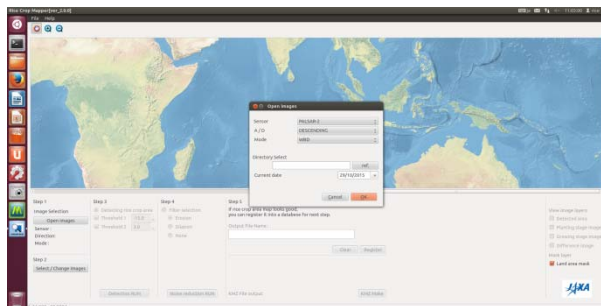
Rice planted area/production estimation software

Significant feature in the design of INAHOR :

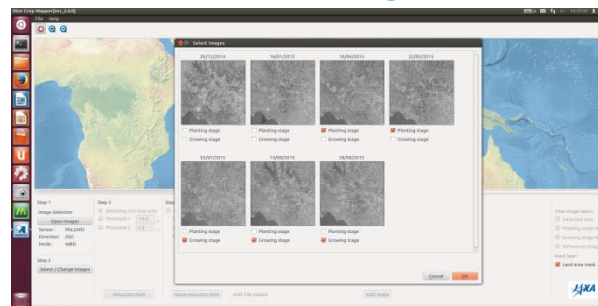
The software was designed for a local officer so that they can get easily the useful information from satellite data.

You can get the rice mapping result, only 5 steps, from open the data until save the result.

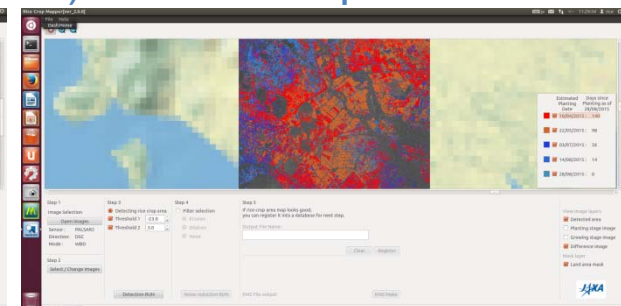
1) Select satellite data



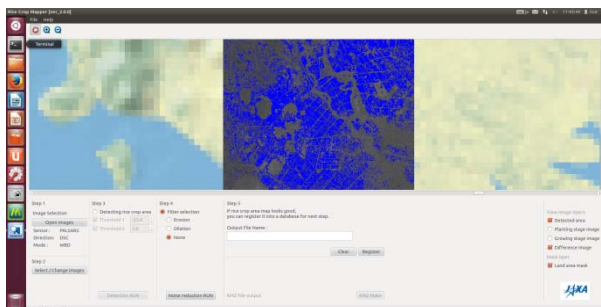
2) Select image data



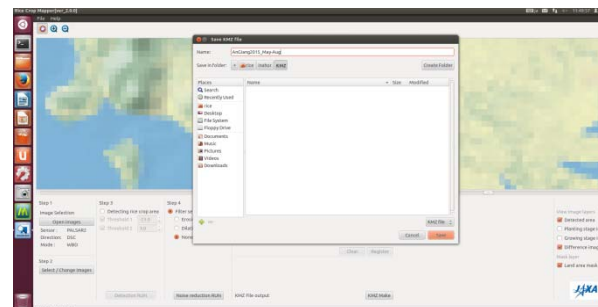
3) Detect rice planted area



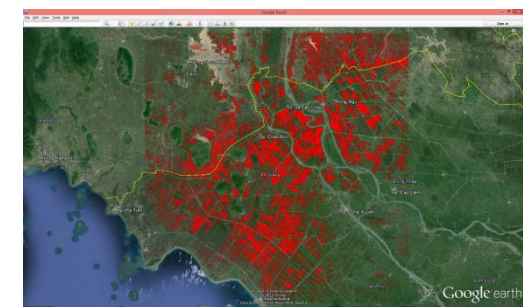
4) Binarization



5) Save the result



Export to KMZ



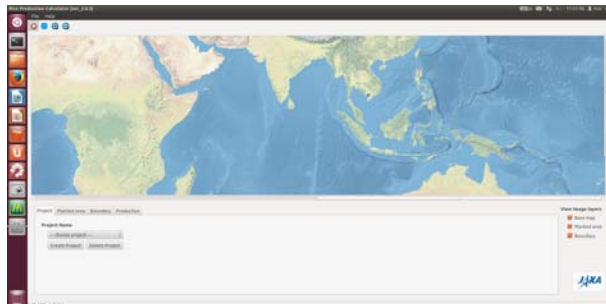
Rice planted area/production estimation software

Significant feature in the design of INAHOR :

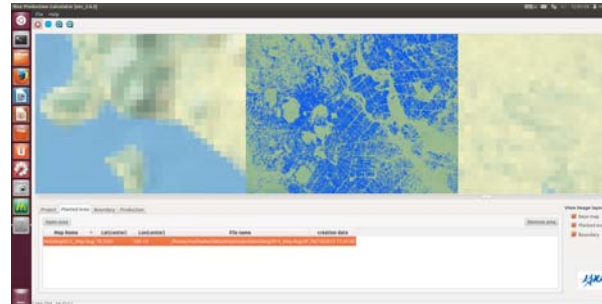
After rice crop mapping, you can get the planted area and the production easily.

The calculating procedures are 5 step only as well.

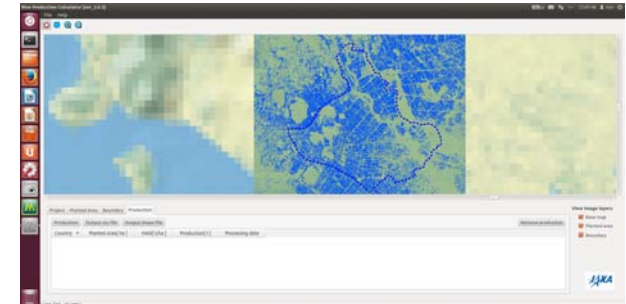
1) Launch calculator



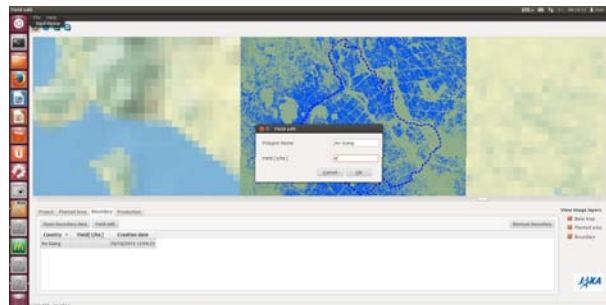
2) Load the rice map



3) Load a boundary



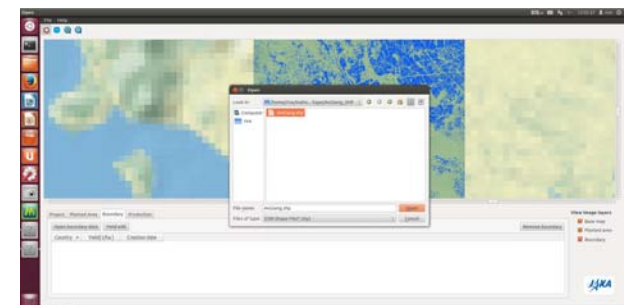
4) Input yield data



5) Calculate area & production



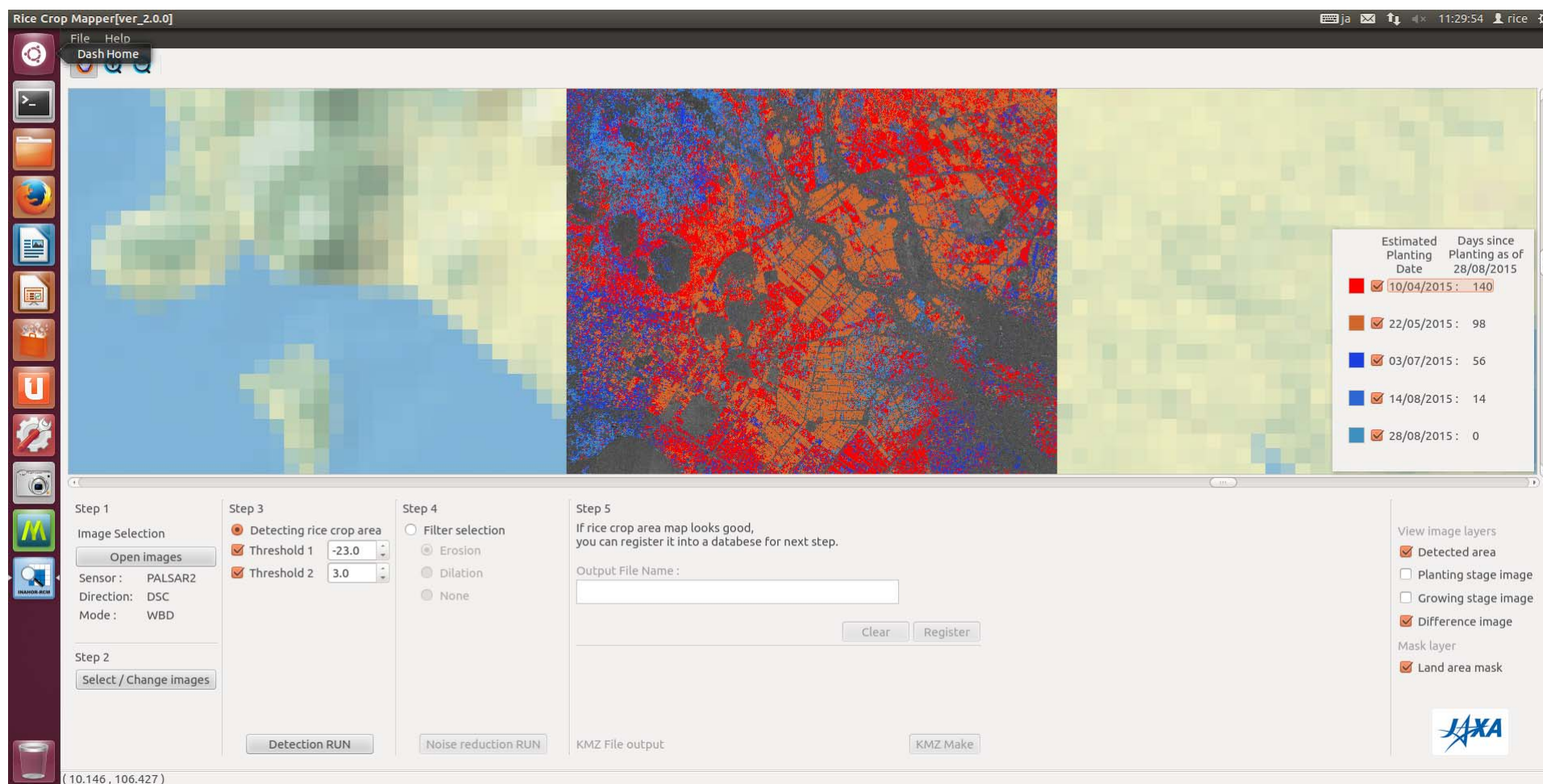
Export to shp and csv



The initial validation status

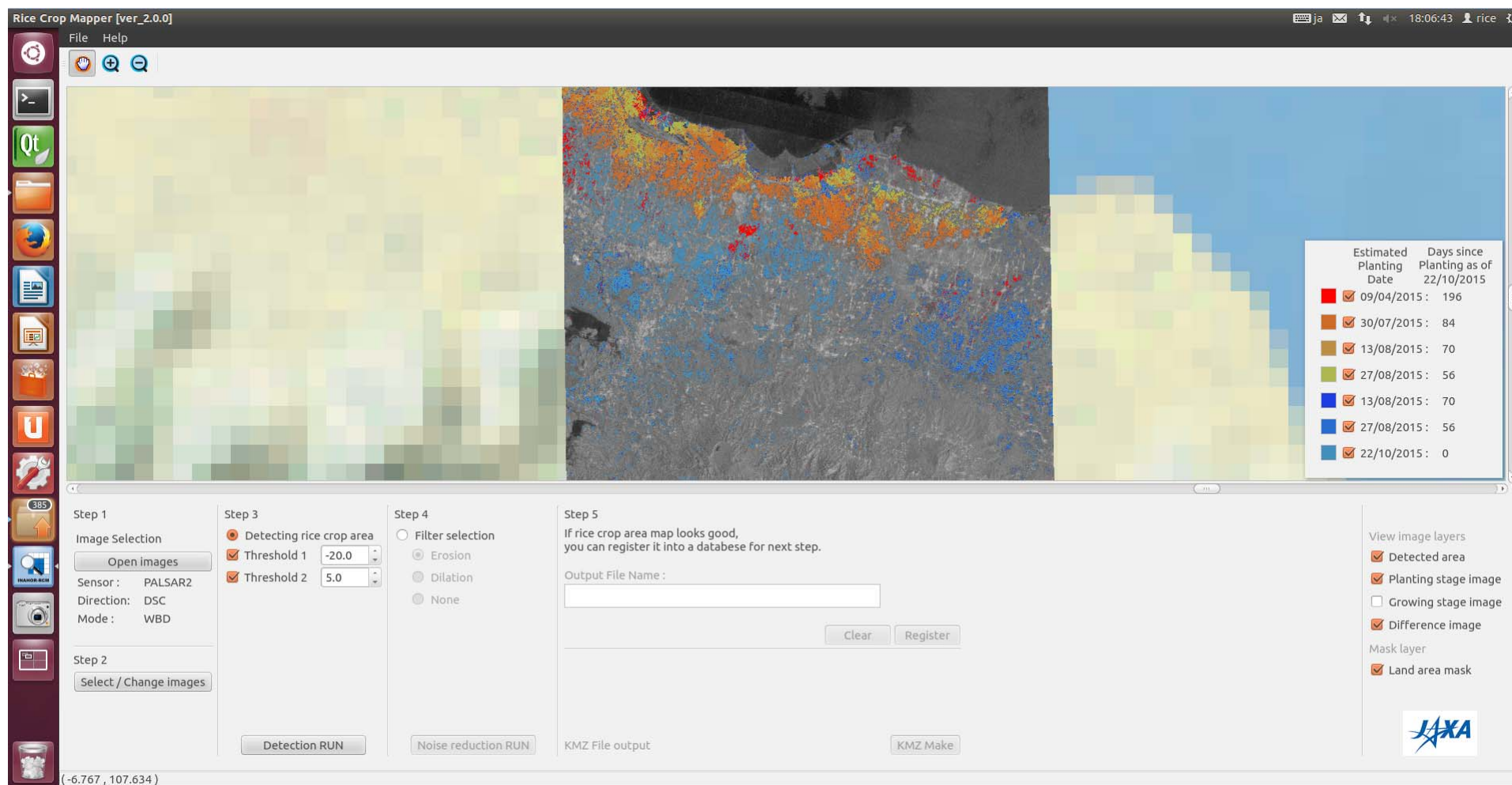
Example of the rice planted area estimation result at An Giang in southern Vietnam

- Red area is planted area where the estimated planting date was on Apr. (140 days since planting)
 - Orange area is planted area where the estimated planting date was on May. (98 days since planting)
 - Blue color group is inundation area where can be estimated as planting or preparation stage.
- The result of roughly validation was good with just looking by local staff.

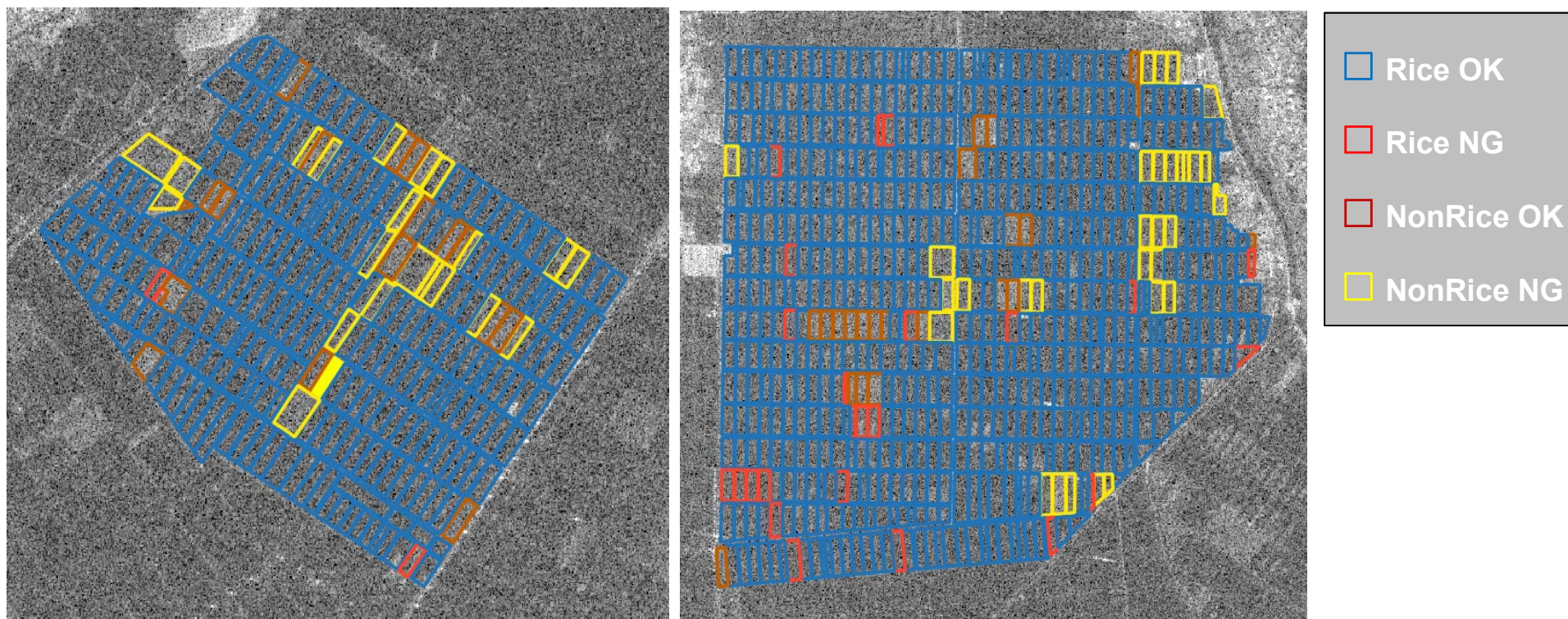


Example of the rice planted area estimation result at Subang in Indonesia

In this site, the planting starts from the mountain side to the sea side in order. The change of growing stages can be seen on the estimation result below. The result of roughly validation was good with just looking by local staff.



Example of the initial validation result at Yamagata in Japan



	GT: Rice	GT: Non-Rice	Total
INAHOR: Rice	813	39	852
INAHOR: Non-Rice	27	53	80
Total	840	92	932

The total accuracy is 92% = $(813+53)/932 \times 100$. But rice fields are too much to get actual accuracy. Most of error for “Non-Rice” were soybeans.

Reference

Soybeans

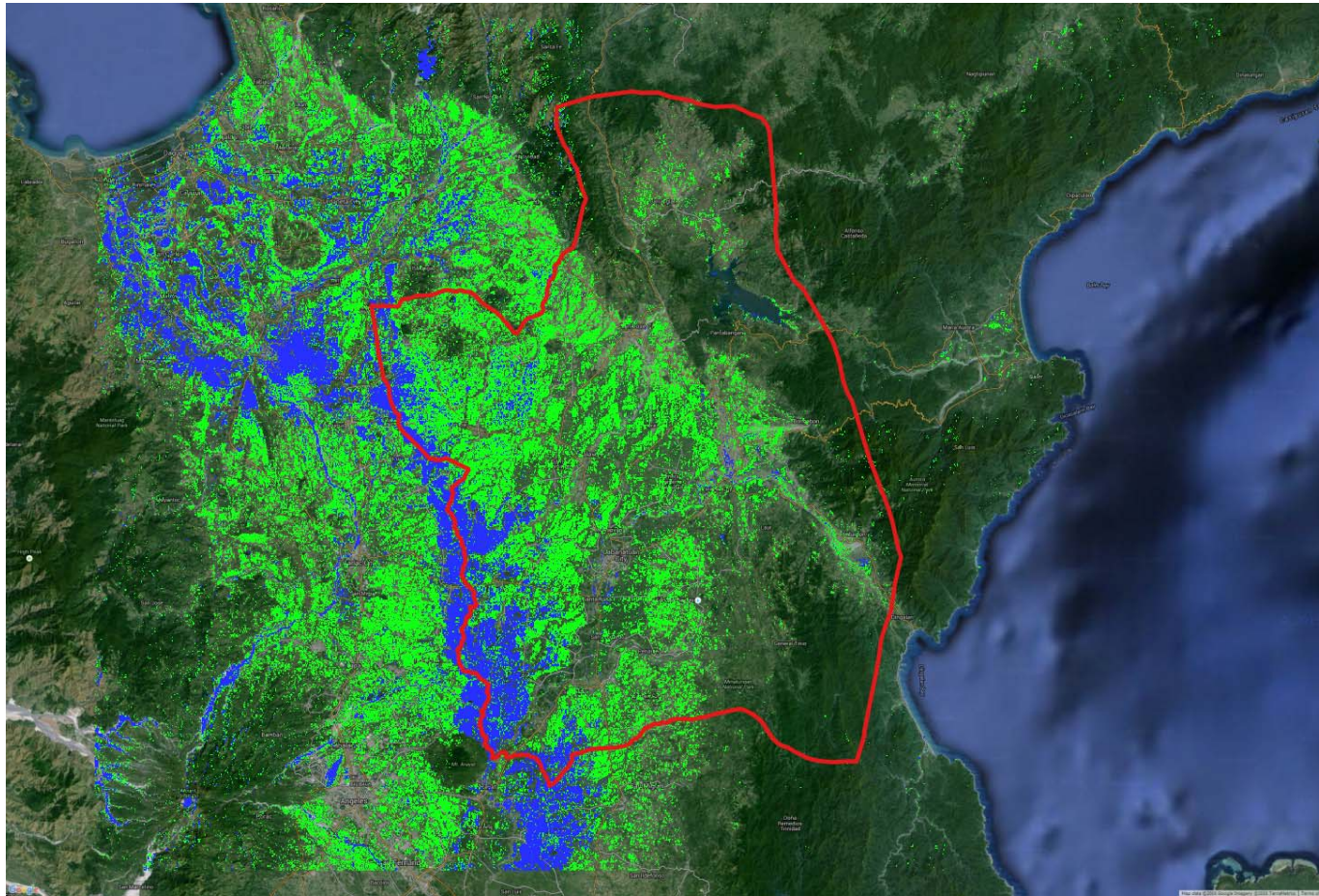


Rice



According to the other projects with Ministry of Agriculture, Forestry and Fisheries, the change of soybeans is very similar to rice in HH polarization. There's a possibility soybeans can be identified by using HV polarization. Now the method is been validating in that project.

“Koppu” Flood damaged assessment at Nueva Ecija in the Philippines



Last Oct., typhoon “Koppu” attacked Nueva Ecija where was study site of ADB project in the Philippines.
We made the flood damaged assessment map by using INAHOR, and provided it to the government of the Philippines.

Summary

Summary

- Asia-RiCE team is tackling to develop target products (P1, P2, P3, P4, P5) by using PALSAR-2 data in each country.
- Now we are trying initial analysis for last season rice and initial validation.
- The result of roughly validation was good.
- We will continue to validate the result by using field survey data.
- Myanmar and Cambodia are joining us in this season.
- The target area in Indonesia and Vietnam will be expanded to country (half) level from provincial level.
- Validations in the Philippines, Vietnam, Thailand and Lao PDR are going on in ADB Project.
- For observation, ideally, it is required at least every month, in order to monitor the planting situation which is dramatically changed by depending on water condition, in ASEAN countries.

Thank you for your attention