# ASIA RICE CROP TEAM (ASIA-RICE) ACTIVITY IN GEO GLAM

Shinichi Sobue

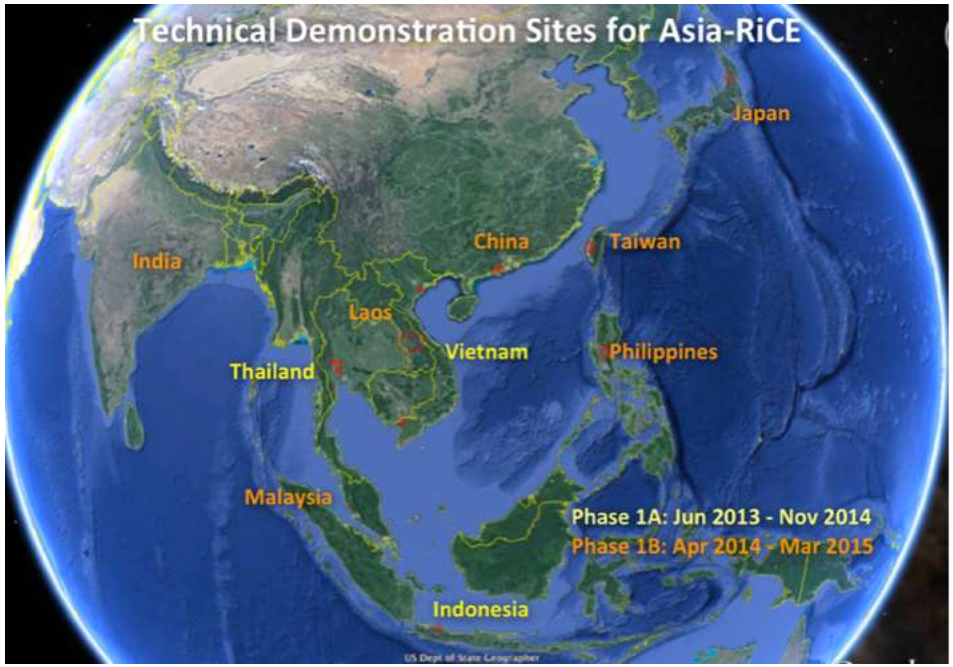
On behalf of Asia RiCE team in GEOGLAM

# Asia-RiCE for GEOGLAM (Global Agriculture Monitoring)

- **GEOGLAM** was endorsed by the G20 Summit, aims to enhance regional and global agricultural production (wheat, maize, soybean, and **rice**) estimates through the use of Earth observations

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

- Asian agencies are implementing ***Asia-RiCE (Asia Rice Crop Estimation & Monitoring)*** to strengthen ***rice crop*** monitoring ability ***by using remote sensing***, which is a component for GEOGLAM.




GEOGLAM Global Agricultural Monitoring

G20 FRANCE 2011 NOUVEAU MONDE NOUVELLES IDÉES

Asia-RiCE Crop Estimation and Monitoring

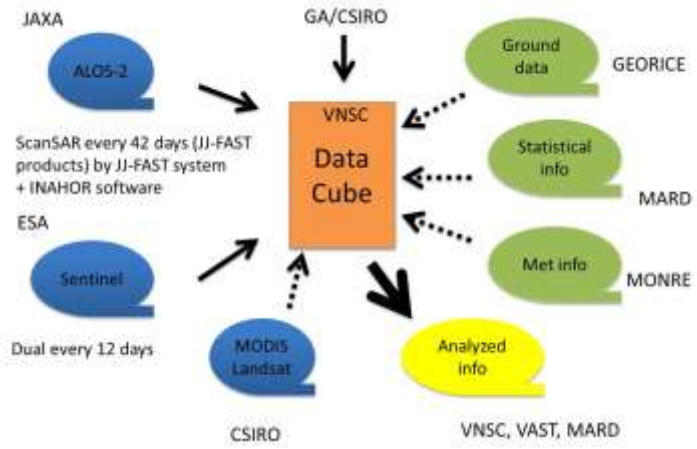
**Asia-RiCE Website: http://www.asia-rice.org**

# GEOGLAM AsiaRiCE (from demo to operation)

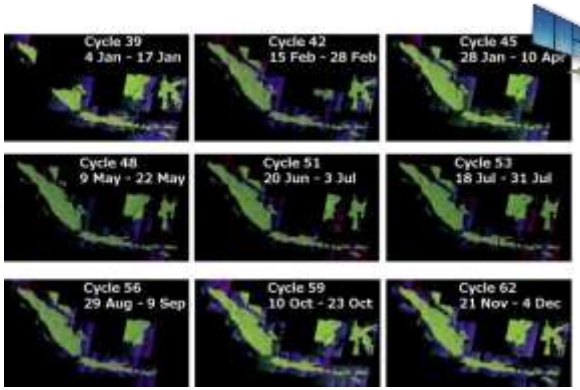
http://www.asia-rice.org

**Asia-RiCE (Asia Rice Crop Estimation & Monitoring) program led by JAXA with CNES and more than 20 Asian Space agencies and Ministries of Agriculture with International organization such as ASEAN/AFSIS, UN/FAO, IRRI from 2013 (POC: Sobue.shinichi@jaxa.jp, ohyoshi.kei@jaxa.jp, Thuy.letoan@cesbio.cnes.fr**

| ID | Target Agricultural Products | Requirements of EO data for operational use |
|---|---|---|
| P1 | **Rice Crop Area Estimates/Maps** | Wall-to-wall observation with SAR dual polarization with Opticals (week – bi-weekly – monthly) : Indonesia, Vietnam/Cambodia and Thailand/Lao projects |
| P2 | **Crop Calendars/Crop Growth Status** | Mid/coarse resolution opitcal frequent observation (MODIS, GCOM-C, Landasat, Sentinel-2, etc.) with SARs weekly |
| P3 | **Crop Damage Assessment** | Very High resolution SAR and Optical timely under international disasater charter, Sentinel Asia, etc. |
| P4 | **Agro-meteorological Information Products** | Daily Mid/coarse resolution optical, passive microwaver and PR with geostatinary met sat frequent observation (MODIS, Sentinel, GCOM-C/W, GPM, Himawari, etc.) |
| P5 | **Production Estimation and Forecasting** | Data fusion, data integration with ground base observation / statisitcal information and crop models |




Vietnam Data Cube starting from GEOSS-AP (Hanoi, September) by VNSC/VAST with CEOS




Time series observation by SAR for top 10 Indonesia main rice regions by ALOS-2 with MOA

# Recent highlight activities in Asia Rice

1. Rice Crop Mapping in Southeast Asia
   - Technical demonstration site in Asia using SARs - R2/Sentinel-1/2/ALOS-2/RISAT
   - Scale up in Indonesia, Vietnam using ALOS-2
   - Vietnam data cube preparation
   - ALOS-2 ScanSAR provision with free internet access for governmental use in selected Asia countries under JAXA-JICA cooperation
2. Agricultural Damage Estimation by Multi-Temporal ALOS-2 in Philippine with ADB and PSA
3. Agro-meteorological Monitor for Asia-RiCE
   - Continuous and stable operation with ASEAN countries in cooperation with ASEAN food security information project using MODIS/GCOM-W/GPM
   - GCOM-C (MODIS type morning sensor – SGLI) will be available from next year to provide more high resolution information with MODIS and GCOM-W
4. Next challenge will be discussed at APRSAF in India and JECAM/Asia rice meeting in Taiwan
   - Data integration / data fusion (L/X/C with optical)
   - Crop model for Yield estimation and GHG support

# Product 1:
# Rice Crop Mapping in Southeast Asia

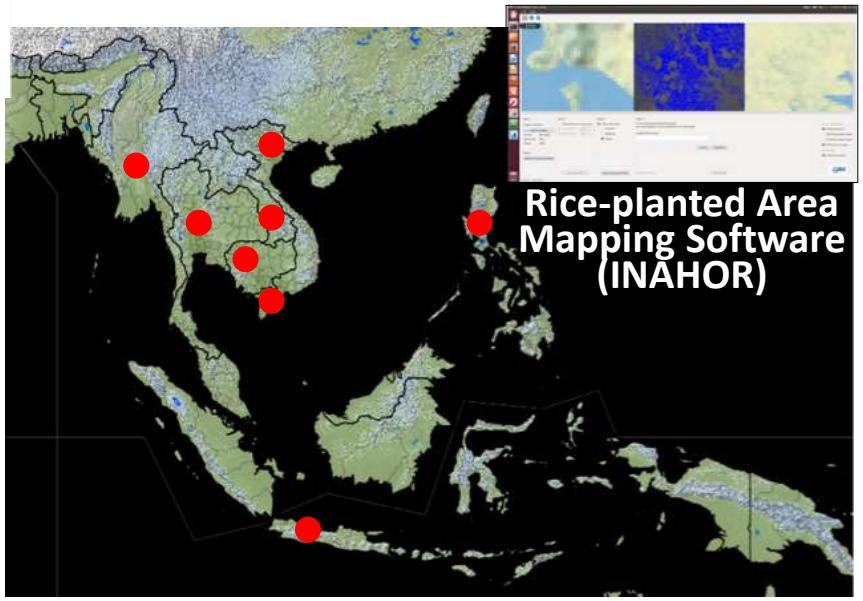
- ADB Technical Assistance project and SAFE project under the APRSAF have successfully demonstrated INAHOR using ALOS-2 with the mapping accuracy of 80-90% for the target provinces.
- Scaling-up for major rice producing areas is currently demonstrated in Vietnam and Indonesia.

ADB | Japan Fund for Poverty Reduction | From the People of Japan

## ADB TA Project

- Laos
- Thailand
- Vietnam (North)
- Philippines

[2014-2016]




SAFE

## SAFE Project (Test site)

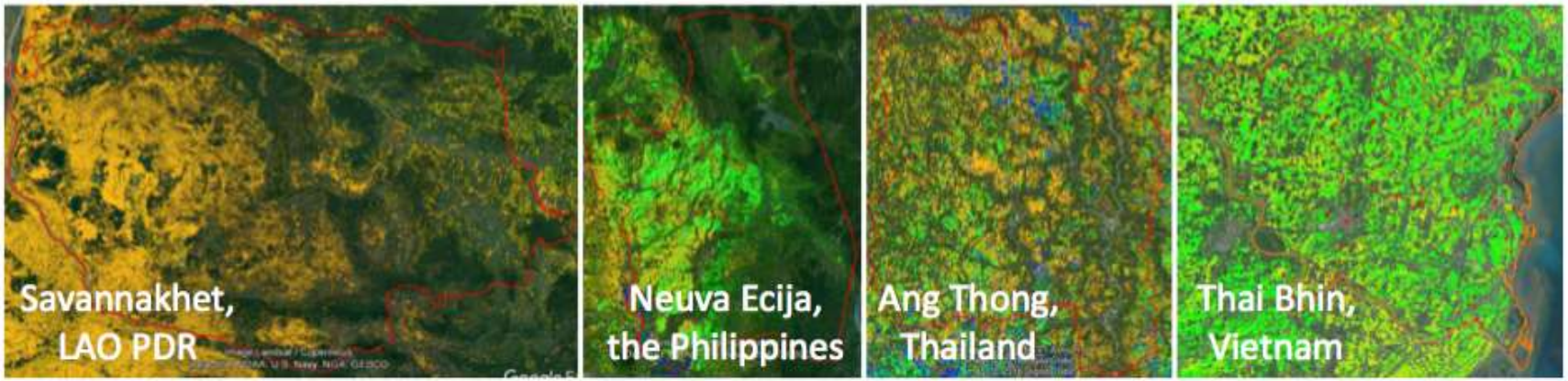
- Myanmar
- Cambodia

[2016-]

## SAFE Project (Scaling-up)

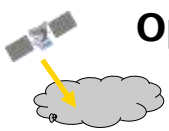
- Vietnam (Mekong Delta)
- Indonesia

[2014-]

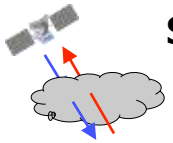


# Rice Crop Monitoring using ALOS-2 ScanSAR

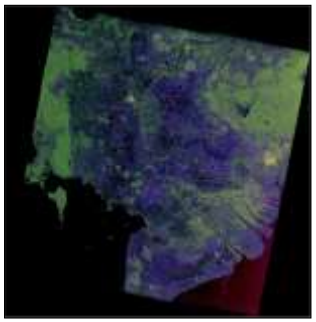
## SAR: Synthetic Aperture RADAR
**- Penetrate cloud -**



**Optical**



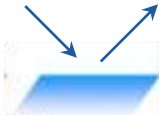
**SAR**



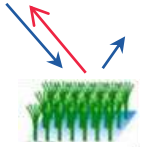
※Observed on the same day

## Rice planted Area Identification

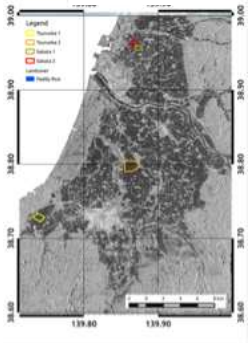
**Planting**

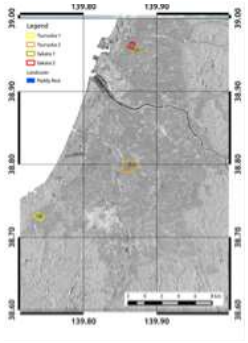


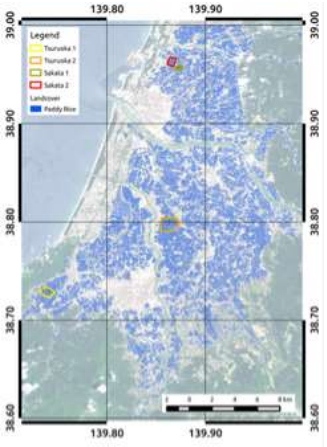
**Growing**



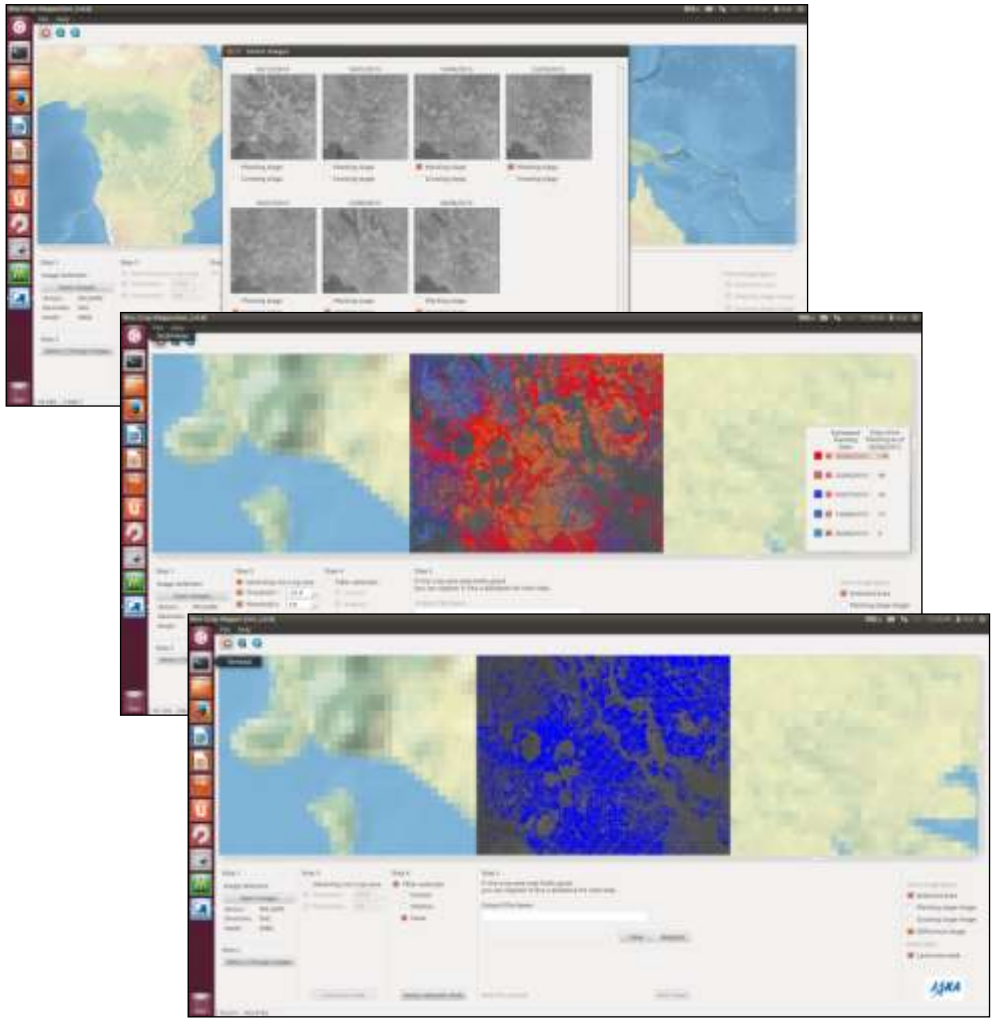
**Planted area**








## Rice Mapping Software (INAHOR)
**- Estimate rice planted area and growing stage -**

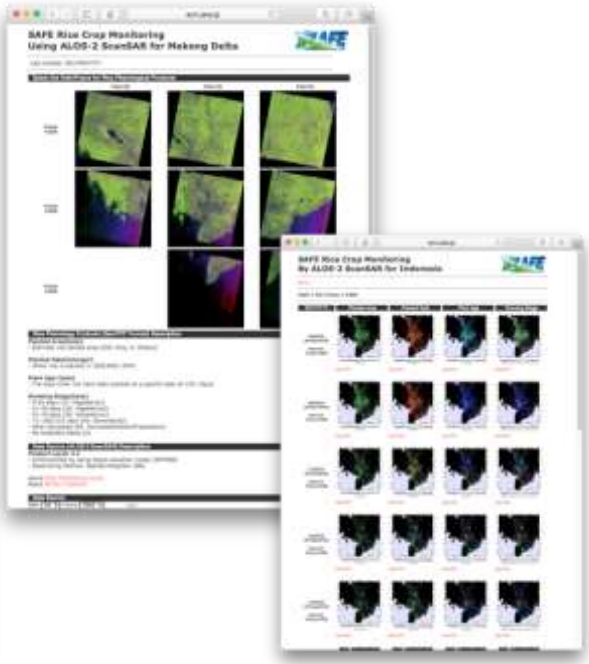


[Oyoshi et al., Paddy Water Env, 2016]

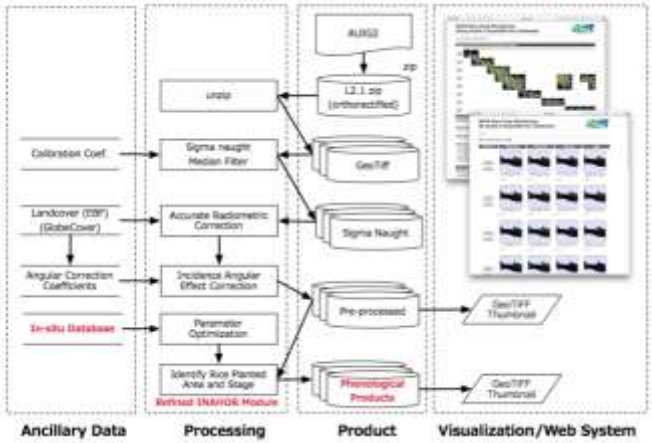
# Rice Crop Monitoring System for Scaling-up

## Indonesia


## Mekong Delta



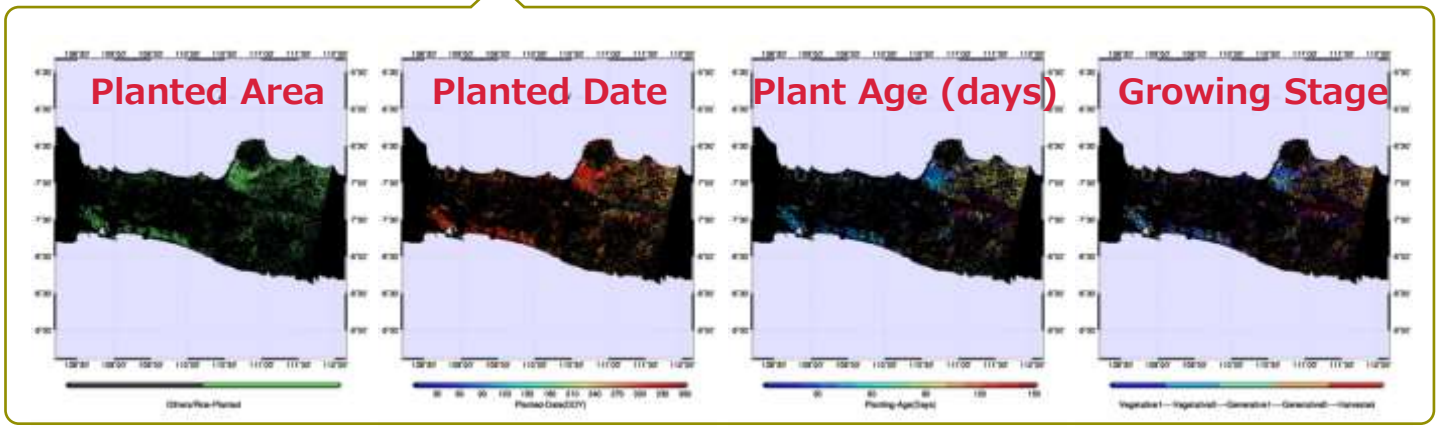

## Data Processing Flow



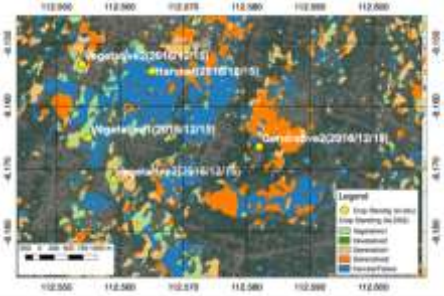

SAFE

Asia-RiCE
Crop Estimation and Monitoring

VNSC

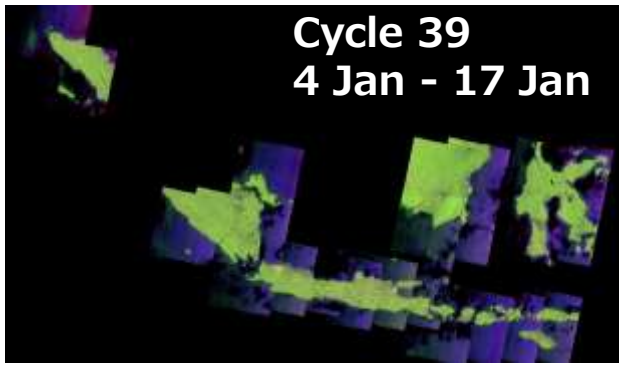


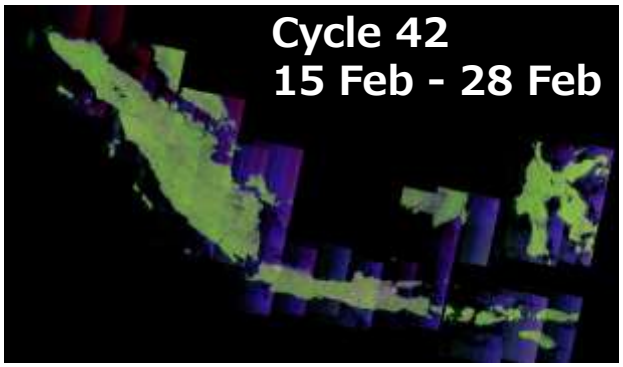

## Validation with in-situ data

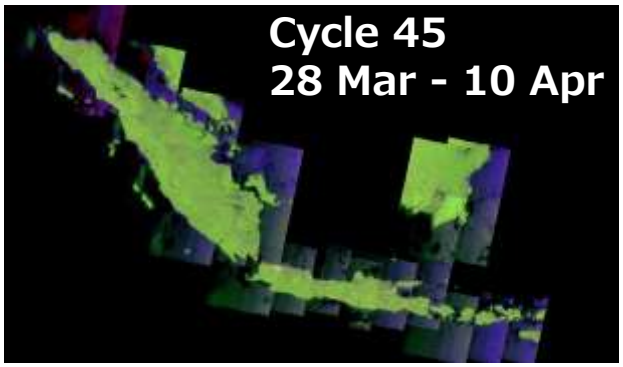


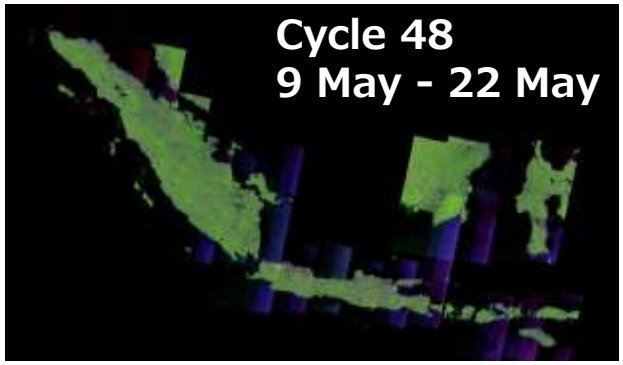
**Demonstrating scaling-up monitoring for rice by multi-temporal SAR data.**

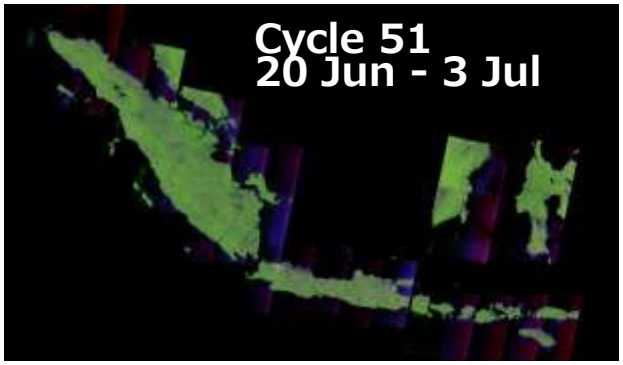
# Scaling-up Activities Towards Operational Use

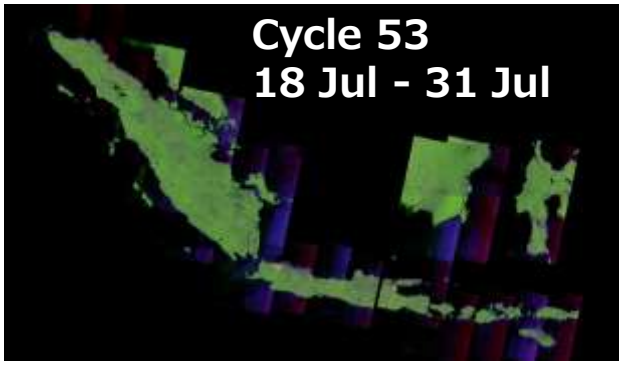


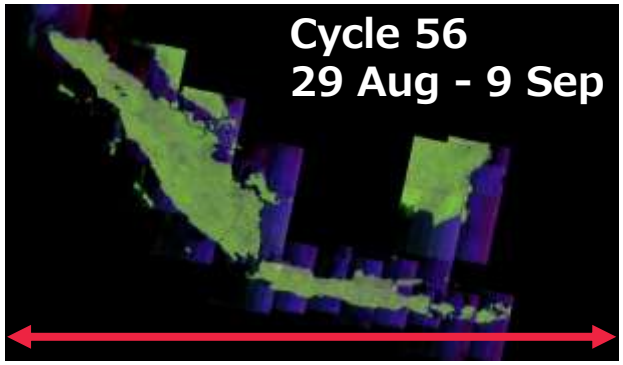



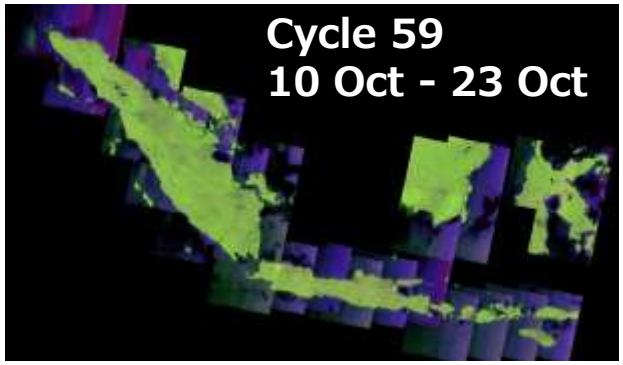



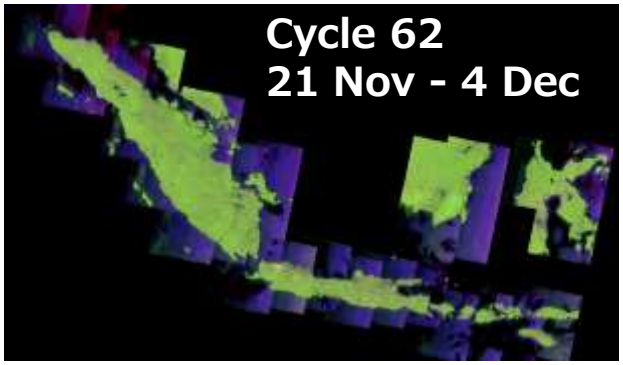



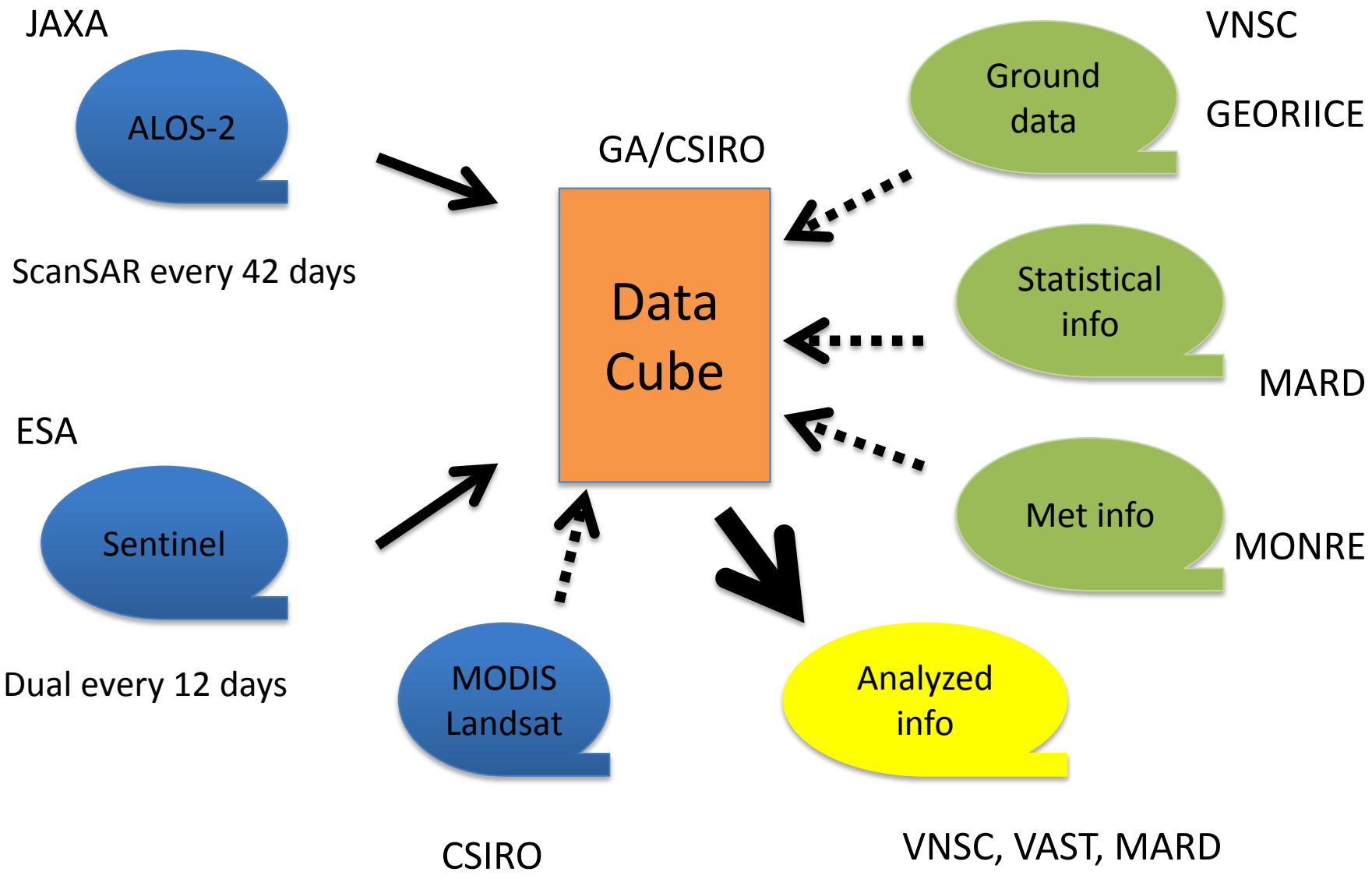

3000 km

ScanSAR Mode: 25m Spatial Resolution with 300km swath

# CEOS Mekong Datacube Pilot

- This pilot project will develop a Geoscience Datacube for the Mekong region based on satellite information to support forest and crop mapping, water resources assessments, marine monitoring, water quality and fisheries and in support of disaster risk reduction. The datacube will be developed using Australian open source software, with satellite information derived from US, Japanese and EU satellite systems.
- As an open source activity, other partners including other nations in the region, non-governmental organisations, and scientists from around the global, will be able to both benefit from, and contribute to, this work led by Australia and Vietnam. Upon successful completion of the pilot, the model can be developed and tailored for other economies in the APEC region.
- Economy project partners: Australia: Geoscience Australia, CSIRO; United States: USGS, NASA; Vietnam: VNSC, VAST, MARD; Japan: JAXA; and other countries (Europe, etc.)

# Vietnam SAR based rice crop monitoring scheme



# ALOS-2

| | |
|---|---|
| Application | Disaster, Land, Agriclture,<br>Natural Resources, Sea Ice & Maritime Safety |
| L-band SAR<br>(PALSAR-2) | Stripmap: 3 to 10m res., 50 to 70 km swath<br>ScanSAR: 100m res., 350km/490km swath<br>Spotlight: 1×3m res., 25km swath |
| Orbit | Sun-synchronous orbit<br>Altitude: 628km<br>Local sun time : 12:00 +/- 15min<br>Revisit: 14days<br>Orbit control: ≦+/-500m |
| Life time | 5 years (target: 7 years) |
| Launch | JFY2013, H-IIA launch vehicle |
| Downlink | X-band: 800Mbps(16QAM)<br>400/200Mbps(QPSK)<br>Ka-band: 278Mbps (Data Relay) |
| Experimental<br>Instrument | Compact InfraRed Camera (CIRC)<br>Space-based Automatic Identification System<br>Experiment 2 (SPAISE2) |

# ALOS-2 ScanSAR data provision

- For GEOGLAM and CEOS
  - Under GEOGLAM/Asia Rice and ALOS K&C project, JAXA provides ScanSAR data at technical demonstration sites (100km x 100km – one province) in Cambodia, Myanmar, Malaysia, Lao, India, China, Thailand and Taiwan to Asia Rice crop team members with ALOS-2 download system now.
  - Under Asia Pacific regionsal space agency forum (APRSAF) framework with GEOGLAM/Asia Rice, JAXA provides scale up activity for Indonesia (Top 10 rice crop production provinces) and Vietnam (Mekong)
- Proposal from JAXA
  - Under cooperation with JICA and commerical data providers, JAXA starts to prepare to provide on-line access to intermidate JJ-FAST products = ScanSar ortho-slop corrected DN data and/or ALOS-2 25m path ortho-slop correct data (gamma naught) from ALOS-2 path mosaic to selected countries for each target country data where JAXA, ADB and APRSAF countries have cooperative aggeement (Indonesia, LaoPDR, Thailand, Philippine, Low Mekong (Vietnam + Cambodia)) for governmental use in respecting countries.
  - JAXA starts to prepare sample data of ScanSAR data to ingest Vietnam data cube and propose CEOS ARD of SAR (1-5 degree mesh tiled data or path orth-slop corrected data) in cooperation with CEOS SEO (NASA)
  - Other than ASEAN area, JAXA will discuss with commercial data distributor to have same framework of ALOS-2 ScanSAR intermidate product to target countrys' governmetal use if CEOS and GEO community are interested in.

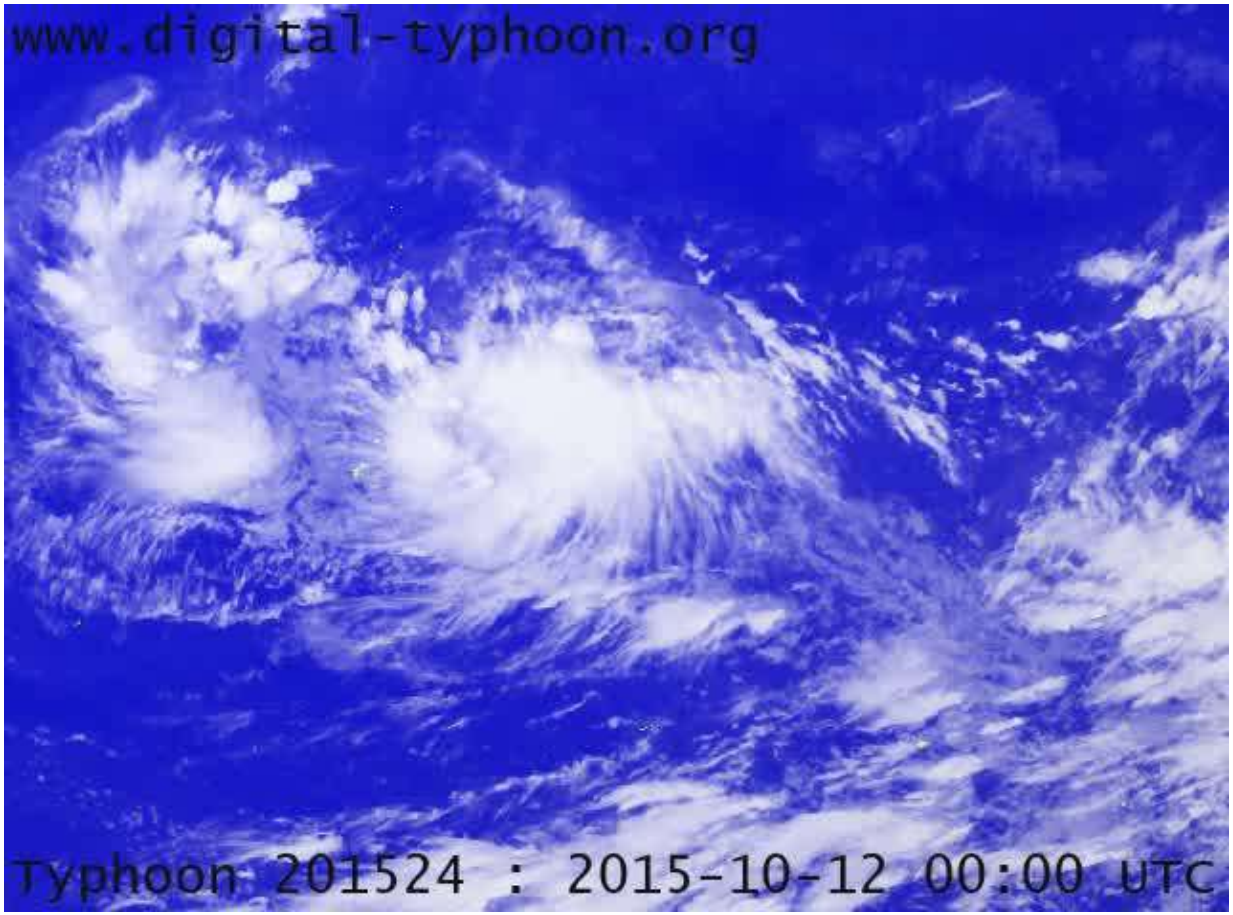
# Coordination status with respecting countries

1. Vietnam
- VNSC and CSIRO/GA already prepare to implement CEOS Mekong data cube by the end of this year
- VNSC and JAXA agreed to coordinate ALOS-2 ScanSAR data ingestion with rice crop area estimation software (INAHOR) to CEOS Mekong data cube
- JAXA and VNSC will finalize MOU for Vietnam data cube with ALOS-2 ScanSAR data and will have Data cube workshop as a pre-workshop of GEOSS-AP agriculture working group (WG5)

2. Indonesia
- LAPAN, MOA and JAXA agreed to coordinate coordinate ALOS-2 ScanSAR data ingestion to LAPAN data archive
- JAXA and LAPAN start to coordinate MOU to archive and use ALOS-2 ScanSAR data in Indonesia

3. Thailand
- JAXA and GISTDA start to discuss ALOS-2 ScanSAR data of Thailand and Lao provision to GISTDA

# Product 3: Damage Assessment
# Typhoon Lando hit Philippines (13-21 October 2015)

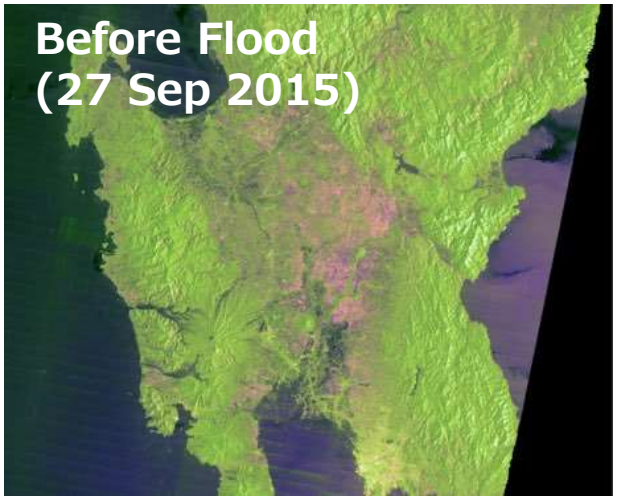


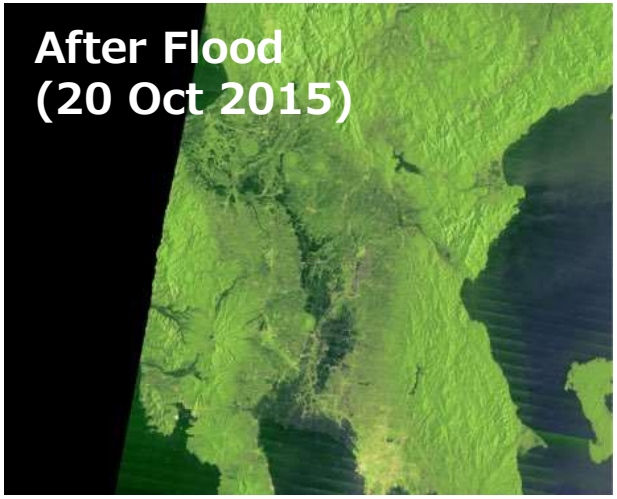

**Digital Typhoon (Prof. Kitamoto, NII, Japan)**
**http://agora.ex.nii.ac.jp/digital-typhoon**

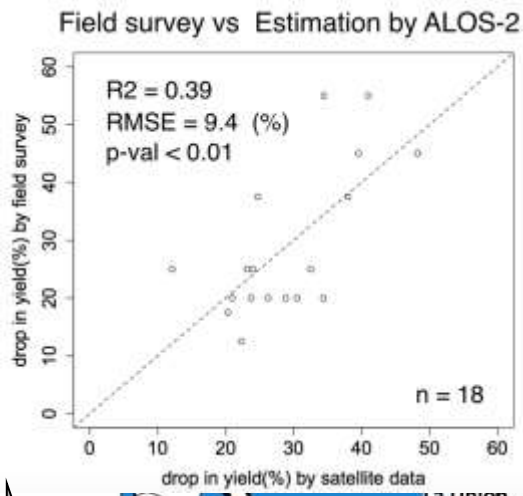
Observed by Himawari-8
Japanese Geostationary Satellite

# Agricultural Damage Estimation by Multi-Temporal ALOS-2

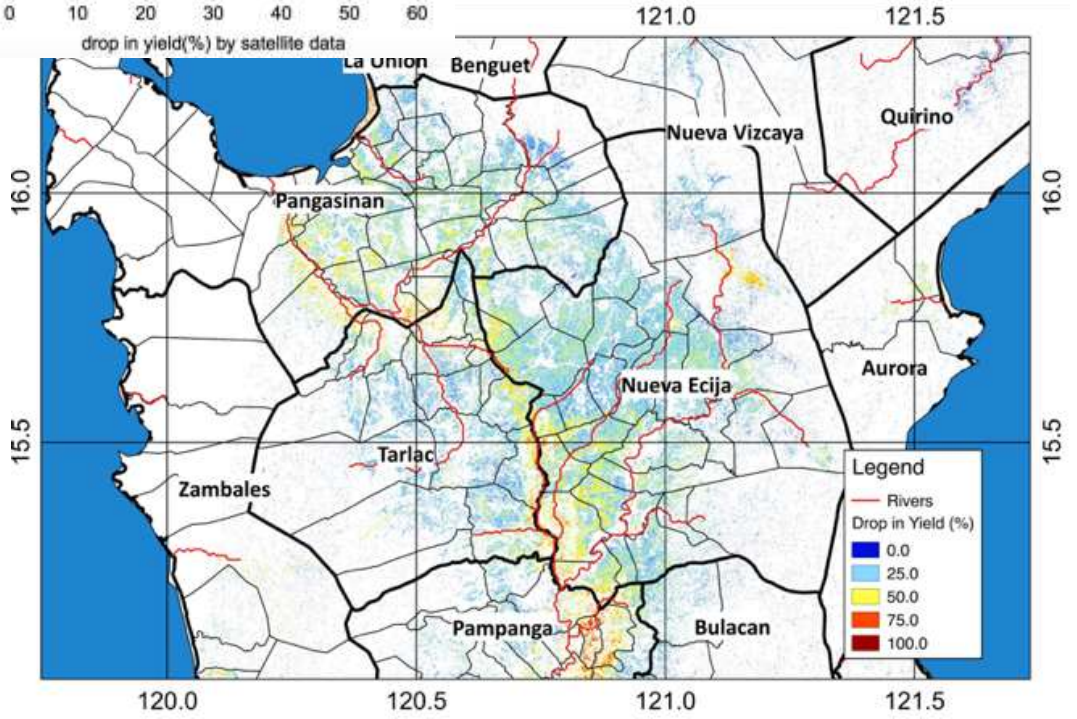
- Damage (yield decrease) were estimated by using ALOS-2 data (before/after flooding).







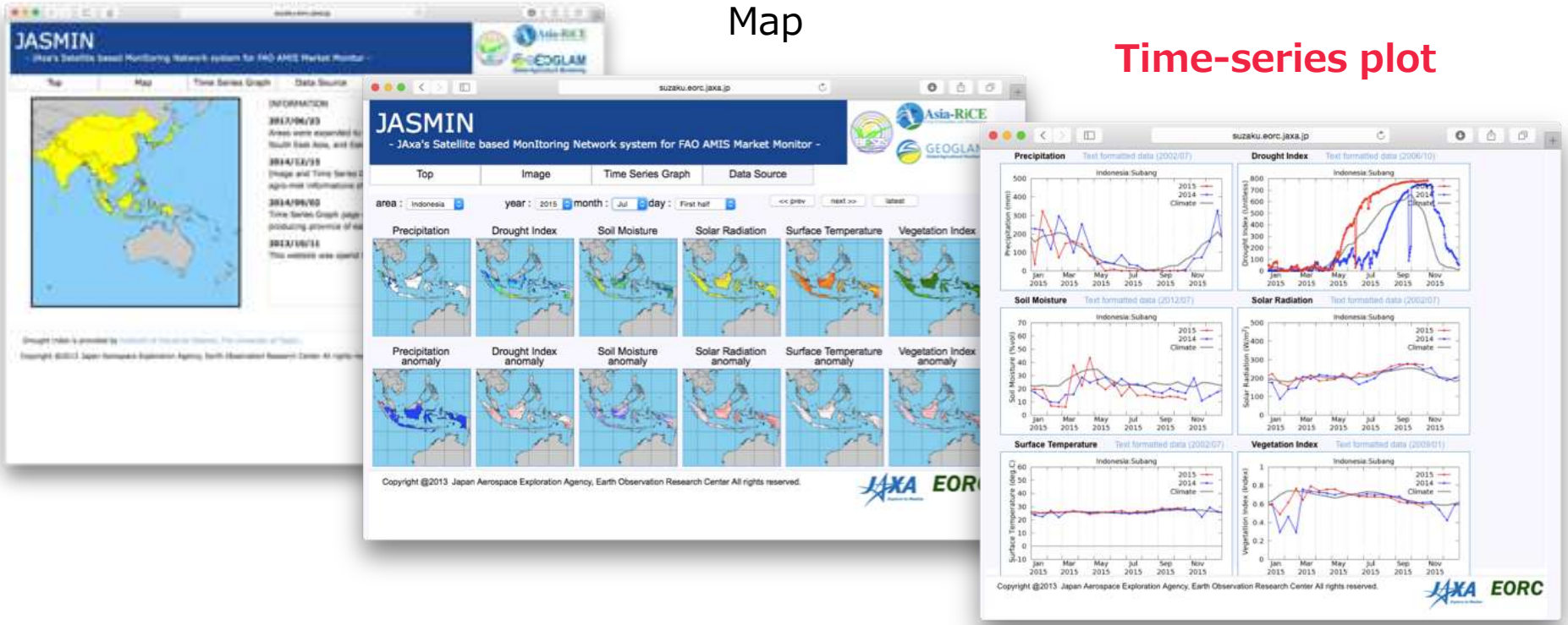
# Product 4: Agro-meteorological Monitor for Asia-RiCE

- **JASMIN** provides satellite-based precipitation, drought index, solar radiation, land surface temperature, soil moisture, and vegetation index (updated twice a month).
- Map, Time-series plot, and text data are available.

Top Page

Map

**Time-series plot**

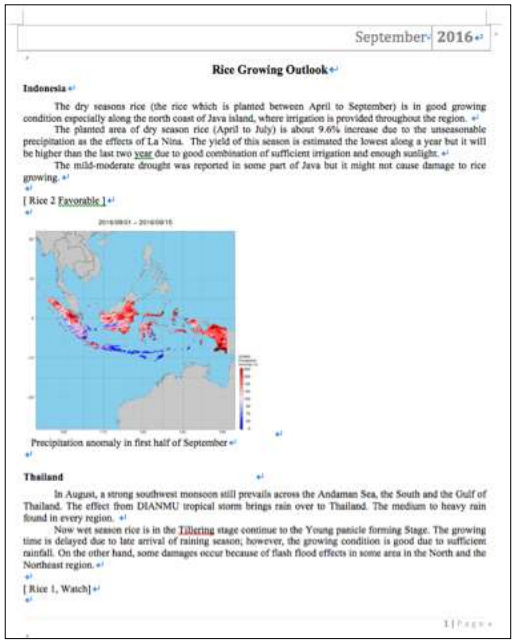



http://suzaku.eorc.jaxa.jp/JASMIN/index.html

[Oyoshi et al., JSPRS., 2016]

# Example: Rice Growth Outlook in Vietnam

**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 ]

Precipitation anomaly in first half of September

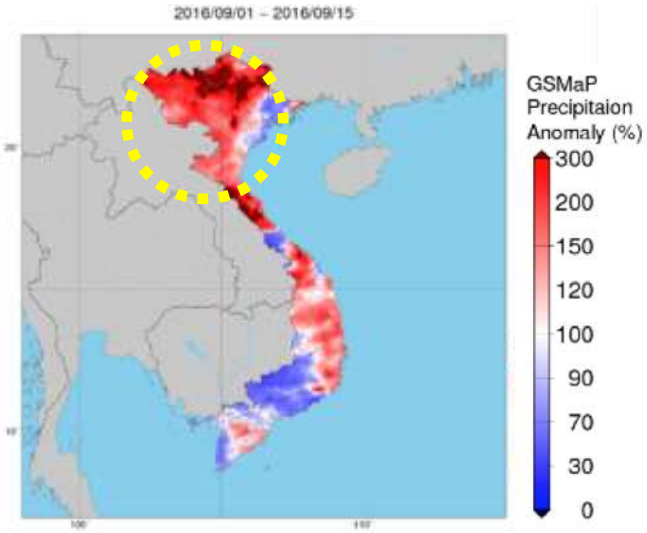
**Thailand**

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.

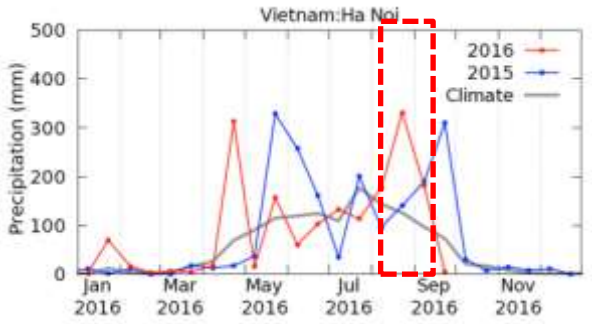
Now wet season rice is in the Tillering stage continue to the Young panicle forming Stage. The growing time is delayed due to late arrival of raining season; however, the growing condition is good due to sufficient rainfall. On the other hand, some damages occur because of flash flood effects in some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

# Rice Growth Outlook to GEOGLAM for FAO AMIS

**Market Monitor** is published by **FAO.AMIS** on monthly basis to assess international agricultural market situation and **outlook** of **wheat, maize, rice, and soybeans**.

Asia-RiCE Crop Estimation and Monitoring

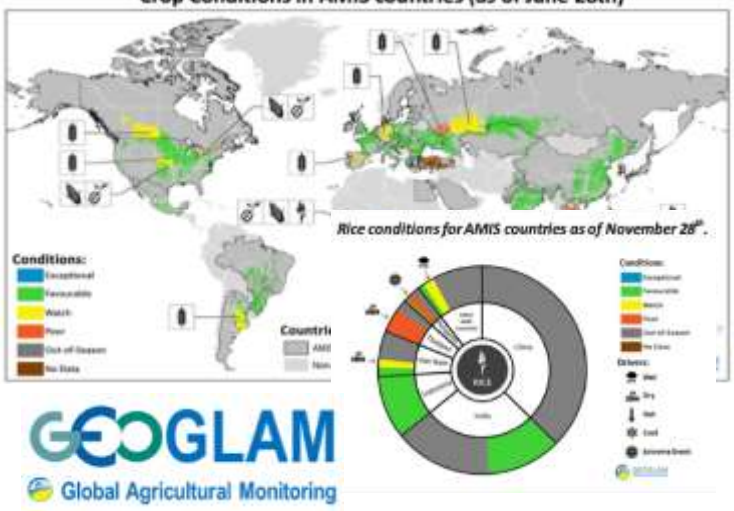
JAXA Explore to Realize

AFSIS ASEAN Food Security Information System


Agro-met Data


AFSIS

**Rice Growth Outlook**

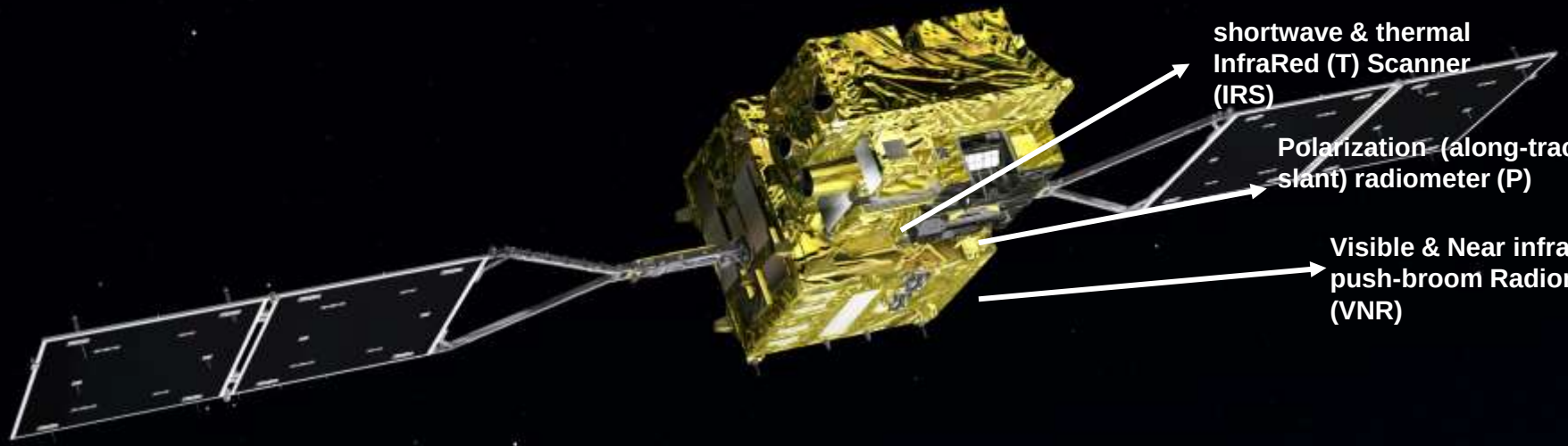

**Phase-1** **Phase-2**

Thailand Indonesia Vietnam Philippines Cambodia Laos Myanmar

**Agricultural Statisticians**

**Monthly Rice Growth Outlook is reported to GEOGLAM for FAO/AMIS**

# Coming satellite for Agri-met with MODIS and Sentinel
# GCOM-C: Global Change Observation Mission- Climate

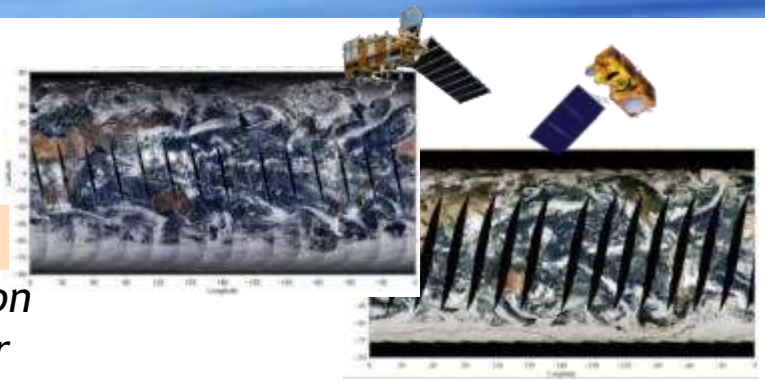


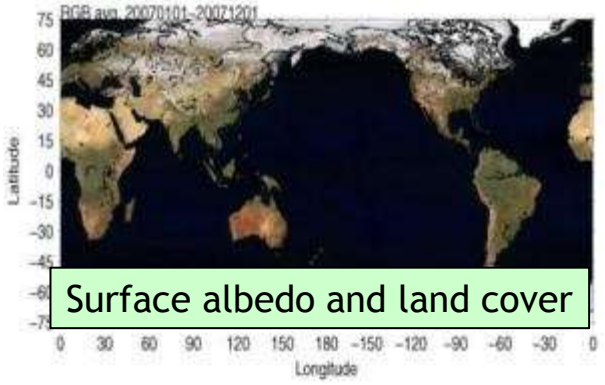

| GCOM-C SGLI characteristics | |
|---|---|
| Orbit | Sun-synchronous (descending local time: 10:30), Altitude: 798km, Inclination: 98.6deg |
| Launch Date | **JFY 2017** |
| Mission Life | 5 years |
| Scan | Push-broom electric scan (VNR: VN & P)<br>Wisk-broom mechanical scan (IRS: SW & T) |
| Scan width | **1150km** cross track (VNR: VN & P)<br>**1400km** cross track (IRS: SW & T) |
| Spatial resolution | **250m** (land and coastal areas), 500m, 1km |
| Polarization | **3 polarization angles for POL** |
| Along track tilt | Nadir for VN, SW and TIR, & +/-45 deg for P |

# Examples of GCOM-C SGLI Products

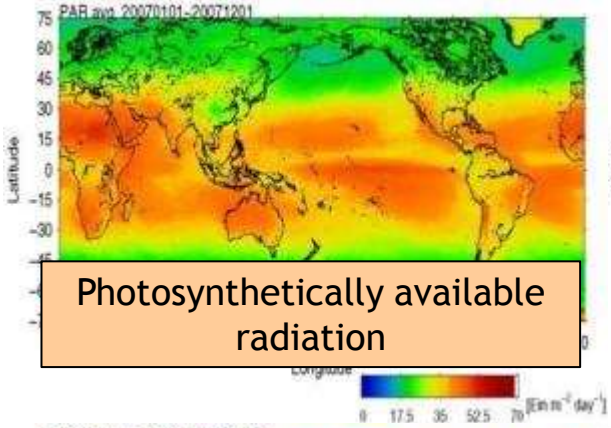

**GCOM-C observation**

*Global data accumulation and synthesis with other satellite data*

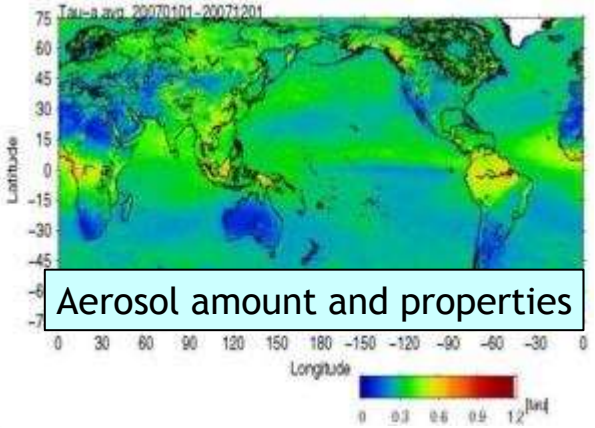




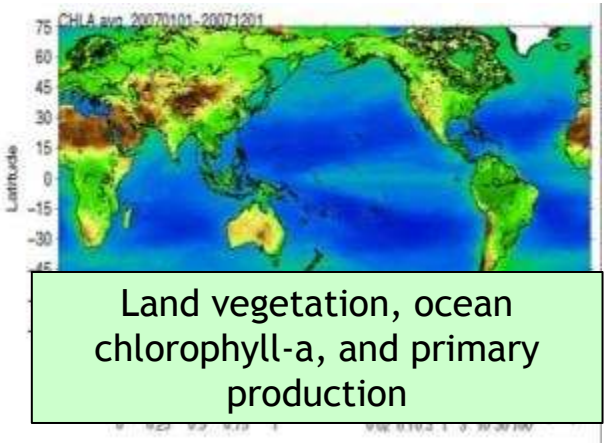

Surface albedo and land cover



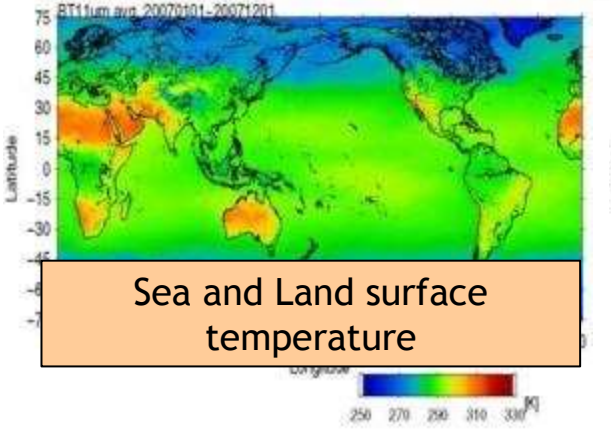

Photosynthetically available radiation



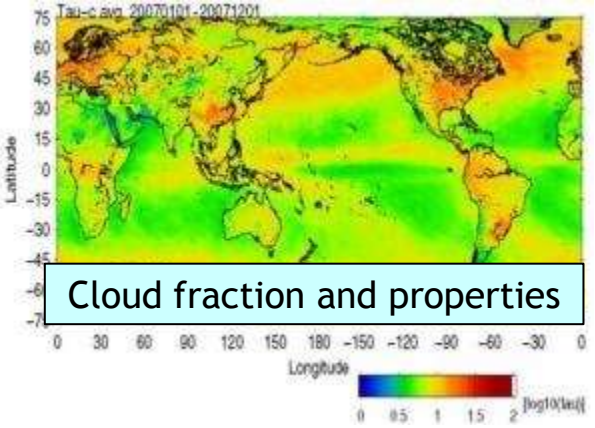

Aerosol amount and properties




Land vegetation, ocean chlorophyll-a, and primary production



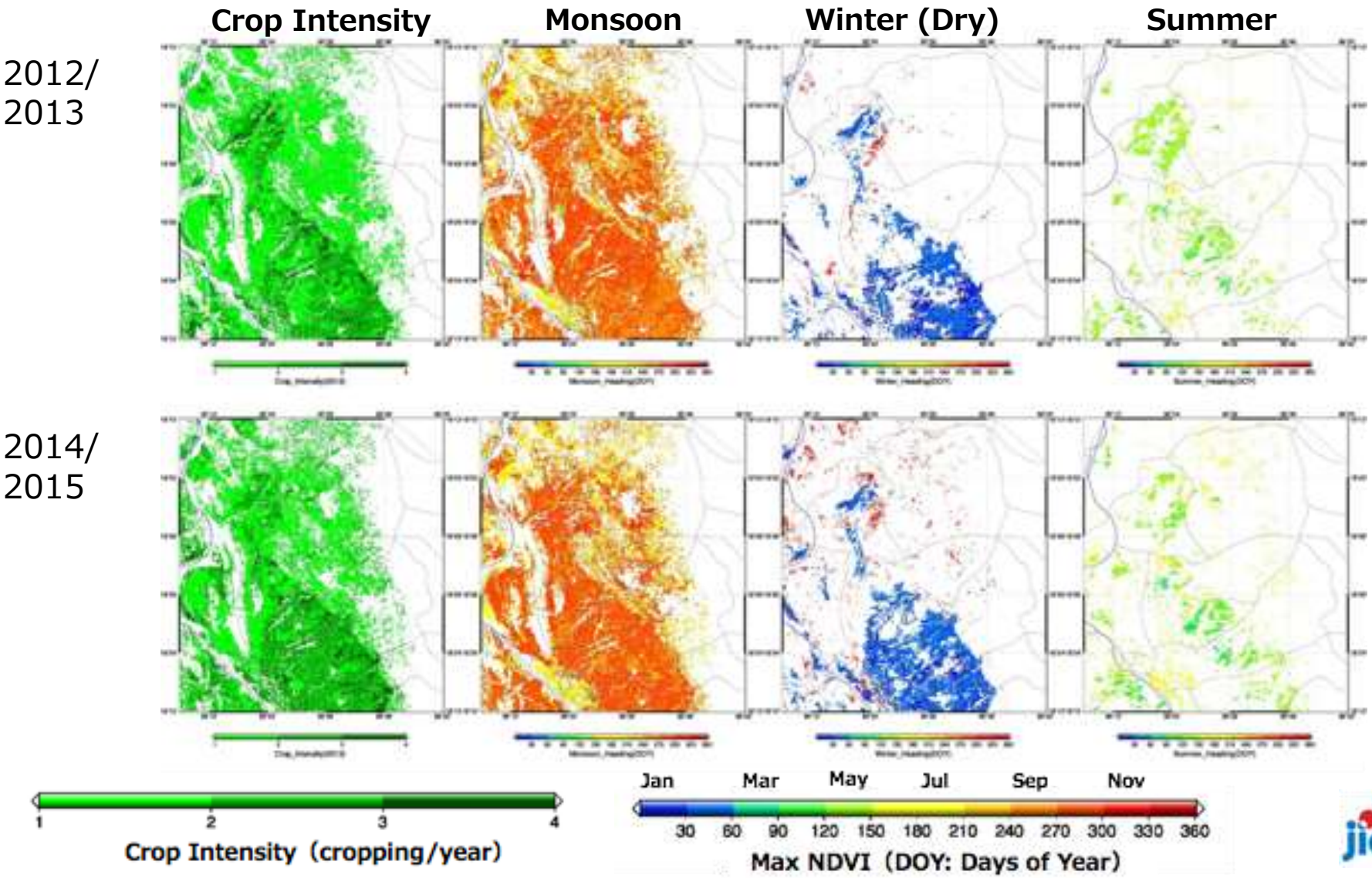

Sea and Land surface temperature




Cloud fraction and properties

# Crop Calendar using MODIS (West Bago, Myanmar)

- GCOM-C can capture crop phenology including crop intensity and growing season globally using its multi-temporal observation data.

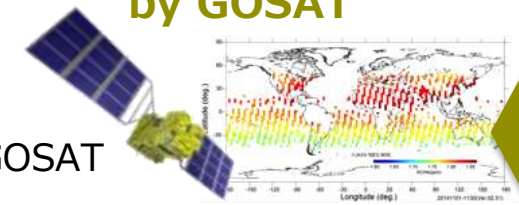


# Next challenge

- Scaling-up CH4 Measurement at a regional scale for MRV by SAR/Optical with GHG observation from space
- Data fusion / integarted usage and inter comparison (L/X/C SARs and VHR and medium optical)

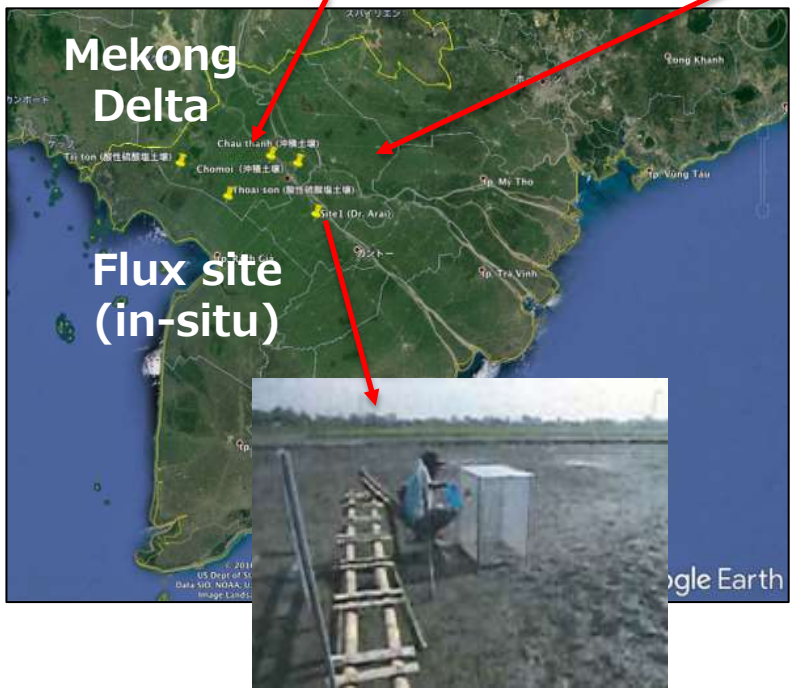
# Scaling-up CH4 Measurement at a regional scale for MRV

## Direct Measurement by GOSAT



GOSAT

・Point Source Obs.
（10.5kmθ）

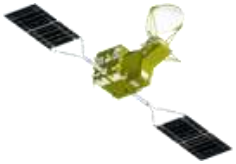



## In-situ Measurement

CH4 emission modeling with environmental factors

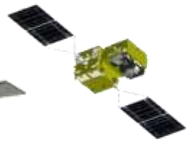
## Integrate Monitoring by Opt, SAR and MWR

GCOM-W



ALOS-2/ Sentine-1

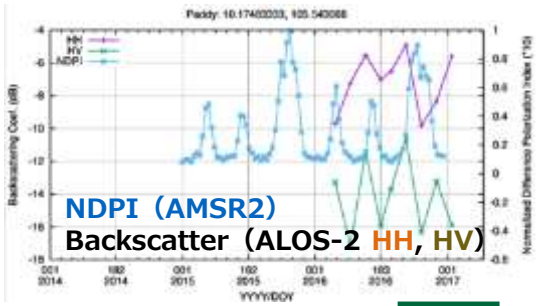
GCOM-C/ MODIS

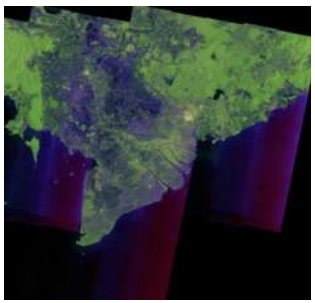


Himawari

## Phenology + Water Condition

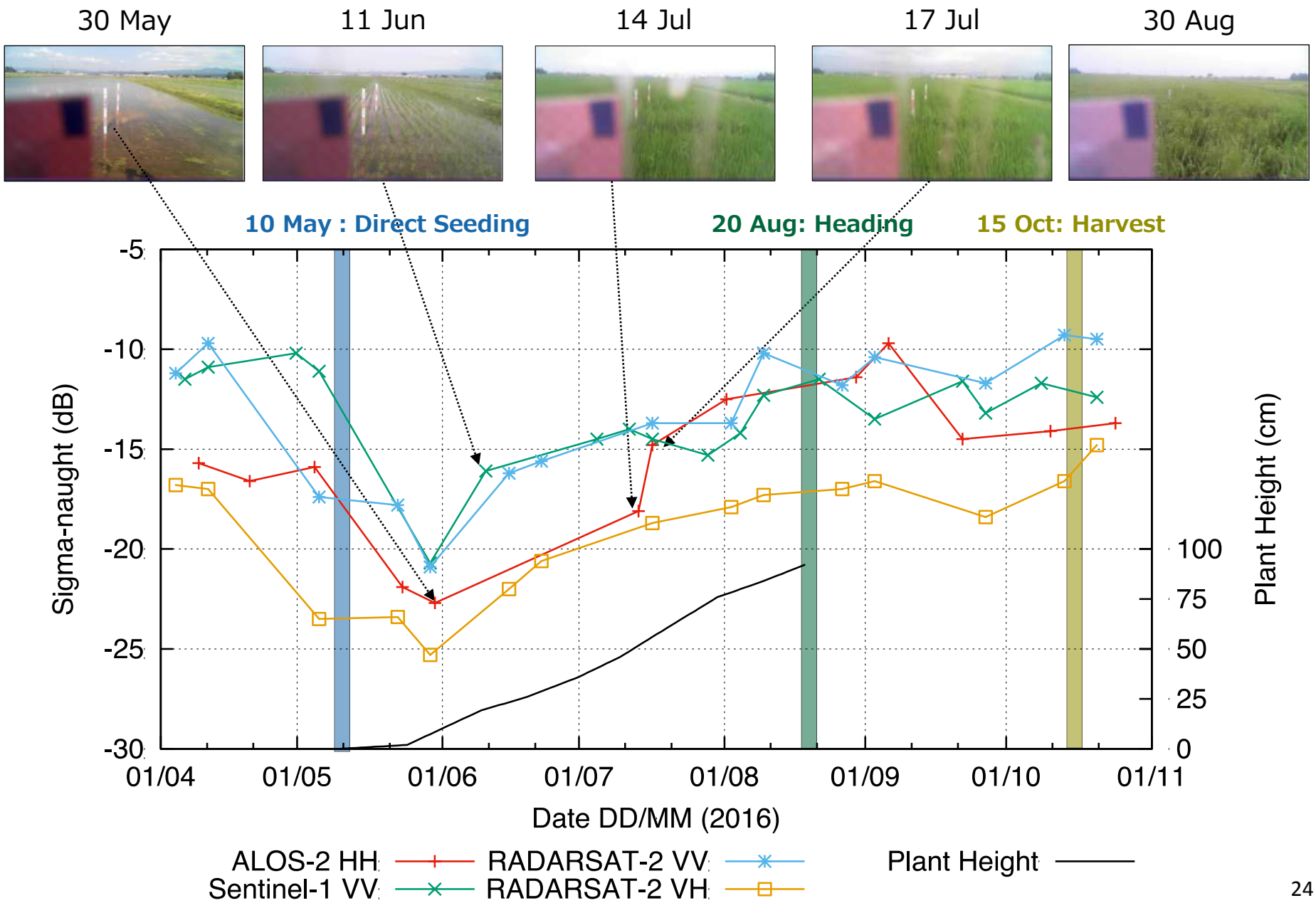
・identifying the conditions of paddy field whole rice cropping cycle including fallow season



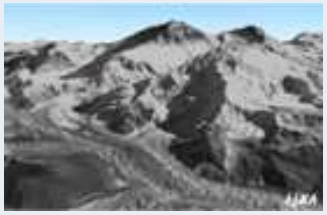
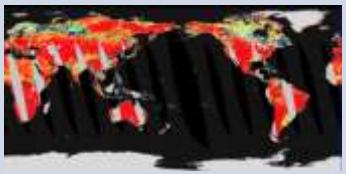



## Scaling-up CH4 Emission Model / Evaluation

# Paddy Rice Monitoring using Multiple-SAR in Tsuruoka, Japan



# Food Security Related Products by JAXA

| | Portal Name and URL |
|---|---|
|  | **G-Portal: JAXA's Satellite data (for remote sensing expert) (GPM, TRMM, JERS-1, AQUA/AMSR-E....etc.)**<br>https://www.gportal.jaxa.jp/gp/top.html<br>*Free and Open Data<br>**Raw Satellite Data** |
|  | **JASMIN: Agro-Meteorological Information**<br>http://suzaku.eorc.jaxa.jp/JASMIN/index.html<br>*Free and Open Data<br>**Agro-Meteorology** |
|  | **GSMaP: Global Satellite Mapping of Precipitation**<br>http://sharaku.eorc.jaxa.jp/GSMaP_crest/index.html<br>*Free and Open Data<br>**Rainfall** |
|  | **Precise Global Digital 3D Map "ALOS World 3D" (30m resolution)**<br>http://www.eorc.jaxa.jp/ALOS/en/aw3d/index_e.htm<br>*Free and Open Data<br>**Topography** |
|  | **JASMES: JAXA's Satellite Monitoring for Environmental Studies**<br>http://kuroshio.eorc.jaxa.jp/JASMES/index.html<br>*Free and Open Data<br>**Climate Variables** |

# Summary

Asia Rice team meeting was held at Asia Pacific Regional Space Agency Forum in Manila with ADB in November, 2016 and GEOSS-AP working group 5 was also held in January, 2017 in Tokyo

-> GEOSS-AP and mekong data cube workshop in September in Vietnam, ACRS in India in October (GEOGLAM/AsiaRiCE session by ISRO and JAXA), APRSAF in India in November, 2017 and AsiaRice/JECAM rice meeting will be held in Taiwan next year

1. Rice crop area and growth monitoring

- Techinical demonstration sites = one province (Chinese Taipei, India, Japan, Malaysia, Philippine, Thailand + Cambodia and Myanmar from 2016).
- Regional area (wall-to-wall): Vietnam and top 10 rice production provinces in Indonesia
- GEORIICE for Vietnam
- ADB project for 4 countries – rice crop area estimation Innovative Data Collection Methods for Agricultural and Rural Statistics results sharing finished by November 2016 with holding regional workshop with on-line training course with INAHOR and ALOS-2 (this training course will be open in ADB from March, 2017)
- L/X/C with optical sensors (S2/Landsat/Venus/Formosat-5) integration usage study is going with JECAM for rice to estimate rice yield
- Start to set up pre-operational service for rice crop growing monitoring using ALOS-2 ScanSAR on-line service, Sentinel and other satellites in Indonesia and Vietnam (as a suucessful result of wall-to-wall study by Asia Pacific Regional Space Agency Forum SAFE prototyping in Vietnam and Indonesia with ADB project). Especiall, for Vietnam, under the cooperation with CSIRO and VNSC, JAXA prepares ALOS-2 ScanSAR data on-line access as SAR ARD to CEOS Mekong Data Cube.

2. Rice crop outlook using agro-met information derived from EO satellites such as GPM, GCOM-W, MODIS, Himawari

- 5 countries (Indonesia, Philipine, Thailand, Vietnam, Japan) from 2013 + Cambodia, Laos, Myanmar in cooperation with AFSIS

3. Capacity Building and training

- Held a workshop for rice crop growth and outlook monitoring using space technology to ASEAN countries (Vietnam, Lao, Thailand, Philippine and Indonesia) in cooperation with AFSIS in March, 2017 and will discuss with ESCAP and APRSAF/ADB

GROUP ON EARTH OBSERVATIONS

GEOGLAM Global Agricultural Monitoring

# Upcoming Events

- 9/19; GEOSS-AP WG5 (agriculture and food security) with Mekong data cube workshop @ Hanoi
- 10/15-; ACRS2017 @ India – GEOGLAM and Asia Rice session
- 11/20-; APRSAF2017@India – Space Application working group and Asia Rice side meeting
- JECAM/Asia Rice meeting @ Chinese Taipei

- Plan to have publishment of international journal