JAXA LULCC related activity

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Shin-ichi Sobue, Ph. D
ALOS-2 Project Manager
Space Technology Directorate I
Japan Aerospace Exploration Agency
JAXA’s Priority Issues for Societal Benefit

Disaster Management

Climate Change
## ALOS-2
Advanced Land Observing Satellite-2

<table>
<thead>
<tr>
<th>Application</th>
<th>Disaster, Land, Agriculture, Natural Resources, Sea Ice &amp; Maritime Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-band SAR (PALSAR-2)</td>
<td>Stripmap: 3 to 10m res., 50 to 70 km swath</td>
</tr>
<tr>
<td></td>
<td>ScanSAR: 100m res., 350km/490km swath</td>
</tr>
<tr>
<td></td>
<td>Spotlight: 1×3m res., 25km swath</td>
</tr>
<tr>
<td>Orbit</td>
<td>Sun-synchronous orbit</td>
</tr>
<tr>
<td></td>
<td>Altitude: 628km</td>
</tr>
<tr>
<td></td>
<td>Local sun time: 12:00 +/- 15min</td>
</tr>
<tr>
<td></td>
<td>Revisit: 14 days</td>
</tr>
<tr>
<td></td>
<td>Orbit control: ± +/- 500m</td>
</tr>
<tr>
<td>Life time</td>
<td>5 years (target: 7 years)</td>
</tr>
<tr>
<td>Launch</td>
<td>May 24, 2014; H-IIA launch vehicle</td>
</tr>
<tr>
<td>Downlink</td>
<td>X-band: 800Mbps(16QAM)</td>
</tr>
<tr>
<td></td>
<td>400/200Mbps(QPSK)</td>
</tr>
<tr>
<td></td>
<td>Ka-band: 278Mbps (Data Relay)</td>
</tr>
<tr>
<td>Experimental Instrument</td>
<td>Compact InfraRed Camera (CIRC)</td>
</tr>
<tr>
<td></td>
<td>Space-based Automatic Identification System Experiment 2 (SPAISE2)</td>
</tr>
</tbody>
</table>
ALOS-2 Mission Objectives

Disaster monitoring
- Earthquake
- Volcano
- Flooding

Environment and land management
- Forest and wetland

Agriculture & natural resources

Ocean
- Ice
- Oil Spill

2015 PALSAR-2 Forest/Non-Forest
Monitoring Deforestation

**JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)**

JJ-FAST website (http://www.eorc.jaxa.jp/jjfast//jj_index.html)

- **Data source**: ALOS-2/PALSAR-2 (ScanSAR mode)
- **Target area**: 77 countries
- **Update**: Every 1.5 months

*Red* indicates the latest Deforestation Point
*Yellow* indicates all Deforestation Point

Monitoring forests in 77 countries
Usage for deforestation monitoring

Office

Government's Forest Division
responsible for monitoring illegal logging

Field

In-situ survey

Air survey

Warning of JJ-FAST

Directive of survey
Global Change Observation Mission (GCOM)

**“Shizuku”**

**GCOM-W (Water)**
- **Instrument**: Advanced Microwave Scanning Radiometer-2
- **Orbit**: Sun Synchronous orbit
  - Altitude: 699.6km (on Equator)
  - Inclination: 98.2 degrees
  - Local sun time: 13:30+/−15 min
- **Size**: 5.1m (X) * 17.5m (Y) * 3.4m (Z) (on-orbit)
- **Mass**: 1991kg
- **Power gen.**: More than 3880W (EOL)
- **Launch**: May 18, 2012
- **Design Life**: 5-years

**“SHIKISAI”**

**GCOM-C (Climate)**
- **Instrument**: Second-generation Global Imager
- **Orbit**: Sun Synchronous orbit
  - Altitude: 798km (on Equator)
  - Inclination: 98.6 deg.
  - Local sun time: 10:30+/−15 min
- **Size**: 4.6m (X) * 16.3m (Y) * 2.8m (Z) (on-orbit)
- **Mass**: 2093kg
- **Power gen.**: More than 4000W (EOL)
- **Launch**: December 23, 2017
- **Design Life**: 5-years
GCOM-C/SGLI 250m images

Effective cloud particle radius

RGB

(673, 530, 380)

AOT500

Effective cloud particle radius

RGB

(673, 530, 380)
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

![Planted Date](image)

<table>
<thead>
<tr>
<th>ID</th>
<th>Target Agricultural Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Rice Crop Area Estimates/Maps</td>
</tr>
<tr>
<td>P2</td>
<td>Crop Calendars/Crop Growth Status</td>
</tr>
<tr>
<td>P3</td>
<td>Crop Damage Assessment</td>
</tr>
<tr>
<td>P4</td>
<td>Agro-meteorological Information Products</td>
</tr>
<tr>
<td>P5</td>
<td>Production Estimation and Forecasting</td>
</tr>
</tbody>
</table>

- ADB project, APRSAF/SAFE project and GEORICE project have successfully demonstrated INAHOR using SARs with the mapping accuracy of 80-90% for the target provinces. Scaling-up for major rice producing areas (planted area and growing stages) are currently demonstrated in **Vietnam and Indonesia**
- Continue to work for rice crop outlook in Asia using EO data in cooperation with ASEAN
- Estimate damage assessment to rice production using EO data in cooperation with PSA, Philippines and ADB caused by Typhoon
- GEOSS-AP AGRICULTURE AND FOOD SECURITY WG was held to sharing Asia rice accomplishments and linkage with SDGs

Next Challenge and events:
- GEOGLAM session at ACRS, APRSAF Space Application WG (India) and JECAM/AsiaRice meeting (Chinese Taipei)
- 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)
Earth observation satellites provide a large variety of environmental information
ADB TA Project
- Laos [2014-2016]
- Thailand
- Vietnam (North)
- Philippines

SAFE Prototype [2014-2016]
- Myanmar
- Cambodia

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

• 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.
Utilized AI technology (machine learning: Random Forest) to refine INAHOR (INAHOR-AI)

Dramatically improved (more than 90%) the mapping accuracy from the conventional INAHOR.

Time-series Radar imageries

Training Data

Rice planted Area in the rainy season 2018
Summary of the Rice Crop Cambodia in 2019

- DPS/MAFF needs additional tools to check the quality of statistics reported by local offices, and expects to utilize space technology to confirm the statistics with an effective way.
- Two key space technologies, Japanese RADAR satellite (ALOS-2) and rice mapping software (INAHOR) are utilized in the “Validation Framework”
- Demonstrated the validation framework for two provinces around the Tonle Sap lake, and the framework can refine the rice statistics in many districts (37 of 73 communes in Battam Bang and Kampong Thom provinces)
- Presented the report to the state of secretary and he gave positive comments

<table>
<thead>
<tr>
<th>Battam Bang province (6 districts)</th>
<th>Validated value</th>
<th>Number of refined commune</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Commune</td>
<td>Closer to Reported value</td>
<td>Closer to INAHOR value</td>
</tr>
<tr>
<td>52</td>
<td>35</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kampong Thom province (4 districts)</th>
<th>Validated value</th>
<th>Number of refined commune</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Commune</td>
<td>Closer to Reported value</td>
<td>Closer to INAHOR value</td>
</tr>
<tr>
<td>38(17)</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

note: 17 for no-response

Planted Area of 2019 Wet Season Rice by INAHOR with ALOS-2
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.


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 Resourcetsat-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
Rice Crop Planting area estimation in Sacramento, CA, USA

Planting activity monitoring by NDVI from GCOM-C, Sentinel-2 and Landast-8 and ALOS-2 ScanSAR during 2018 and 2020 to assess COVID-19 impact.
Annual Meeting

Plenary Session
- WG activity reports
- Country reports
- Special session under the main theme
- Space policy session
- Space leader's roundtable

SA WG
SPACE APPLICATIONS WORKING GROUP

ST WG
SPACE TECHNOLOGY WORKING GROUP

SEU WG
SPACE ENVIRONMENT UTILIZATION WORKING GROUP

SE WG
SPACE EDUCATION WORKING GROUP

SAFE: Space Applications For Environment
Kibo-ABC: Asian Beneficial Collaboration through Kibo Utilization

Poster Contest
Water Rocket Event
More information at SAFE portal site: [https://www.eorc.jaxa.jp/SAFE/](https://www.eorc.jaxa.jp/SAFE/)  

(Last Update: August, 2020)

These were implemented as bi-lateral cooperation mainly with JAXA data.
APRSAF SAFE projects under multilateral cooperation

Solve environmental problems and improve the quality of life in the Asia-Pacific region

**Rice Crop Monitoring Project**
Since 2018
- Rice crop monitoring by SARs in South East Asia, especially Mekong Region
- Linkage to AFSIS and GEOGLAM
- Joint appeal to GEO by Europe, India and Japan
- Future expansion to South Asia through the cooperation with India

**Agromet Project**
Since 2018
- Decision-making on food security with provision of outlook information by Agromet information in ASEAN
- Contribution to the drought monitoring project in next RESAP by UN ESCAP
- Future expansion to South Asia through the cooperation with India
Asia Pacific Regional Space Agency Forum
SAFE Project: Rice Crop Monitoring (To Future)

South East Asia & South Asia countries
Space and S&T agencies

Stakeholders
(Not limited to governmental, including industries)

MoA/Indonesia MAFF/Cambodia etc.

Regional Data/Tool/Knowledge Providers

JAXA
ISRO
EC-COPERNICS
NSPO

“Virtual Constellation” Concept

LAPAN
GISTDA
VNSC
Private sectors

Funds from multiple source (JAIF, MDBs etc)

Facilities & resources for training

LAPAN
GISTDA
ISRO
SERVIR, UN ESCAP

Data & Tools sharing via Platformers
Knowledge Sharing on Virtual Collaboration Tools (Slack, Web Meeting etc)

Provide data, tools, knowledge
Feedback from end user
VHR data as training data

Provide Trainings
Feedback from end user

Univ. Res. Institute

Univ. Res. Institute

Private sectors
## Land Cover

<table>
<thead>
<tr>
<th>Datasets</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global PALSAR-2/PALSAR/JERS-1 Mosaic and Forest/Non-Forest map</td>
<td></td>
</tr>
<tr>
<td>Precise Global Digital 3D Map &quot;ALOS World 3D - 30m (AW3D30)&quot;</td>
<td></td>
</tr>
<tr>
<td>High-Resolution Land Use and Land Cover Map *Japan and Vietnam</td>
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## Agriculture

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
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<tbody>
<tr>
<td>International Asian Harvest mOnitoring system for Rice (INAHOR)</td>
<td></td>
</tr>
<tr>
<td>JASMIN(JAXA’s Satellite based Monitoring Network system for FAO AMIS outlook)</td>
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</table>

## Water Cycle

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Satellite Mapping of Precipitation &quot;GSMaP&quot;</td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td>3D Precipitation data</td>
</tr>
</tbody>
</table>

High-Resolution Land Use and Land Cover Map of the Southern Region of Vietnam
The 2007 land cover map (left) and the 2017 land cover map (right).
JAXA’s EO Data distribution system: G-Portal

Available at https://gportal.jaxa.jp/gpr/
Free and open access to ALOS/ALOS-2 data

✓ JAXA will provide free and open access to the wide-swath observation data from the L-band Radar satellites, such as ALOS (ALOS/AVINIR-2, PALSAR) and ALOS-2(ALOS-2/ScanSAR)