Asia Rice Crop Team Activity in GEOGLAM

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On behalf of Asia-RiCE Team

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[3] Centre d'Etudes Spatiales de la BIOsphère (CESBIO),

International Meeting on Land Use and Emissions
in South/Southeast Asia

@Ho Chi Minh City
17th October 2016

GEOGLAM/Asia-RiCE

❖ GEOGLAM (GEO Global Agriculture Monitoring)

- Improve market information and transparency in order to make international markets for agricultural commodities more effective
- Coordinate satellite monitoring observation systems in different regions of the world in order to provide transparent and timely crop outlook (wheat, maize, soybeans, and rice)

[G20 Summit in France, 2011]

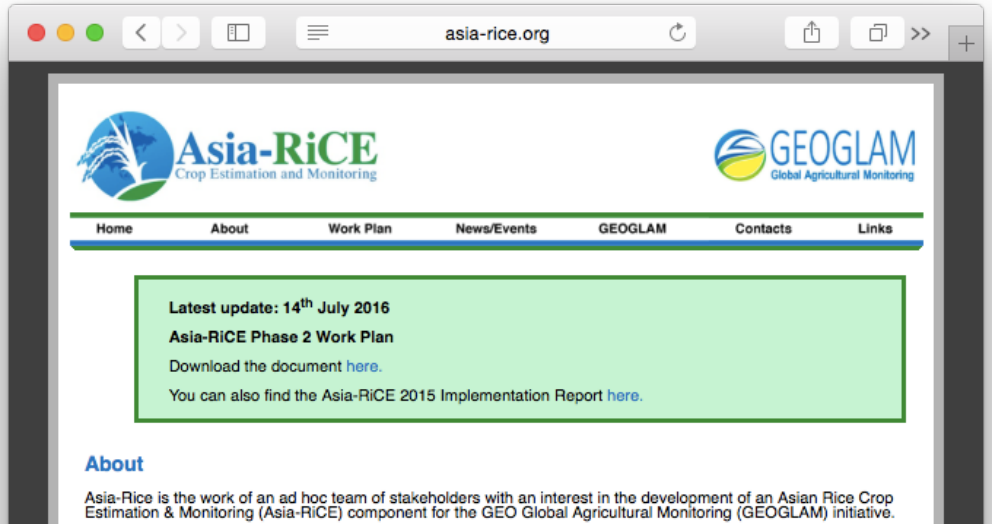
❖ Asia-RiCE (Asia-Rice Crop Estimation and Monitoring)

- Asian region produces and consumes 90% of the global rice
- Asian space and agricultural agencies are implementing Asia-RiCE to strengthen rice crop monitoring ability by using remote sensing, which is a component for GEOGLAM
- Rice cropping has different characteristics from other crops.
  - Muti-cropping, interference with clouds in rainy season etc.

Asia-RiCE Partners

Asia-RiCE
Crop Estimation and Monitoring

Asia-RiCE Meeting@ACRS2013



Asia-RiCE Website

http://www.asia-rice.org

Rice Crop Monitoring in Asia: Multi-Cropping

❖ Rice is cultivated 2-3 times in Southeast Asia.

Subang, West Java, Indonesia (photo taken during 4-7th Aug 2012)

Planting

Vegetative

Vegetative/Reproductive

Ripening

Harvesting

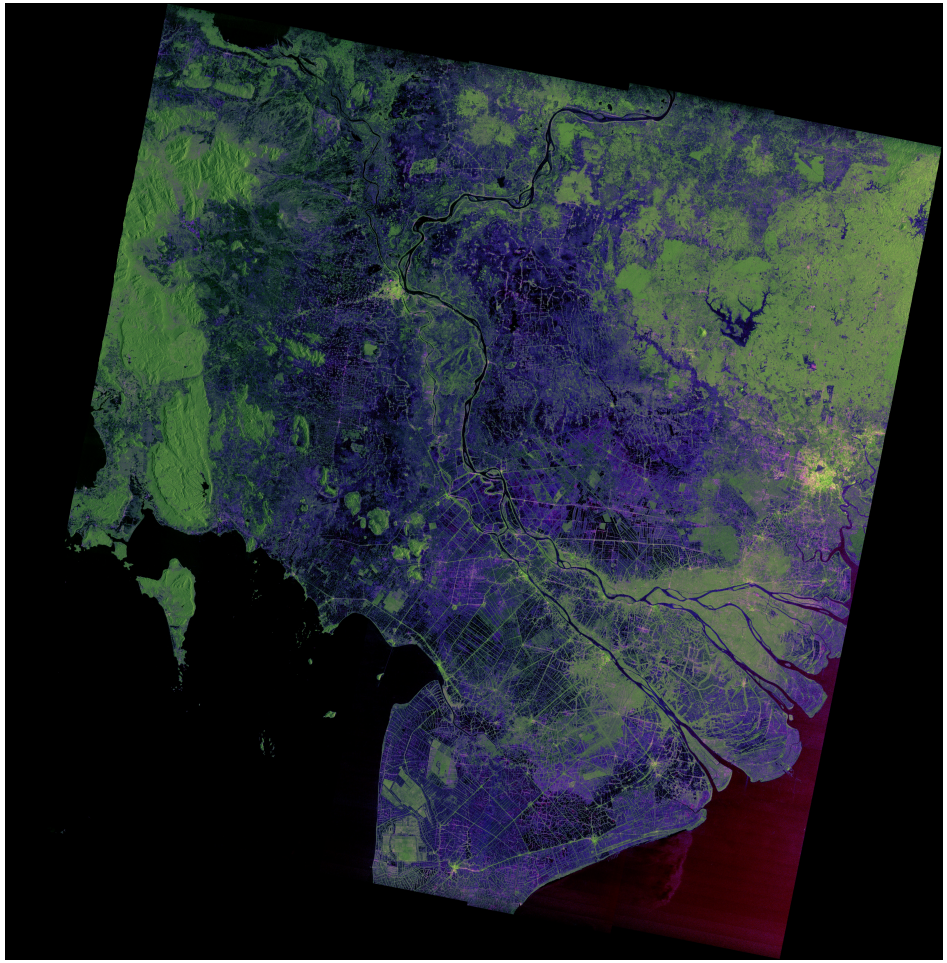
Drought

Crop calendars are different from region to region and much complicated.

Rice Crop Monitoring in Asia: Cloud Cover

Terra MODIS Image
(14 Aug 2015)

ALOS2 ScanSAR Image
(14 Aug 2015)



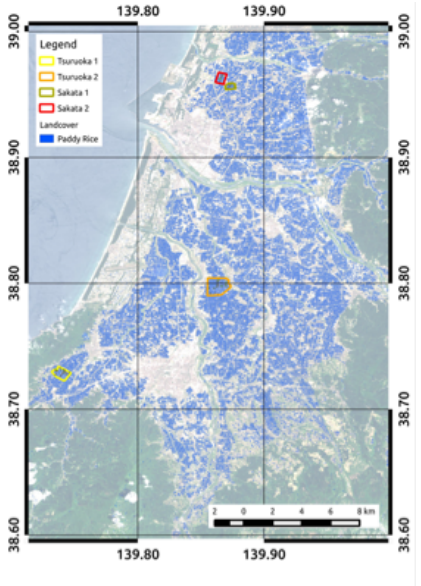
Mekong Delta

Synthetic Aperture RADAR (SAR) is a powerful tool in rainy season.

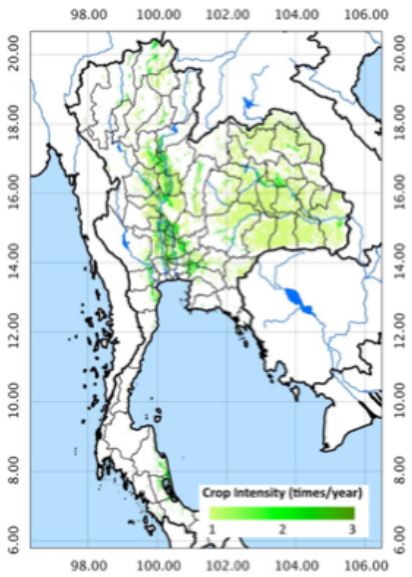
Asia-RiCE: Defined Agriculture-related Products

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

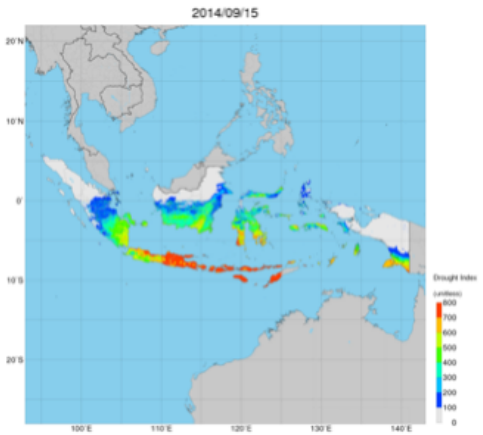
Example of Products



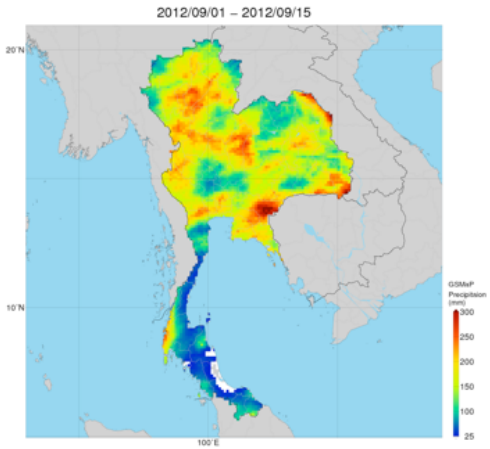
P1: Planted Area



P2: Crop Calendar



P3: Drought Warning

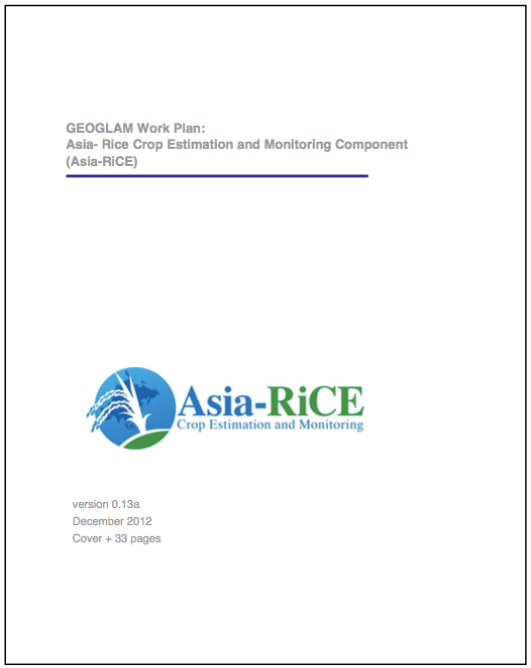


P4: Precipitation

Asia-RiCE: Work Plan

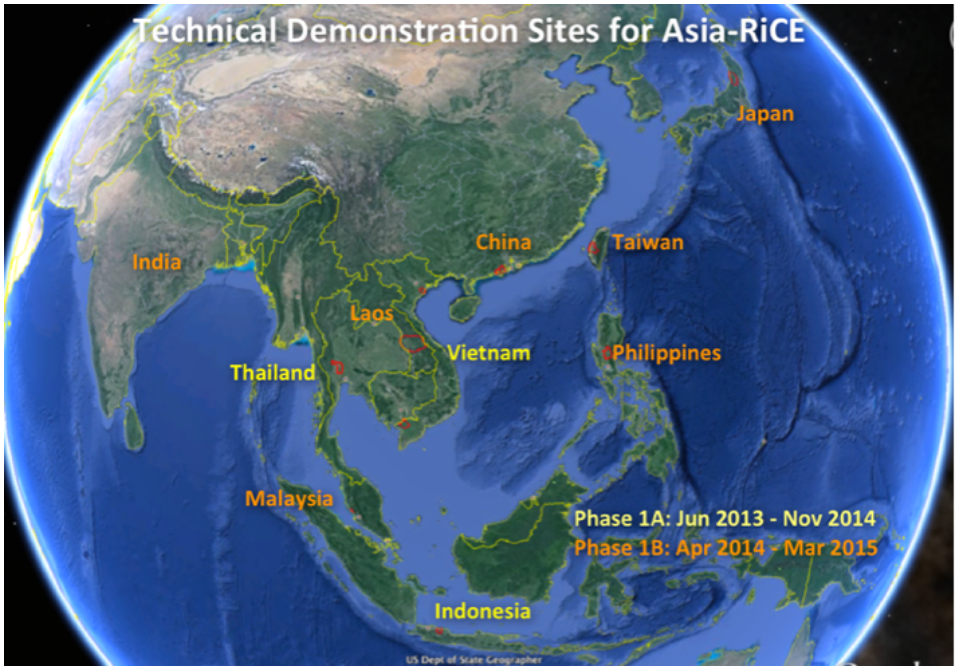
❖ Phase1 (2013-2015)

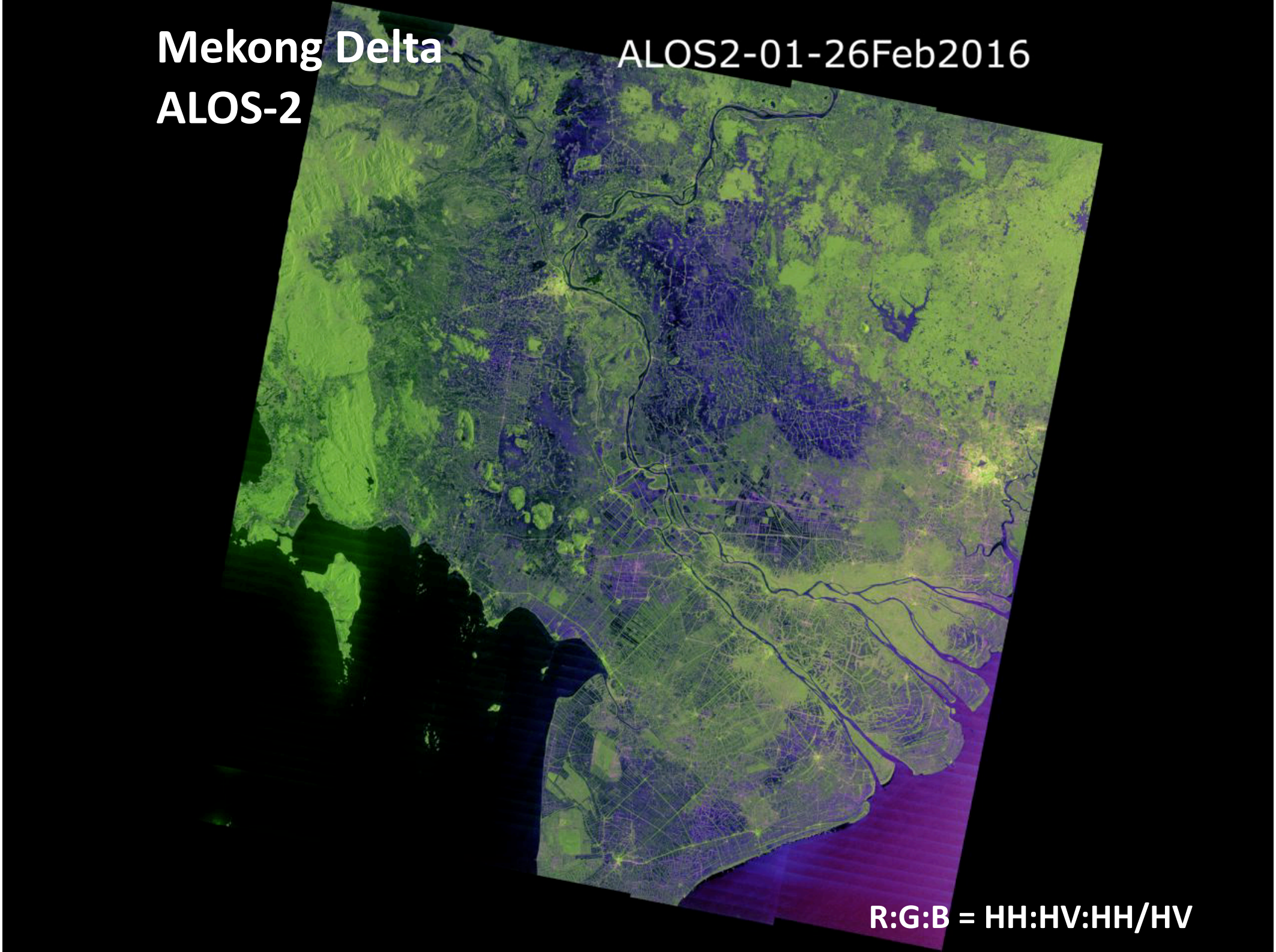
- Defining Technical Demonstration Sites (TDS) in the participating countries
- Development of **provincial-level rice crop monitoring using SAR** (RADARSAT-2, Sentinel-1, TerraSAR-X, COSMO-skyMED, RISAT-1, ALOS-2) and optical data
- Working with the ASEAN Food Security Information System (AFSIS) and agricultural statisticians in the target countries to provide **rice growth outlook** to the GEOGLAM for Agriculture Market Information System (AMIS)


GEOGLAM Work Plan:
Asia- Rice Crop Estimation and Monitoring Component
(Asia-RiCE)

Asia-RiCE
Crop Estimation and Monitoring

version 0.13a
December 2012
Cover + 33 pages




Mekong Delta
ALOS-2
ALOS2-01-26Feb2016
R:G:B = HH:HV:HH/HV

Rice Yield Estimation in Mekong Delta, Vietnam

❖ Using RADARSAT-2 (C-band) 、 COSMO-skyMED (X-band)

RADARSAT-2

COSMO-SkyMED

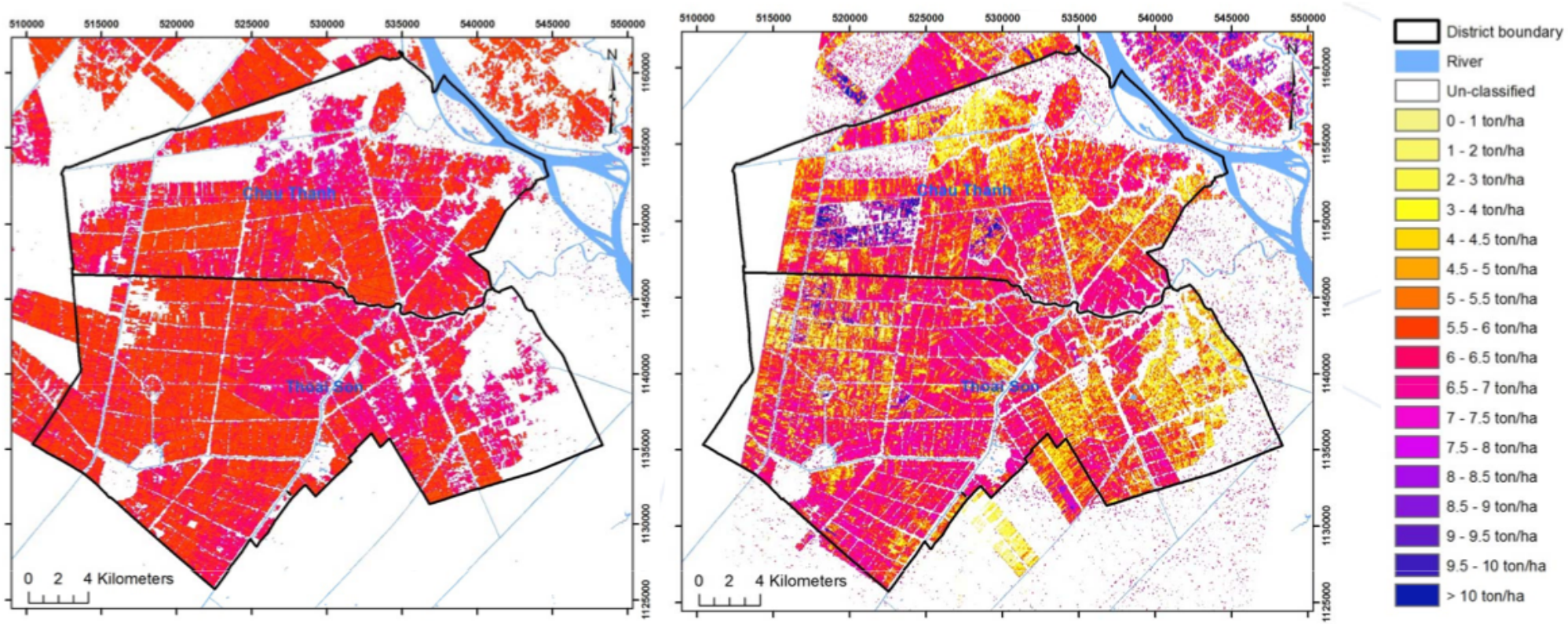
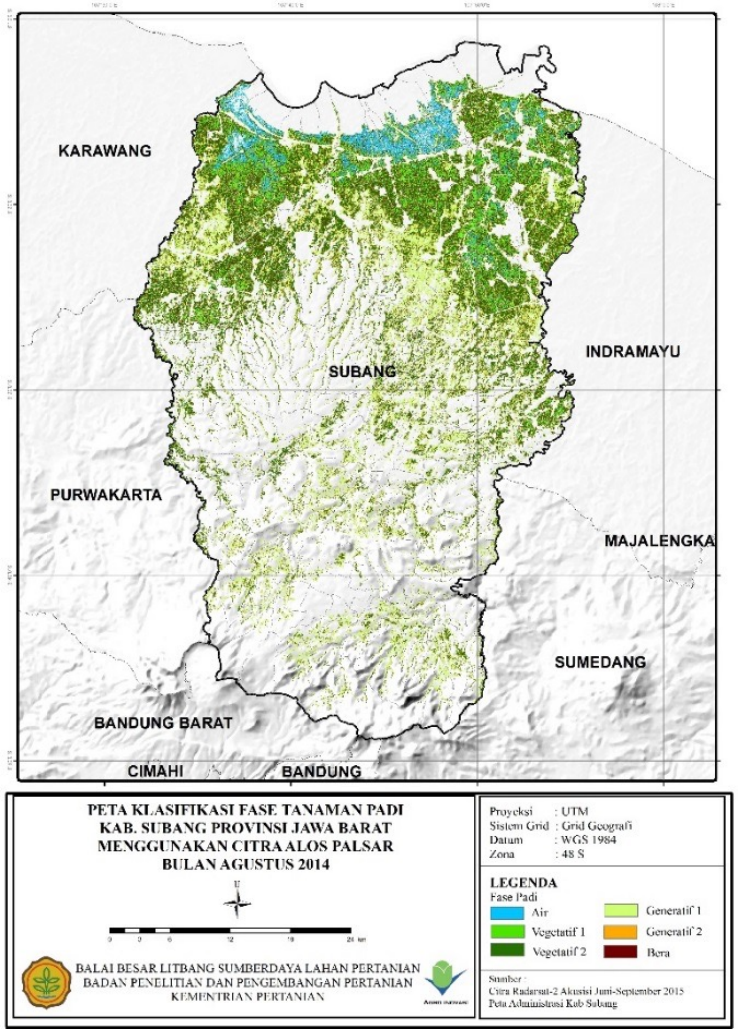


Figure 4 – Distribution maps of estimated rice yield in Chau Thanh and Thoai Son. RADARSAT-2 (left) and COSMO-SkyMED (right). Data from three points approximately 1 month apart.

[Thuy Le Toan and Lam Dao Nguyen]

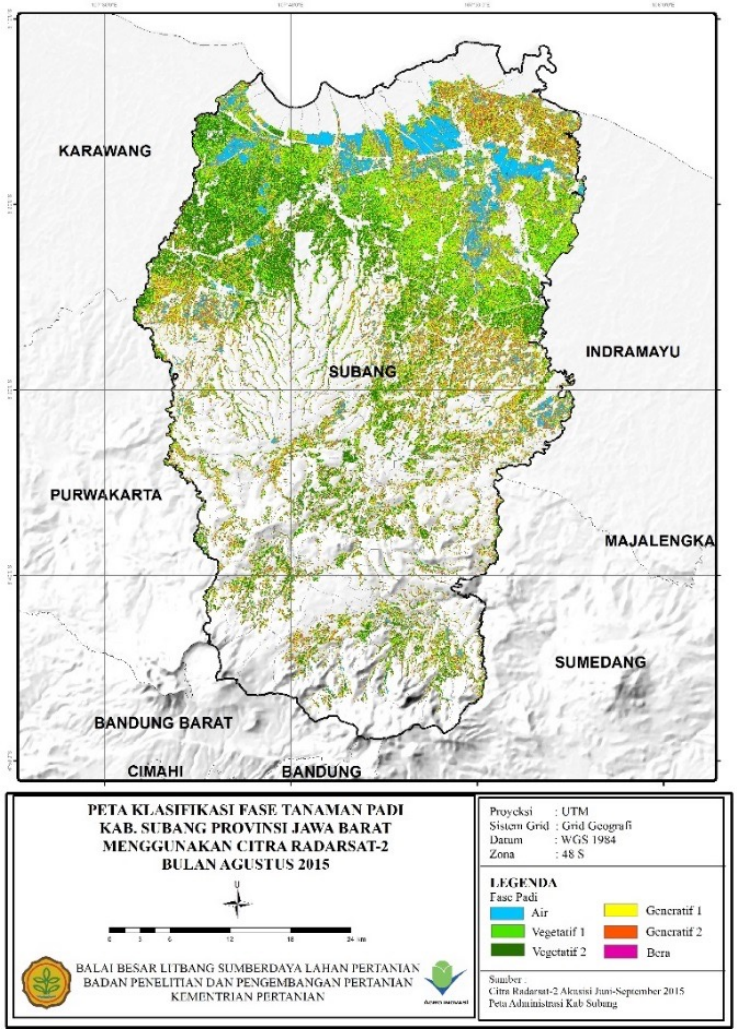
Growth Stage Classification in West Java, Indonesia

- Using ALOS-2 (L-band) and RADARSAT-2 (C-band)



ALOS-2 PALSAR 2 Data (HH+HV)

Aug 2014



RADARSAT-2 (VV+HV)

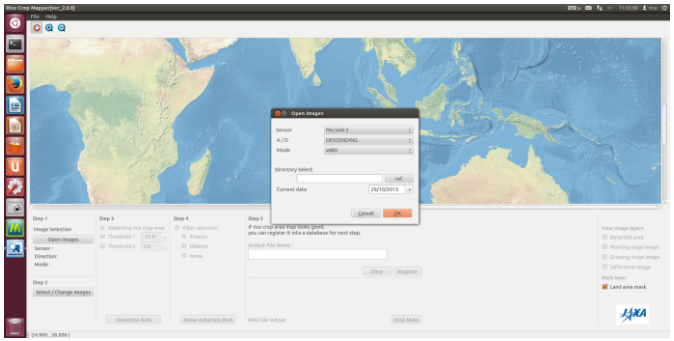
Aug 2015

[Rizatus Shofiyati]

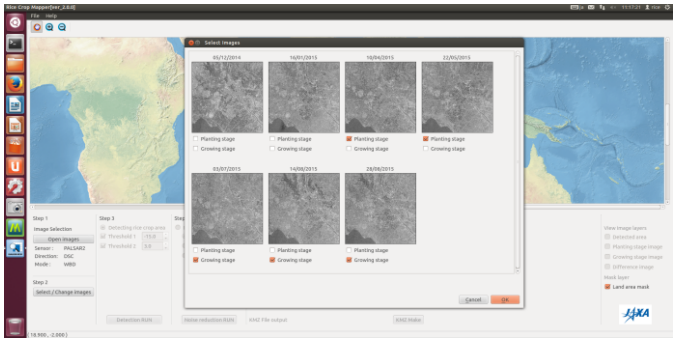
Rice Planted-Area Mapping Software “INAHOR”

- ❖ Easy to use with simple Graphical User Interface (GUI)
- ❖ Only 5 steps to open the data to save the result
- ❖ Use time series ALOS-2 data and other C-band SAR data

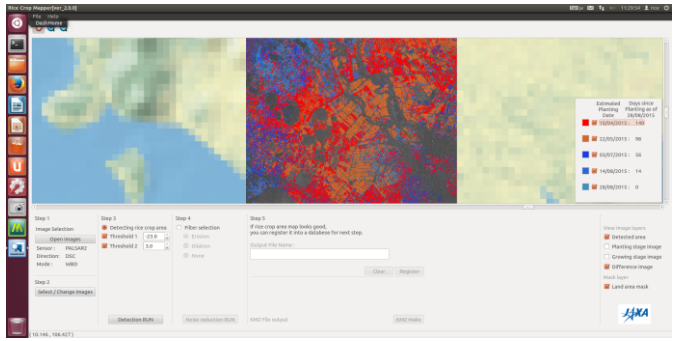
1) Open satellite data



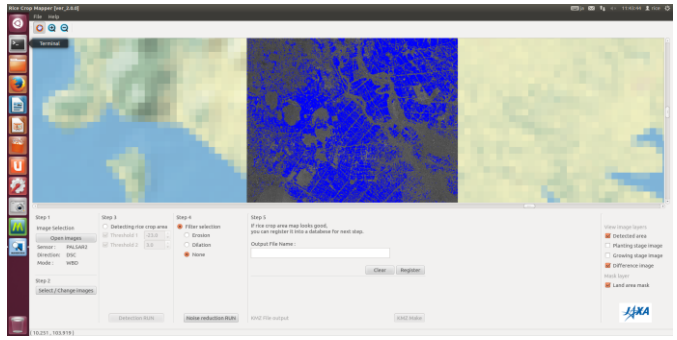
2) Select the data



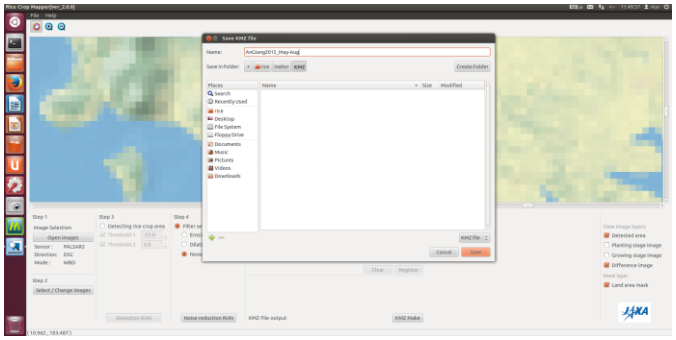
3) Input two parameters



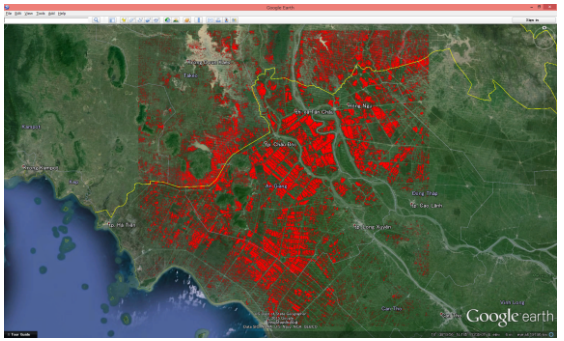
4) Rice Planted-Area



5) Save the result



Export to KMZ



[Oyoshi et al., Paddy and Water Env., 2016]

Easy to use tool for capacity building and currently used in ADB project.

Rice-Planted Area Mapping in Northeast District, Japan

❖ INAHOR with thresholds optimization by in-situ data can estimate rice-planted area with the accuracy of more than 80%

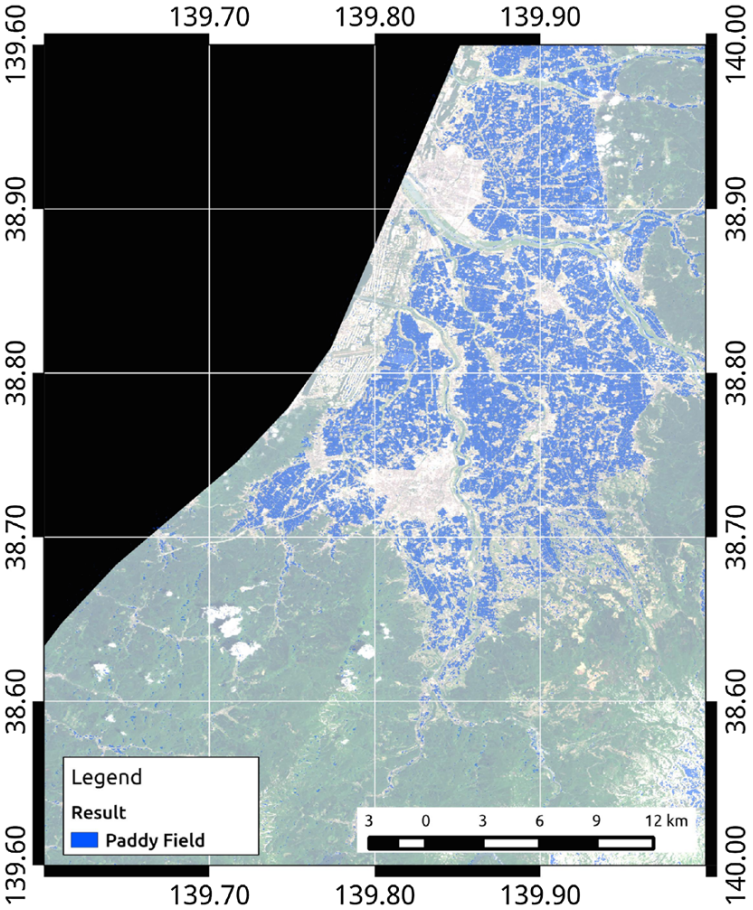


Fig. 8 Map of rice-planted areas derived from time-series RADARSAT-2 VH data over the area around Tsuruoka city, Yamagata prefecture, Japan

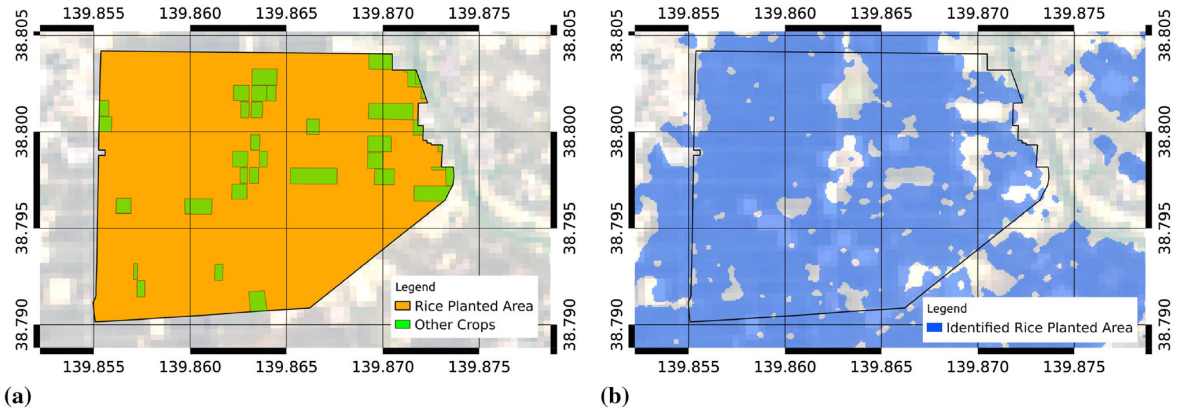


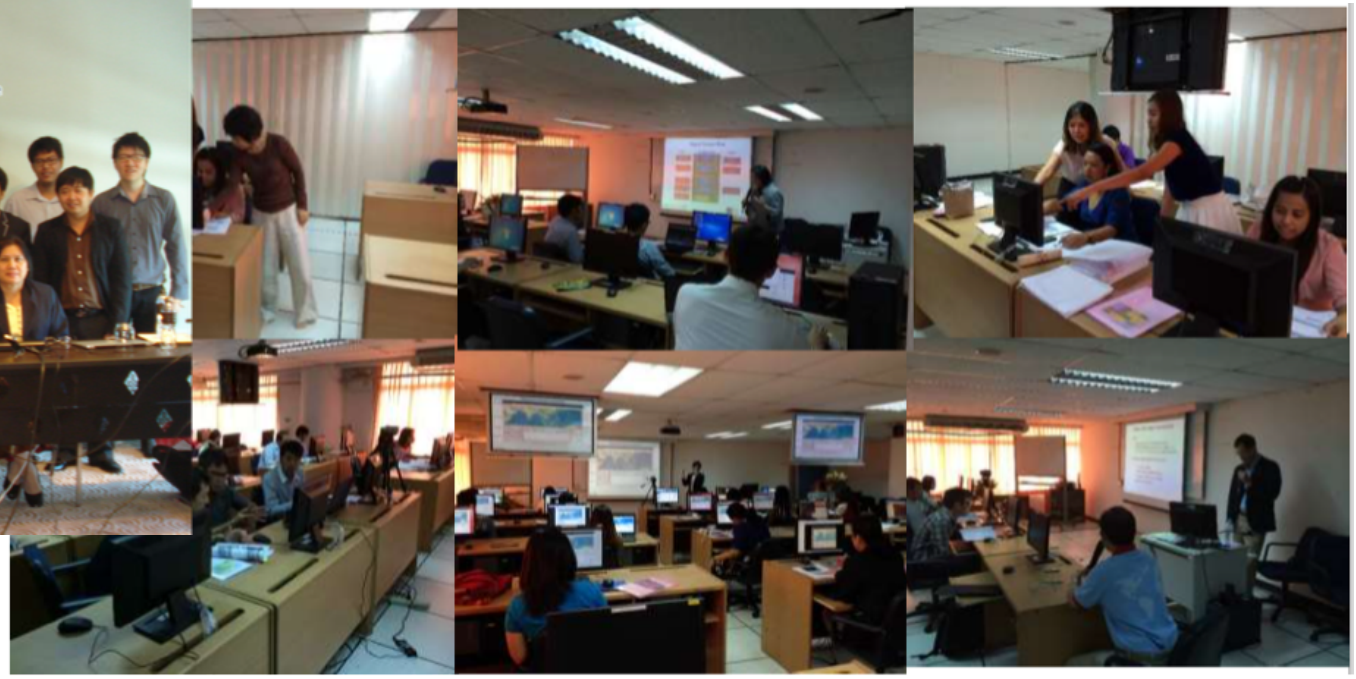
Fig. 9 Comparison of rice-planted areas identified using SAR data and land cover data collected in a field survey. **a** Example image of field survey area where rice and other crops are co-located. **b** Identified rice-planted area by SAR data with INAHOR

	Optimized Min Threshold	Optimized Range Threshold	Model Accuracy (n = 6000)	Accuracy (n = 6000)
VV	-12.5 dB	1.0 dB	0.77	0.76
VH	-20.5 dB	3.0 dB	0.83	0.83

[Oyoshi *et al.*, Paddy Water Environ, 14(4), 2016]

Towards the Practical Use in Agricultural Statistics Collection

- Asian Development Bank R-CDTA 8369
  - "Innovative Data Collection Methods for Agricultural and Rural Statistics" (2014-2016)
  - Deploying INAHOR and ALOS-2 ScanSAR data to the agricultural statisticians, Ministry of Agriculture in the target four countries



ADB

Japan Fund for Poverty Reduction

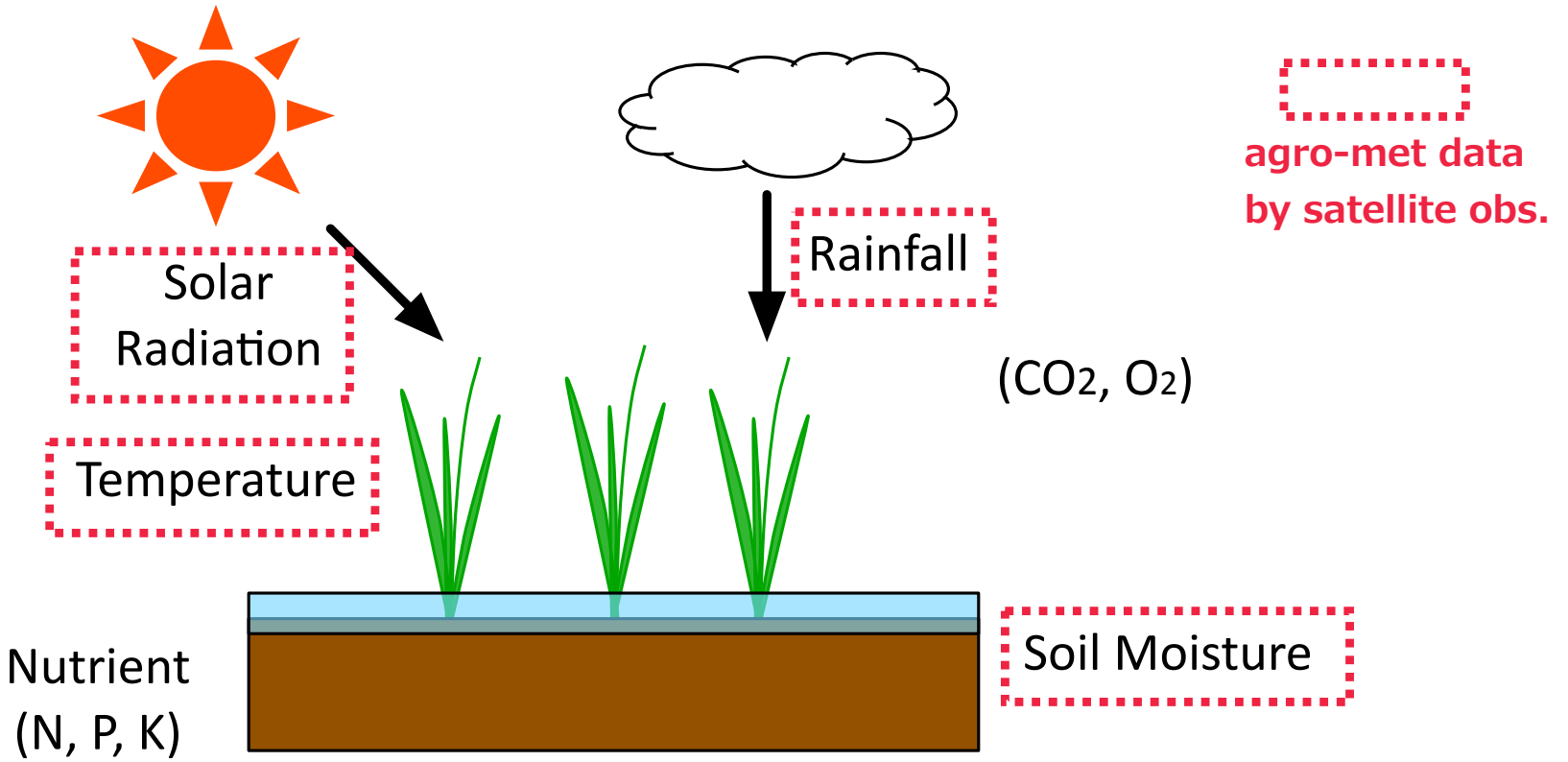
RESTEC JAXA Explore to Realize

APRSAF SAFE Projects

- **Myanmar (2016-2017)**
  - Enhance the “land management system” of Department of Agricultural Land Management and Statistics (DALMS) using innovative rice crop area mapping with space based technologies
  - Department of Agricultural Land Management and Statistics, MOAI
- **Cambodia (2016-2017)**
  - Promote rice planted area and production estimation using space based technologies in Cambodia
  - Department of Planning and Statistics, MAFF

Agro-Meteorological Data for Rice Outlook

- Agro-Met data (solar radiation, rainfall, temperature etc.)
  - Controls crop growth and development (photosynthesis rate, leaf senescence、changes CO2 assimilate partitioning ...)
  - Spatio-temporal agro-met data are useful to assess rice crop growth



Satellite can measure agro-met variables spatially and temporally.

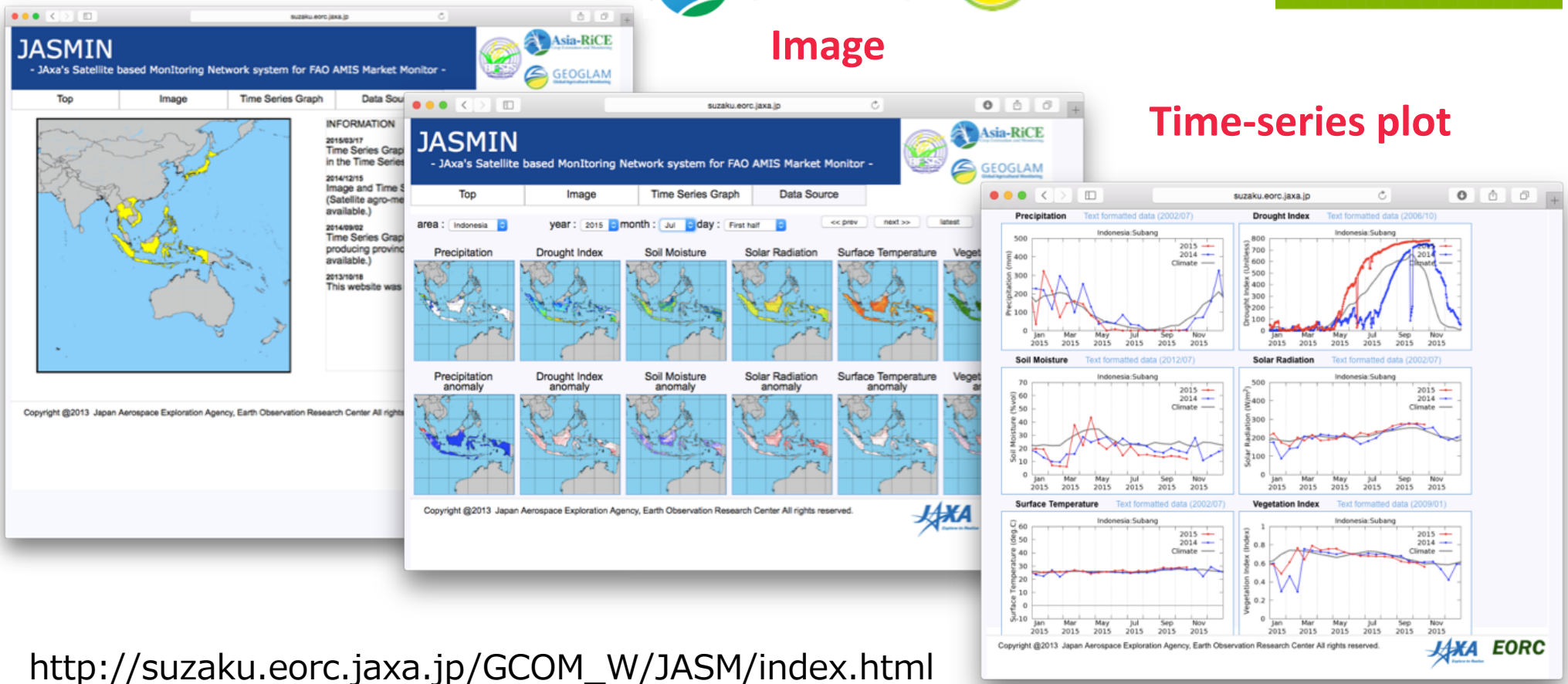
Agro-met Information Provision System

- **JASMIN** provides satellite-based precipitation, drought index, solar radiation, land surface temperature, soil moisture, and vegetation index (updated twice a month).

Top Page

Image

Time-series plot



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

[Oyoshi et al., JSPRS., 2016]

Assessment Source for Rice Growth Outlook

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

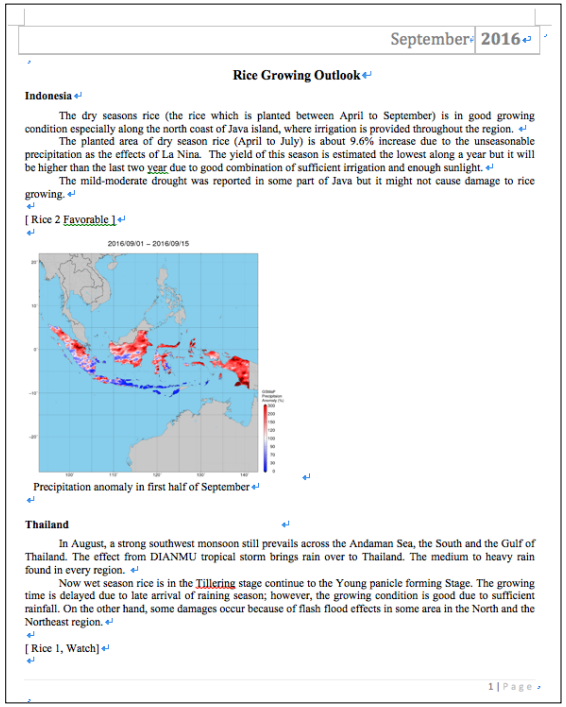
Parameters	Interval	Spatial Resolution	Data Period (anomaly calc.)	Satellite Data Source
Precipitation	Cumulative (15-day)	10 km	2002- (2009-2014)	GSMaP (GCOM-W1, TRMM, MTSAT etc.)
Solar Radiation	15-day Average	5 km	2007- (2009-2014)	MODIS
Land Surface Temperature	15-day Average	5 km	2002- (2009-2014)	MOD11
Soil Moisture	15-day Average	50 km	2002- (2009-2014)	AMSR-E, AMSR-2
Drought Index	15th /31[30]th day of month	10 km	2003- (2009-2014)	GSMaP, MTSAT
Vegetation Index	15th /31[30]th day of month	5 km	2009- (2009-2014)	MODIS

Asia-Rice Crop Estimation and Monitoring (Asia-RiCE) Meeting and Rice Growing Outlook Workshop, OAE, Bangkok, Thailand

October 29-30, 2014

Example: Rice Growth Outlook

Rice Growth Outlook (September 2016)



September 2016

Rice Growing Outlook

Indonesia

The dry seasons rice (the rice which is planted between April to September) is in good growing condition especially along the north coast of Java island, where irrigation is provided throughout the region.

The planted area of dry season rice (April to July) is about 9.6% increase due to the unseasonable precipitation as the effects of La Nina. The yield of this season is estimated the lowest along a year but it will be higher than the last two year due to good combination of sufficient irrigation and enough sunlight.

The mild-moderate drought was reported in some part of Java but it might not cause damage to rice growing.

[Rice 2 Favorable]

2016/09/01 – 2016/09/15

Precipitation anomaly in first half of September

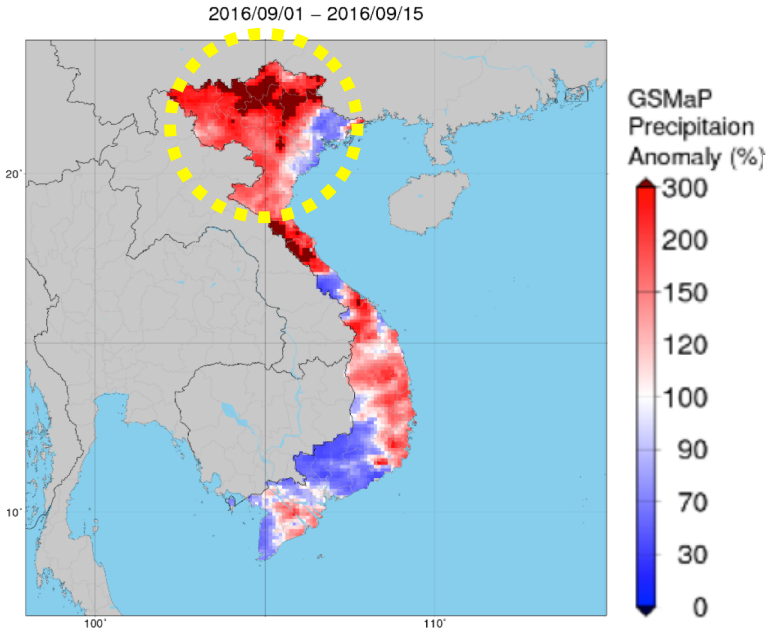
Thailand

In August, a strong southwest monsoon still prevails across the Andaman Sea, the South and the Gulf of Thailand. The effect from DIANMU tropical storm brings rain over to Thailand. The medium to heavy rain found in every region.

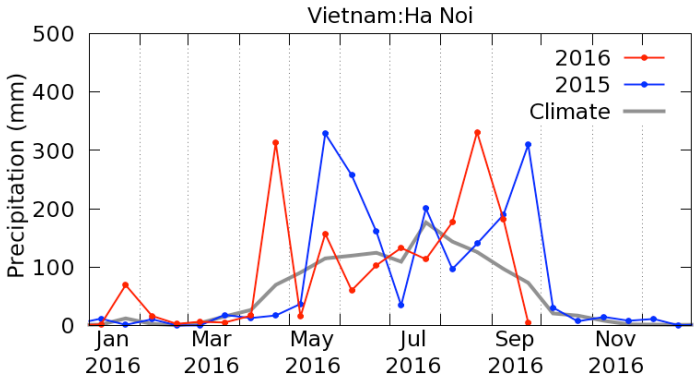
Now wet season rice is in the Tillering stage continue to the Young panicle forming Stage. The growing time is delayed due to late arrival of raining season; however, the growing condition is good due to sufficient rainfall. On the other hand, some damages occur because of flash flood effects in some area in the North and the Northeast region.

[Rice 1, Watch]

1 | Page



Precipitation anomaly in first half of September



Precipitation (Hanoi Province)

Vietnam

In the North, the seeding of autumn-winter rice (wet season rice) is completed. The sown area is around 1.1 million ha, accounting for 99.2% of the last year area. **The weather in the North is not good for paddy due to storm and flood.**

In the South, the summer-autumn rice enters a harvesting time. The harvested area is around 1.0 million ha …..

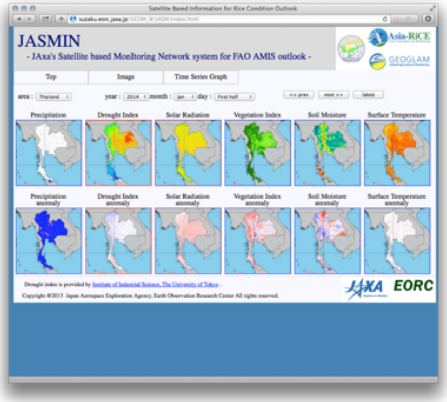
Satellite derived Agro-met information can support judging rice growth outlook.

Rice Growth Outlook to GEOGLAM for FAO AMIS

Asia-RiCE
Crop Estimation and Monitoring

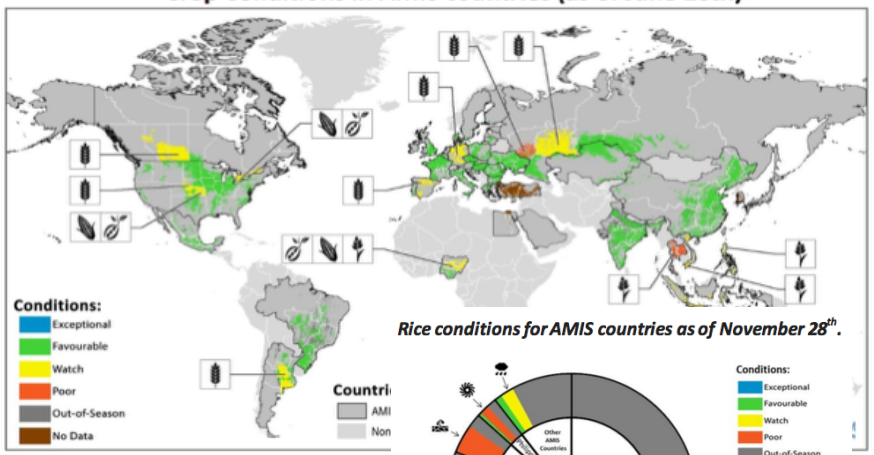
JAXA
Explore to Realize

AFSIS
ASEAN Food Security Information System



Agro-met Data

AFSIS



Crop Monitor

Phase-1

Phase-2

Agricultural Statisticians

GEOGLAM
Global Agricultural Monitoring

Monthly Rice Growth Outlook is report to the GEOGLAM for AMIS

Asia-RiCE Team Phase2 Work Plan (2016-2017)

❖ Expanding Rice Growth Outlooks

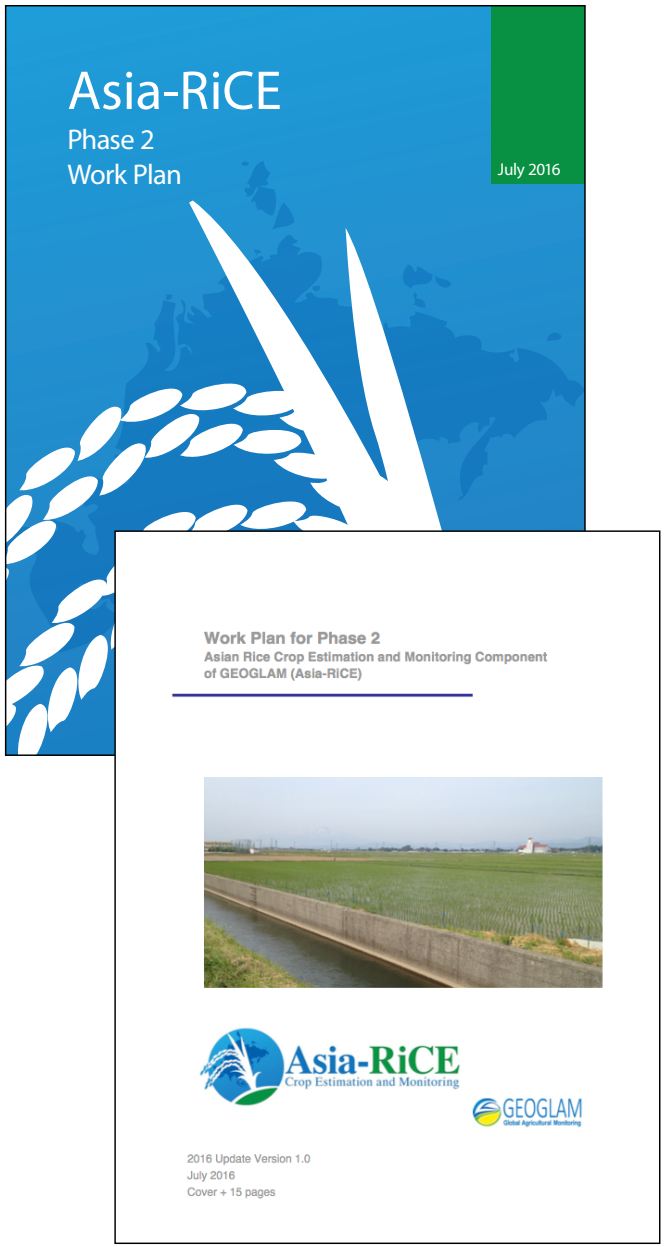
- Continue to prepare rice growth outlooks and provide them to AMIS and related agencies via GEOGLAM in collaboration with AFSIS
- Add rice growth outlooks for Laos, Cambodia, and Myanmar

❖ Scaling-up Monitoring

- Expand provincial-level to country/region-level estimates
- Vietnam (Mekong River Delta) and Indonesia (the top-10 rice producing provinces)

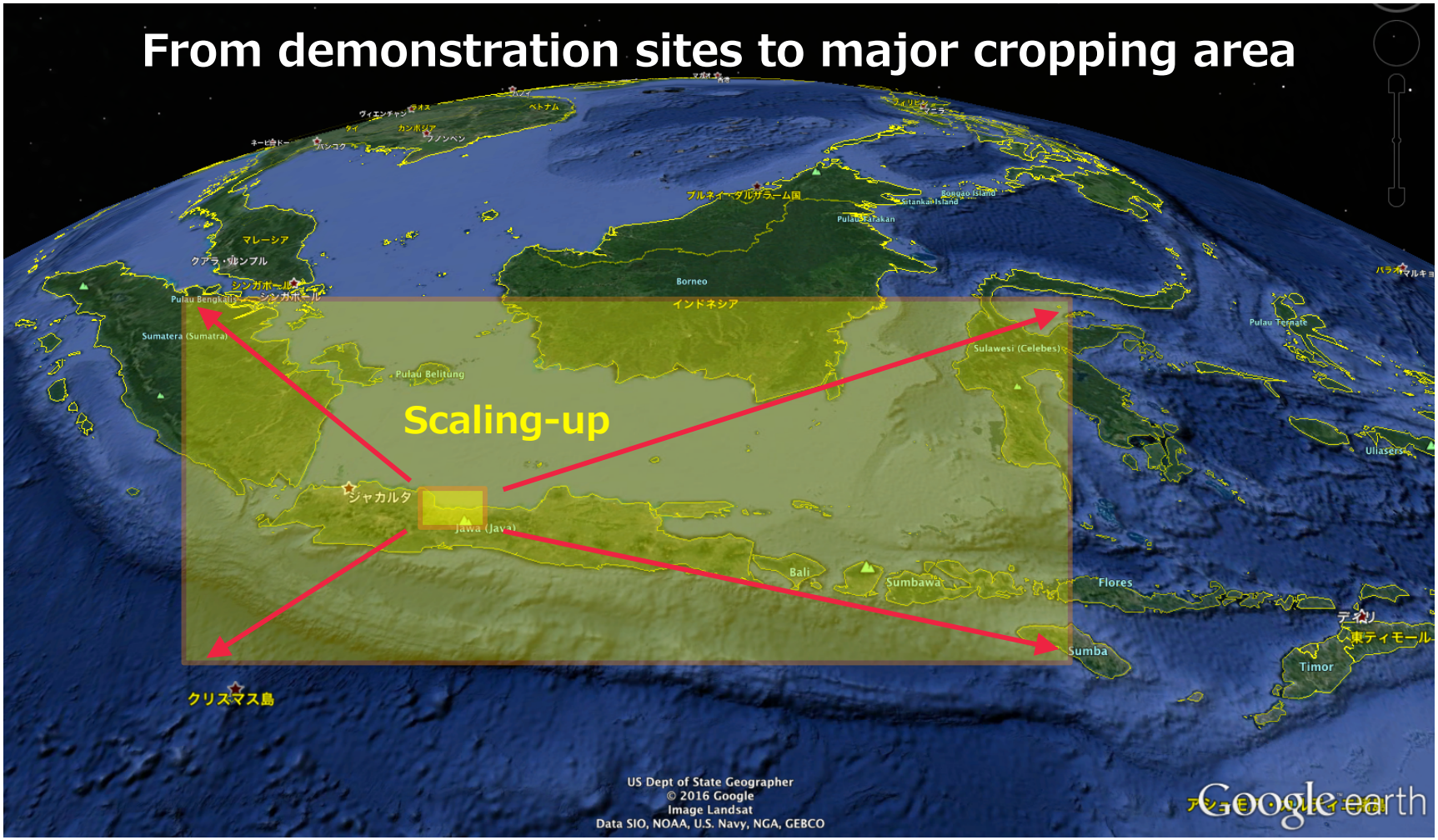
❖ Other Topics

- Fusing optical and SAR data (including multi-frequency SAR) for rice growth monitoring
- Standardization of an in situ measurement procedure for essential rice variables (paddy/non paddy, plant height, yield, etc.) and the selection of sampling points for validation
- Start to investigate methane emission from paddy field



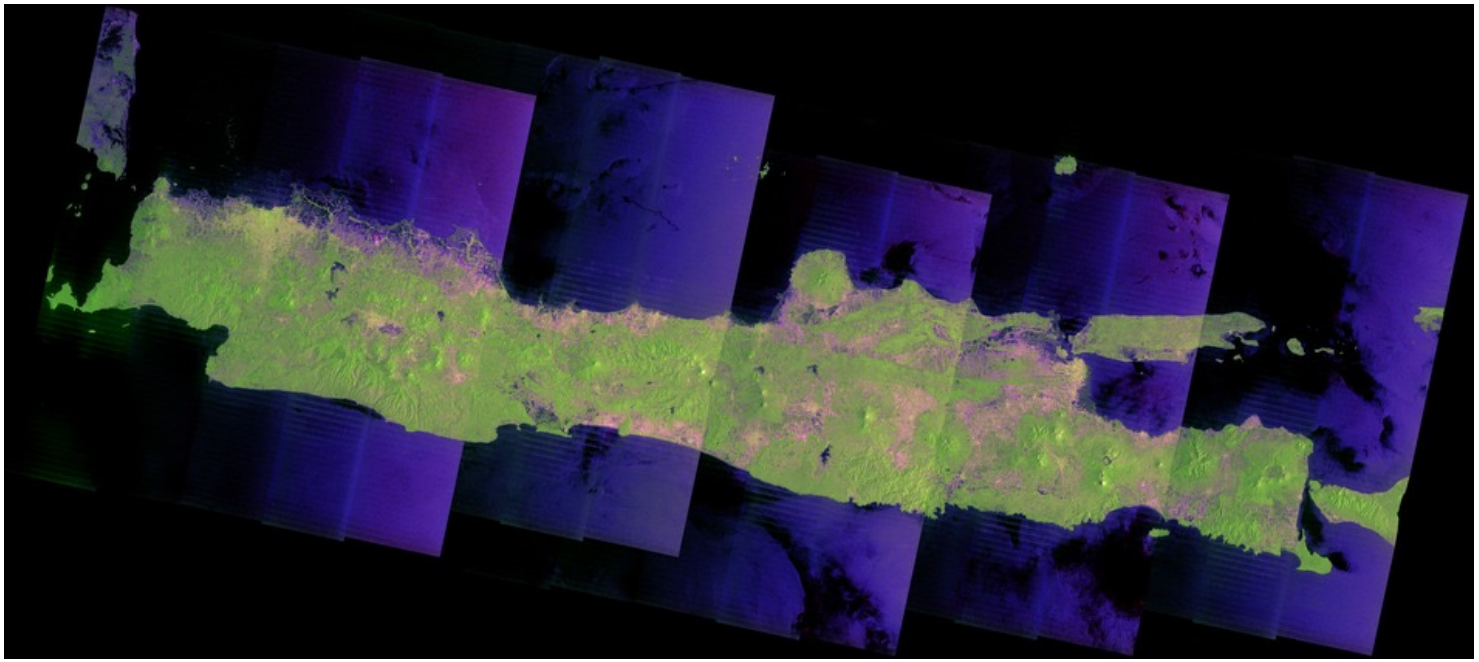
Scaling-up Monitoring by SAR

- Scaling-up monitoring for covering whole country/major rice crop area is quite important for practical use.
- Large amount of SAR data management/processing system is needed.

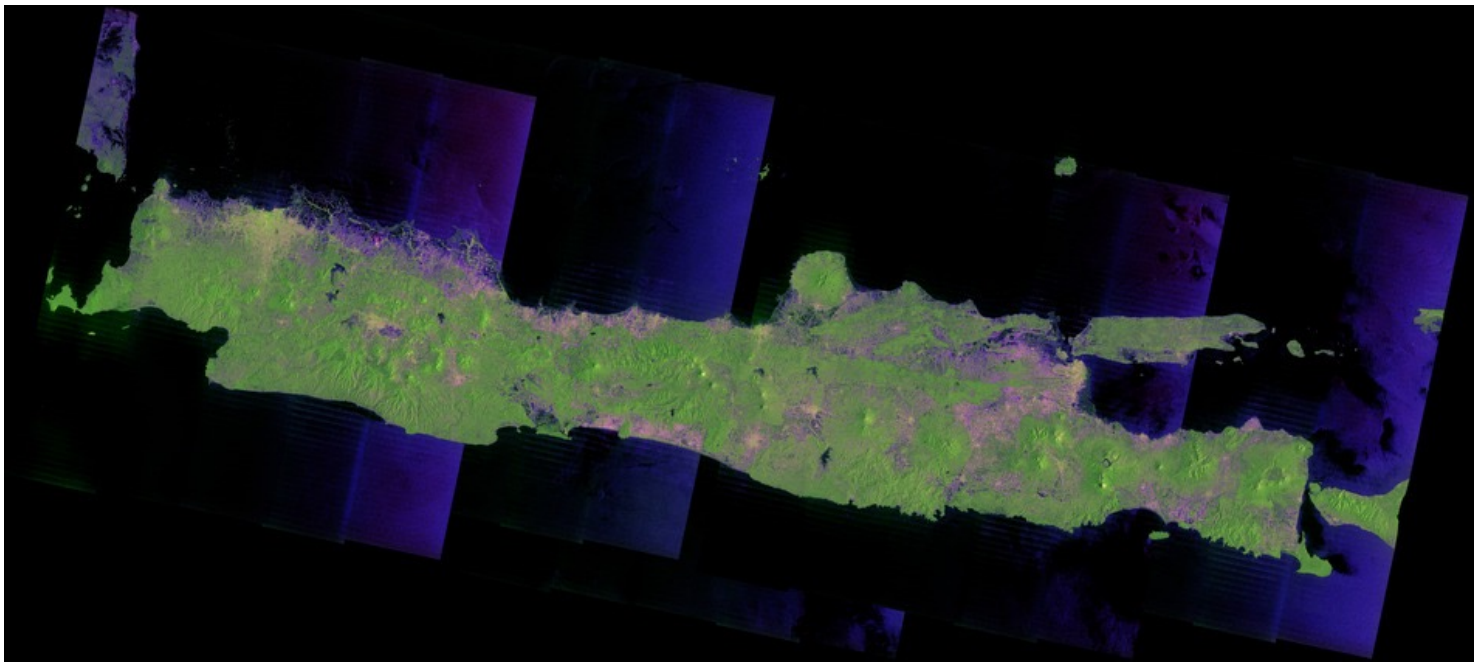


Pre-processing : Incidence Angular Effect

Befor Correction



After Correction

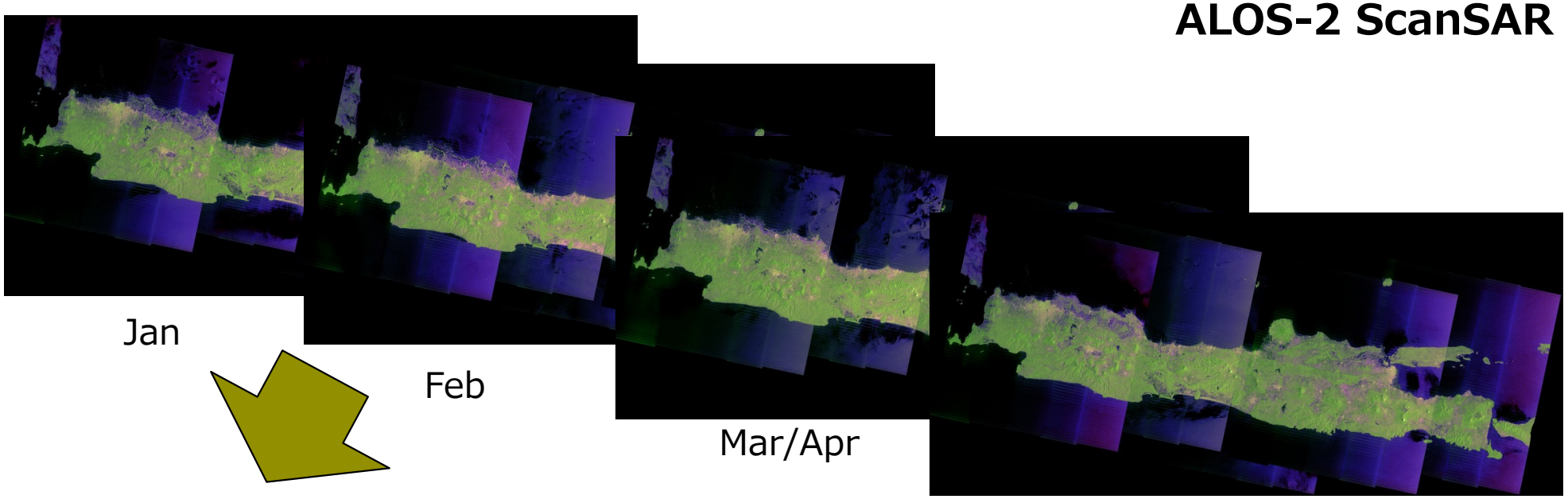


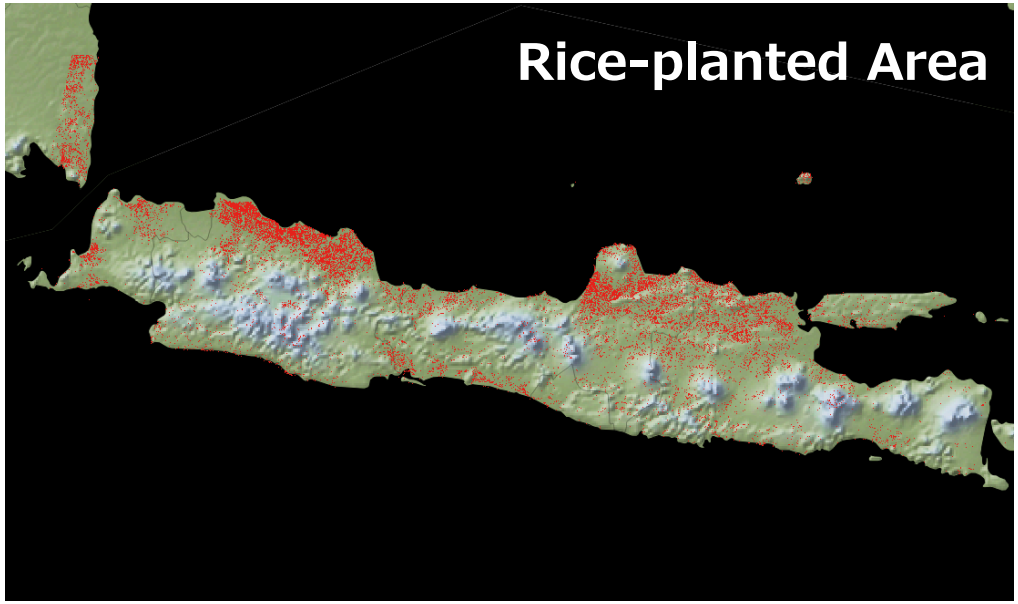
ALOS-2 ScanSAR

Scaling-up Monitoring : Java Island, Indonesia

❖ Large SAR data are needed to cover major rice cropping regions.

ALOS-2 ScanSAR





Joint research with
MoA Indonesia

Top10 Rice Producing Provinces in Indonesia

- ALOS-2 ScanSAR

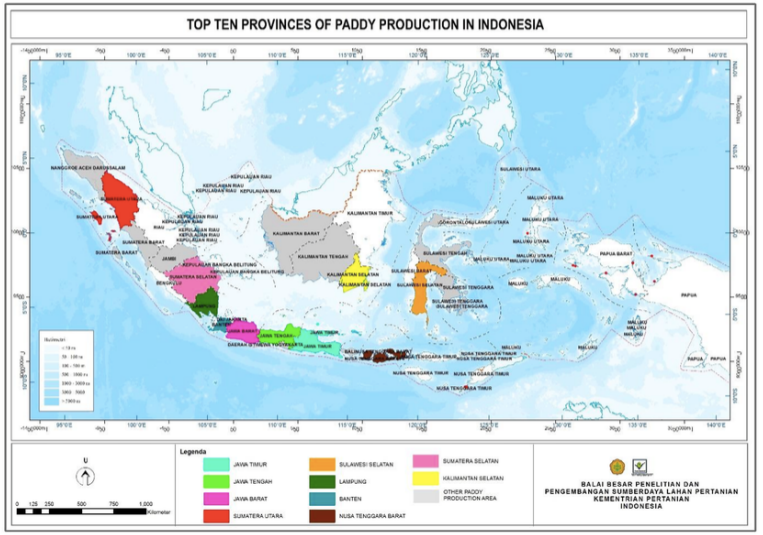
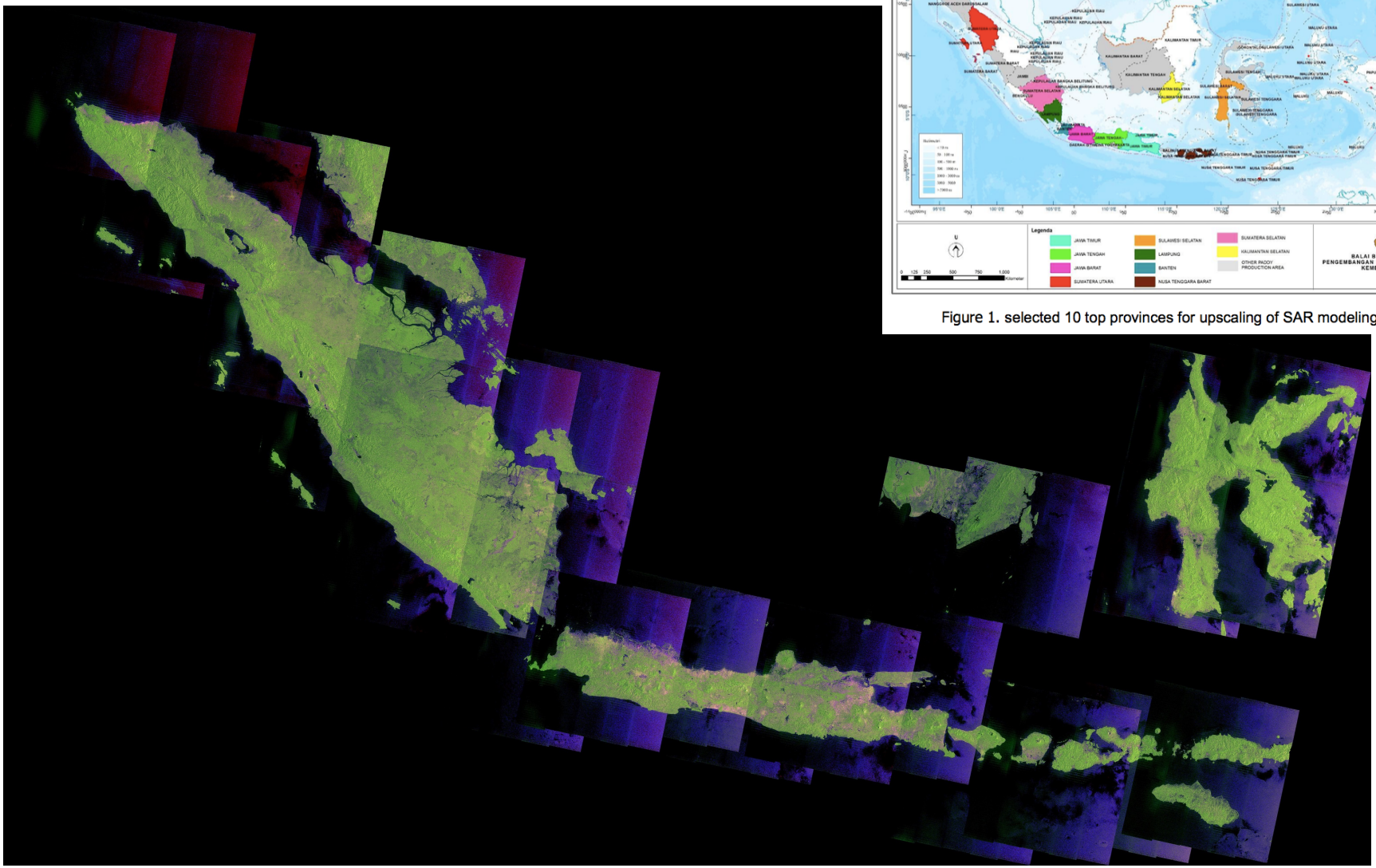


Figure 1. selected 10 top provinces for upscaling of SAR modeling of paddy



3000 km

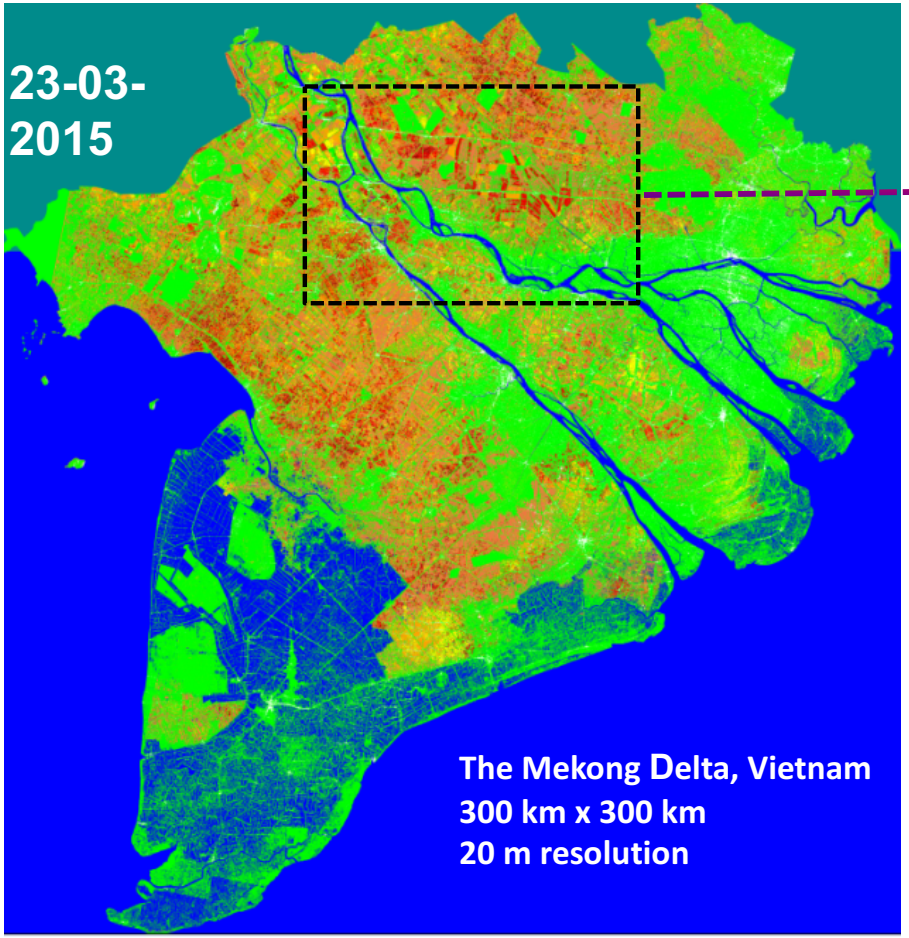
Rice Growth Monitoring
- Mekong Delta -

GROUP ON EARTH OBSERVATIONS

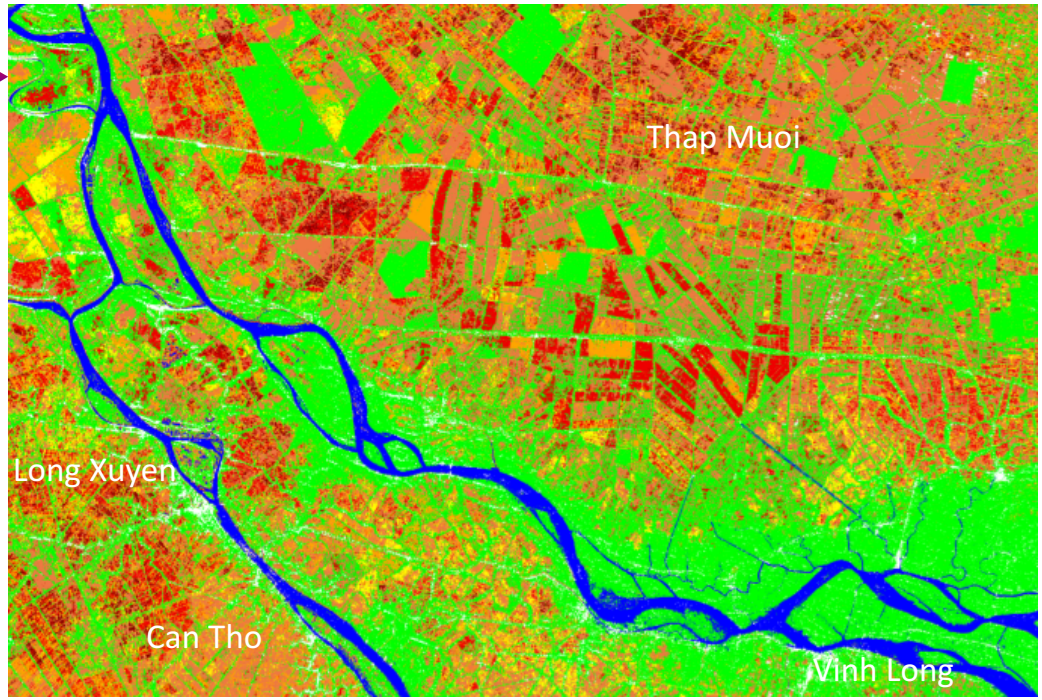
GEOGLAM Global Agricultural Monitoring

Monitoring of Winter-Spring rice

Sentinel-1



100 km x 70 km, 20 m resolution



- Rice: early stage
- Rice: tillering stage
- Rice: reproductive stage
- Rice: maturity stage
- Non rice (forest, other LULC)
- Water (ocean, river, aquaculture)
- Land outside the Vietnam Mekong delta

CESBIO

V.A.S.T

Asia-RiCE Crop Estimation and Monitoring

innovators georice

[Thuy Le Toan and Lam Dao Nguyen]

Cloud Computing Solution for Large SAR Data Processing

Analysis Tool

JAXA Japan Aerospace Exploration Agency

INAHOR

Developed by JAXA

Datasets

JAXA Japan Aerospace Exploration Agency

AFE

JECAM Joint Experiment for Crop A[illegible]ito

ALOS-2

Provided by JAXA

RADARSAT-2

Provided by CSA

CSA ASC

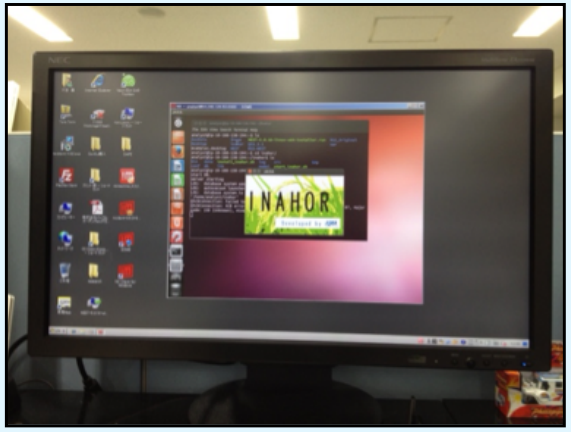
Broad-Band (10GB-)

Cloud Computing System (SDMS)

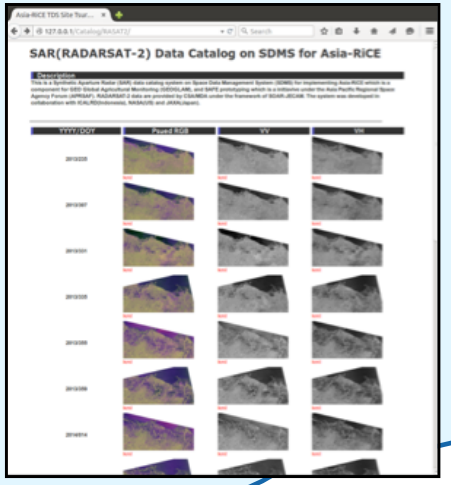
- High performance
- Huge database

NASA

Processing Software



Database

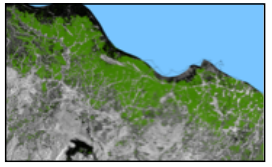


Too big to download the data

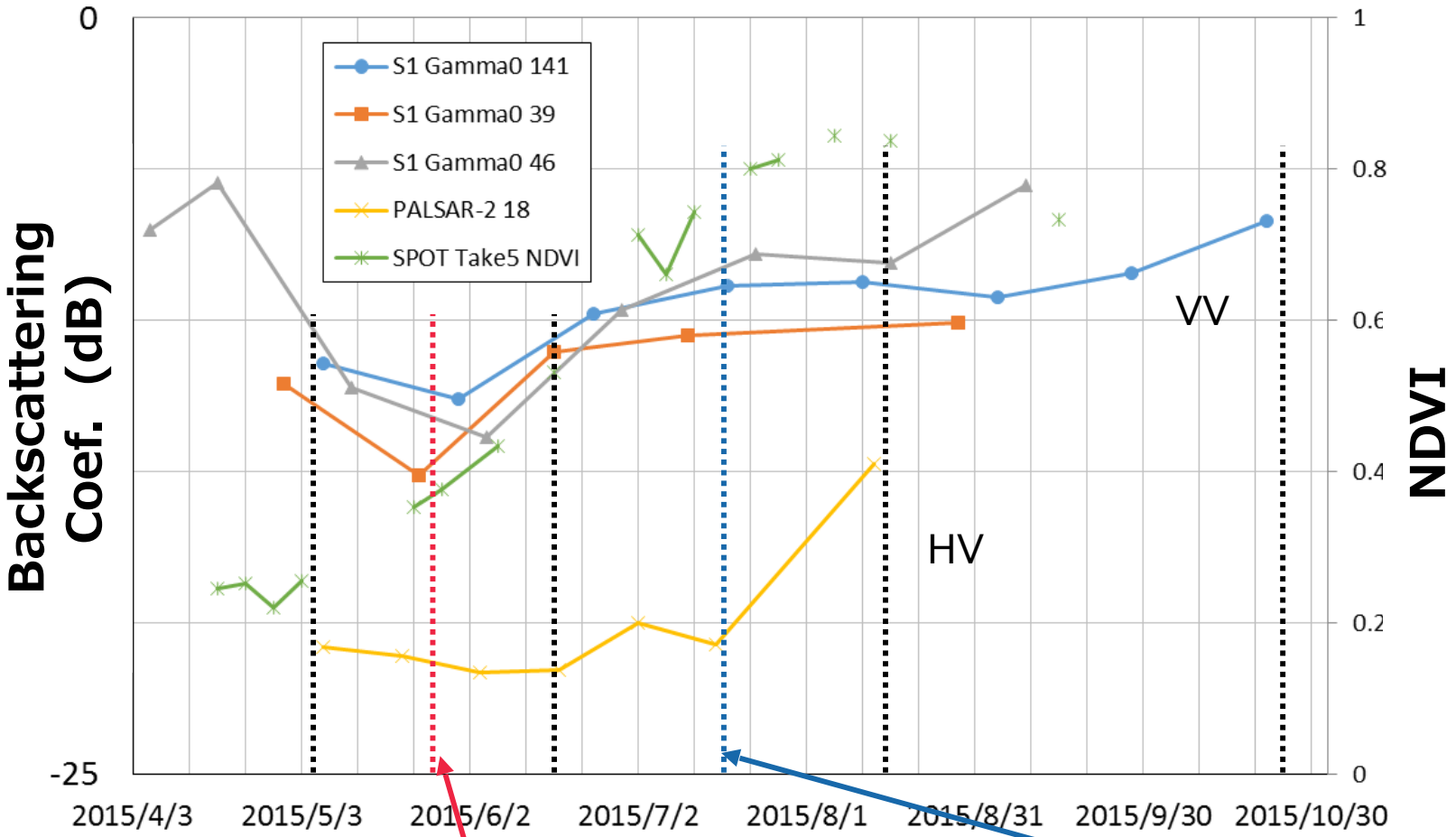
Narrow-Band (10-100MB)

End-User

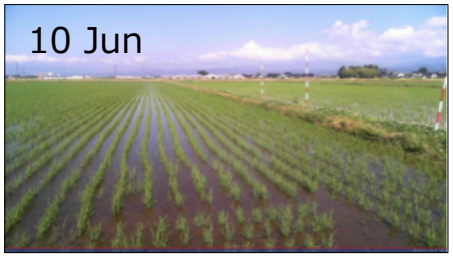
Rice Planted Area Map



Multiple-SAR and Optical Data Comparison in Tsuruoka, Japan



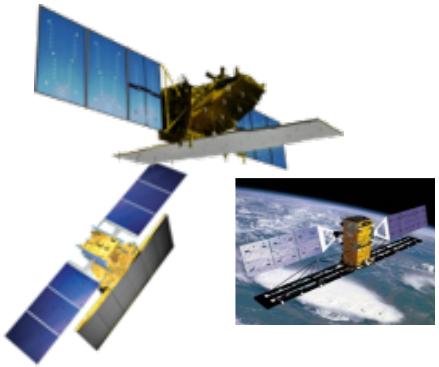
AWS with Camera

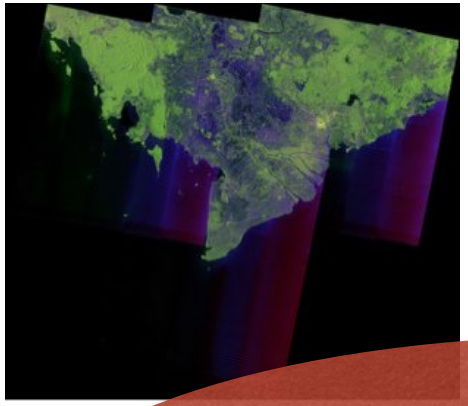


Methane Emission from Paddy Field

Rice-planted Area/Water Inundation

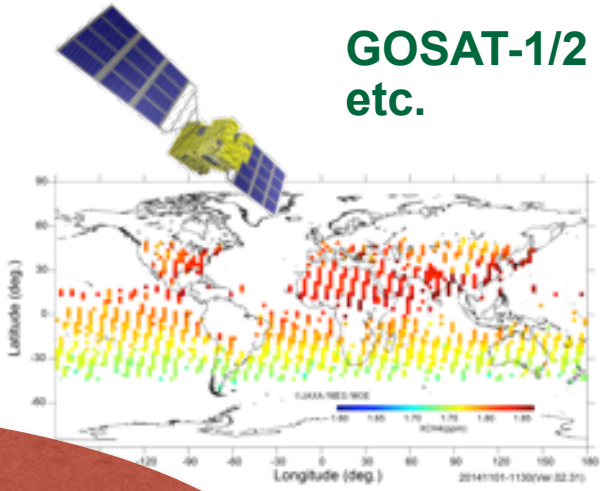
ALOS-2, Sentinel-1
RADARSAT-2, etc.





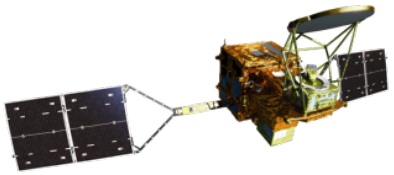
CH_4 Concentration (column)

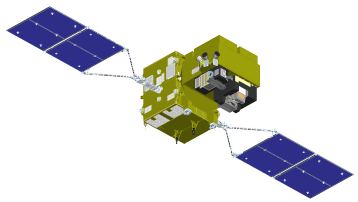
GOSAT-1/2
etc.

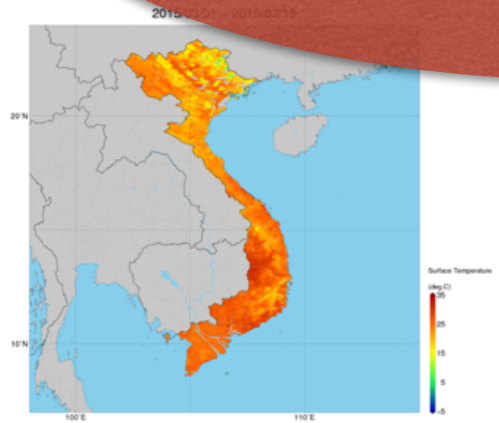


CH4 Emission Monitoring/Evaluation

GCOM-C, GCOM-W
GPM, Himawari-8 etc.







(e.g. Land Surface Temperature)

Agro-met Information

in-situ Measurement
Inventory

Summary

❖ **In Phase1, Asia-RiCE team successfully demonstrated:**

- Province-level rice crop monitoring using SAR (RADARSAT-2, Sentinel-1, TerraSAR-X, COSMO-skyMED, RISAT-1, ALOS-2) data for technical demonstration sites (TDS);
- Reporting rice growth outlook with AFSIS and agricultural statistician using agro-met data to GEOGLAM for AMIS.

❖ **Phase 2 focuses on:**

- Expanding rice growth outlook activities (adding countries, refinement of agro-met information provision system);
- Expand provincial-level to whole country (or major crop area) rice monitoring (Mekong Delta, Vietnam and the top-10 rice producing provinces in Indonesia) with consideration for the utilization of cloud computing system to process very large SAR data.


Thank you very much for your attention.
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JAXA
Explore to Realize