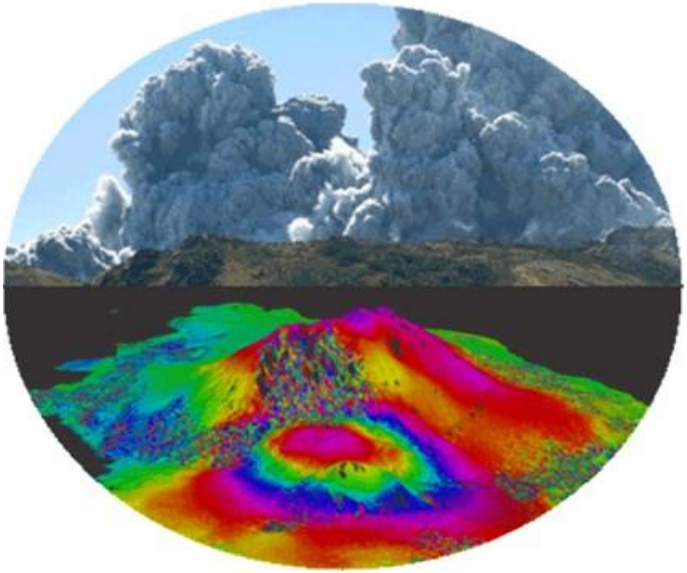
JAXA LULCC related activity

October 20, 2020

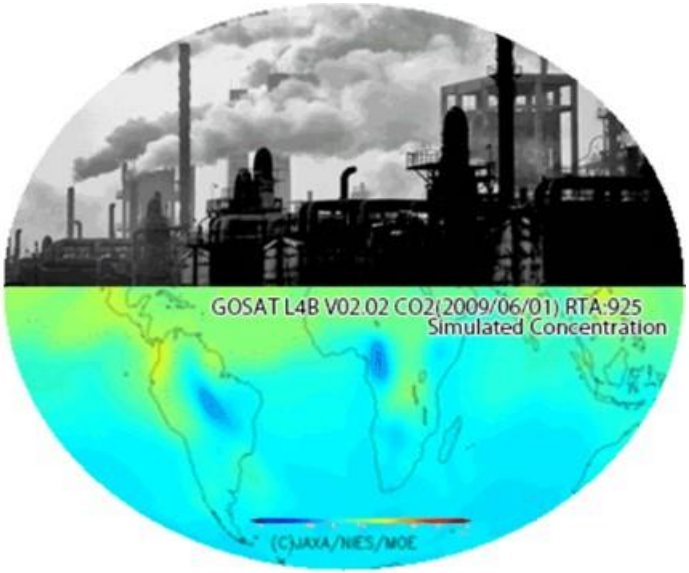
Shin-ichi Sobue, Ph. D
ALOS-2 Project Manager
Space Technology Directorate I
Japan Aerospace Exploration Agency

JAXA's Priority Issues for Societal Benefit

Disaster Management

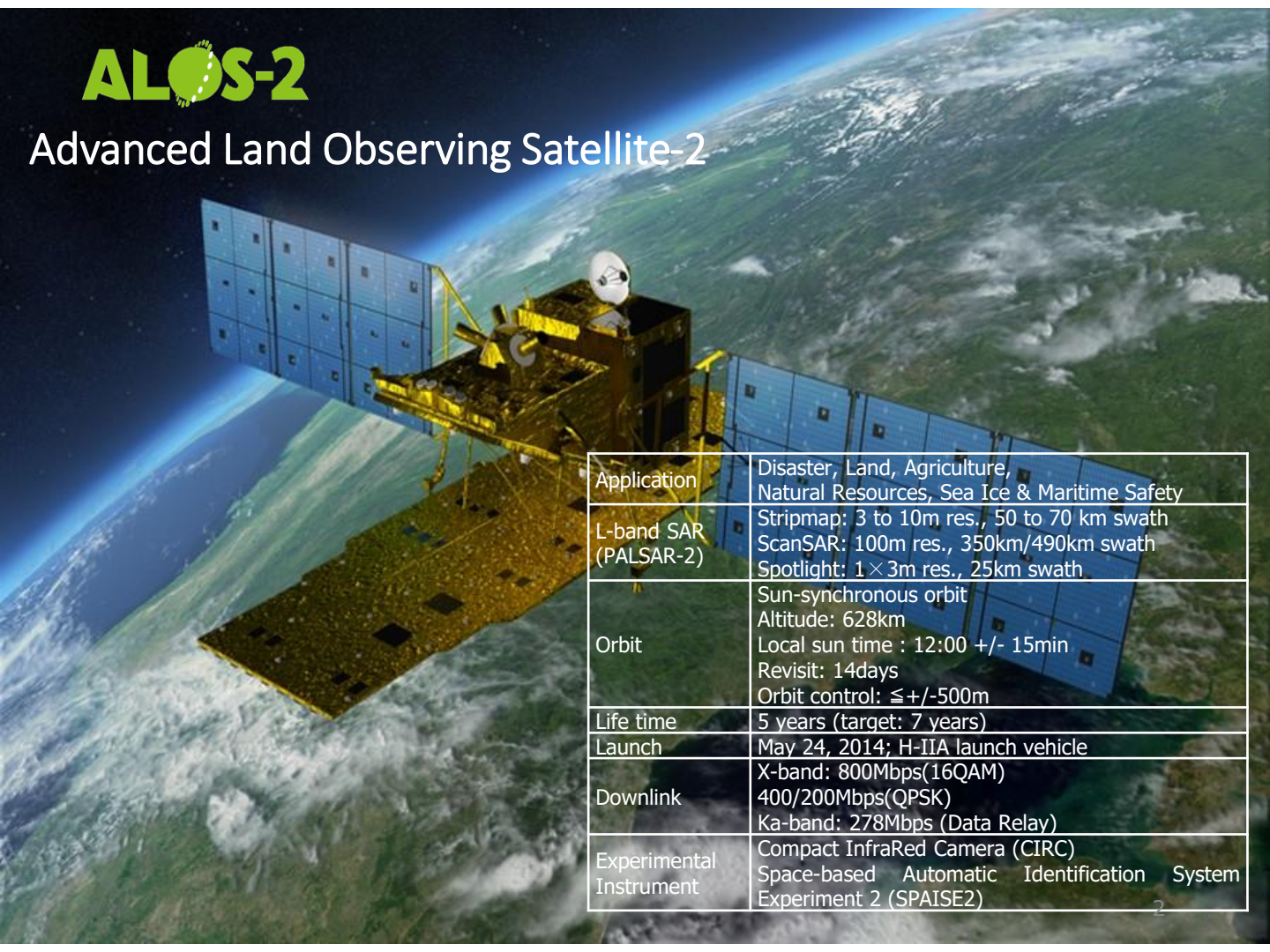


Climate Change



ALOS-2

Advanced Land Observing Satellite-2

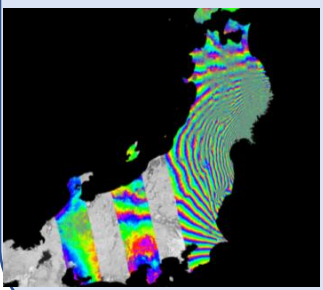


Application	Disaster, Land, Agriculture, Natural Resources, Sea Ice & Maritime Safety
L-band SAR (PALSAR-2)	Stripmap: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km/490km swath Spotlight: 1×3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: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

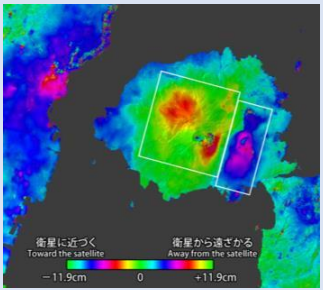
ALOS-2 Mission Objectives

Disaster monitoring

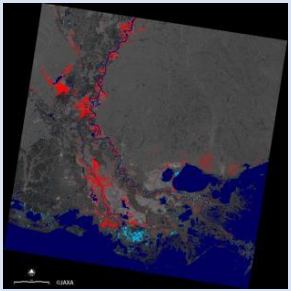
Earthquake



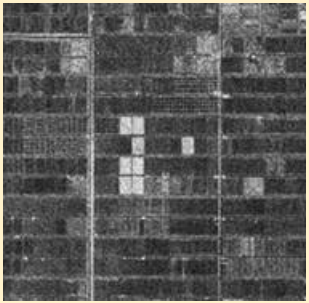
Volcano



Flooding

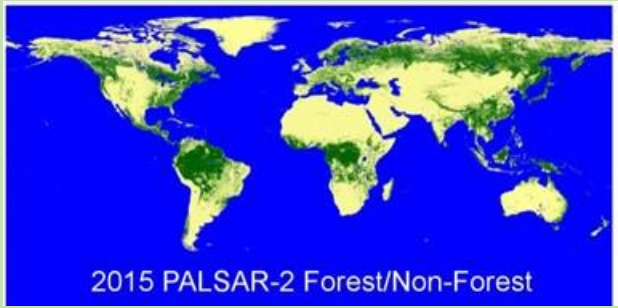


Agriculture & natural resources



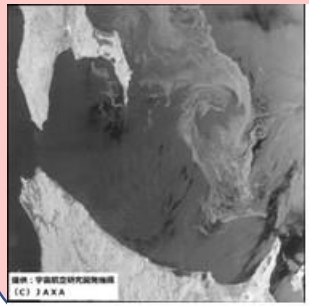
Environment and land management

Forest and wetland

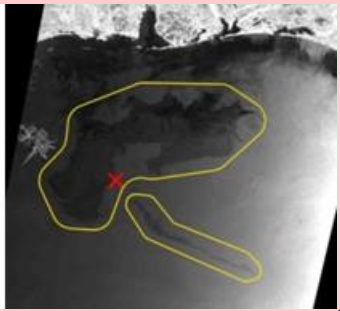


Ocean

Ice



Oil Spill



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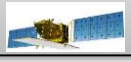
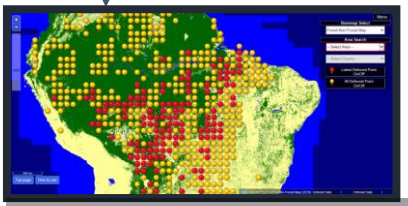
Monitoring Deforestation

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



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



Red indicates the latest Deforest Point
Yellow indicates all Deforest Point

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

Monitoring forests in 77 countries

Usage for deforestation monitoring

Office

Field

Government's Forest Division
responsible for monitoring illegal logging

Warning of JJ-FAST

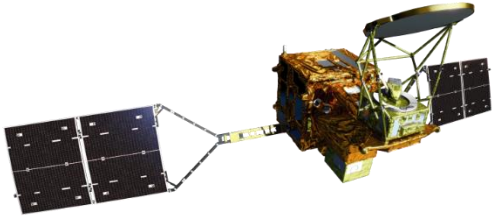
Directive of survey

Air survey

In-situ survey

Global Change Observation Mission (GCOM)

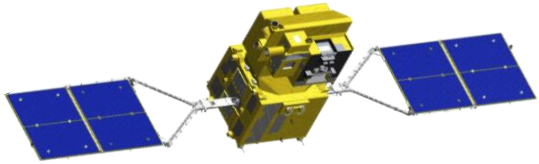
"Shizuku"



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"

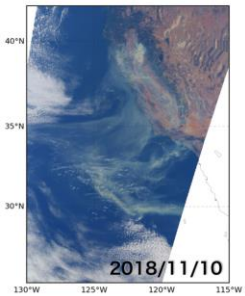


GCOM-C (Climate)

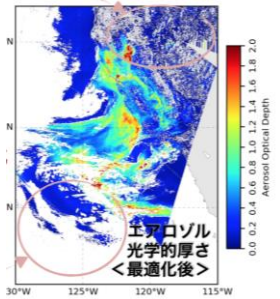
Instrument	**Second-generation Global Imager**
Orbit	Sun Synchronous orbit Altitude：798km (on Equator) Inclination: 98.6 deg. Local sun time: 10:30+/- 15min
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z) (on orbit)
Mass	2093kg
Power gen.	More than 4000W (EOL)
Launch	December 23, 2017
Design Life	5-years

6

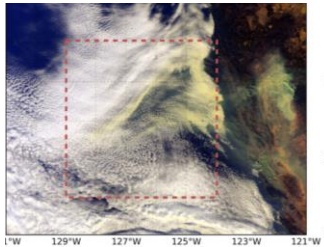
GCOM-C/SGLI 250m images



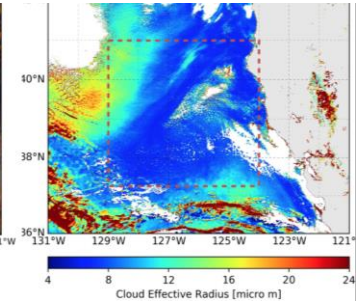
AOT500



Effective cloud particle radius



RGB
(673, 530, 380)



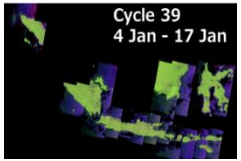
7

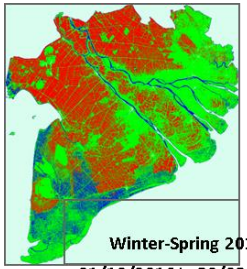
AsiaRiCE

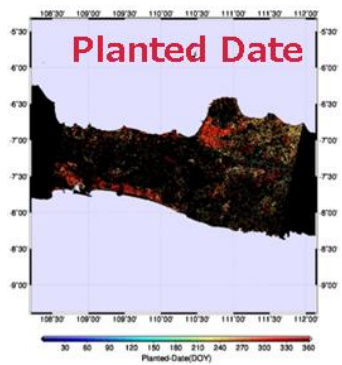
http://www.asia-rice.org

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

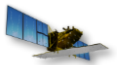
ID	Target Agricultural Products
P1	Rice Crop Area Estimates/Maps
P2	Crop Calendars/Crop Growth Status
P3	Crop Damage Assessment
P4	Agro-meteorological Information Products
P5	Production Estimation and Forecasting



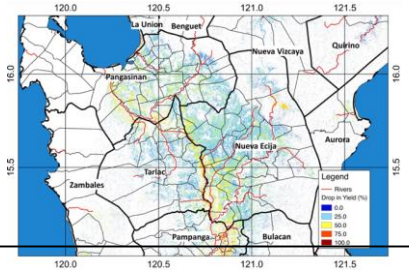




- ADB project, APRSAF/SAFE project and GEORICE project have successfully demonstrated INAHOR using SARs with the mapping accuracy of 80-90% for the target provinces. Scaling-up for major rice producing areas (planted area and growing stages) are currently demonstrated in **Vietnam and Indonesia**
- Continue 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



Agricultural Damage Estimation by Multi-Temporal ALOS-2



Next Challenge and events:

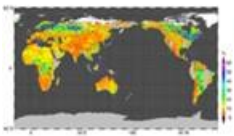
- GEOGLAM session at ACRS, APRSAF Space Application WG (India) and JECAM/AsiaRice meeting (Chinese Taipei)
- Scaling-up CH4 Measurement at a regional scale for MRV by SAR/Optical with GHG observation from space
- Data fusion / integarted usage and inter comparison (L/X/C SARs and VHR and medium optical)

Satellite Derived Environmental Info for Agriculture

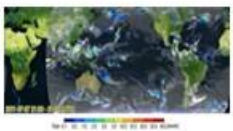
GCOM-W (2013-) | GPM (2014-) | ALOS-2 (2014-) | Himawari-8 (2014-) | GCOM-C (JFY 2017)

+ Other Satellites

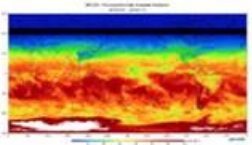
Environmental Info.



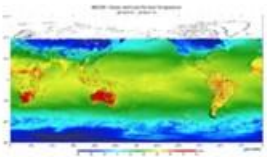
Soil Moisture



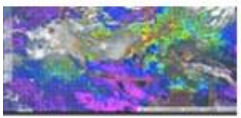
Precipitation



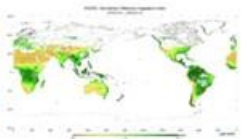
Solar Radiation



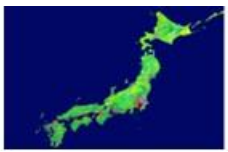
Land Surface Temp.



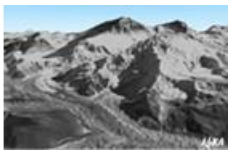
Aerosol



Vegetation Index



Land cover



Topography etc.

Earth observation satellites provide a large variety of environmental information

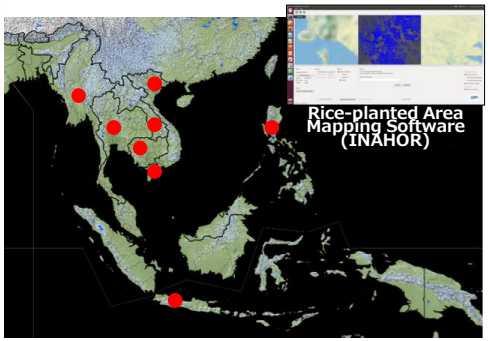
Collaboration with Southeast Asian Countries

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

ADB TA Project [2014-2016]

- Laos
- Thailand
- Vietnam (North)
- Philippines



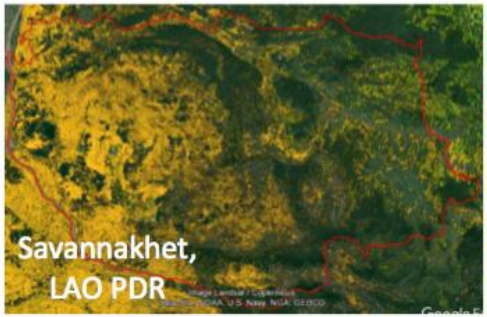
[2016-2018]

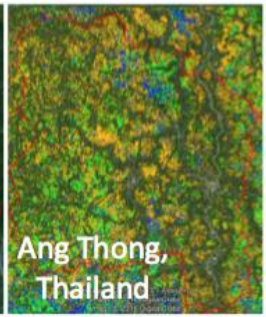
SAFE Prototype [2016-]

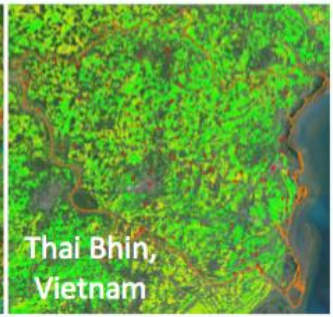
- Myanmar
- Cambodia

SAFE Prototype (Scaling-up) [2014-2017]

- Vietnam (Mekong Delta)
- Indonesia

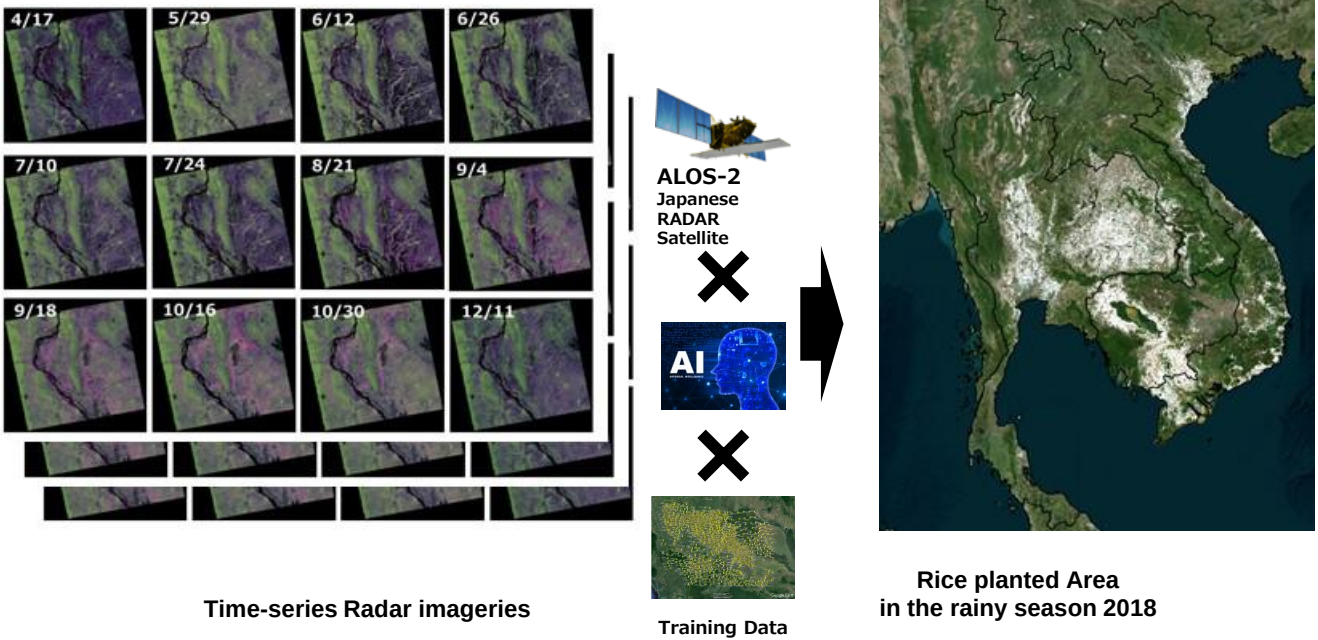






Rice Planted Area Mapping using AI Technology

- Utilized **AI technology (machine learning: Random Forest)** to refine INAHOR **(INAHOR-AI)**
- **Dramatically improved (more than 90%) the mapping accuracy** from the conventional INAHOR.



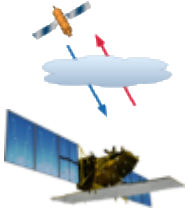
Time-series Radar imageries

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**



ALOS-2

×

INAHOR

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

Battam Bang province (6 districts)

Total Commune	Validated value		Number of refined commune
	Closer to Reported value	Closer to INAHOR value	
52	35	17	17

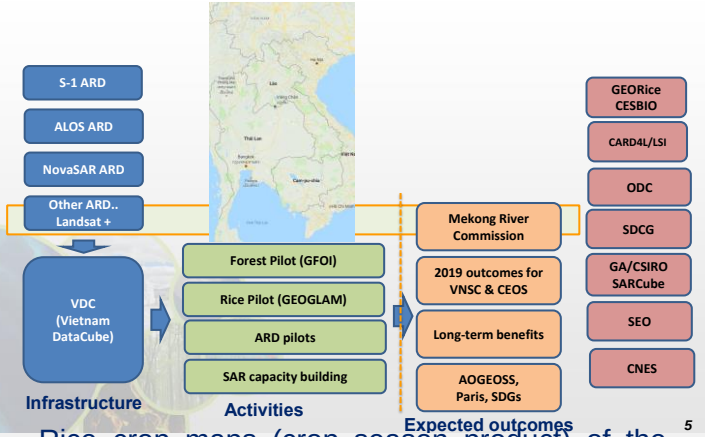
Kampong Thom province (4 districts)

Total Commune	Validated value		Number of refined commune
	Closer to Reported value	Closer to INAHOR value	
38(17)	11	10	20

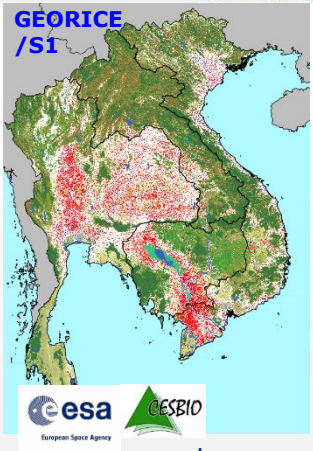
note: 17 for no-response

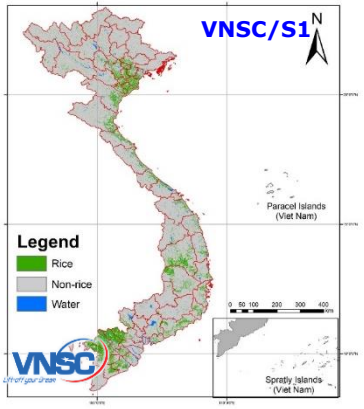
CEOS 2019 VNSC chair initiative

Proposed Initiative Summary



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
2. Rice Phenology / Growth Stage (monthly product) of the Mekong Delta and Red River Delta, Vietnam.
3. Rice Crop Production / Yield Estimation (crop season product) of provinces in the Mekong Delta and Red River Delta, Vietnam.
4. Continued development of GEOGLAM National Crop Monitor with NASA Harvest.





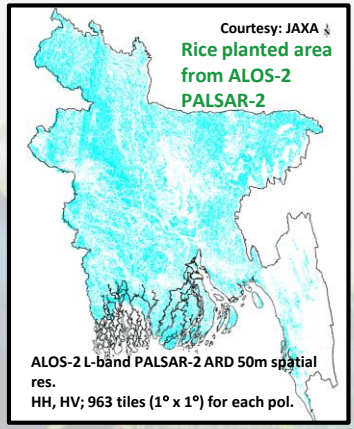
Cross comparison among rice crop growth map of Mekong region by VNSC, JAXA and GEORICE by ALOS-2 and S1 in cooperation with respecting countries (space agencies and ministries of agriculture) under APRSAF SAFE and other regional framework

-> 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



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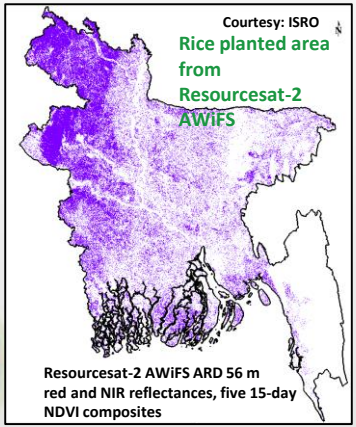

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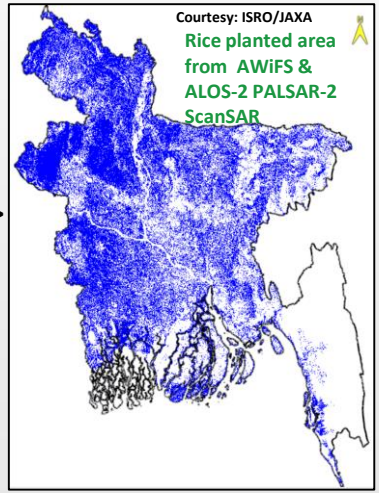


Training/test data :

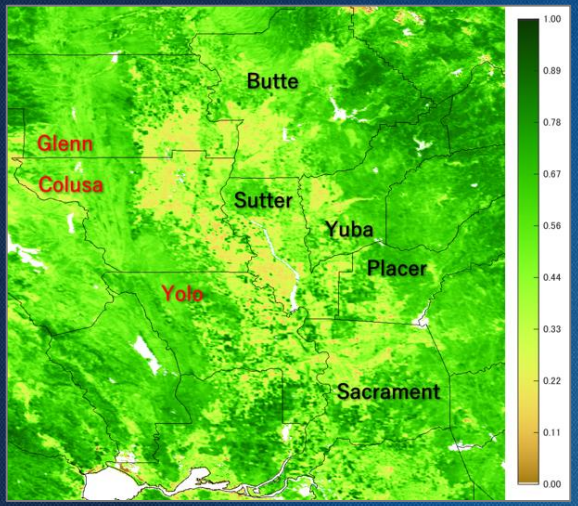
Visual interpretation from VHR data

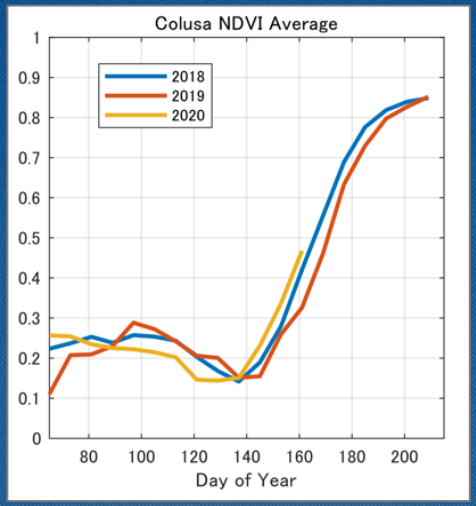
Past RISAT-1 & Radarsat-2 data

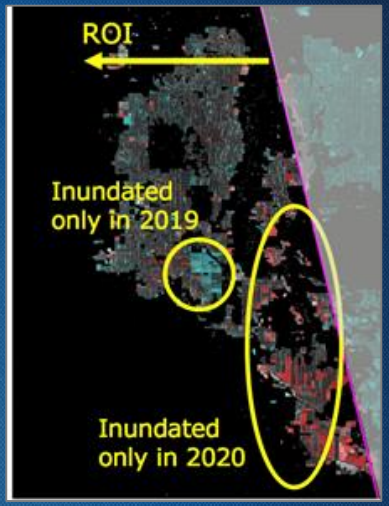
Common rice area ALOS-2 & past Radarsat-2

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








APRSAF
APRSAF Executive Committee(ExCom)
Annual Meeting
Plenary Session
• WG activity reports
• Country reports
• Special session under the main theme
• Space policy session
• Space leader's roundtable
reports
reports
reports
reports
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
Sentinel Asia
Sentinel Asia:
Aiming at contributing to disaster reduction
SAFE
SAFE:
Space Applications For Environment
KIBO-ABC
Kibo-ABC:
Asian Beneficial Collaboration through "Kibo"Utilization
Poster Contest
Water Rocket Event

APRSAF SAFE prototyping summary

26 completed, and 1 following

◎ongoing ●complete
○following d

Country (proposal number)	Agriculture (7)	Drought (2)	Water resource (7)	Coast (3)	Forest (4)	Atmosphere (1)	Ecosystem (1)	Fishery (2)
Vietnam (6)	●		●●	●	●●			
Indonesia (6)	●●	●●			●	●		
Sri Lanka (4)			●	●			●	●
Cambodia (3)	○		●●					
Malaysia (2)	●●							
Lao P.D.R (1)					●			
Bangladesh (1)				●				
Pakistan (1)			●					
Thailand (1)								●
Myanmar (1)	●							
International Organization (1)			●					

More information at SAFE portal site: 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

UN World Conference on Disaster Risk Reduction 2015 Sendai Japan
Sendai Framework 2015-2030

SUSTAINABLE DEVELOPMENT GOALS

COP21・CMP11 PARIS 2015 UN CLIMATE CHANGE CONFERENCE

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

Rice Crop Monitoring Project

Since 2018

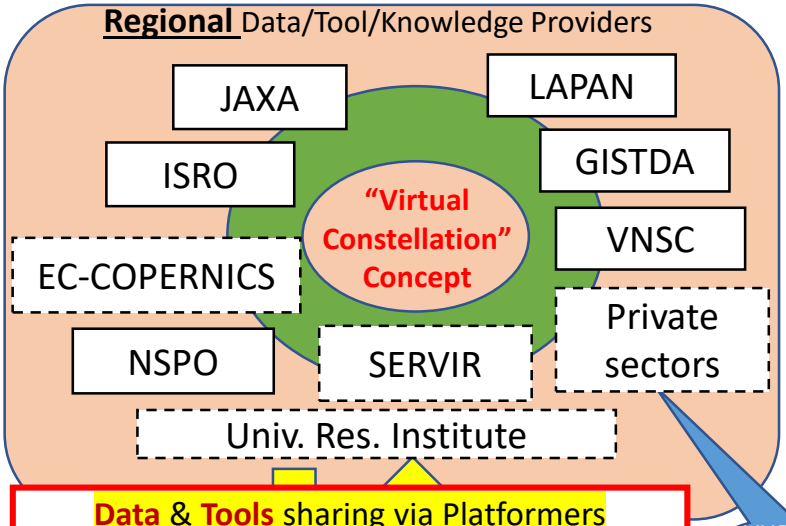
- Rice crop monitoring by SARs in South East Asia, especially Mekong Region
- Linkage to AFSIS and GEOGLAM
- Joint appeal to GEO by Europe, India and Japan
- Future expansion to South Asia through the cooperation with India

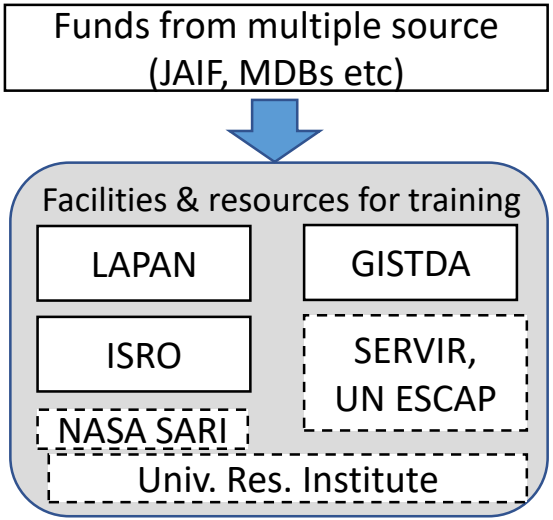
Agromet Project

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)





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

VHR data as training data

Provide data, tools, knowledge

Feedback from end user

Provide Trainings

Feedback from end user

South East Asia & South Asia countries

Space and S&T agencies

Stakeholders
(Not limited to governmental, including industries)

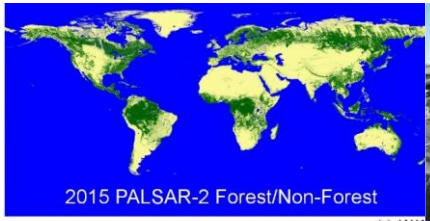
MoA/Indonesia
MAFF/Cambodia
etc.

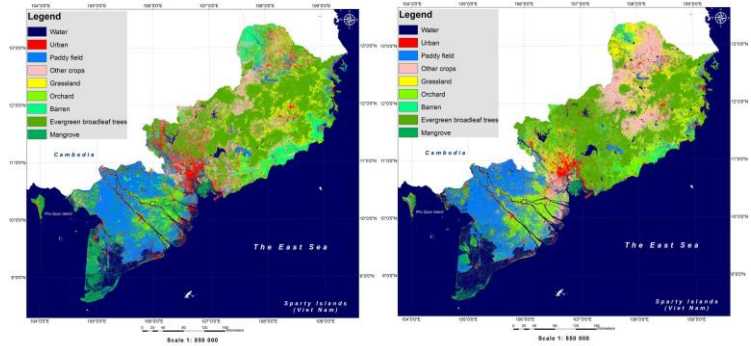
Free and Open Data and Products

Land Cover	
Datasets	Global PALSAR-2/PALSAR/JERS-1 Mosaic and Forest/Non-Forest map
Datasets	Precise Global Digital 3D Map "ALOS World 3D - 30m (AW3D30)"
Datasets	High-Resolution Land Use and Land Cover Map *Japan and Vietnam

Agriculture	
Program	International Asian Harvest mOnitoring system for Rice (INAHOR)
Datasets	JASMIN(JAXA's Satellite based MonItoring Network system for FAO AMIS outlook)

Water Cycle	
Program	Global Satellite Mapping of Precipitation ”GSMaP”
Product	3D Precipitation data

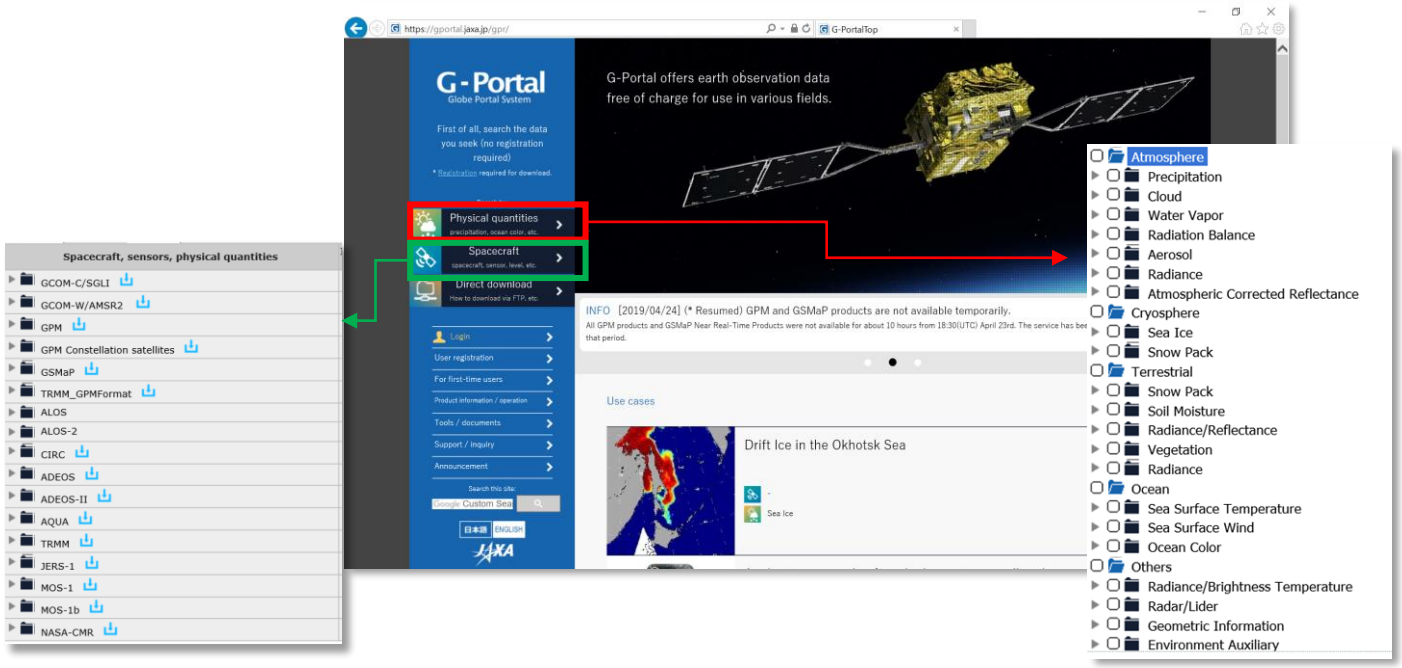




High-Resolution Land Use and Land Cover Map of the Southern Region of Vietnam
The 2007 land cover map (left) and the 2017 land cover map (right).

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)