

# Updates of EORC Activities

**Riko OKI**

Director, Earth Observation Research Center

Space Technology Directorate I

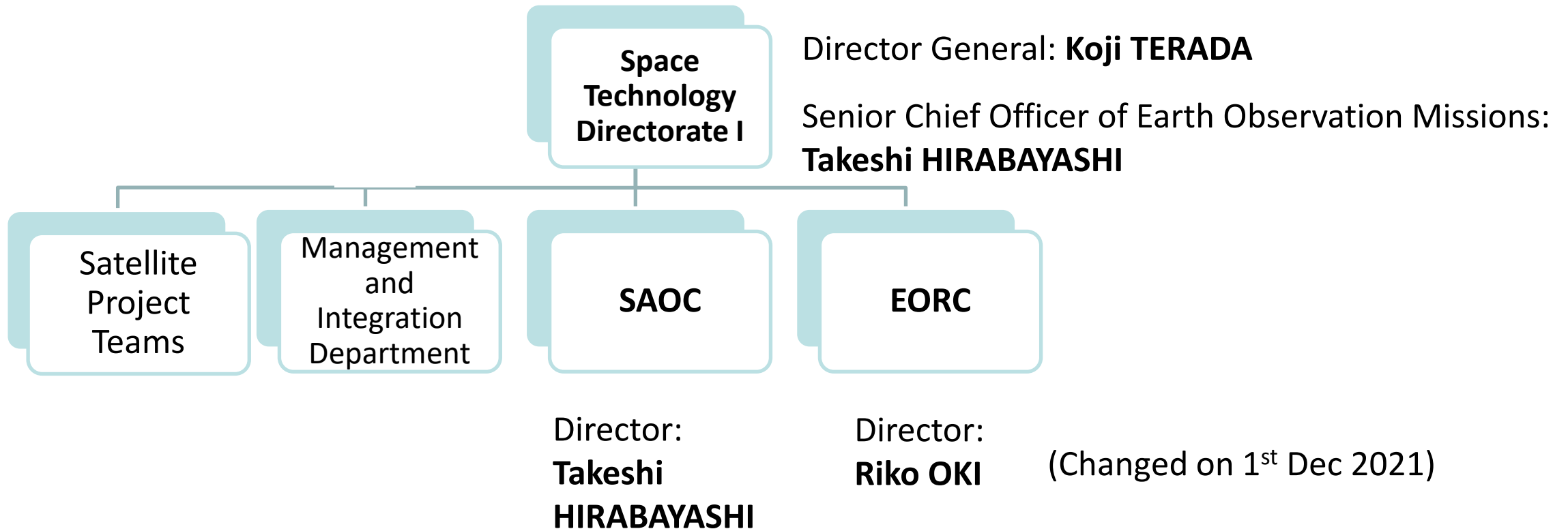
Japan Aerospace Exploration Agency (JAXA)



# Contents

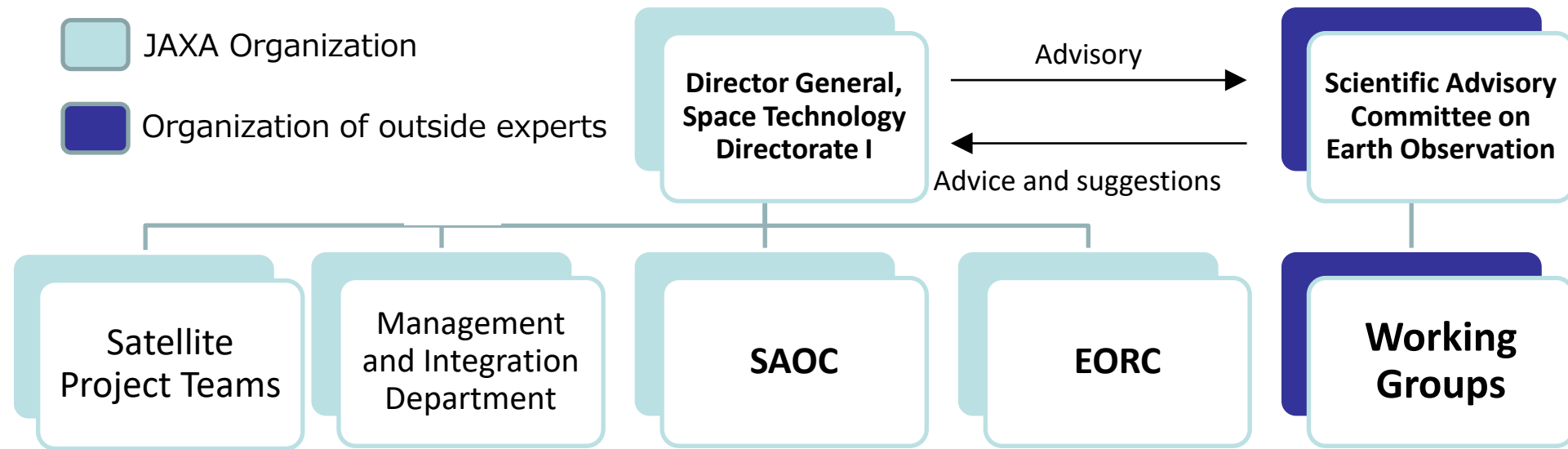
- Organization Structure of Space Technology Directorate I / Scientific Advisory Committee and Working Groups
- JAXA Missions Status
  - Status and results of each satellite mission will follow this presentation by the project manager/the leading scientist
  - Future mission study
- IPCC contributions
- SDGs
- Most featured articles of Updates on Earth (pumice stones, eruption of La Soufrière volcano, heavy rainfall in Tokai & southern Kanto)
- Model collaborations
- EORA2 & EORA3
- Web site renewal

# JAXA Space Technology Directorate I Organization Structure





# Scientific Advisory Committee and Working Groups



## 1. Activities of the Scientific Advisory Committee on Earth Observation will provide advice and recommendations on:

- research activities with scientific point of view
- existing and future satellite missions
- collaboration with universities and research institutes

## 2. Working Groups

### ○ Cross-disciplinary

- Future Mission Study Task Team

### ○ Project Support

- PMM WG
- EarthCARE WG
- SGLI WG
- ALOS-3 F/O WG
- AMSR WG
- DWL WG





# 第一宇宙技術部門事業方針 Business Policy of Space Technology Directorate I



- 「連携」と「協業」の推進/Promotion of “collaboration” and “cooperation”
- 環境変化への対応と挑戦意欲/Responding to changes in the environment and a willingness to take on new challenges
- 「Quality First」
- 新規ミッション、技術課題への取り組み/Addressing new missions and technical issues

地球観測については、「持続性」を強く意識し、社会実装・定着化を目指す。特に、衛星開発と並行して行われるデータ利用の準備、さらには次期計画の立案においては、政策課題をよく理解し、連携相手や出口を見据えて検討・推進を行う。

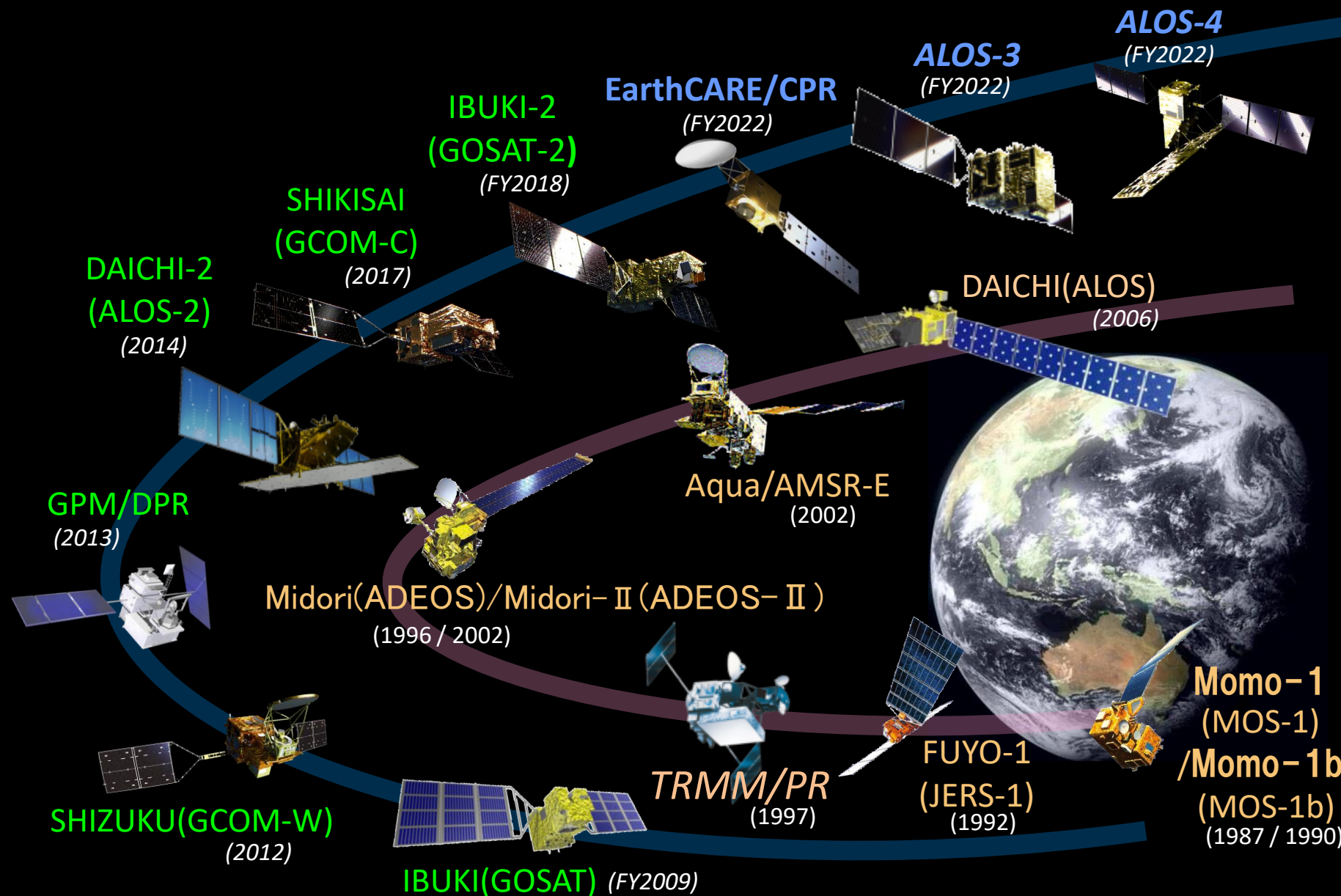
Our aim in promoting EO

- Social implementation with a strong awareness on "sustainability".
- Good understanding of policy issues and consideration for stakeholders when:
  - Preparing data utilization and satellite development carried out in parallel
  - Planning the next plan



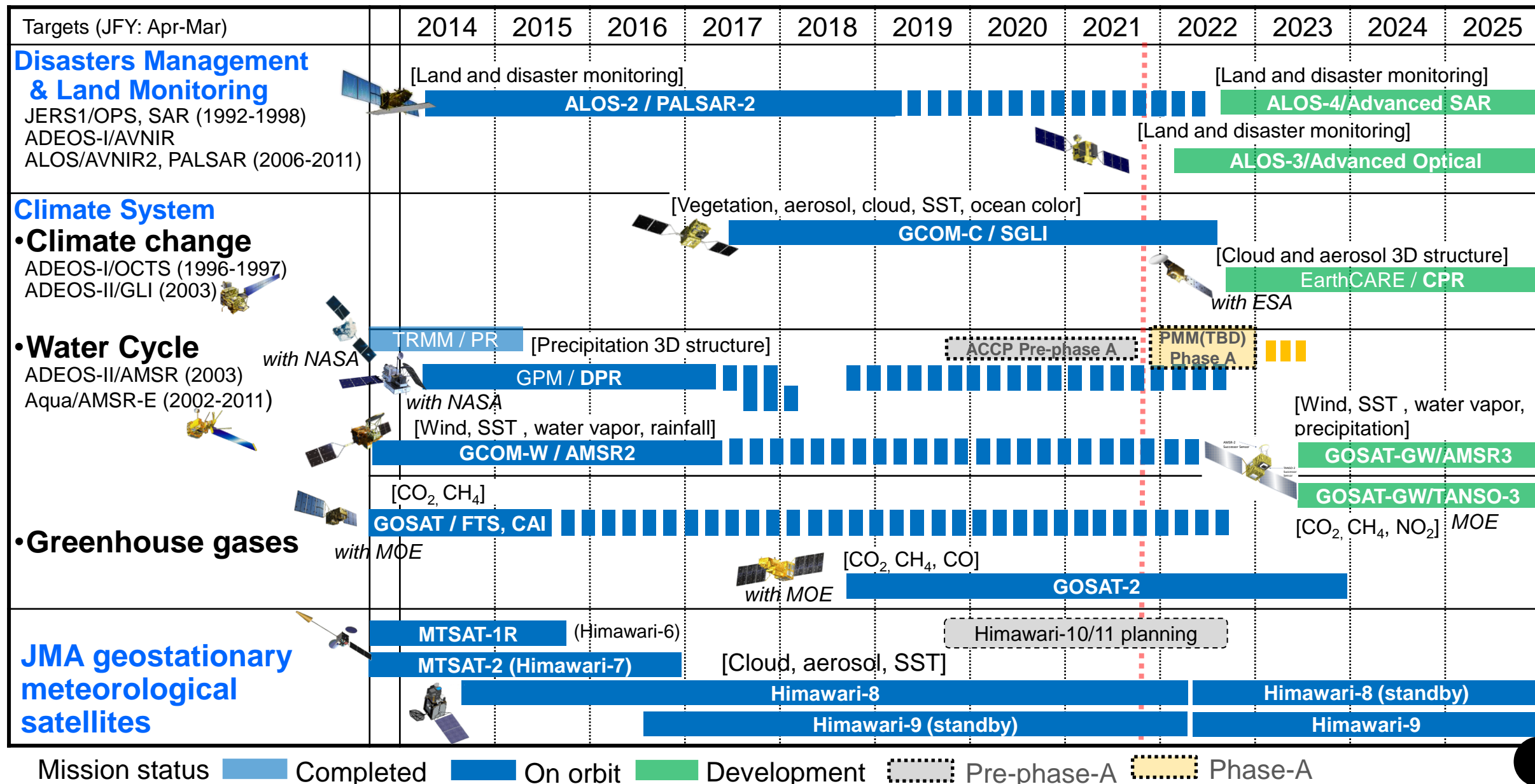


# JAXA's Earth Observation Satellite Programs





# Japanese Earth Observation Satellites





# IPCC AR6 WG1 report (Aug. 2021)

- Many **JAXA EO satellite papers** were cited in the IPCC AR6 WG1 Full report (IPCC, 2021: Climate Change 2021: The Physical Science Basis)
- For example, Yokoyama et al. (2019) “*A Study on Future Projections of Precipitation Characteristics around Japan in Early Summer Combining GPM DPR Observation and CMIP5 Large-Scale Environments*” were cited in Chapter 10.
- The GSMaP was used in **Figure 10.8** in the IPCC AR6 WG1 Full report, which showed the climate model evaluation, and the chapter 10 also showed the **acknowledgment to JAXA** for providing the GSMaP data.

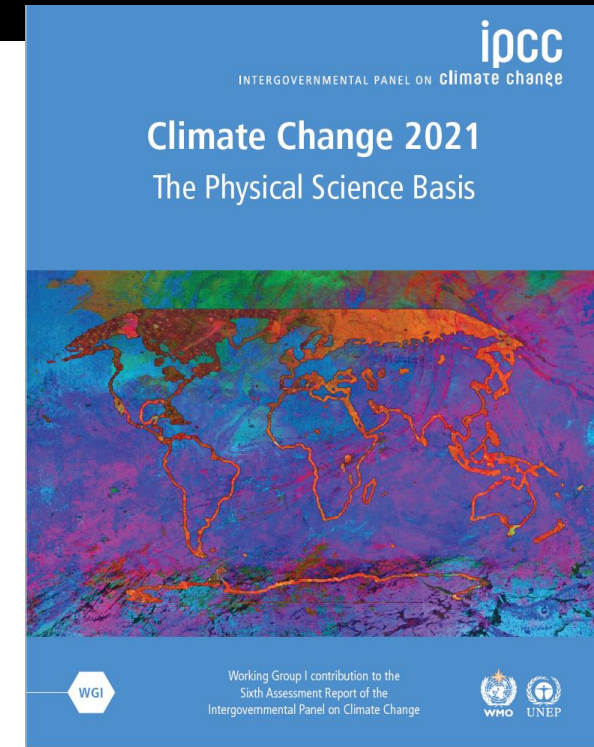
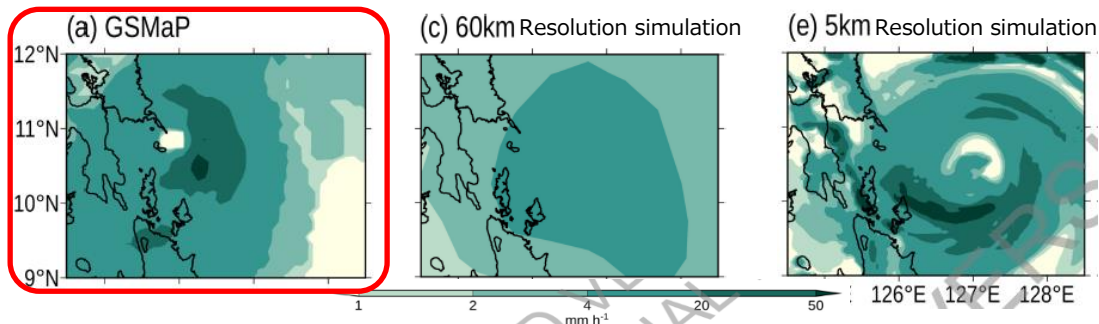


Figure 10.8 in IPCC AR6 WG1 Full report



Comparison of precipitation from GSMaP and numerical simulations (60 km and 5 km resolution) for the case of Typhoon Haiyan.

## Acknowledgment to the JAXA (Chapter 10)

Final Government Distribution	Chapter 10	IPCC AR6 WG1
1	<b>Acknowledgements</b>	
2		
3	We acknowledge the E-OBS dataset and the data providers in the ECA&D project ( <a href="https://www.ecad.eu">https://www.ecad.eu</a> ) for	
4	their help and the Japan Aerospace Exploration Agency (JAXA) for delivering the GSMaP (Global Satellite	
5	Mapping of Precipitation) data to us. The invaluable contributions from Lisa van Aardenne (South Africa),	
6	Peng Cai (China), Joseph Ching (China), Huili He (China), Kenshi Hibino (Japan), Yukiko Imada (Japan),	
7	Nazrul Islam (Saudi Arabia), Isadora Christel Jiménez (Spain) and Misako Kachi (Japan) are also greatly	
8	acknowledged. We acknowledge the World Climate Research Programme for coordinating the modelling	
9	intercomparison projects CMIP and CORDEX and thank the climate modelling groups for producing and	
10	making available their model output.	
11		

# Earth Observation Satellite Data for SDGs

## Goals



## Indicators

- 6.3.2 Proportion of bodies of water with good ambient water quality
- 6.6.1 Change in the extent of water-related ecosystems over time
- 11.3.1 Ratio of land consumption rate to population growth rate
- 14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations
- 15.2.1 Progress towards sustainable forest management
- 15.3.1 Proportion of land that is degraded over total land area





# Supporting SDG Goals (1/2)



## Save Tropical Forest

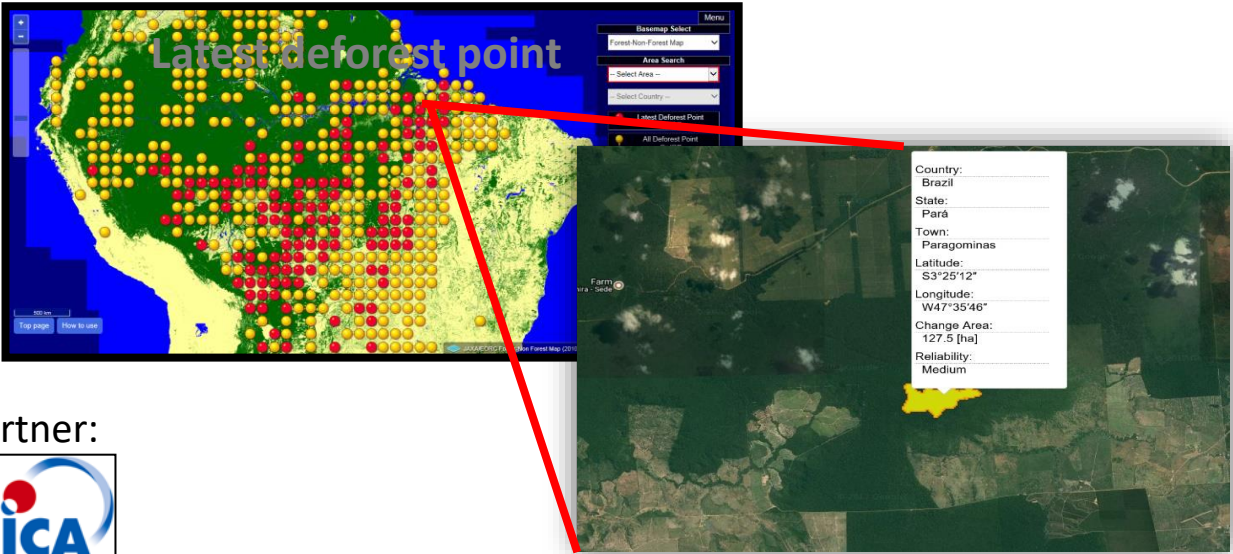
Broad Ground Surface Observation by Radar Capable of Penetrating Clouds

Manage forest sustainably using satellite data of monitoring forest changes



Coverage Area: 77 Countries

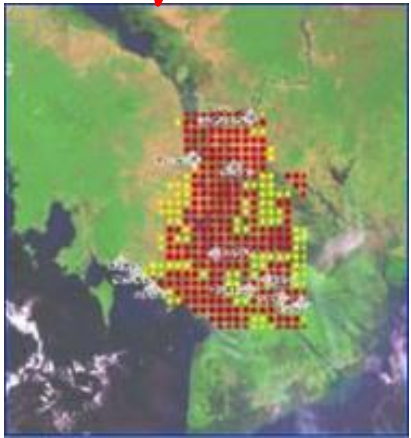
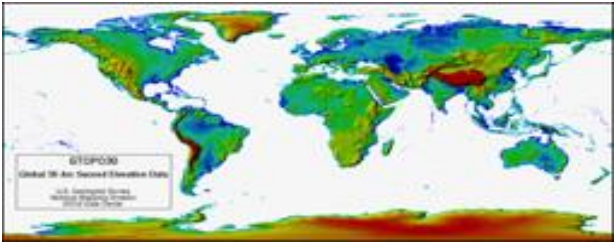
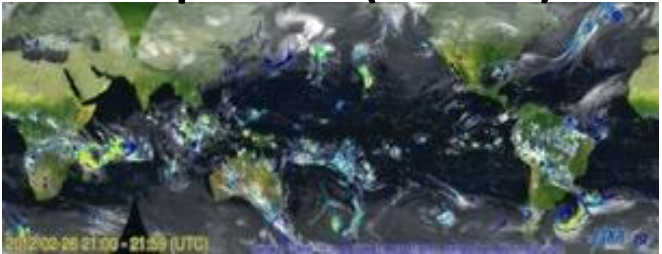
JJ-FAST



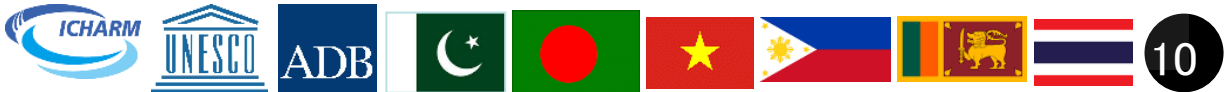
## Reduce Flood Damage

Global satellites grasp the situation on water level of International cross-border rivers.

### Global Satellite Mapping of Precipitation (GSMaP)



Partners:





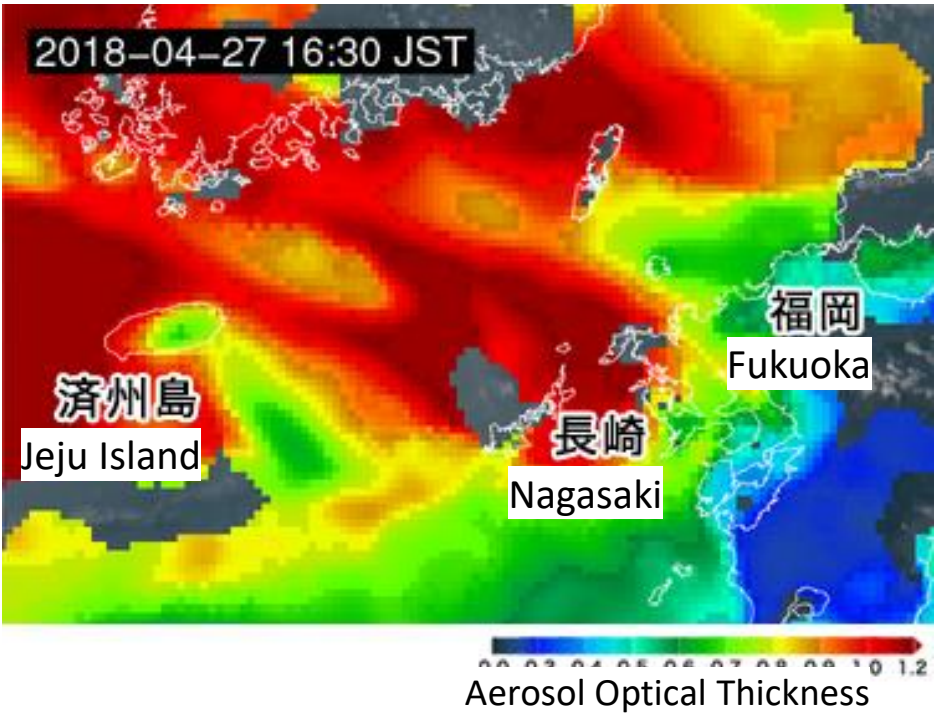


# Supporting SDG Goals (2/2)



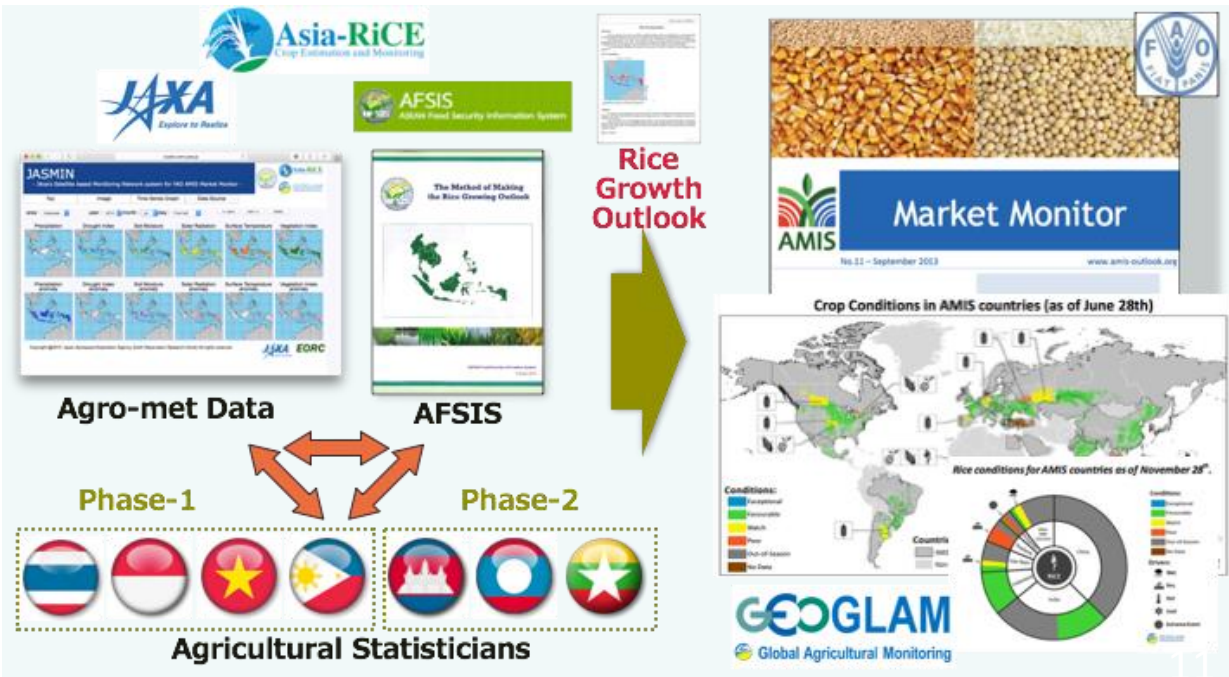
## Support Health from Atmospheric Pollution

Himawari and GCOM-C data enables to improve forecast on arrival of aerosols (Yellow dusts, PM2.5, etc.) in Asia-Oceania region.

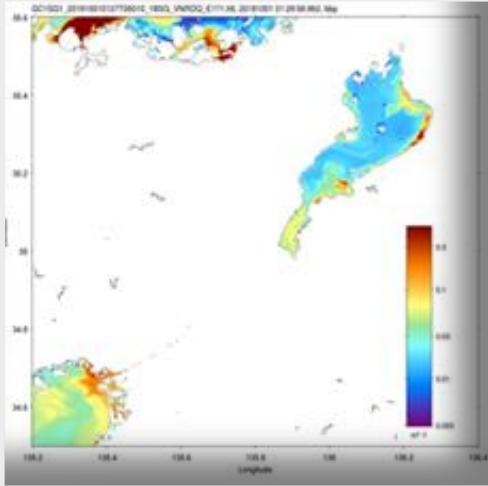


## Rice Crop Monitoring for Early Warning

Rice crop condition and early warning of crop failure is reported based on agrometeorology information (precipitation, soil moisture, solar radiation, land surface temperature) monitored from space

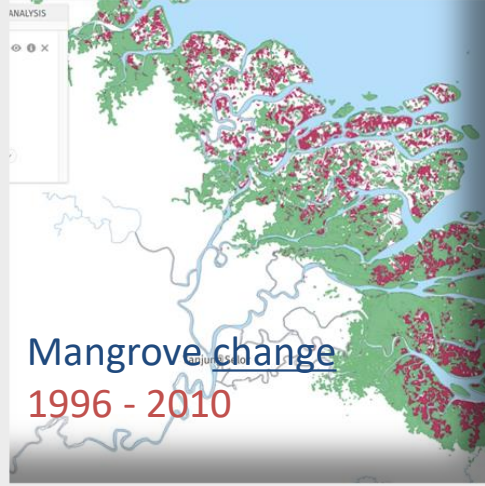


# Supporting SDG Indicators



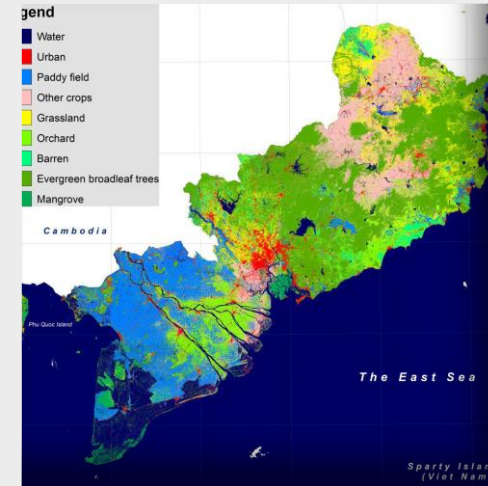
## ✓ GCOM-C Ocean Color Product

- 6.3.2 Proportion of bodies of water with good ambient water quality



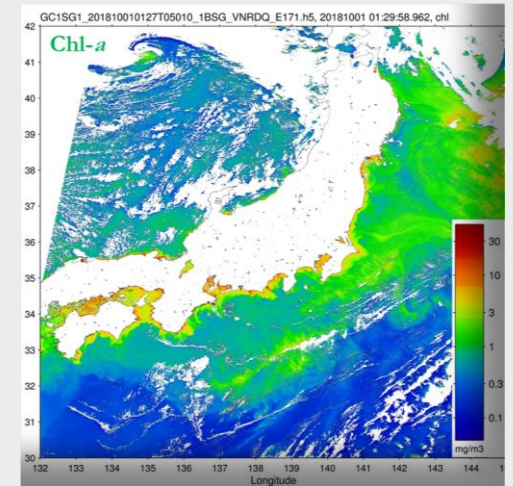
## ✓ Mangrove Map ✓ GCOM-C Ocean Color Product

- 6.6.1 Change in the extent of water-related ecosystems over time



## ✓ High-Resolution Land Use and Land Cover Map

- 11.3.1 Ratio of land consumption rate to population growth rate
- 15.3.1 Proportion of land that is degraded over total land area

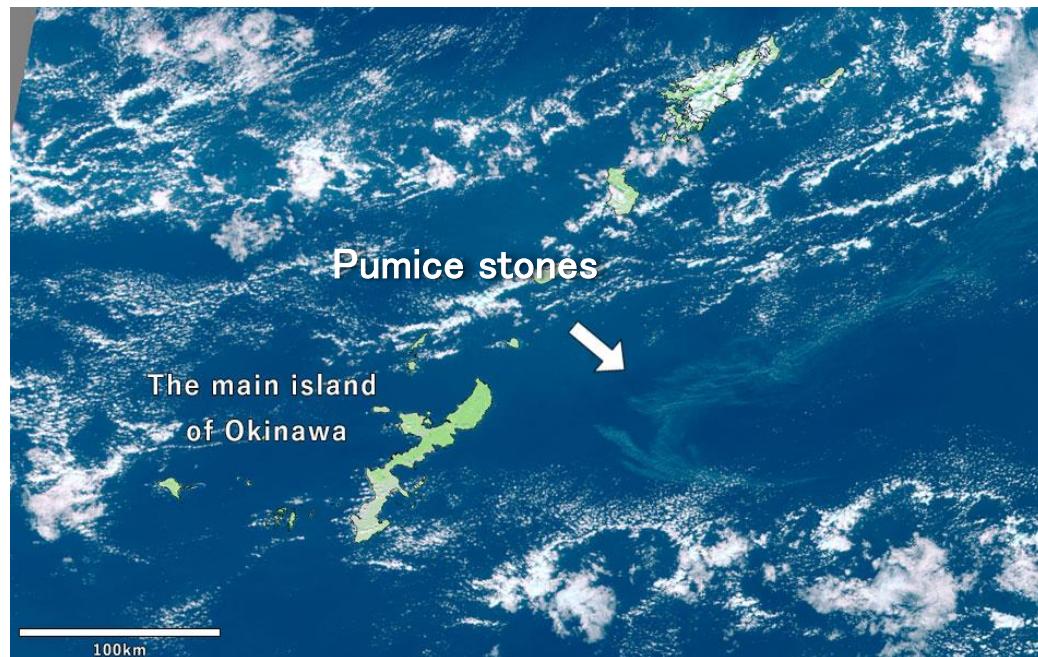


## ✓ GCOM-C Chlorophyll-A Product

- 14.1.1 Index of coastal eutrophication and floating plastic debris density

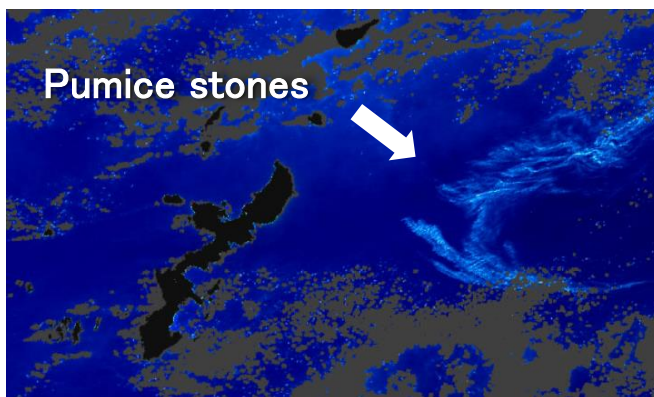


# Most featured articles of Updates on Earth (地球が見える) 1/3



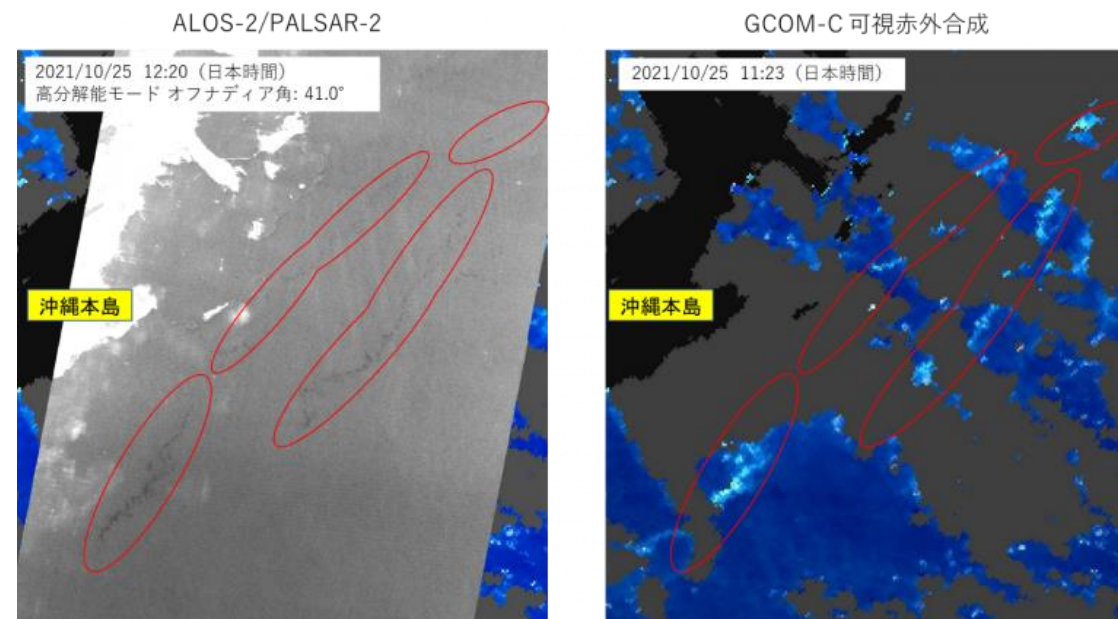
Observation image  
captured by GCOM-  
C/SGLI at 10:34 on  
October 15, 2021 (JST)

Up: RGB image  
Right: Visible infrared  
composite image



## Satellite observation information on pumice stones approaching and drifting to the main island of Okinawa

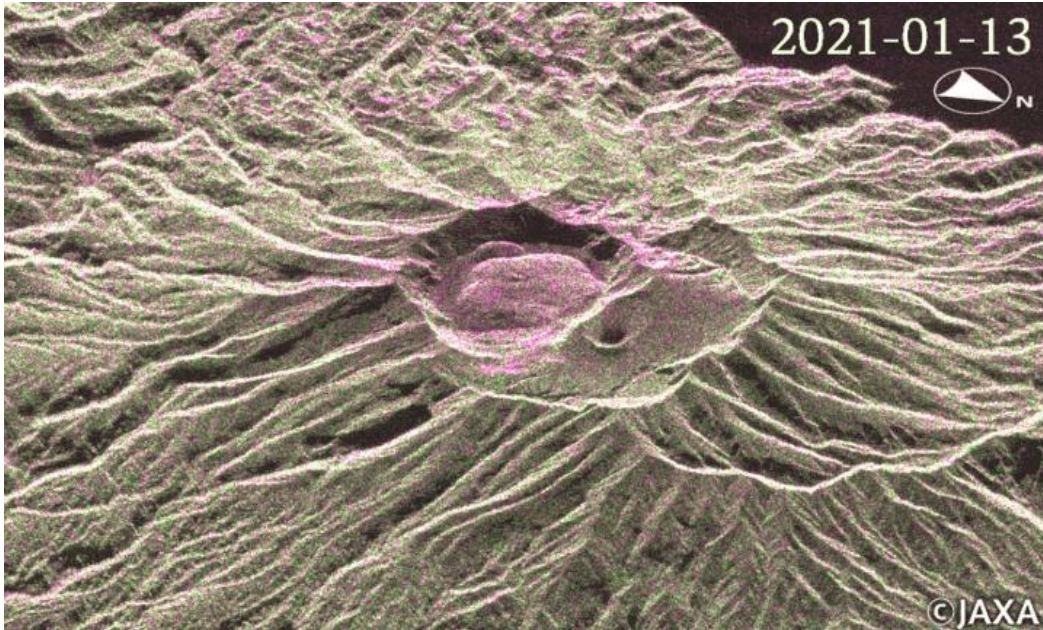
ALOS-2/Palsar-2 and GCOM-C/SGLI observed the  
distribution of pumice stones. JAXA provides the  
information to relevant organizations.



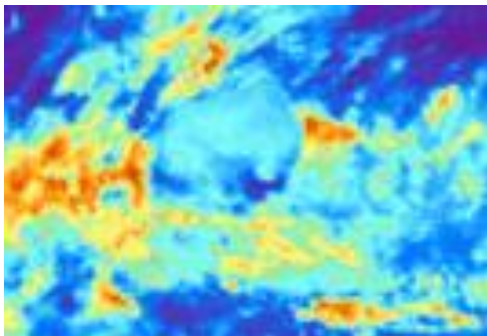
ALOS-2/PALSAR-2 image (left) and visible infrared composite image of  
GCOM-C (right) around the main island of Okinawa on October 25, 2021.



# Most featured articles of Updates on Earth (地球が見える) 2/3



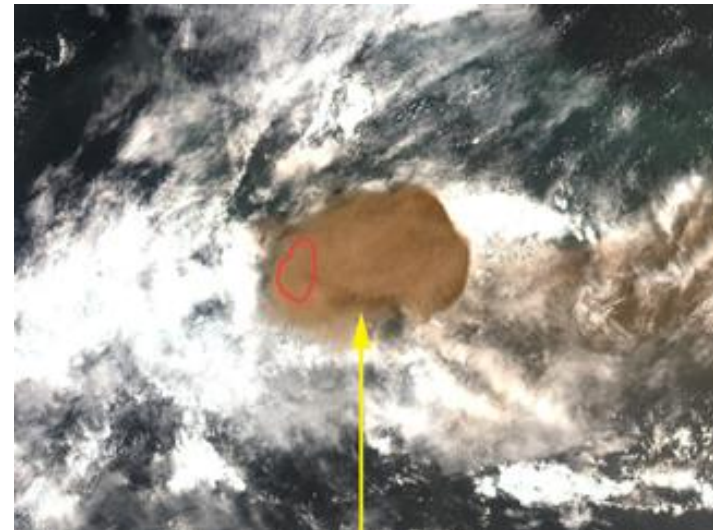
Animation of ALOS-2 image from January 13 to April 21, 2021  
(every 14 days)



Animation by observation  
images of forward viewing,  
nadir viewing and backward  
viewing at wavelengths of  
867nm captured by SGLI  
onboard GCOM-C around  
14:26 on April 11, 2021, UTC

## Eruption of La Soufrière volcano in St Vincent

La Soufrière volcano in “Saint Vincent and the Grenadines” erupted on April 9, 2021, for the first time in over 40 years. JAXA observed the eruption by ALOS-2 and GCOM-C. JAXA is observing not only for emergency response to disasters, but also providing data for monitoring Japanese active volcanoes and crustal movement during normal times.



The RGB image at  
wavelengths of 672nm,  
530nm and 443nm observed  
by SGLI onboard GCOM-C  
around 14:26 (UTC) on April  
11, 2021.

The location of Saint Vincent  
is shown as red line.



# Eruption of Volcano in Tonga



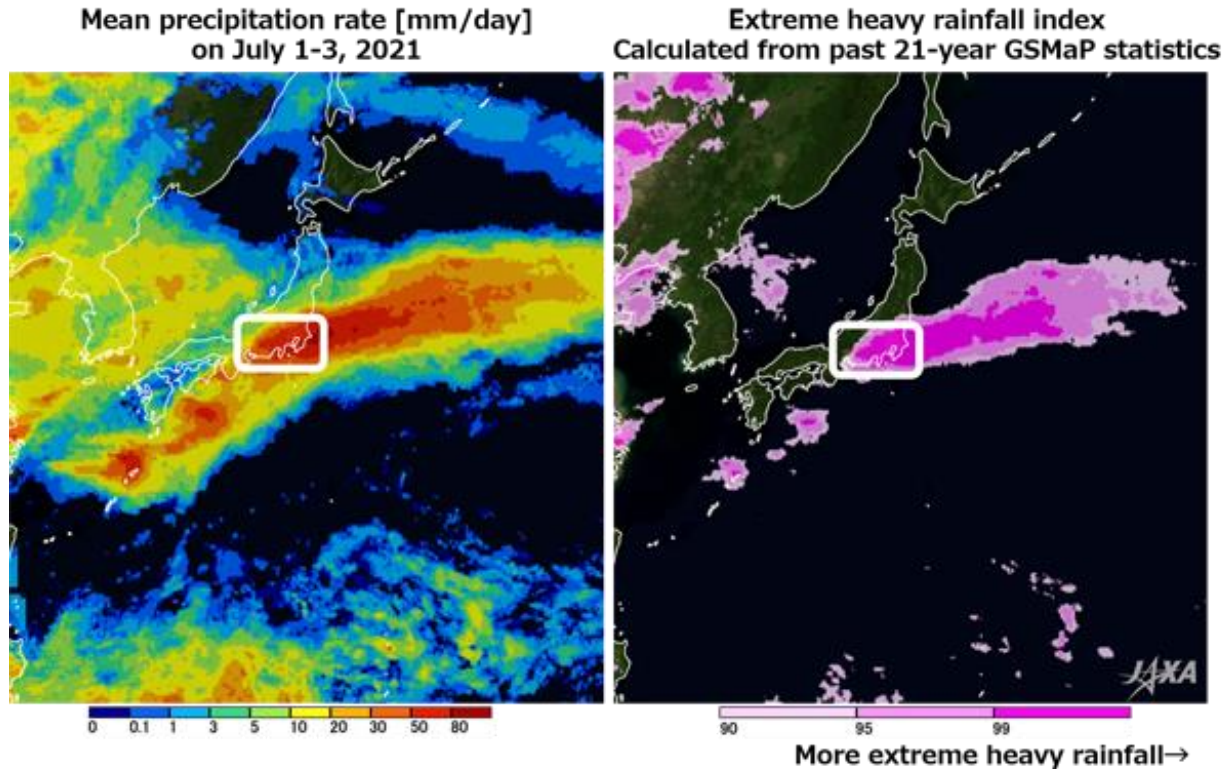
Observations by *PALSAR-2/ALOS-2* on Jan. 17, 2022, 2days after the eruption (right) and on Dec. 14, 2019, about 2 years before the eruption (left). By the eruption, most of the land has disappeared in the right image.



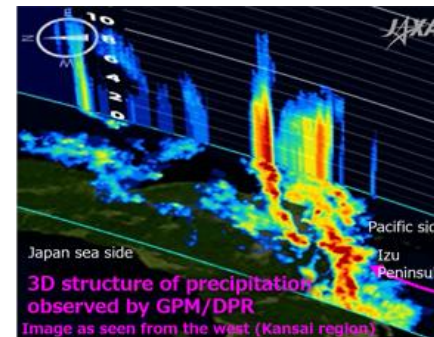
# Most featured articles of Updates on Earth (地球が見える) 3/3

## Observation of heavy rainfall in the Tokai and the southern Kanto regions

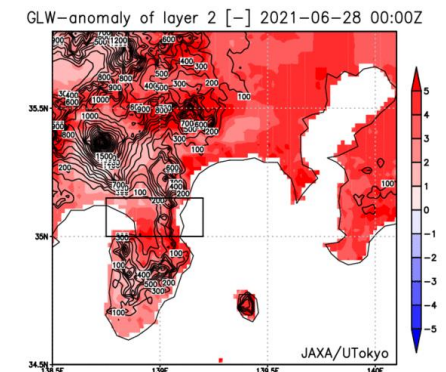
In July 2021, an active rainy baiu front stalled near Japan and causing enormous damage particularly in the Tokai and the southern Kanto regions. JAXA conducted the analysis using data from the GPM core observatory, GSMaP and Today's Earth.



Mean precipitation [mm/day] and extreme heavy rainfall index (90th, 95th and 99th percentile values) observed by GSMaP on July 1-3, 2021 (UTC).



3D conformation of precipitation band associated with the rainy baiu front observed by DPR at 02:08 on July 3, 2021 (JST)



Changes in soil moisture with heavy rainfall estimated by TE-Japan

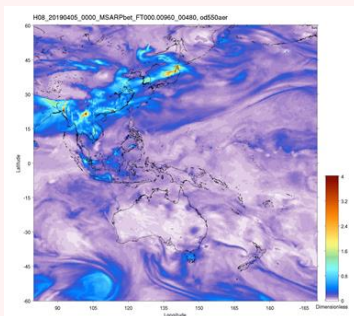




# Satellite and Model Collaborations toward Earth Environment Predictions

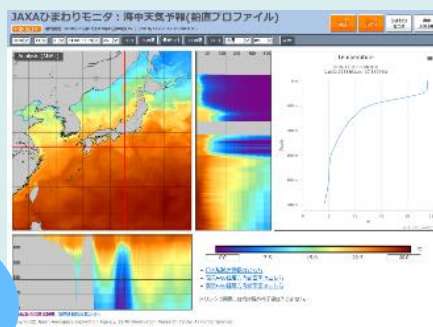
Alert for  
Public Health

with JMA, MRI, NIES, Kyushu Univ.



Aerosol Model

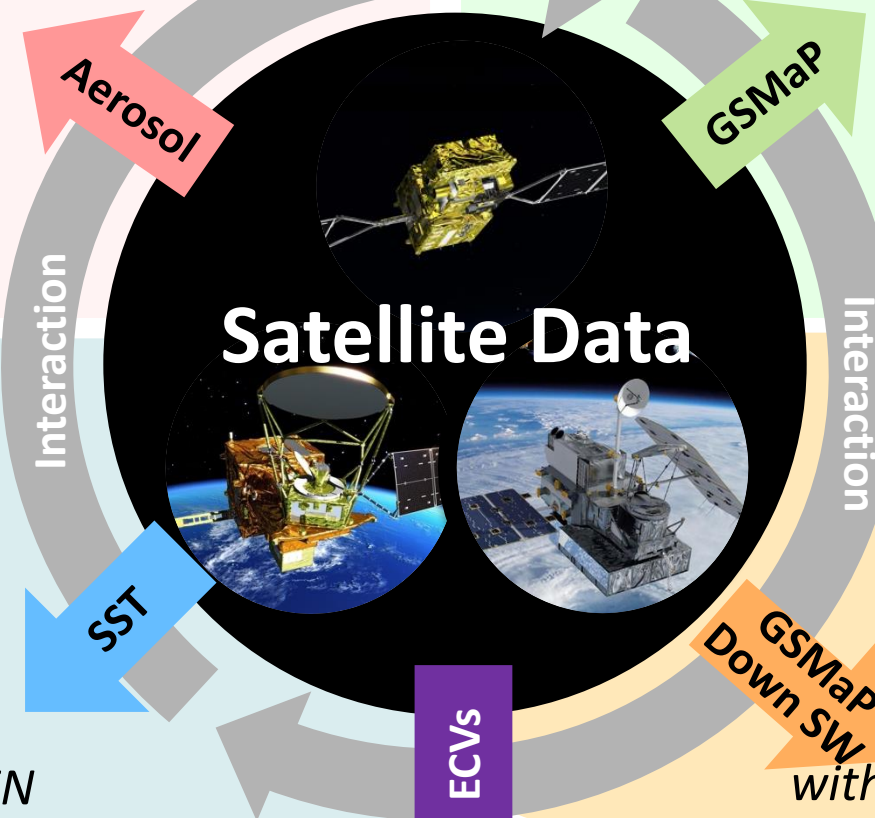
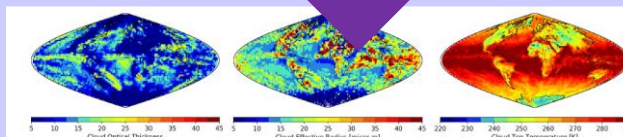
Ocean Model



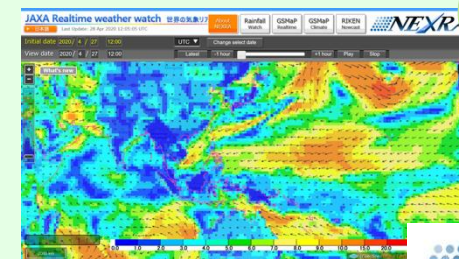
Fisheries,  
Ocean Transport,  
Climate

with JAMSTEC, RIKEN

Climate Model &  
Earth System Model



with U. Tokyo, RIKEN

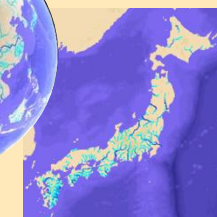


Severe Weather  
Heavy Rainfall,  
Flood

**NEXRA**

Atmospheric Model

Land/River Model



Drought, Flood,  
Water-related  
Hazard

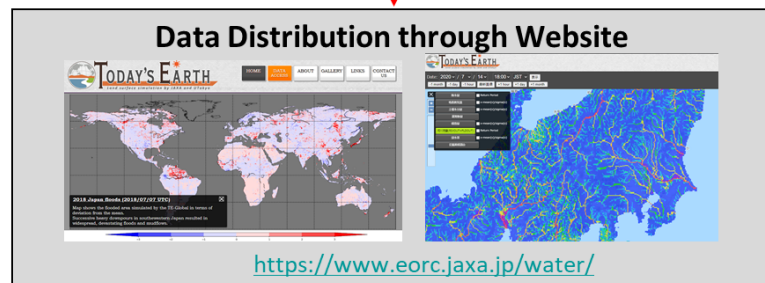
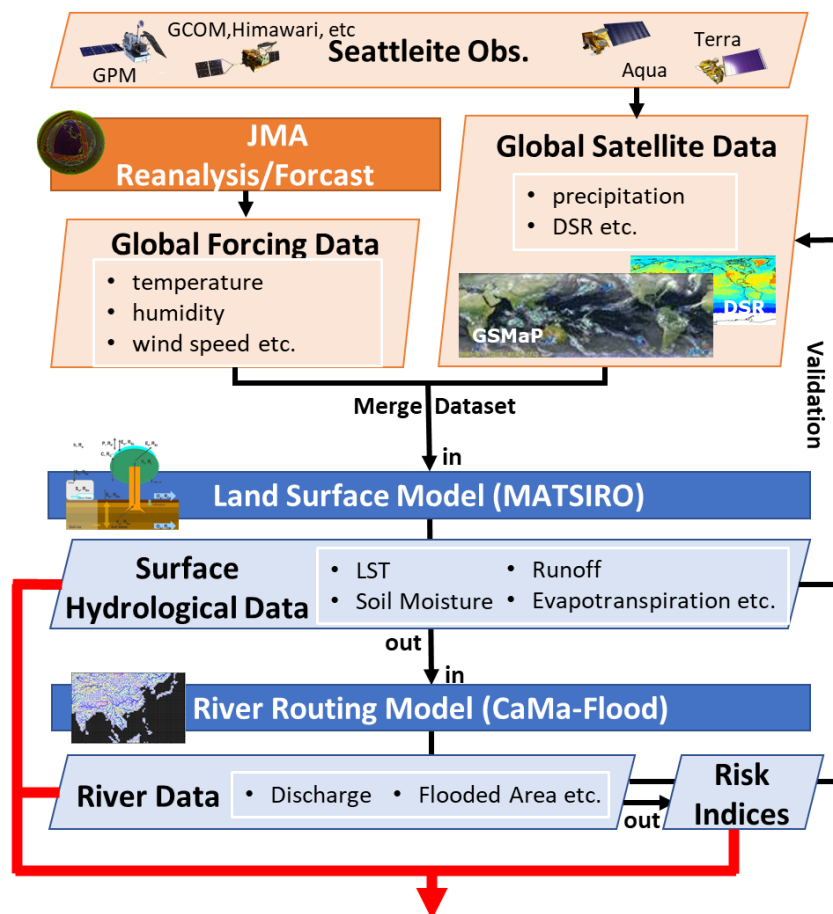
with U. Tokyo



Integrated Research Program  
for Advancing Climate Models

with U. Tokyo, JAMSTEC, etc.

# Global Terrestrial Hydrological Simulation System: Today's Earth



- JAXA has developed the “Today's Earth”, the satellite merged global terrestrial hydrological simulation system, under the joint research with the University of Tokyo.

<https://www.eorc.jaxa.jp/water/>

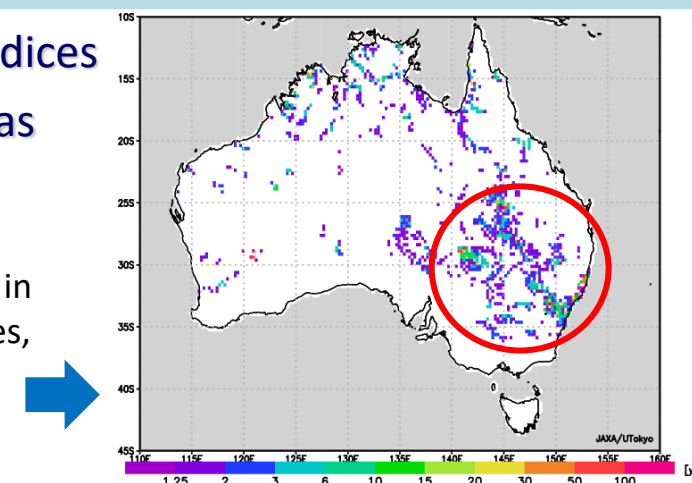


	TE-Global (Global System)	TE-Japan (Regional System)
Horizontal resol. (lat/lon)	Land: 0.5 deg., River: 0.25 deg.	1/60 deg.
Temporal resol.	Every 3 hour	Every hour
Latency	About 3 days	<b>Real-time</b> *Forecast data distribution is limited within research purpose due to the Japanese law
Satellite data used in the System (in prep.)	GSMaP, Terra/Aqua MODIS, SRTM30, NOAA AVHRR, (AW3D, GCOM-C)	SRTM30, NOAA AVHRR, (GSMaP, Himawari-8, ALOS HRLC)
Product	River discharge, Flooded area, Soil moisture, Snow amount, Latent heat flux, etc.	

- Today's Earth can visualize risk indices in terms of return period as well as various hydrological products.

Example of flood risk estimation by TE-Global in the case of the sever flood in New South Wales, Australia, March 2021

<https://edition.cnn.com/2021/03/21/australia/australia-flood-natural-disaster-intl-hnk/index.html>



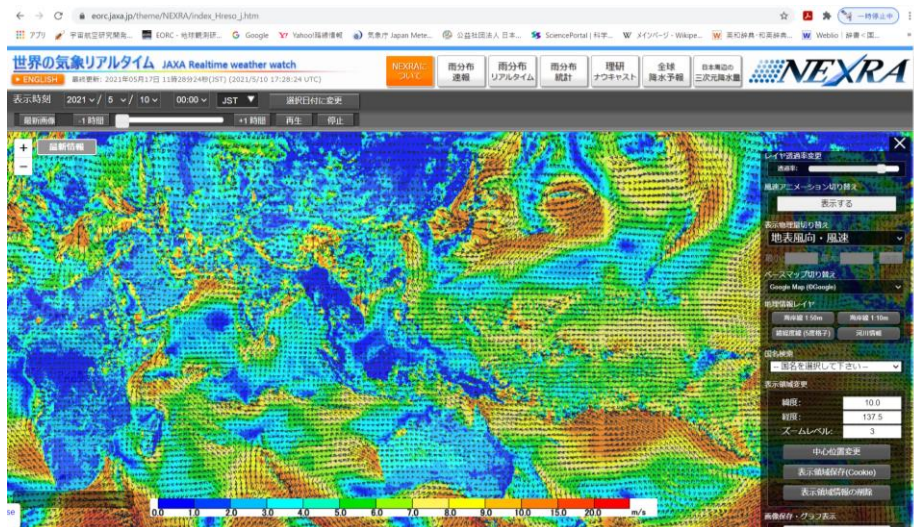


# “JAXA Realtime Weather Watch” GSMaP Assimilation in JAXA Supercomputer System (NEXRA)

- JAXA, Univ. Tokyo and RIKEN installed the NICAM-LETKF data assimilation system using the GSMaP at JAXA supercomputer system generation 3 (JSS3) and has experimentally operated it in near-real time (Kotsuki et al. 2019, SOLA).
- Monitoring home page of the NEXRA is now available as “JAXA realtime weather watch”.



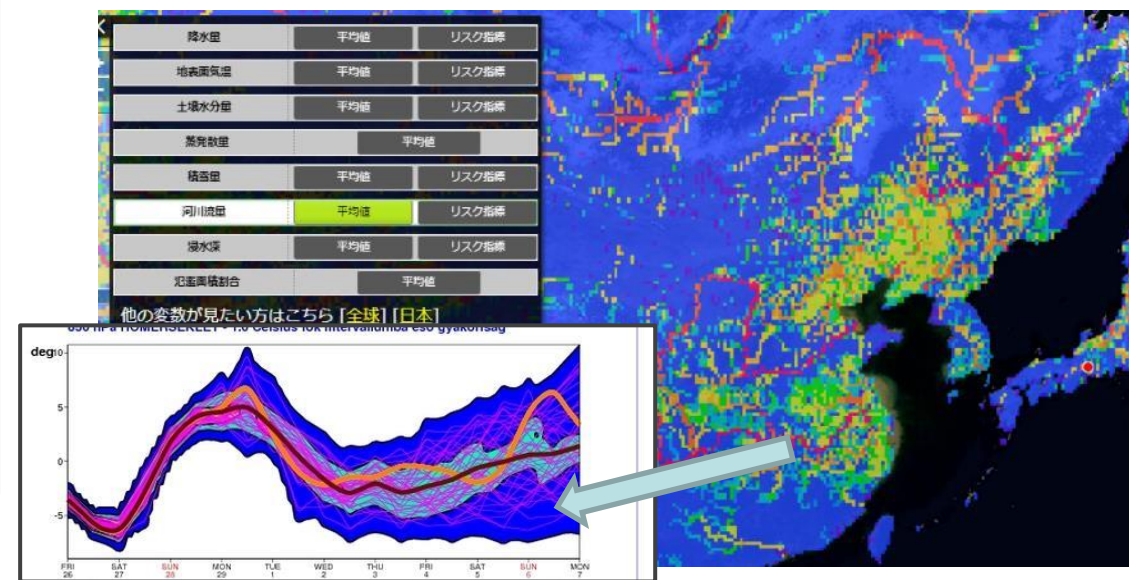
NICAM-LETKF at JAXA Research Analysis = NEXRA



Kotsuki et al., 2019: Predictability of Record-Breaking Rainfall in Japan in July 2018: Ensemble Forecast Experiments with the Near-real-time Global Atmospheric Data Assimilation System NEXRA. SOLA, 15A, <https://doi.org/10.2151/sola.15A-001>.

5-day weather prediction data with **14km horizontal resolution** have been computed since July 2021!

TE-Global (NEXRA ver.) ensemble visualization home page will be coming soon!



<https://www.eorc.jaxa.jp/theme/NEXRA/>



# Summary of the 2nd EO-RA

Purpose : JAXA Satellite Project Research

Research Category :

- (1) Algorithm Development
- (2) Standard Algorithm Calibration/validation,  
and Provision of Validation Data
- (3) Application Research

Research Duration : JFY2019 ~ JFY2021

Reports from PIs : @annual Joint PI WSs  
& annual submission of progress reports

Mission	Domestic PIs	Foreign PIs	PIs in Total
GCOM-W	15	6	21
GCOM-C	36	10	46
GPM	20	6	26
ALOS-2	19	169	188
ALOS-3	3	1	4
ALOS-4	9	13	22
MOLI	4	3	7
EarthCARE	2	0	2
AMSR3	0	3	3

Total 319 PIs

Please **SUBMIT FINAL REPORT** to JAXA RA Office by March 31, 2022!!!





# Summary of the 3rd EO-RA

- JAXA widely announced the third Research Announcement on the Earth Observations (EO-RA3) both within and outside of Japan regarding its Earth observation satellite projects.
  - A total of 368 proposals are selected, and the evaluation results are sequentially sent out to applicants.
  - We have newly solicited Multidisciplinary Application, combined utilization research for solving global issues and social issues.
- Through this adoption, using JAXA satellite data and various related products, it is expected to solve urgent/medium- to long-term social issues and global issues such as climate change, and to contribute to the achievement of the Sustainable Development Goals (SDGs).

Mission	Domestic PIs	Foreign PIs	PIs in Total
AMSR3 & GCOM-W	18	8	26
GCOM-C	33	8	41
GPM	18	2	20
ALOS-2 & ALOS-4	29	202	231
ALOS-3	11	5	16
MOLI	4	1	5
EarthCARE	6	0	6
Multidisciplinary Application Research	19	4	23
Total	138	230	368

# Contents Classification of Multidisciplinary Application

Multidisciplinary Application adopts 23 compound-use themes which could not be conducted due to budget usage constraints in RA2.

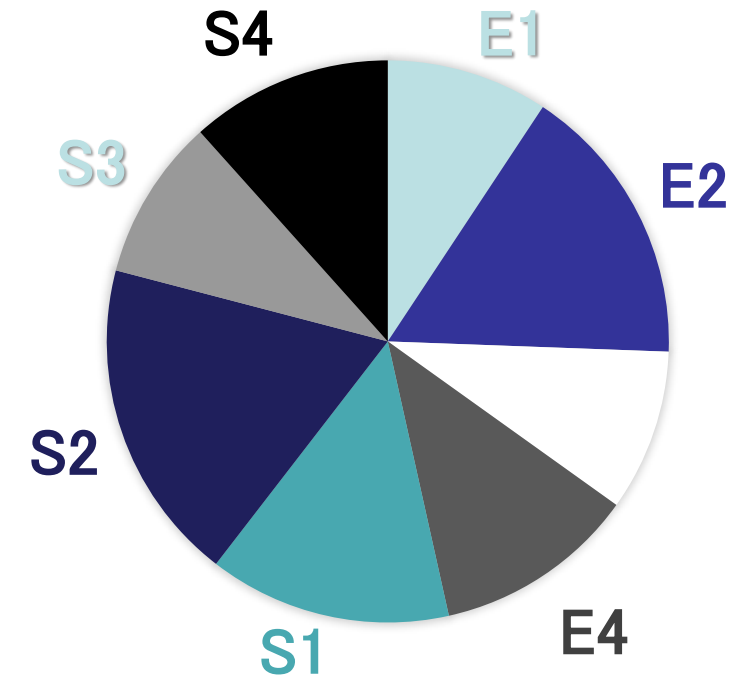
The results of the analysis of adoption categories are as follows.

Applied Researches related to comprehensive understanding of the Earth System

Symbol	Classification	No. of Proposals
E1	Research combined various satellite data regarding aerosol, cloud, and precipitation	4
E2	Quantitative study of the global water cycle	7
E3	Quantitative study of material cycle such as carbon cycle	4
E4	Research on long-term fluctuation monitoring and elucidation of mechanisms in polar regions and oceans	5

Applied research contributing to solving social issues

Symbol	Classification	No. of Proposals
S1	Research with multiplex use of JAXA satellite data etc	6
S2	Technology development integrating JAXA satellite data etc. into a numerical model	8
S3	Research using a new data set which combines JAXA satellite data and numerical models	4
S4	Technology development and research to promote cooperation between JAXA satellite data and big data/geospatial information	5



The graph above shows that each category has almost same number of proposals.  
(Some proposals have multiple classifications in one proposal.)



# JAXA Earth observation main website renewal



**EORC's main website was renewed as the JAXA Earth observation main website in September 2021.**

## New Websites Objectives:

- To share observation results and knowledges through the owned media - Updates on Earth (地球が見える)
- To guide data users to some JAXA satellite data providing sites.
- To nurture data users to consider and encourage the use of satellite data to solve their own issues and social issues.
- To reconstruct promotion of satellite applications by using online.



Earth-graphy (earth.jaxa.jp)

# JAXA-NASA-ESA cooperation in Earth Observation Dashboard



- Trilateral collaboration to analyze the changes in the global environment and socio-economic activities before and after the COVID-19 global pandemic using Earth observation satellite data from the three agencies and launched “**Earth Observation Dashboard**” on 25 June, 2020.

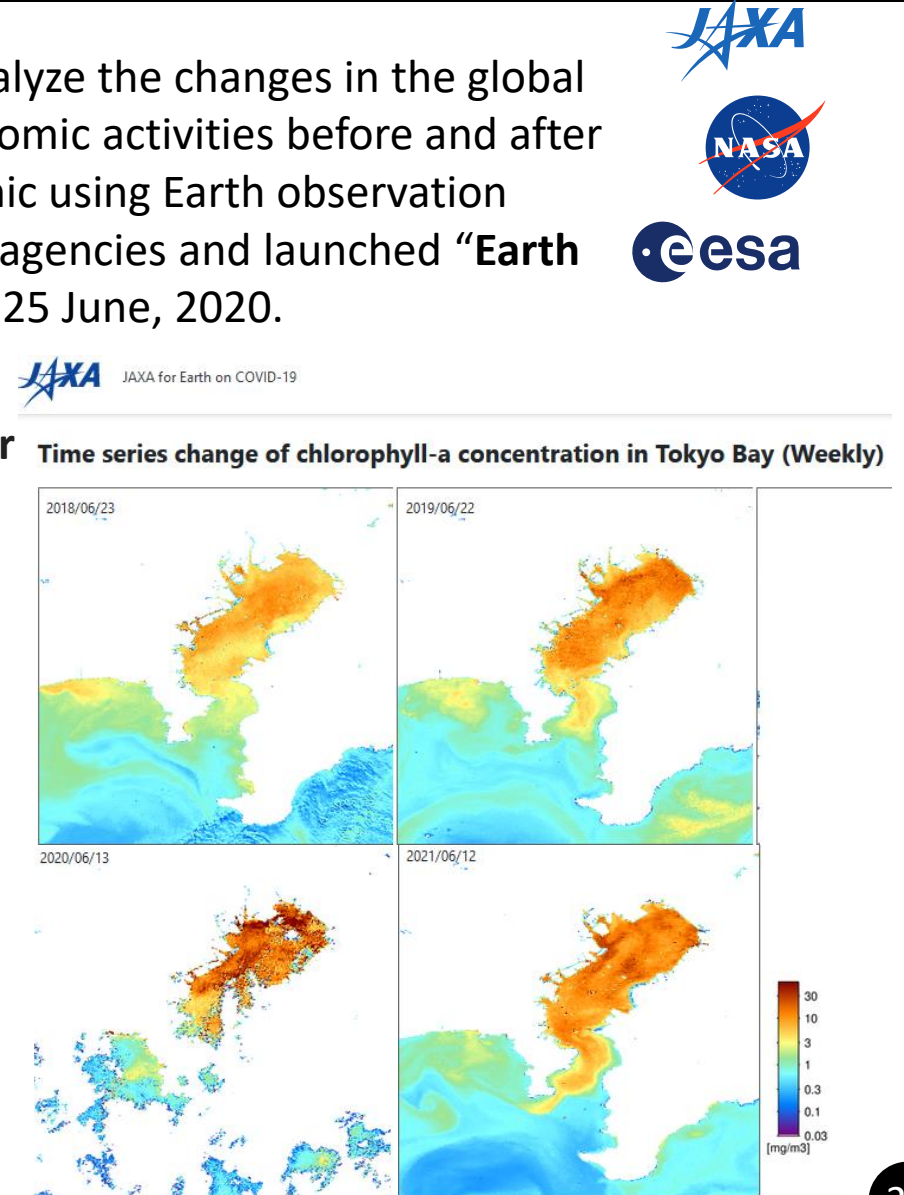
(<https://eodashboard.org>)

- JAXA also launched “**JAXA for Earth on COVID-19**” on the same day.

- Three agencies expanded each dashboard to cover wider range of Earth observation in 2021

**JAXA for Earth on COVID-19**

<https://earth.jaxa.jp/covid19/>







# Summary

- JAXA 's Earth Observation aims to both acquire scientific knowledge about global change and contribute to human society through Earth Observation from space.
  - Contribution to water/energy cycle and climate studies, disaster mitigation, and various operational applications, including weather forecast, fishery, and agriculture, is a big target of JAXA's Earth observation program.
- For this purpose, JAXA currently operates six EO satellites/missions in orbit and will continue these contributions by launching ALOS-3, ALOS-4, ESA-JAXA joint EarthCARE and GOSAT-GW in near future.
- We recognize the importance of Calibration/Validation activities (and Sensor Technology study), which guarantee the quality of data from EO satellites and are the basis of science and application.
- We collaborate with algorithm developer to enhance the quality of data.
- Also application developers to utilize EO data in the better and wider manner to broaden the field of outcomes.
- We also collaborate with various model communities to utilize satellite data in their models to enhance predictions and contribute to science and society.

JAXA expects PIs to create cutting-edge scientific achievements that can contribute to solving various social and global issues such as Natural Disaster, Global Warming, Climate Change, SDGs, and so on.



*Thank you  
for your attention*

*Global NDVI  
from SGLI/GCOM-C*

NDVI (植生指数)



水域



太陽天頂角 $>90^\circ$ 、極域