Asia-RiCE - GEOGLAM Regional Activity for rice crop monitoring and outlook -

Asia-RiCE team co-lead

Earth Observations for Asia-Oceania
GEOGLAM Asia-RiCE
(From demo to operation)

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)

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<td>Wall-to-wall observation with SAR dual polarization with Opticals (week – bi-weekly -monthly) : Indonesia, Vietnam/Cambodia and Thailand/Lao projects</td>
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<td>Mid/coarse resolution optical frequent observation (MODIS, GCOM-C, Landsat, Sentinel-2, etc.) with SARs weekly</td>
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<td>Daily Mid/coarse resolution optical, passive microwave and PR with geostationary met sat frequent observation (MODIS, Sentinel, GCOM-C/W, GPM, Himawari, etc.)</td>
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<td>Data fusion, data integration with ground base observation / statistical information and crop models</td>
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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
Regional Rice Monitoring in Asia (Asia-RiCE)

- Activities focus on
  - Rice crop area estimates / maps
  - Crop calendar / crop growth status / crop outlook
  - Damage assessment
  - Yield estimation and forecasting
- Capacity building of
  - Rice crop outlook for ASEAN using Japan ASEAN fund led by LAPAN and MOA
  - SAR data applications on rice monitoring in Hanoi, Quy Nhon (VN), New Delhi, Malaysia using funds from CNES, ESA and GEORICE and in Chinese Taipei (TARI)
- Support to CEOS2019 Initiative of VNSC (Rice crop area estimation in low Mekong using VNSC data cube with ESA/CESBIO (GEORICE) and JAXA/INAHOR)

http://www.asia-rice.org
Engagement of EO with Agricultural Monitoring

Asia-RiCE seeks to contribute to National and regional Info.System

- Meteo Data
- EO Data
- In Situ Data and statistical info

Space Agency, R&D entities for Crop Area, Growth, Condition, Outlook, Yield, Agromet

National Agriculture Ministry / regional activities

Area outlook
Area estimate
Outlook bulletin
Early warning
Yield forecast
Prod estimate
Vulnerab. report
Int market report
Asia-Rice phasing approach

Phase 1
2013-2015

Rice Crop monitoring

Technical demonstration (province)

Phase 2
2016-2018

Wall-to-wall -> national/region

Phase 3
2019-2022

Rice Crop monitoring

Technical demonstration (province)

Agromet / outlook
First 4 countries + 3 countries

ASIA
Collaboration with Southeast Asian Countries

- 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.

ADB TA Project
- Laos [2014-2016]
- Thailand
- Vietnam (North)
- Philippines

SAFE Prototype (Scaling-up)
- Myanmar
- Cambodia

SAFE Prototype [2014-2017]
- Vietnam (Mekong Delta)
- Indonesia

Rice-planted Area Mapping Software (INAHOR)
Utilized **AI technology (machine learning: Random Forest)** to refine **INAHOR (INAHOR-AI)**

Dramatically improved (more than 90%) the **mapping accuracy** from the conventional INAHOR.
1. Rice crop maps (crop season product) of the Mekong area (Cambodia, Laos, Thailand, Vietnam) linked with ESA GEORice, JAXA and GEO GEOGLAM Asia Rice team.


Cross comparison among rice crop growth map of Mekong region by VNSC, JAXA and GEORICE by ALOS-2 and S1 in cooperation with respecting countries (space agencies and ministries of agriculture) under APRSAF SAFE and other regional framework.

-> Continue to support CEOS 2020 chair activities.
Aman’ Rice Planted Area over Bangladesh – ISRO-JAXA joint initiative for BIMSTEC region (CEOS2020 Chair Initiative by ISRO)

- Major crop type mapping and acreage estimates are one of the major focus to use ISRO and JAXA data cubes for BIMSTEC countries as CEOS2020 chair initiative, a follow-up from CEOS2019 chair initiative by VNSC for low Mekong
- Opti-SAR combination from ISRO’s Resourcesat-2 AWiFS and JAXA’s ALOS-2 L-band PALSAR-2 ScanSAR data were used to map ‘Aman’ (July – December) rice planted area over Bangladesh for a common year, 2018. This resulted into acreage estimates with 95% accuracy of reported long-term averages and was found better than ‘only-optical’ and ‘only-SAR’ data.
- ISRO-JAXA will jointly continue this effort over specified regions over India, Thailand and other Asian countries including BIMSTEC for rice monitoring in cooperation with GEOGLAM Asia Rice and APRSAF SAFE rice crop project.

Machine learning based (Random Forest) unsupervised classification

Training/test data:
- Visual interpretation from VHR data
- Past RISAT-1 & Radarsat-2 data
- Common rice area ALOS-2 & past Radarsat-2

Courtesy: ISRO
Rice planted area from Resourcesat-2 AWiFS

Courtesy: JAXA
Rice planted area from ALOS-2 PALSAR-2

ALOS-2 L-band PALSAR-2 ARD 50m spatial res.
HH, HV; 963 tiles (1° x 1°) for each pol.

Resourcesat-2 AWiFS ARD 56 m red and NIR reflectances, five 15-day NDVI composites

Common rice area ALOS-2 & past Radarsat-2
Rice Growth Outlooks for Crop Monitor using Agro-meteorological Information

- Asia-RiCE continued its work monthly with the ASEAN Food Security Information System (AFSIS) to provide rice growth outlooks using satellite derived agro-met information such as precipitation (GPM, Himawari etc.), NDVI, LST, and solar radiation (MODIS, GCOM-C), soil moisture (GCOM-W) to the GEOGLAM Crop Monitor (UMD) for FAO AMIS.

- By Japan ASEAN integrated trust fund (JAIF) led by LAPAN and MOA, rice crop outlook capacity building to ASEAN member states has been implemented from May, 2018

**Rice Growth Outlook**

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.

(Example: Vietnam, Sep 2016)
Cross-Validation/Comparison and Improvements of Agromet data 
Application Research Work

Comparing Rainfall, Solar Radiation, LST, Drought Index etc. 
developed by JAXA, ISRO, GISTDA. 
New application / research using agro-met information.

Data Application Sharing

Agromet Data & Products for Outlook

End Users / Stakeholders
National, State/Province, 
Local Governments, 
Private Companies

Capacity Building
Knowledge sharing of usage of agro-met information
Training about usage of agro-met information 
(ISRO/GISTDA/JAXA)

Supported by Japan-ASEAN Integration Fund
Science based information sharing derived from Earth Observation 
Satellites for agriculture management in the ASEAN Region 
(2-year programme)
Comparison of agromet products of ISRO and JAXA

Objective
To compare products of ISRO and JAXA and to promote application of satellite agromet data in the Asia-Pacific region.

Implementation period
3 years: 2019-2021

Data Base
ISRO: MOSDAC, VEDAS   JAXA: JASMIN

Target Agromet Products
Precipitation, LST (land Surface Temperature), NDVI (Normalized Vegetation Index)

Study Areas
Eastern zonal council of India, Central part of Thailand (Major rice production area)

Target Events
Flood (Sep 2018 in India) and Drought (April 2016 in Thailand)
Comparison of agromet products of ISRO and JAXA

Activities in 2019
- Comparison planning
- Discussion between ISRO and JAXA
  - 2 conferences in ISRO HQ and SAC, 3 teleconferences
- Data exchange
- Trial studies in two provinces in India and Thailand

Current Status
- Both ISRO and JAXA’s precipitation products could detect flood and drought events for trial study areas.

Future Plan
- Comparison using NDVI and LST.
- Continue studies to survey more detail.

Precipitation in India during flood

Precipitation in Thailand during drought
GISTDA-JAXA Agro-Met Product Comparison (Drought)

GISDTA – JAXA & Univ. of Tokyo
Drought Monitoring Workshop at GISTDA’s Academy
(17 May, 2019)

Learnt the different character between DRI (including Land Use) and KBDI (focus on metrological drought)

Improved the correlation between KBDI and Soil moisture measured by GISTDA’s Monitoring Station with identifying artificial irrigation days (Analyzed by Mr. Prakhar Misra, U-Tokyo)
Way Forward – AsiaRiCE

- Research has matured and access to satellites data (microwave and optical) derived information with ground based observation data and model makes operational monitoring feasible

- Way forward on
  - Continue capacity building of rice crop monitoring using available international donor or other resources (e.g. ASEAN fund, ADB, etc.)
  - Support CEOS2020 priority by ISRO and APRSAF SAFE project (rice crop project) from SE Asia to Asia (BIMTEC and beyond)
  - R&D for data fusion using SAR and optical sensors and Machine learning with LULCC projects (e.g. Support GEO-GEE rice watch project)
  - Cooperate with other related regional activities such as AOGEO (water related disaster resilience, GHG, etc.), UN ESCAP, Servir/Mekong, etc. with available plat form providers
Way Forward – AsiaRiCE

- Challenge / Issue

- Share applications to provide INFORMATION (not data or products) to end users for practical use (especially for microwave observation – current ARD is not enough and need ECV/EAV type information from EO)

- Collect and share in-situ or compare among country level information under multiple bilateral cooperation

- Time series big EO Data sharing (too much data and need to have enough Internet to Asian end users (last mile issue) v.s. information sharing (EAV/ECV)