

Precipitation Measuring Mission and JAXA Earth observation programs

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Anniversary

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JAXA Earth Observation Programs

JAXA Earth Observation Programs



JAXA's lineup of earth observation satellites.



Inundated area by "DAICHI-2" (ALOS-2) observation

Earth observation satellites play an important role in terms of monitoring the situation before and after water-related disaster strike. This is an example of the inundation area due to river flooding, which changes on a daily basis, as observed by the Daichi-2. When disasters such as floods occur, JAXA conducts emergency observations using DAICHI-2 in cooperation with the government and local disaster management agencies. Observation results and extracted damage information are used to help assess the disaster situation and formulate rescue plans.









Inundated area around the Kuma river (July 2020)

Photo by Ministry of Land, Infrastructure, Transport and Tourism, Kyusyu Regional Development Bureau

First images from "DAICHI-4" (ALOS-4)

- -AXA
- JAXA is currently conducting the initial functional verification operations for the Advanced Land Observing Satellite-4 "DAICHI-4" (ALOS-4), which was launched on July 1, 2024. We have obtained the first observation images using the L-band Synthetic Aperture Radar (PALSAR-3) onboard the satellite.
- "DAICHI-4" is a radar satellite with up to four times wider observation swath width while maintaining the high spatial resolution of its predecessor "DAICHI-2", by applying the Digital Beam Forming technology that is the world's first demonstration as the spaceborne Synthetic Aperture Radar (SAR).



- (Left) Observation including the Kanto region and the vicinity of Mount Fuji by "DAICHI-4" PALSAR-3 (Resolution 3 m, observation width 200 km), Observation Date: July 15, 2024
- (Right) Observation of the vicinity of Mount Fuji by "DAICHI-2" PALSAR-2 (Resolution 3 m, observation width 50 km), Observation date: November 23, 2022 (for comparison)
- Both images indicate a range of 70 km in north-south direction.

https://global.jaxa.jp/press/2024/07/20240731-1_e.html

Climate changes shown by satellites such as "SHIZUKU" (GCOM-W)



Arctic sea ice extent trends



The polar regions are the most affected by global warming. The left graph shows the long-term trend of sea ice extent in the Arctic observed by SHIZUKU satellite and others, which clearly shows a decreasing trend. **Global SST trends**



The right side shows the long-term trend of global SST observed by SHIZUKU satellite and other satellites. Since March 2023, the global average SST has been the highest in the past 20 years.

JAXA will continue these observations with the Advanced Microwave Scanning Radiometer AMSR3 onboard the GOSAT-GW.

Earth Cloud Aerosol and Radiation Explorer



- EarthCARE is the Europe-Japan joint mission, targeting global distributions of cloud and aerosol profiles to improve the climate projections.
- JAXA and NICT developed world's first spaceborne radar at 94 GHz with Doppler Capability, Cloud Profiling Radar (CPR).
- JAXA/NICT/ESA released the first CPR images on 27 June as shown on the right.

By observing the cloud area and capturing the interior of the clouds, the CPR succeeded in measuring the vertical motion of clouds from space for the first time in the world. The following images visualize the measured Radar Reflectivity Factor and Doppler Velocity obtained by CPR observation as a cross-section of clouds.



Global Precipitation Measurement (GPM)

GPM Core Observatory by NASA-JAXA





- The GPM is an international mission consisting of the GPM Core Observatory by NASA-JAXA and constellation satellites by international partners for high-precision and high-frequency global precipitation observation.
- The GPM Core Observatory is equipped with the Dual-frequency Precipitation Radar (DPR) developed by Japan and the GPM Microwave Imager (GMI) developed by NASA.
- The GPM Core Observatory was launched by the H-IIA rocket from the Tanegashima Space Center in February 2014. This February 2024, it has been in operation for 10 years.
- JAXA have provided the Global Satellite Mapping of Precipitation (GSMaP) that integrate the GPM Core Observatory and constellation satellites observations.

DPR observation and utilization in NWP



- DPR was developed by JAXA and NICT (manufactured by NEC)
- DPR can capture 3-D precipitation structure.



https://www.youtube.com/watch?v=AfDKYoMBl8s&t=1s

 Observation of the typhoon over the ocean approaching Kyushu Island in Japan

- The Japan Meteorological Agency (JMA) started the DPR assimilation in the meso-NWP (Numerical Weather Prediction) system in March 2016.
- This was the world's first "operational" assimilation of spaceborne radar data in the NWP system of meteorological agencies!

Global Satellite Mapping of Precipitation (GSMaP)



• JAXA is operating the "GSMaP", which integrates domestic and international satellite observation data such as the GPM Core Observatory and the "Shizuku".

Color: rain by GSMaP White: cloud by JMA Himawari-9

- Hourly global rainfall data
- Spatial resolution: about <u>11x11km (0.1x0.1 deg. lat/lon)</u>

You can get these products very easily from the Web site below. (<u>http://sharaku.eorc.jaxa.jp/GSMaP/</u>)







Precipitation Measuring Mission (PMM)

Toward reducing the impact of water disasters on human society

Reducing the impact of increasingly frequent and severe water disasters on human society. Improvement of Numerical Weather Prediction (NWP) model is very important.

Cloud

Elucidation of the precipitation process is essential to improve this NWP model. To elucidate the precipitation process, it is necessary to accumulate observation of aerosol, cloud, convection and precipitation.

Aerosol

Precipitation

onvection

JAXA is currently working with NASA and other space agencies on the Atmosphere Observing System (AOS) mission to develop new observational techniques to realize a mission to observe aerosols, clouds, convection and precipitation.

Precipitation Measuring Mission (PMM)



- PMM is JAXA's next generation precipitation radar mission
- PMM provides the world's first space-borne Ku-band Doppler precipitation radar (KuDPR).
- PMM is the follow-on mission after TRMM/PR and GPM/DPR.
- PMM provides continuous measurement of the 3D precipitation (30 years and beyond).
- PMM data will be used for upgrading future GSMaP.



PMM Mission Statement

The realization of space-borne Ku-band Doppler precipitation radar will provide us the information of the spatial and temporal change of the rain and snow fall on a global scale. The observation will enable us to elucidate cloud-precipitation system to mitigate the impact of frequent and severe water-related disasters on human society under the global climate change.

Atmosphere Observing System (AOS) mission



Participation in NASA AOS mission

- JAXA PMM will join the NASA AOS mission and be a part of the spacecraft constellation.
- Comprehensive observation of the atmosphere with international partners will provide several first-ever observations and give extra value beyond the PMM standalone mission outcome.
- The PMM mission is expected to be a symbol of Japan-US cooperation for the global climate change.



NASA AOS architecture



The Atmosphere Observing System (AOS) mission goal is to optimize how we examine links among tiny particles known as "aerosols", clouds, atmospheric convection, and precipitation.





Precipitation Data Applications



GSMaP Various application fields











The GSMaP have been utilized in various application fields. Use cases are collected in the book "Case studies demonstrated by TRMM/GPM/GSMaP". <u>https://www.eorc.jaxa.jp/GPM/doc/data_utilization/latest_jireishu_e.pdf</u>



Water-related disasters

400

350 300

250

200

150

100



Satellite precipitation (GSMaP)



The International Centre for Water Hazard and Risk Management (ICHARM) is developing the **flood early warning system (FEWS) using GSMaP rainfall information** as input data. FEWS will enable efficient flood forecasting and warning in river basins in developing countries where sufficient hydrological information is not available on the ground. They worked to build an **FEWS in the Kalu River basin in Sri Lanka (see example below).**

Bias Corrected GsMAP over the river basin

during flood in Sri Lanka (May 2017) *** [mm/day



Kalu River Basin

River inundation area using GSMaP





Agriculture



In order to ensure food security in Japan, the Ministry of Agriculture, Forestry and Fisheries has established the **JASMAI (JAPAN's Satellite Monitoring of Agrometeorological Information)**, which includes GSMaP, and provides meteorological information from major grain-producing regions overseas in the form of maps and graphs. When you click the target area on the map below, a weather/vegetation map of the area will be displayed.

JASMAI

(JAPAN's Satellite Monitoring of Agrometeorological Information)

https://jasmai.maff.go.jp/en/

1.00	JAPAN's Satellite Monitori	ing system of Agrometeo	ological Informati
气象情報復	「星モニタリングシス	К 7 4	MAFF stry of Agriculture, Forestry and Fit
Top page	Weather and vegetation map	Graph of weather and vegetation by area	User Guide
			Japa

Last update:2024/09/10

This site provides visualization of weather and vegetation data such as soil moisture content, precipitation, and vegetation index, etc. for each country and area in the main production zones of major cereals and other crops obtained from satellite observations by the Japan Aerospace Exploration Agency (JAXA) and the National Aeronautics and Space Administration (NASA).

When you click the target area on the map below, a weather/vegetation map of the area will be displayed.





Precipitation map created by processing JAXA's GSMaP ¹⁹

Weather and Climate Extremes Monitoring



JAXA attends WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) project and provide the GSMaP product with about 25yr-climate data to National Meteorological and Hydrological Service in Asia and Pacific regions.



Based upon results of this WMO project, results including JAXA GSMaP were described in the 2019 Australia drought article of the WMO Statement on the State of the Global Climate 2019.



"JAXA Climate Rainfall Watch", which provides information about extreme heavy rainfall and drought over the world, is now available, based upon the WMO project.



https://sharaku.eorc.jaxa.jp/GSMaP/index.htm



JAXA Global Rainfall Watch



Let's access to the GSMaP homepage!

You can view GSMaP images form this homepage and download GSMaP data after registration.

