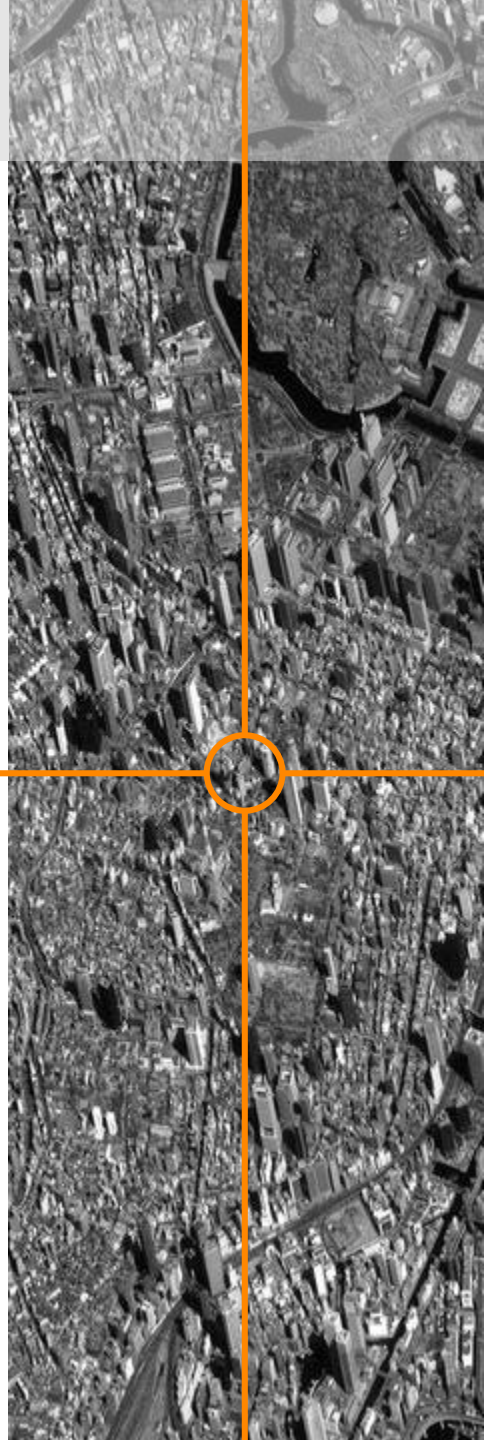
RESTEC

Information services using satellite-based remote sensing technology from Japan



Tsugito Nagano
Deputy Manager / Business Development Division /
Solution Service Department

Remote Sensing Technology Center of Japan
(RESTEC)

REmote Sensing TEchnology Center of Japan

The core organization for satellite-based remote sensing technologies in Japan

More than 40 years, RESTEC works for EO missions mainly entrusted by the Japan Aerospace Exploration Agency (JAXA)

.

Capacity Development;

More than 4,000 trainees

from 55 countries

Five business Domains in RESTEC

Nowadays, focusing on "developing solutions"

- **not limited to satellite**
- **not limited to R&D**
- **ex) paddy field, drought/flood, land subsidence. vessels tracking etc..**

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For Climate Change Adaptation
(demonstrating at Fiji, Samoa and Vanuatu)

環境省

Ministry of the Environment

Government of Japan

RESTEC

東京大学 THE UNIVERSITY OF TOKYO

KANAZAWA UNIVERSITY

BroadBand Tower, Inc.

with introducing
Ministry of the Environment Japan (MOEJ) ‘s project
“Developing methodology to evaluate climate change impact in Small Island States”

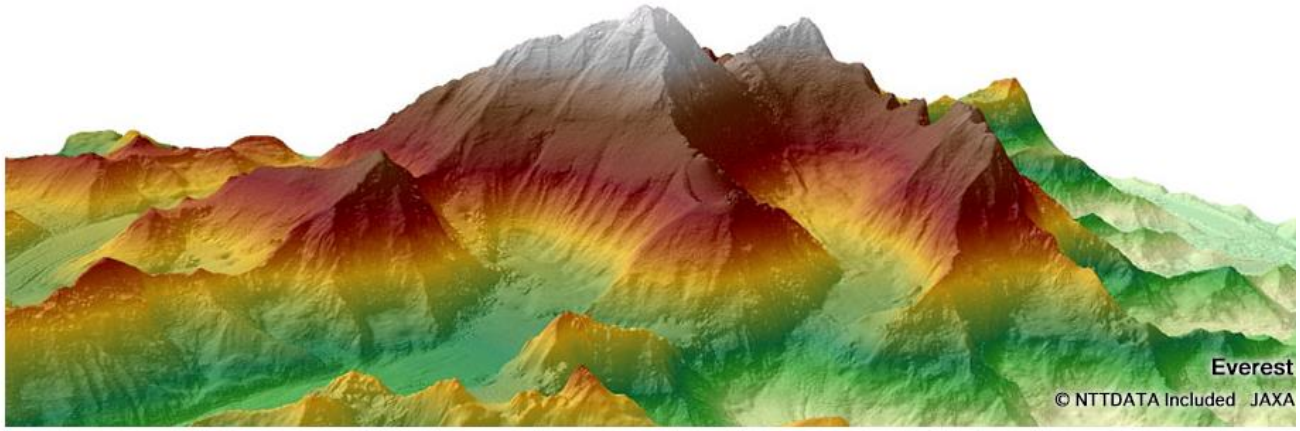
implemented by RESTEC
in association with
the University of Tokyo, KANAZAWA University and Broad Band Tower Inc.

Key Technology :
Satellite based Digital Surface Model (DSM)

AW3D

THE WORLD'S FIRST 3D GLOBAL MAP WITH 5M RESOLUTION

AW3D: Global High-resolution 3D Map



NTT DATA

RESTEC

ALOS
Advanced Land Observing Satellite

※JAXA陸域観測技術衛星「だいち（ALOS）」

DigitalGlobe

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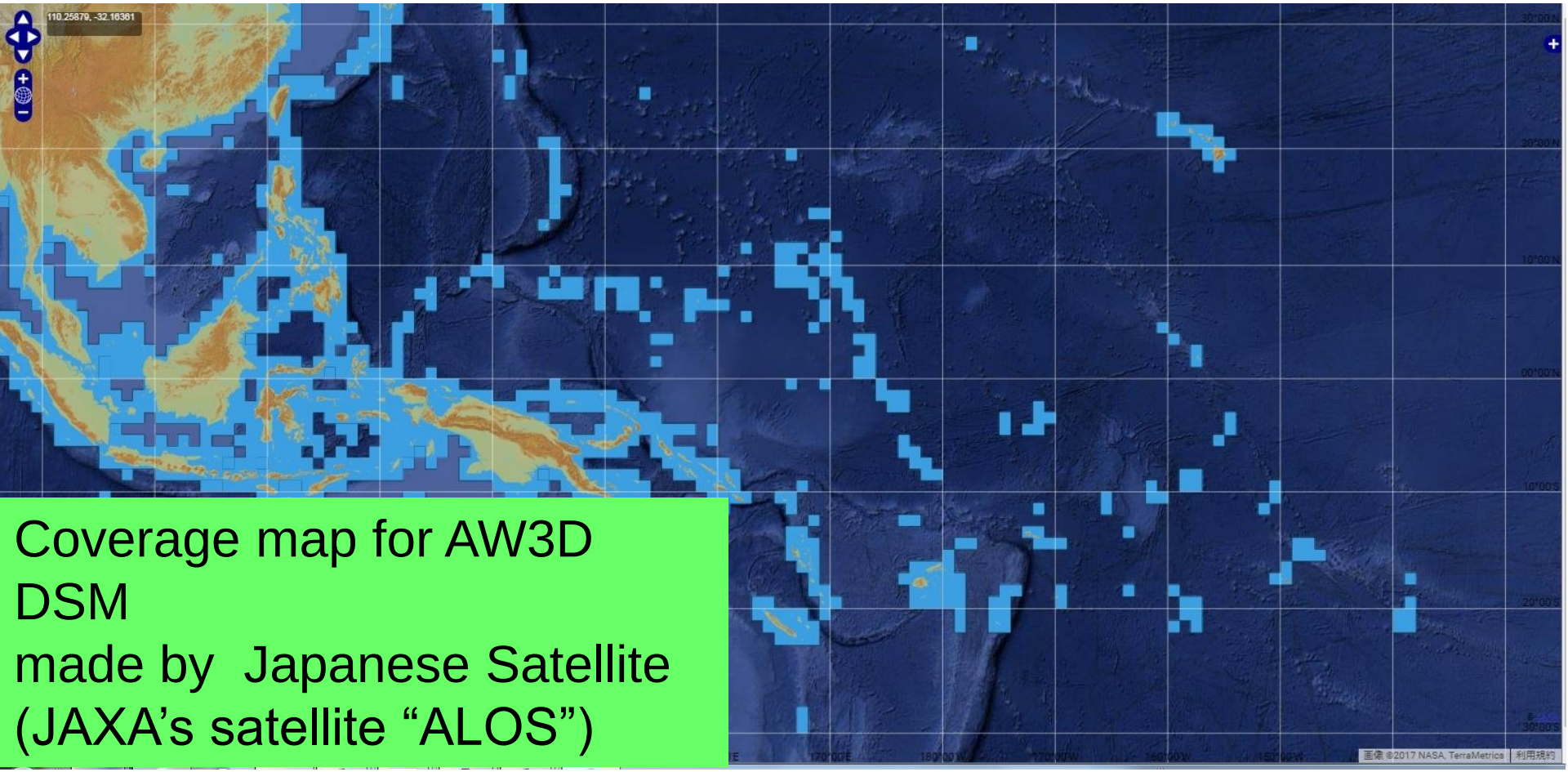
Key Technology :
Satellite based Digital Surface Model (DSM)



Coverage map for AW3D DSM
made by Japanese Satellite (JAXA's satellite "ALOS")

30 m version -> Free of Charge. You can download from JAXA website

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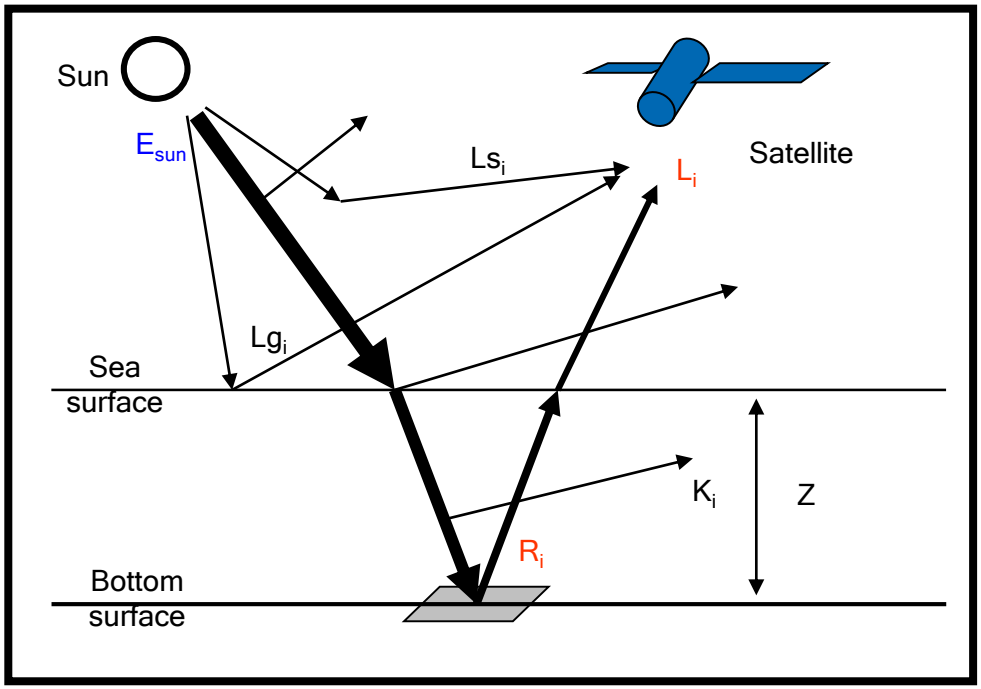
Key Technology :
Satellite Derived Bathymetry (SDB)



- Z: Depth
- L:radiance recorded by satellite sensor
- i: band number
- R: sea bottom reflectance
- La: Coefficient about Sun irradiance and transmittance in atmosphere
- K: Diffuse attenuation coefficient
- F: Geometric factor
- Ls: radiance scatted in atmosphere and sea surface
- Lg: radiance of sunglint effect

Radiance model in coastal water

$$L_i = La_i \cdot R_i \cdot \exp(-K_i \cdot F \cdot Z) + Ls_i + Lg_i \ (W/m^2/sr/\mu m)$$

Depth estimation model by Lyzenga (1978)

$$Z = \beta_0 + \sum_{i=1}^{N} \beta_i X_i \qquad (X_i = \ln(L_i - Lsi - Lgi))$$

Following the increase of N (number of bands), accuracy also increases

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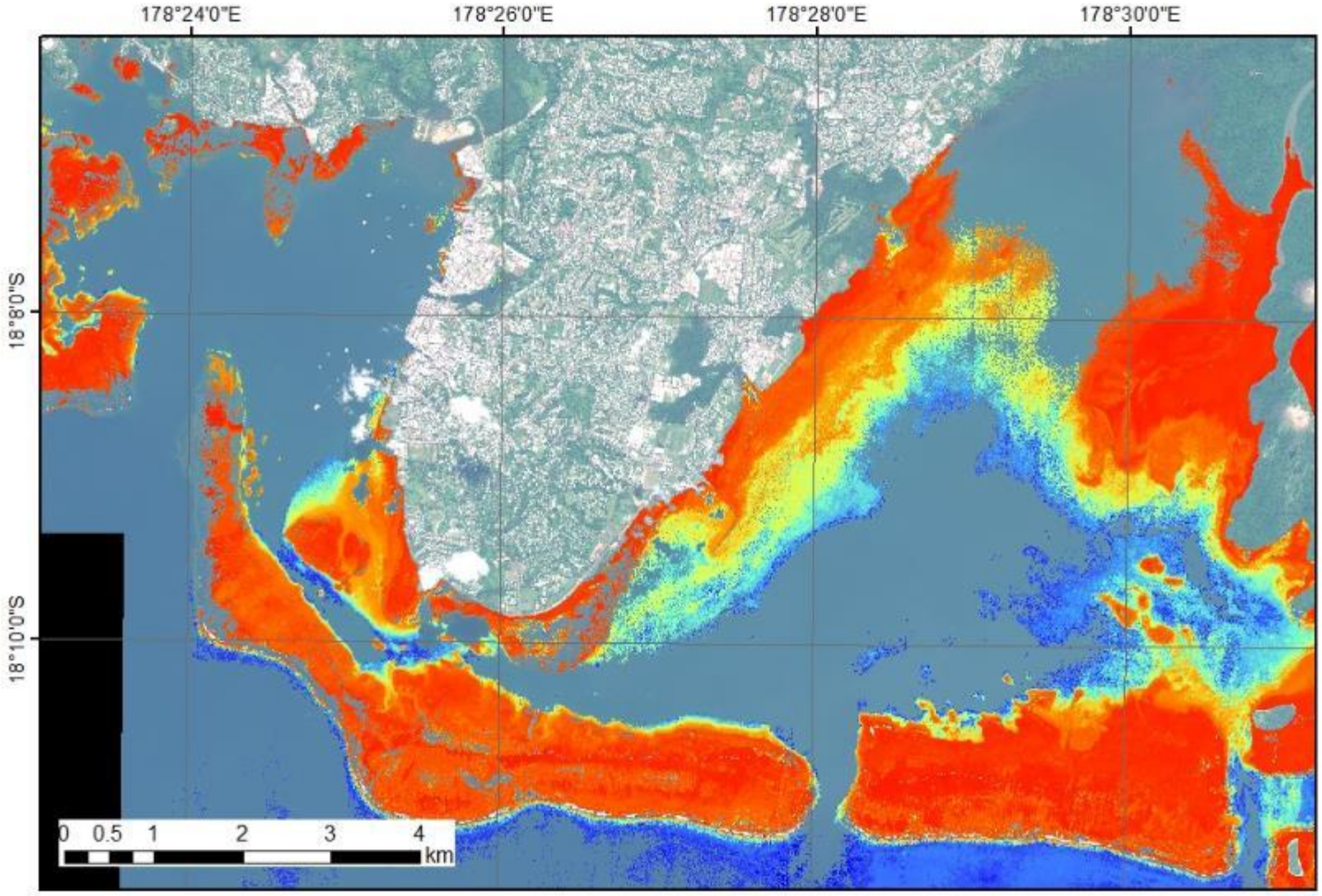
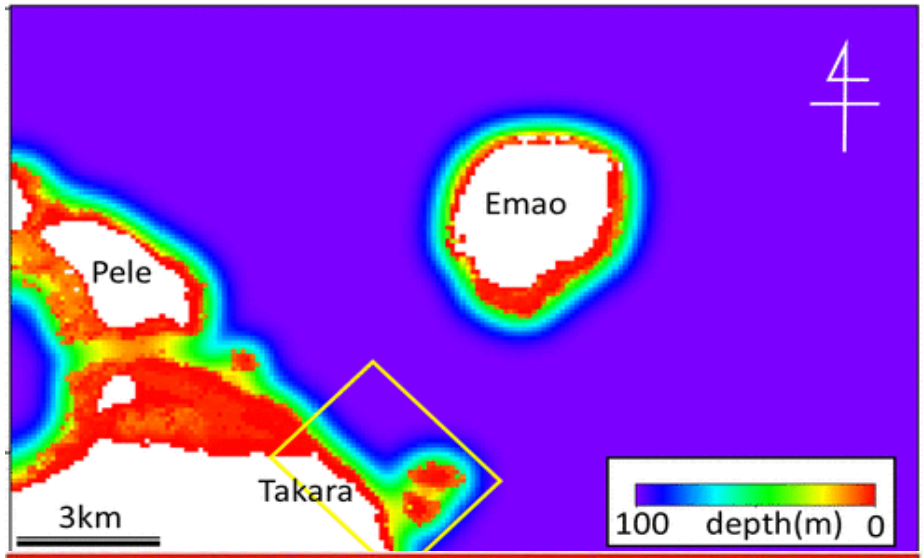
Satellite Derived Bathymetry

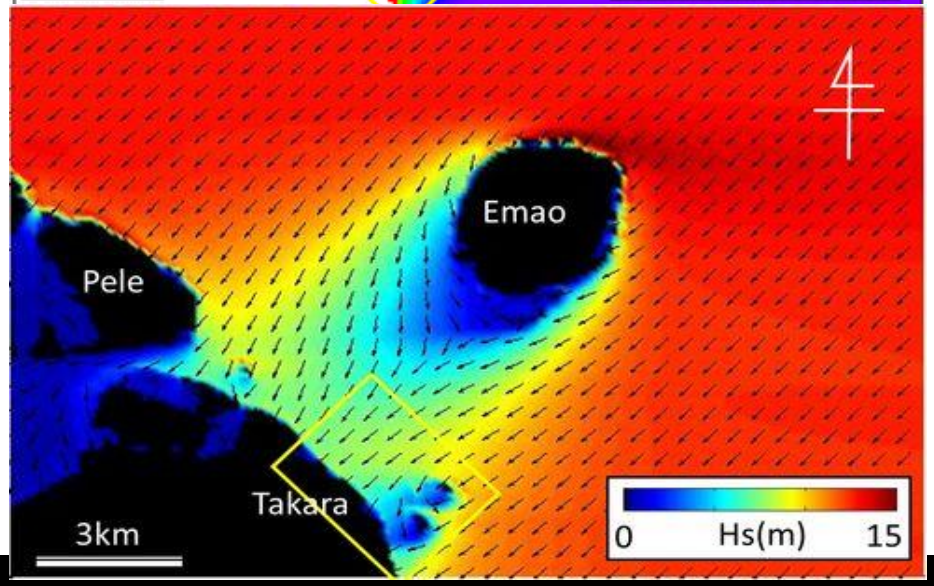
(by Tatsuyuki Sagawa, RESTEC)



Key Technology :
Computing simulation for wave height / direction



←Estimated water depth by SDB at Takara Bay, Efate island, Vanuatu



←Simulation to reproduce wave height and direction condition at TC Pam case (by University of Tokyo)

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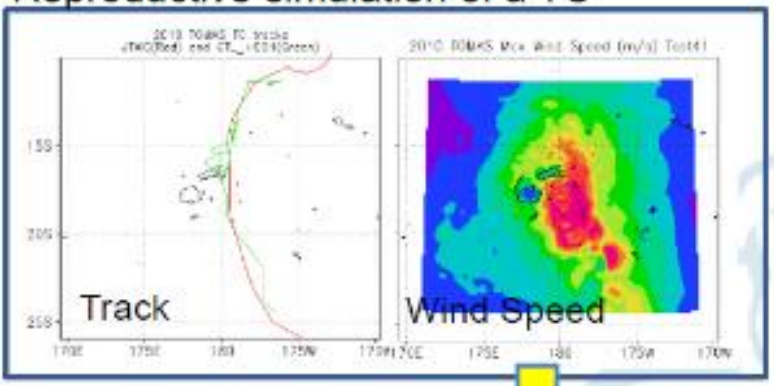
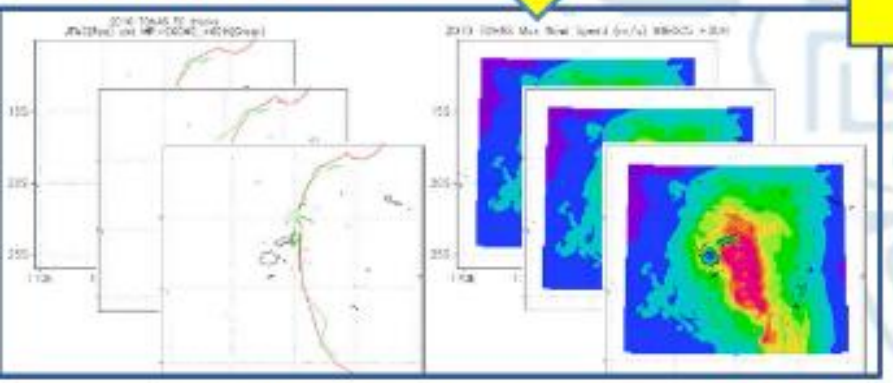
Key Technology :
Applying Climate Change Scenario

Framework for worst case simulation

Reproductive simulation of a TC

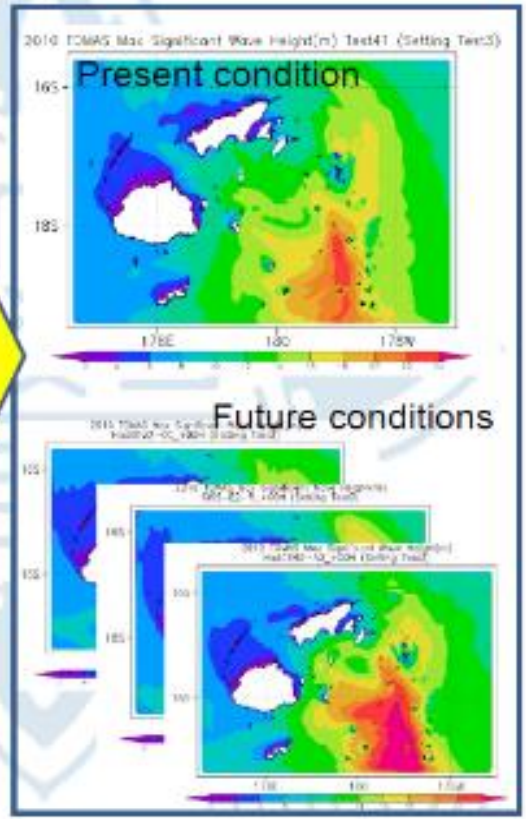


Future variations of a TC



Using multiple AOGMs, climate scenarios

Wave simulation with present/future conditions



The contents will be developed with;

3 scenarios

- RCP 2.6
- RCP 4.5
- RCP 8.5

3 return period

- 50 years
- 100 years
- 200 Years

(by Kanazawa Univ.)

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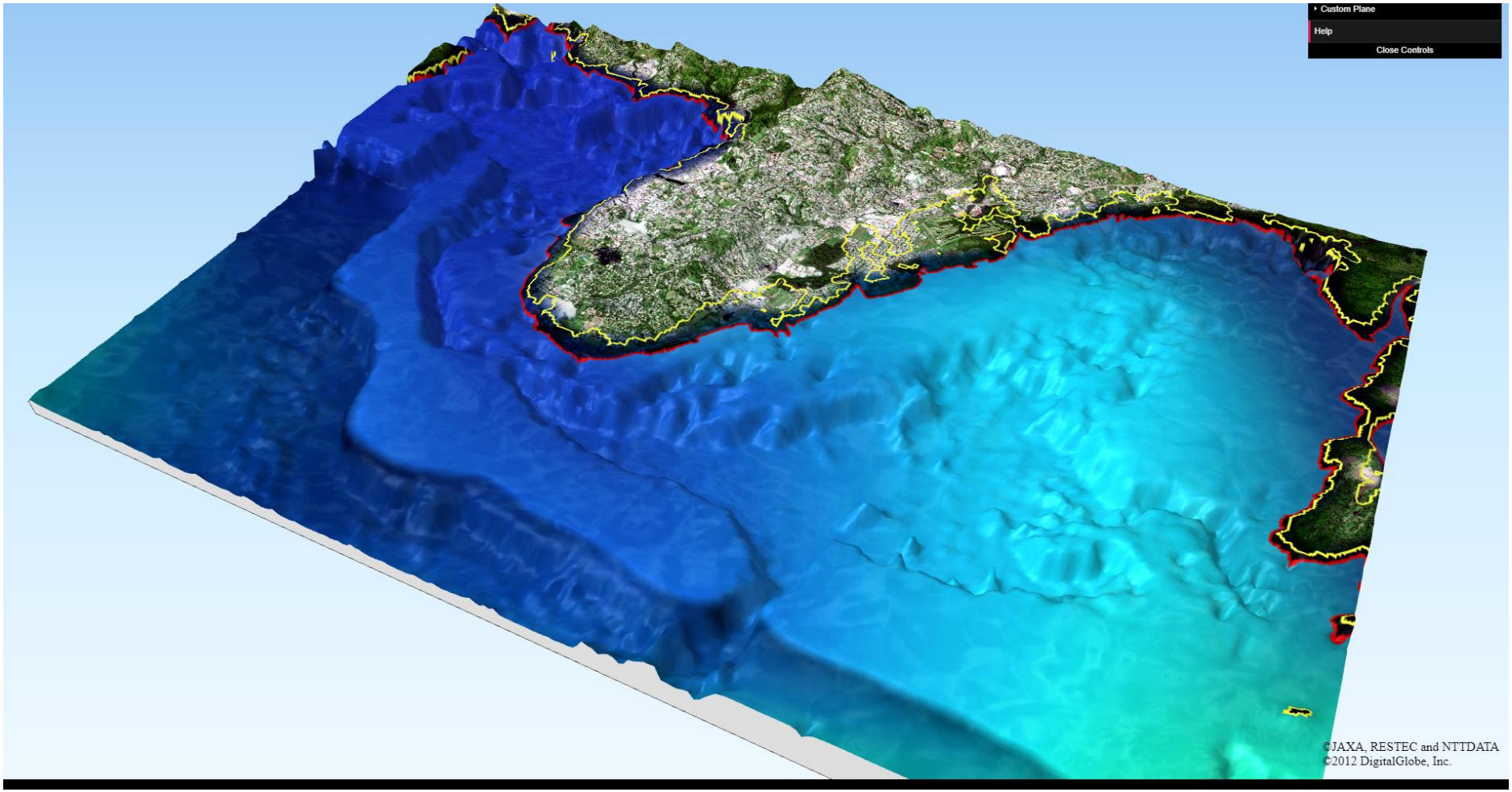
3D Hazard Map (trial version)



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For Dissemination:
Develop “real” 3D map with projected hazard information

COP23 FIJI
UN CLIMATE CHANGE CONFERENCE
BONN 2017

The demonstration system with hazard map for Suva, Fiji was displayed at Japan pavilion at COP23 meeting

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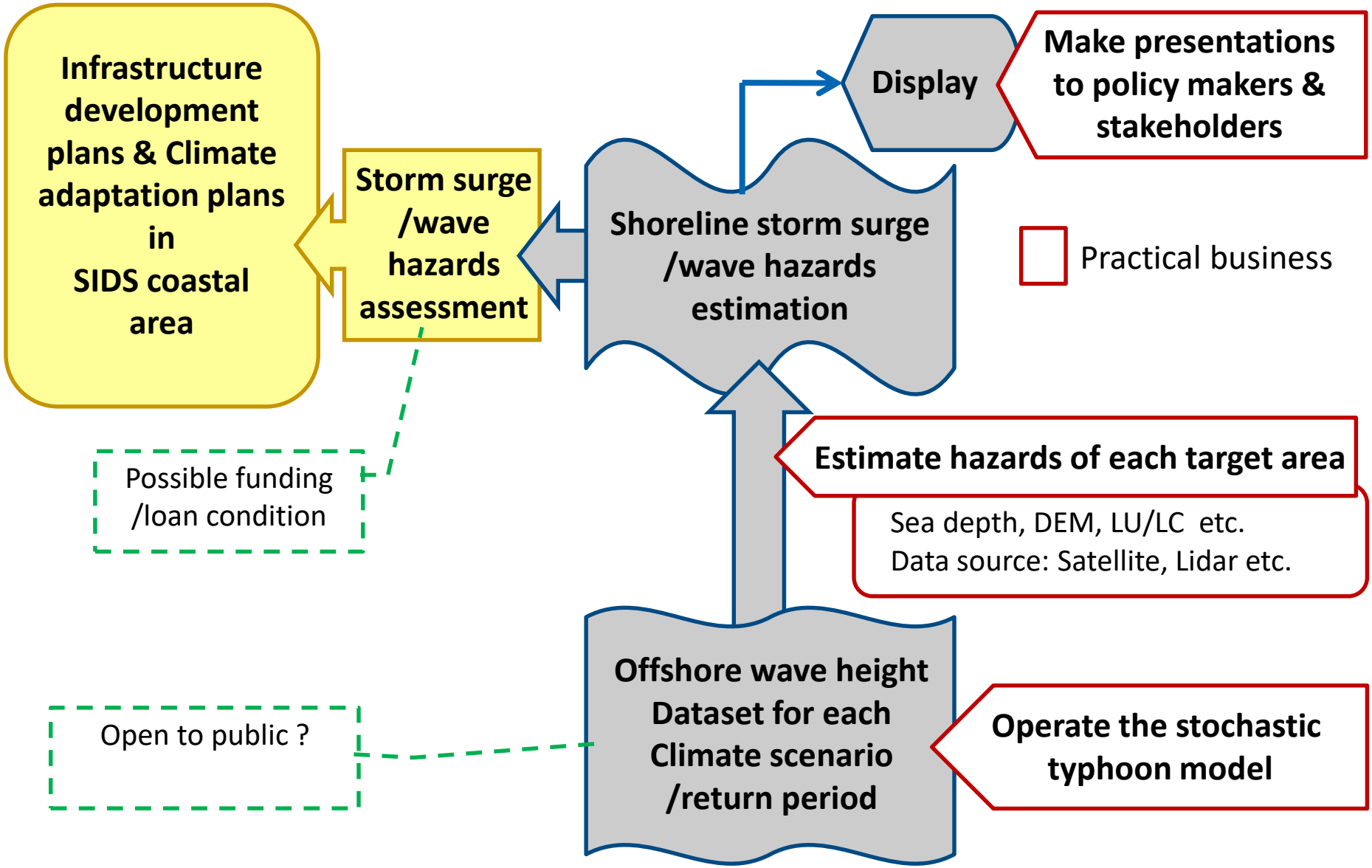
Application of Storm surge/wave hazard information
(Future vision)



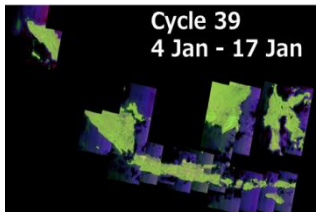
For Agriculture
[potential contribution to the Pacific]

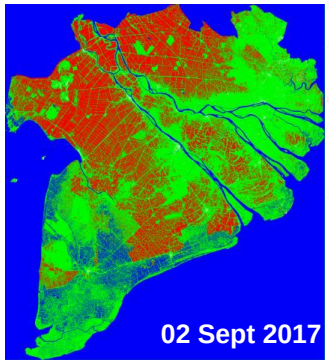
AO-GEOSS Task 5: food security and agriculture GEOGLAM/Asia-RiCE

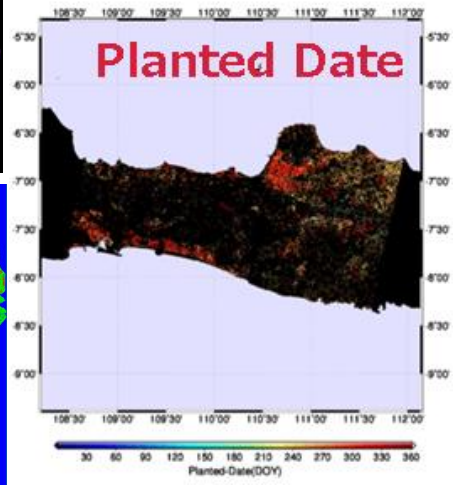
Asia-RiCE (Asia Rice Crop Estimation & Monitoring) is a program led by JAXA and CNES, with more than 20 Asian space agencies and ministries of agriculture, as well as international organizations such as ASEAN/AFSIS, UN/FAO, and IRRI (POCs: Sobue.shinichi@jaxa.jp, ohyoshi.kei@jaxa.jp, Thuy.letoan@cesbio.cnes.fr)

http://www.asia-rice.org

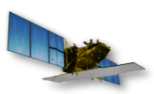
ID	Target Agricultural Products
P1	Rice Crop Area Estimates/Maps
P2	Crop Calendars/Crop Growth Status
P3	Crop Damage Assessment
P4	Agro-meteorological Information Products
P5	Production Estimation and Forecasting



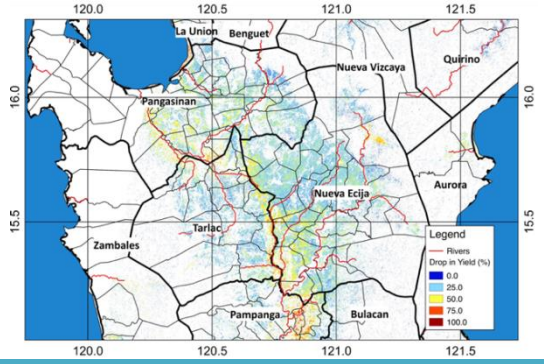




- ADB projects, APRSAF/SAFE projects and GEORICE projects have successfully demonstrated INAHOR, using SAR data to achieve mapping accuracies of 80-90% for the target provinces
- Scaling-up for major rice producing areas (planting area and growing stages) are currently demonstrated in **Vietnam and Indonesia**
- Continuing work on rice crop outlooks for Asia using EO data in cooperation with ASEAN
- Assessing the impact of typhoons on rice production in The Philippines using EO data (in cooperation with PSA and ADB)
- GEOSS-AP AGRICULTURE AND FOOD SECURITY WG was held to share Asia-RiCE accomplishments and linkages with the SDGs



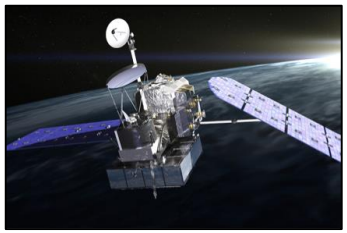
Agricultural damage estimation using multi-temporal ALOS-2 data

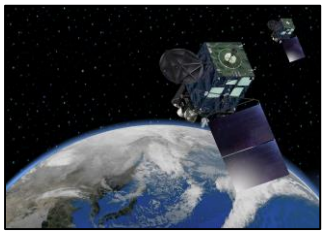


Challenges / next steps / events:

- GEOGLAM sessions at ACRS, APRSAF Space Applications WG (India) and the JECAM/Asia-RiCE meeting (Chinese Taipei)
- Scale-up of CH_4 measurements to regional-scale, for MRV using SAR/optical data with GHG observations from space
- Data fusion / integrated usage and inter-comparison (L/X/C-Band SARs + very high and medium resolution optical)

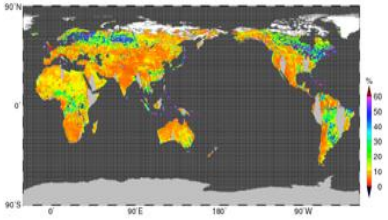
Earth Observation Satellites Contribute to Food Security and Agriculture

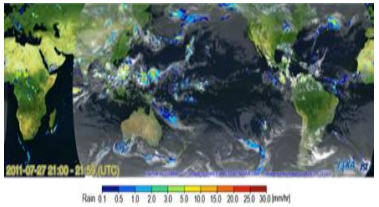


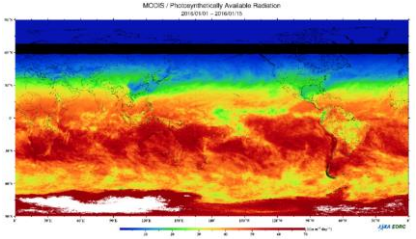


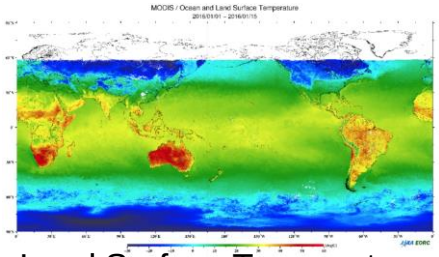
\+
Ground Observation
\+
Models

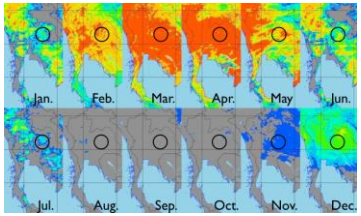
Agriculture-Related Products


Soil Moisture

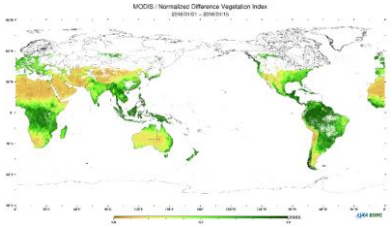

Precipitation


Solar Radiation (PAR)

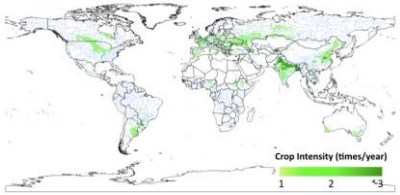

Land Surface Temperature



Drought Index


Vegetation Index

Planted Area



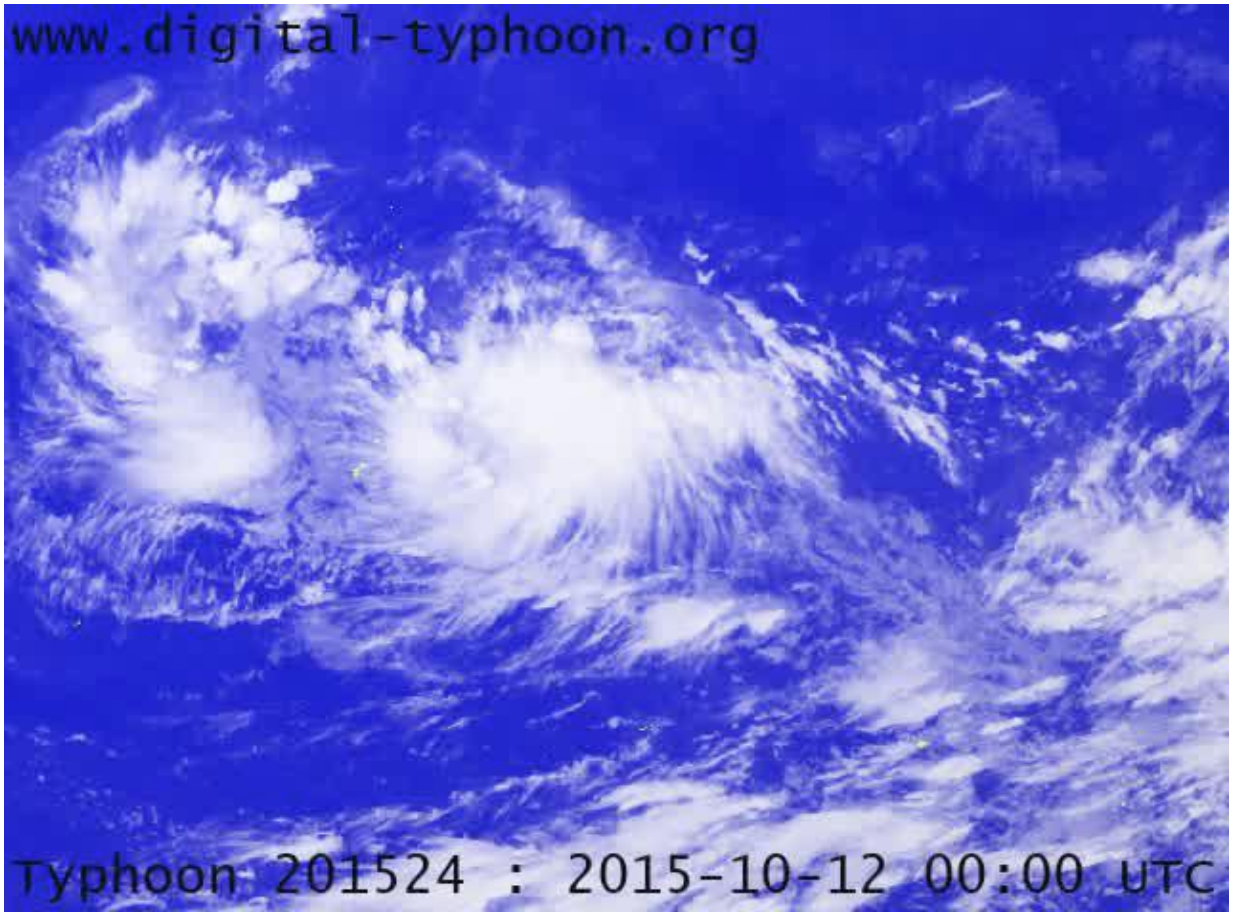
Crop Calendar

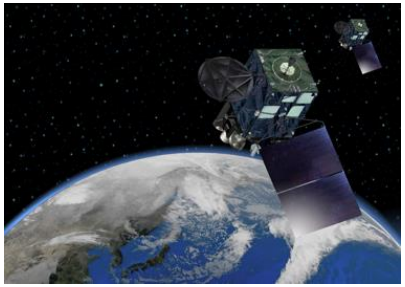
etc.

Agriculture-related Services

Statistics | **Early Warning** | **Damage Asses.** | **Farming**

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



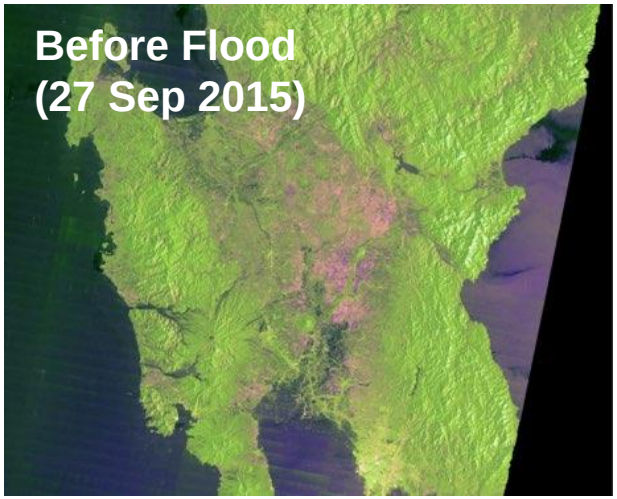


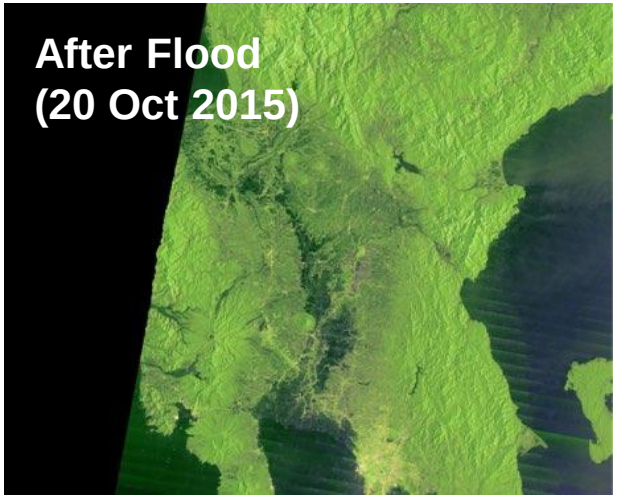
Digital Typhoon (Prof. Kitamoto, NII, Japan)
http://agora.ex.nii.ac.jp/digital-typhoon

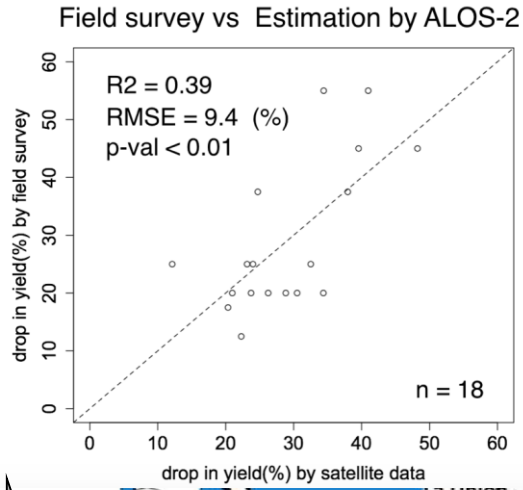
Observed by Himawari-8
Japanese Geostationary Satellite

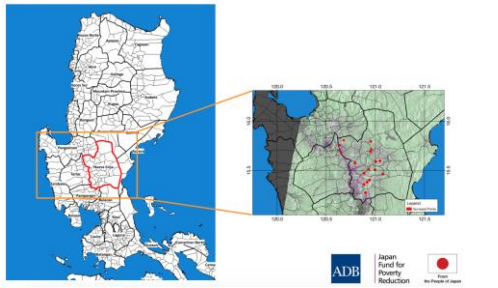
Agricultural Damage Estimation by Multi-Temporal ALOS-2

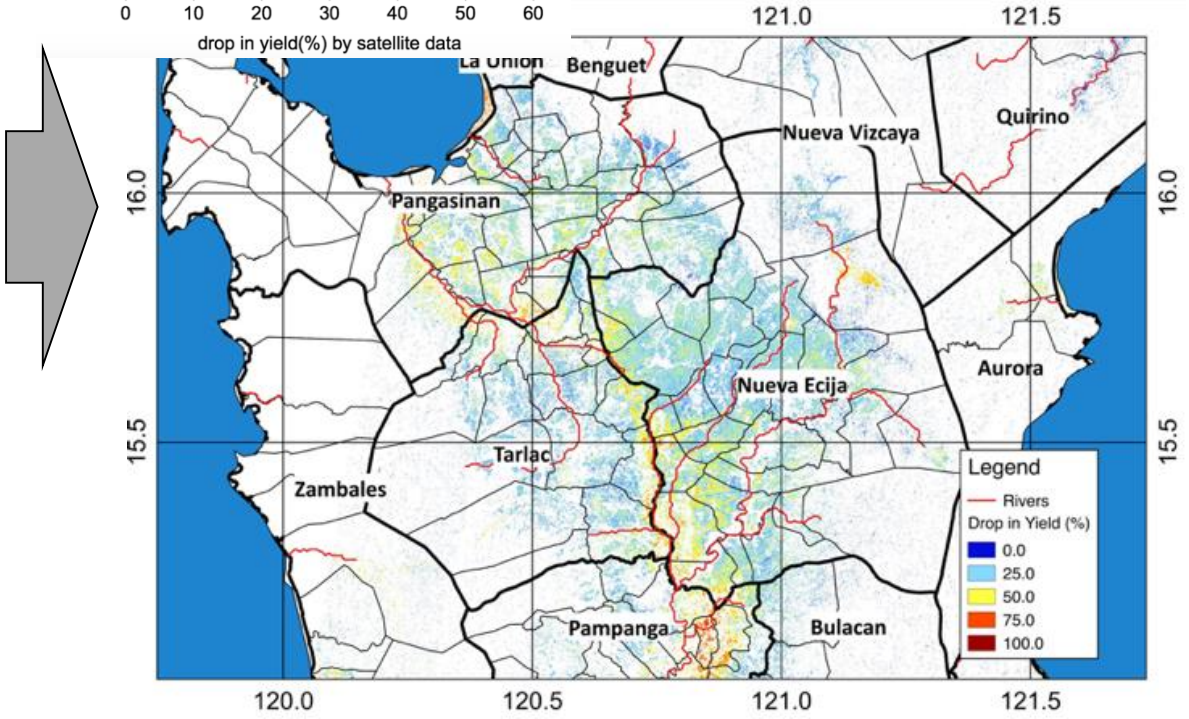
- Damage (yield decrease) were estimated by using ALOS-2 data (before/after flooding).











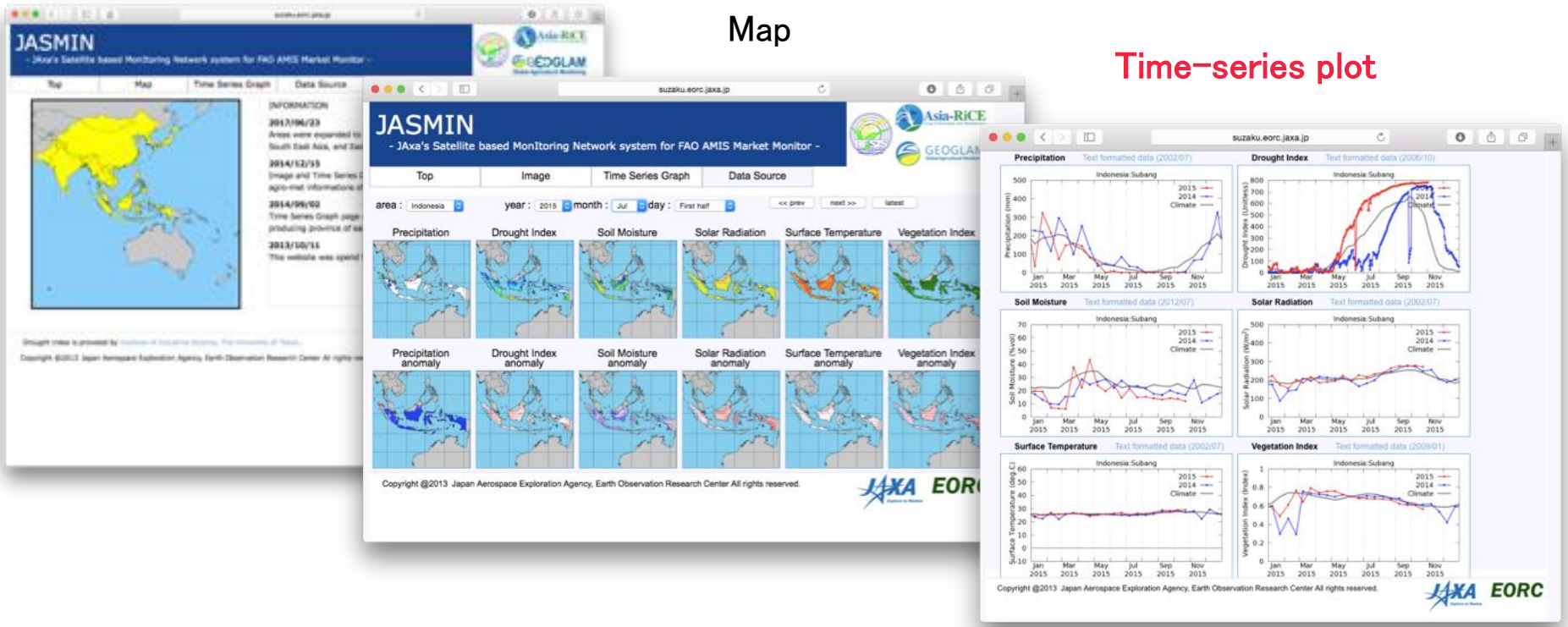
Product :Agro-meteorological Monitor forAsia-RiCE

- **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

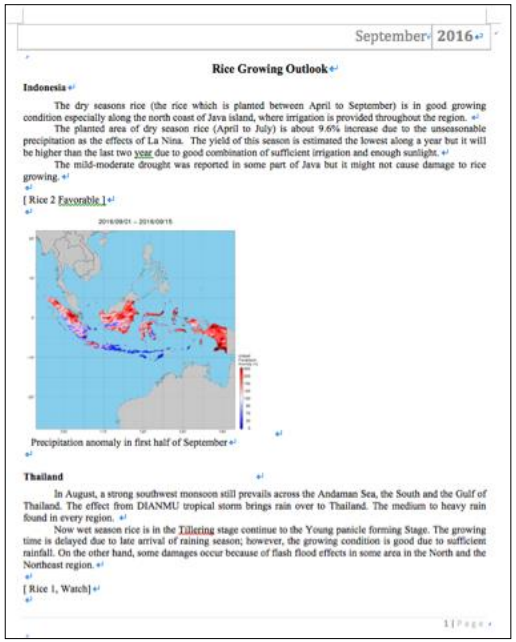


http://suzaku.eorc.jaxa.jp/JASMIN/index.html

[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

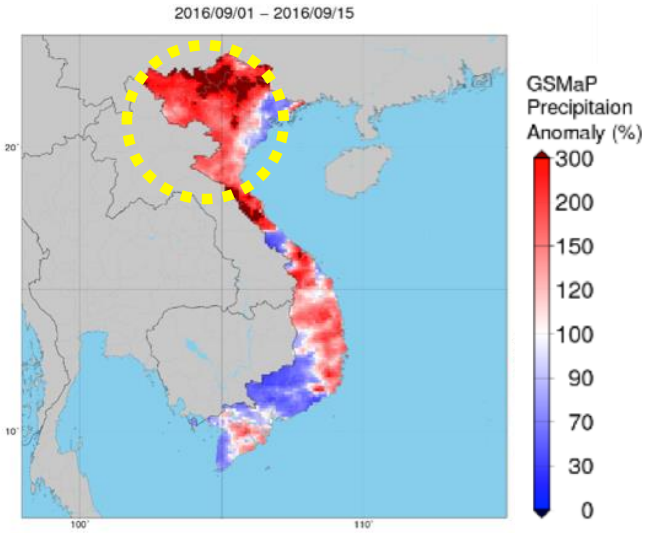
Thailand

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.

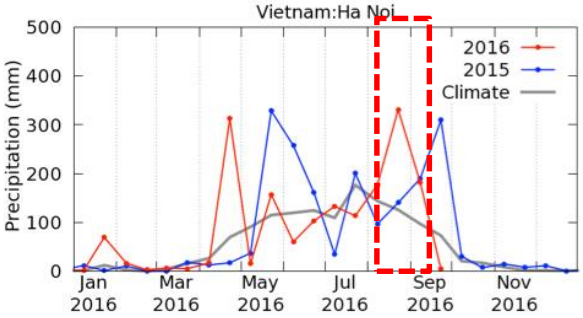
Now wet season rice is in the Tillering stage continue to the Young panicle forming Stage. The growing time is delayed due to late arrival of raining season; however, the growing condition is good due to sufficient rainfall. On the other hand, some damages occur because of flash flood effects in some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

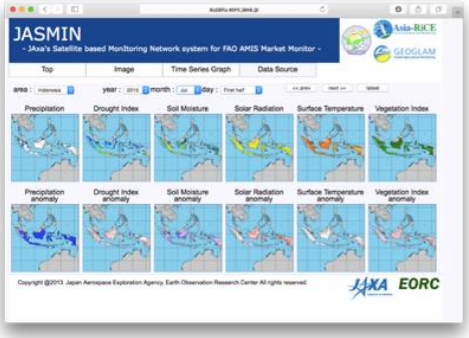
Rice Growth Outlook to GEOGLAM for FAOAMIS

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

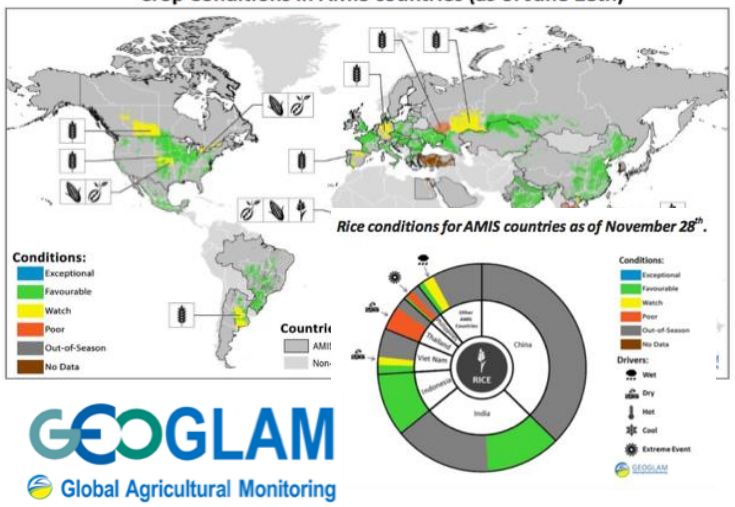
AFSIS ASEAN Food Security Information System



Agro-met Data

AFSIS

Rice Growth Outlook



GEOGLAM Global Agricultural Monitoring

Phase-1

Thailand Indonesia Vietnam Philippines

Phase-2

Cambodia Laos Myanmar

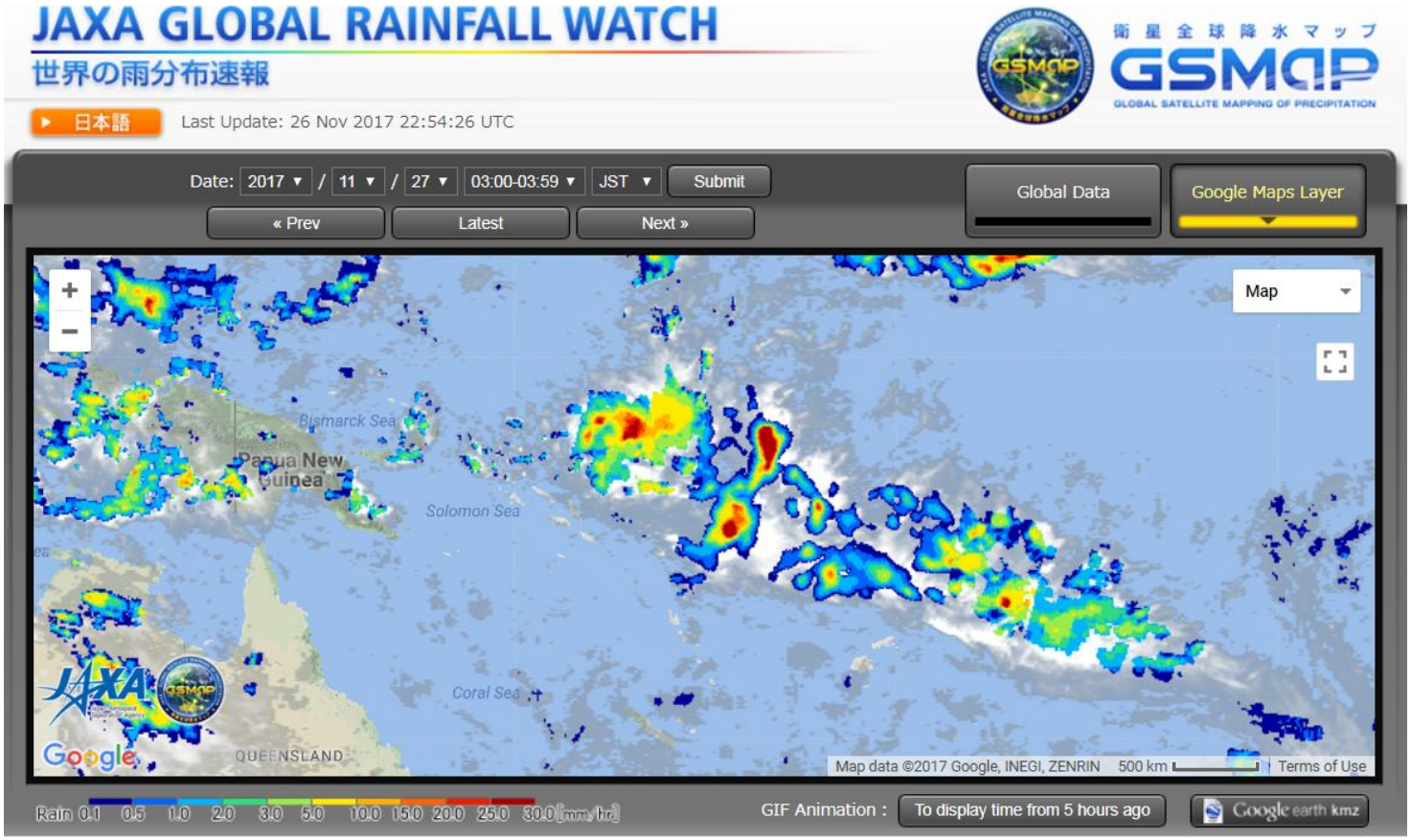
Agricultural Statisticians

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

Introduction JAXA's satellite and service

GSMaP

Global Satellite Mapping of Precipitation



GSMaP Global Satellite Mapping of Precipitation

Dual-Frequency Precipitation Radar

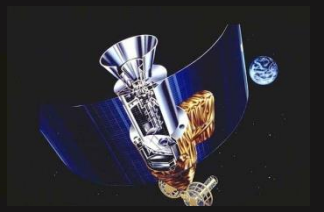
Providing reference standard

GPM Microwave Imager

Global Precipitation Measurement Core satellite

Constellation satellites

IR imager by Geostationary satellite



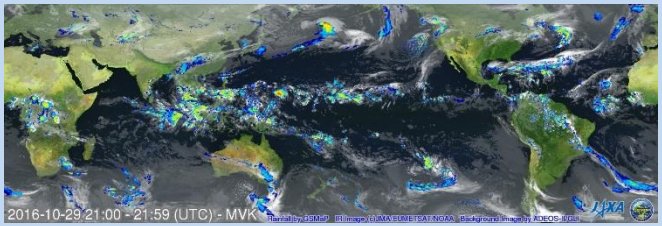
Precipitation Radar

Microwave Radiometer

IR Imager

Multi-satellite Rainfall Product

- hourly global rainfall data
- 0.1x0.1deg. lat/lon
- In near real time

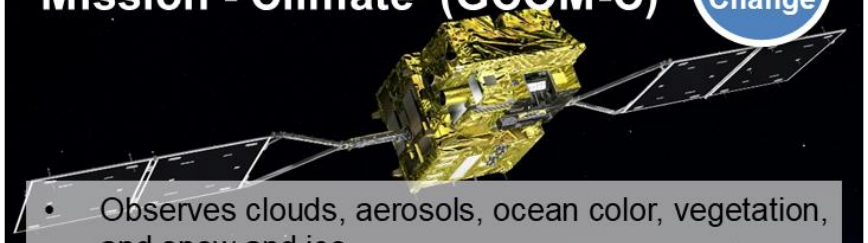


distribution

JAXA satellites scheduled for launch in JFY2017

Global Change Observation Mission - Climate (GCOM-C)

Climate Change



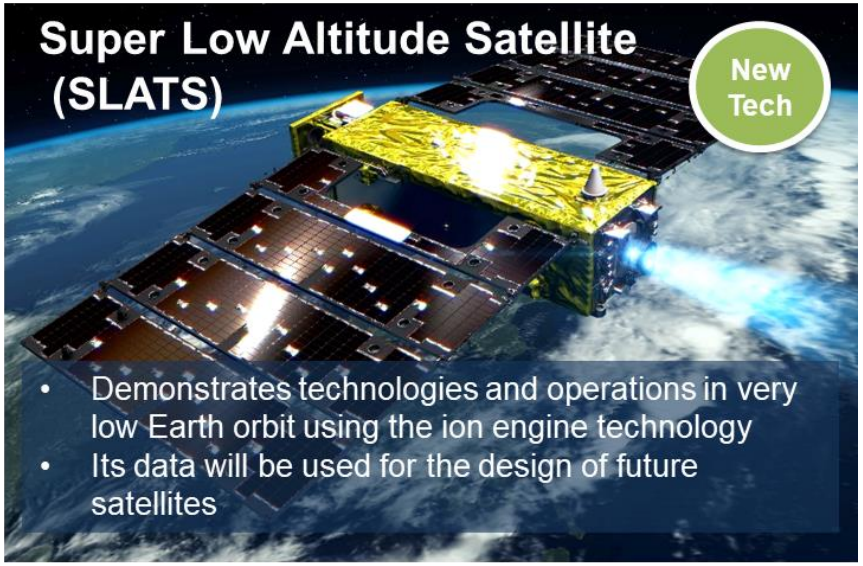
- Observes clouds, aerosols, ocean color, vegetation, and snow and ice
- Contributes to enhancing the precipitation accuracy of future environmental changes
- Used for mapping fisheries, monitoring yellow dust transport and crop growth

STATUS:
Checkout at Tanegashima Space Center for launch

GCOM-C Satellite PFM @ JAXA Tsukuba Space Center

Super Low Altitude Satellite (SLATS)

New Tech



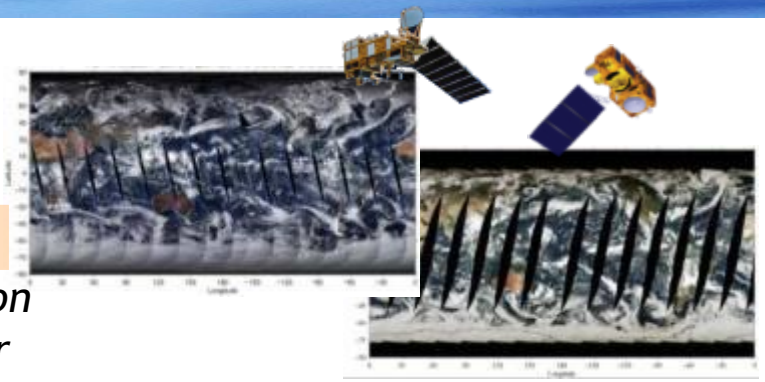
- Demonstrates technologies and operations in very low Earth orbit using the ion engine technology
- Its data will be used for the design of future satellites

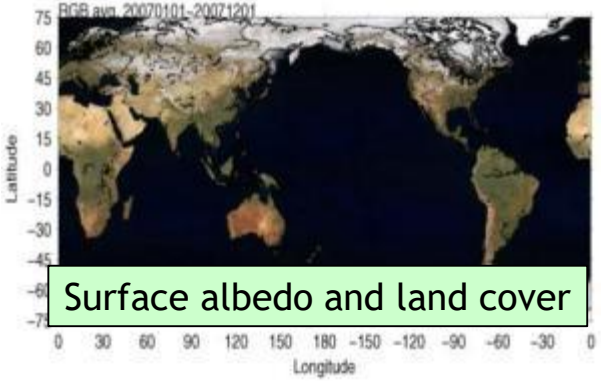
STATUS:
Checkout at Tanegashima Space Center for launch

Examples of GCOM-C SGLI Products

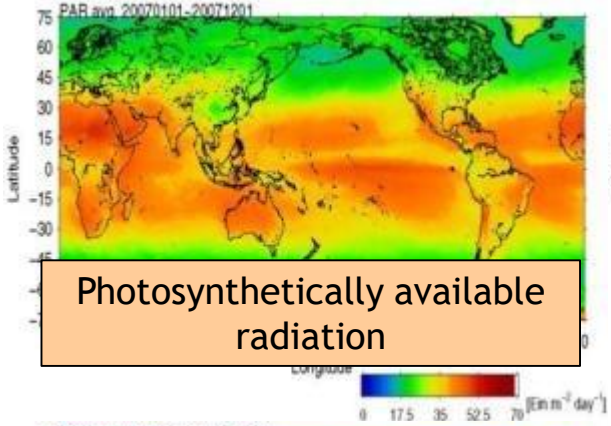
GCOM-C observation

Global data accumulation and synthesis with other satellite data

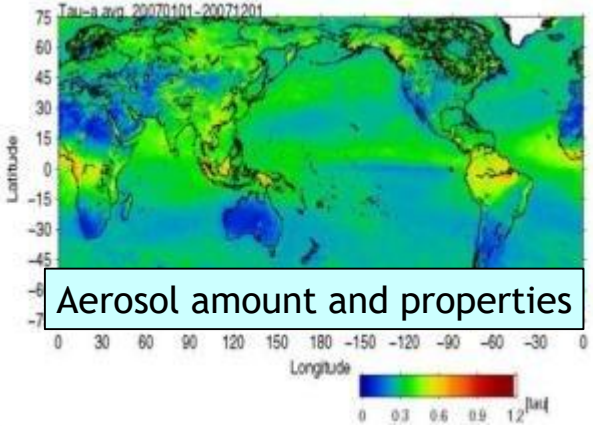




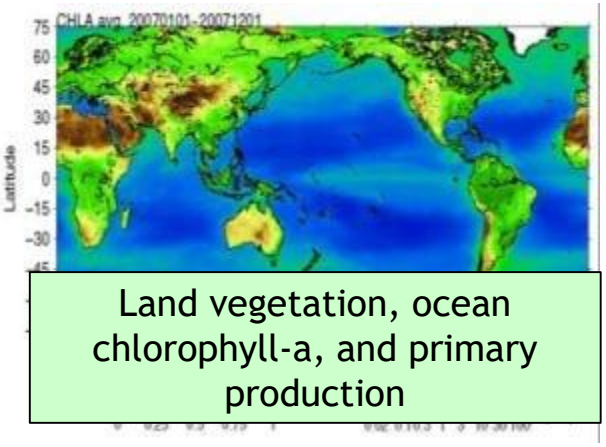
Surface albedo and land cover



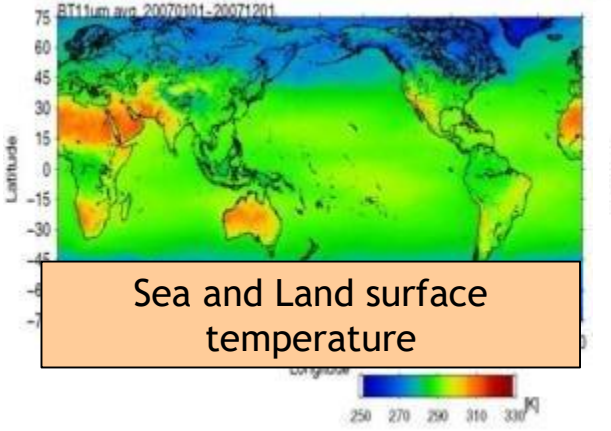
Photosynthetically available radiation



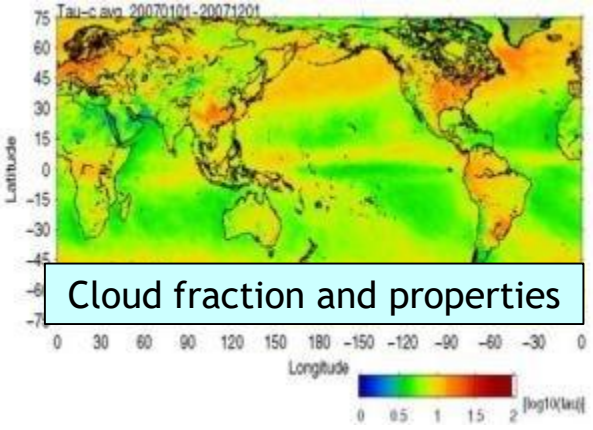
Aerosol amount and properties



Land vegetation, ocean chlorophyll-a, and primary production



Sea and Land surface temperature



Cloud fraction and properties

Conclusion

- **Team Japan is ready for more contribution to the Pacific using Japan's satellites and information services.**
- **For 3D Hazard Mapping, RESTEC proposes to enhance a collaboration with major implementing agencies in the region.**
- **You can contact with us through SPC (Dr. Wolf and Dr.Jens) as the regional partner of RESTEC whenever you want.**
- **10 copies of references (AW3D / 3D hazard map) are available today**

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