# Earth observations in support of the 2030 Agenda for Sustainable Development

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**Humankind is facing a variety of global challenges and crises such as climate change, natural disaster and the consequent need to achieve the Sustainable Development Goals (SDGs). When tackling crises, humans have typically gained knowledge and capabilities through advancing science and technology. To that end, Earth observation by satellite provides a wide-angle view from space. This capability enables frequent and consistent monitoring and, in particular, highly effective observation of remote or sparsely populated locations where monitoring equipment is difficult to install on the ground.**

Through international cooperation, space agencies and meteorological organizations have made efforts to deploy satellite observation over extended periods as well as to develop sensors with higher accuracy, resolution, coverage and various observation targets, through cutting-edge technologies. The result is a catalogue of observation records that play an indispensable role in understanding the status and progress of efforts, in projection of the future Earth and in providing scientific evidence for decision making in the pathways toward A Better World.

**Contributions to SDGs as actions**

In recent years, global-scale environmental shifts such as climate change have brought several issues to the fore including the prevalence of weather disasters and accelerated biodiversity loss. Earth observation is an indispensable tool for facilitating a better understanding of these issues and making effective countermeasures, and the Japan Aerospace Exploration Agency (JAXA) functions as one of the organizations contributing to the Global Earth Observation network by satellite, in collaboration with space agencies and meteorological organizations.

JAXA is a core performance agency set up to support the Japanese government's overall aerospace development and utilization, and has developed and operated various satellites to observe greenhouse gases and aerosols, land surface and forest change, water cycles and precipitation and natural disasters. In the hope of solving global issues, JAXA has also promoted research and utilization of Earth observation data including the development of user-friendly applications in addition to capacity building in those countries affected by consequent issues.

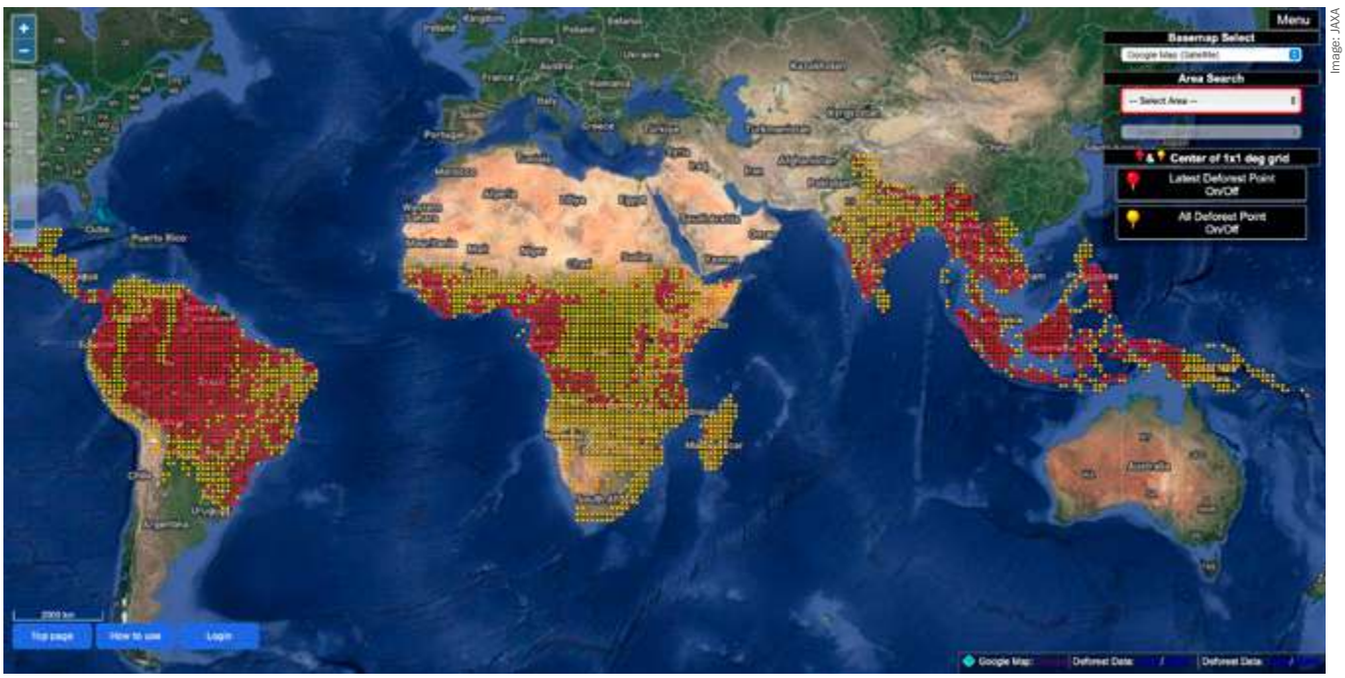


Image: JAXA

Forest Early Warning System in the Tropics (JJ-FAST) web interface

These applications address a variety of issues as well as suggesting actions toward achieving the relevant SDGs. Here are some examples of how they are contributing to SDGs concerned with deforestation, rainfall and disaster monitoring.

**Deforestation**

Deforestation is a global issue and, according to FAO reports, tropical forests are decreasing by about 6 million ha per year across the world. Tropical forests are particularly important in the context of climate change and biodiversity because of their large amount of carbon stock and unique and various ecological systems. Monitoring and early warning of deforestation in tropical forests are also important to the contribution to SDG 13: Climate Action and SDG 15: Life on Land.

Since 2009, the Japan International Cooperation Agency (JICA) and JAXA have cooperated to monitor illegal logging in the Amazon Basin of Brazil in near-real time using observation data from JAXA's Earth observation satellites, ALOS and ALOS-2. The ability of these satellites to penetrate clouds made it possible to constantly monitor tropical forests during the rainy season. By 2012, more than 2,000 incidents of illegal logging were detected by ALOS in Brazil, which greatly contributed to a 40 per cent reduction in the illegal logging in those areas.

In 2016, based on those achievements, JICA and JAXA developed the JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST), which provides the latest information on deforestation and forest changes in tropical regions globally, on an average of once every 45 days. JJ-FAST covers tropical forests over 78 countries and, by 2022, had detected a total of 4.6 million deforestation points. JJ-FAST can be accessed by anyone anywhere through internet, and has been utilized operationally in Kenya, Mozambique, Cameroon, Democratic Republic of the Congo, Brazil and Peru through JICA projects.

In 2022, JICA and JAXA, together with the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and the Institute for Global Environmental Strategies (IGES) made a joint submission to the first Global Stocktake (GST) of the Paris Agreement, with JJ-FAST cited as a means of achieving good practice in contributing to solving global environmental issues related to the GST and for enhancing the implementation of the Paris Agreement.

**Rainfall and disaster monitoring**

According to recent UNESCAP reports, the Asia-Pacific region has the world's highest concentration of disaster-related damage, particularly due to water-related incidents such as flood, storm and drought. The trend of these disasters is affected by changes in rainfall patterns due to climate change, with water-related disasters having caused 70 per cent of all economic losses and affected 90 per cent of the population globally. Fortunately, however, deaths from water-related disasters are decreasing. Providing more advanced meteorological and hydrological information has proven to be effective and necessary to build resilience. It is therefore necessary to accelerate the improvement of the accuracy and dissemination of this information, including that for rainfall, in addition to infrastructure development and integrated water resources management. The necessary improvements will directly affect SDG 6: Clean Water and Sanitation, SDG 11: Sustainable Cities and Communities and SDG 13: Climate Action.

JAXA is disseminating its web-based Global Satellite Mapping of Precipitation (GSMaP), which provides hourly global rainfall information by integrating data from meteorological satellites in Japan, US and Europe. In the case of water-related disasters, GSMaP gives effective supplemental information for meteorological and disaster management organizations to improve their understanding of rainfall distribution in areas where observation by ground-based rain gauges and meteorological radar is difficult, the oceans included. GSMaP is used across 140 countries, including in Southeast Asia and the Pacific, for various purposes such as heavy rain and drought monitoring, and flood forecasting.

GSMaP supplies several types of information, for example rain-gauge calibrated, real-time or forecasted versions, as well as derivative indices concerning heavy rain and drought. Since 2018, the GSMaP heavy rainfall and drought indices has been used for WMO Space-based Weather and Climate Extremes Monitoring (SWCEM), facilitating better utilization and improvement of the monitoring of weather and climate extremes from space, with capacity-building activities having been carried out in East Asia and Western Pacific regions.

### JJ-FAST — stopping deforestation

On February 22, 2018, the JJ-FAST team, accompanied by IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renovaveis), arrived at one site in Brazil at which JJ-FAST had detected deforestation in the form of a bulldozer mowing down trees. Two forest loggers were arrested and the bulldozer was legally seized on site by IBAMA. They seemed to wonder how this illegal deforestation was discovered under the cloud cover of the rainy season, unaware of the possibility of detection by optical satellite.

Image: JAXA

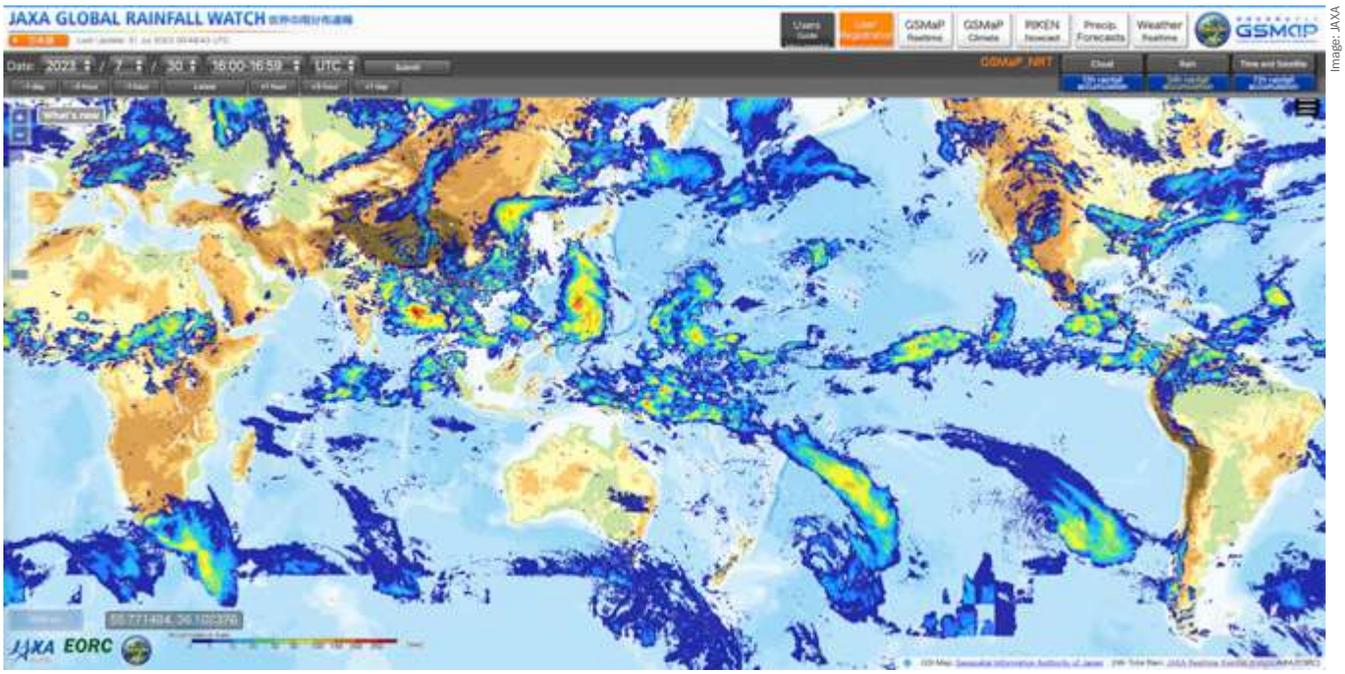


Image: JAXA

Global Satellite Mapping of Precipitation (GSMaP) is web-based, does not require a dedicated computer and is available at no cost, which makes it widely used for monitoring precipitation in Pacific Island countries that have limited ground-based rain gauges and radar

The disaster risk management cycle — response, recovery, mitigation, and preparedness — is an important process in improving resilience to natural disasters and in the achievement of SDG 11: Sustainable Cities and Communities. Earth observation is an effective tool for the management cycle as it is able to monitor the damaged area and recovery progress as well as to create hazard maps useful in covering wide areas and helpful in aiding rescue operations in damaged areas.

There are several initiatives for conducting disaster emergency observation, for example the International Disasters Charter and the Sentinel Asia. The Sentinel Asia is an initiative toward space-based international cooperation for disaster management in the Asia-Pacific region, established in 2006 under the Asia-Pacific Regional Space Agency Forum (APRSAF). The main activities of Sentinel Asia are to conduct emergency observation of disasters with satellites and to provide disaster assessment maps through the web GIS system. JAXA has led Sentinel Asia as its secretariat, with members comprising space agencies, disaster management authorities and international organizations, with a total of 114 Asia-Pacific member organizations registered as of May 2023.

Some of the Sentinel Asia members act as Data Provider Nodes (DPN), which voluntarily provides their own satellite imagery and/or data for Sentinel Asia on an emergency observation request. In 2022, a total of 28 emergency observations were conducted for floods, storms, landslides, earthquakes,and volcano eruptions, with various observation data and value-added products provided.

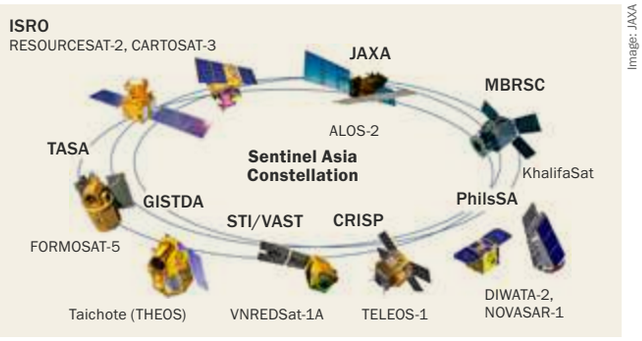


Image: JAXA

The Sentinel Asia DPN's earth observation satellites comprising the Sentinel Asia constellation

**Contributions to SDGs as indicators**

To track progress towards goals and targets, the global indicator framework must capture the multifaceted and ambitious aspirations for the continued development of nations and societies. Effective reporting of progress toward these indicators require the use of multiple types of data, both of which are in hand — traditional national accounts, household surveys and routine administrative data, and new sources of data outside national statistical systems, notably Earth observations and geospatial information, which include satellite, airborne, land- and marine-based data, as well as model outputs, with modern data processing techniques more appropriate to large volumes of Earth observation data.

The integration of these data can produce a quantum leap in how the advancement of the well-being of our societies is monitored and tracked. Since Earth observation and geospatial information have various scales in their spatial and temporal resolutions, their use in SDG monitoring can prove essential in capturing the sustainability of developments underpinning the SDG framework. Earth observation and geospatial information will expand monitoring capabilities at local, national, regional and global levels, and across sectors. Earth observation and geospatial information can significantly reduce the costs of monitoring the aspirations reflected in the goals and

targets, and make SDG monitoring and reporting viable within the limited resources available to governments.

A successful sustainable development agenda will require effective partnerships for implementation. As such, a potential role for Earth observation in supporting the global indicator framework for the SDGs has been developed through cooperation between the Group on Earth Observations (GEO) and the Committee on Earth Observation Satellites (CEOS), the prime body for coordinating the satellite Earth observation programmes of the world's civil space agencies. GEO, CEOS and space agencies are working with governments, academia, scientists, and the private sector in developing such partnerships for implementation of the SDGs.

An analysis by GEO has identified 30 specific indicators that can be supported by Earth observations. Out of those, CEOS has identified four that can be supported by Earth observation satellites — 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; 14.1.1: (a) Index of coastal eutrophication; and (b) plastic debris density; and 15.3.1: Proportion of land that is degraded over total land area.

SDG target 6.6.1 states: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. Indicators are: Change in the extent of water-related ecosystems over time; with several sub-indicators including the extent of change of mangrove forest. JAXA has been aware of the importance of monitoring mangroves by satellite, and has been working through an initiative, K&C Global Mangrove Watch (GMW), to prevent the loss and degradation of mangrove forests since 2011. GMW mapped the extent of mangroves from 1996 to present using observation data by JERS-1, ALOS and ALOS-2, which have the advantage of being able to obtain data on the ground surface regardless of weather conditions.

In 2019, United Nations Environment Programme (UNEP), the custodian agency of Target 6.6, opted to use JAXA's GMW for indicator 6.6.1. UNEP developed and published a methodology document concerning how to use the GMW data in 2020, which allowed countries to independently calculate changes in their mangrove areas with freely available GMW data. In addition, UNEP released Freshwater Ecosystems Explorer in 2020, which provides geospatial information on SDG 6.6.1 indicators.

**Lessons learned and looking forward**

Earth observation data has contributed to solving various social issues such as climate change, biodiversity, and natural disasters, and these efforts are based on several types of cooperation. To contribute to the issues raised in the SDGs as actions, it is essential to collaborate with various stakeholders, especially those closely related to the issues, and to seek effective ways to utilize data. In addition, toward the continuous monitoring of diverse global information, such as SDGs indicators, using earth observation data, it is essential to coordinate satellite observations and the integration of multiple data through international cooperation among space and meteorological agencies around the world. JAXA will continue to contribute to the SDGs and to solutions for global issues with the science and technology of Earth observation in cooperation with relevant organizations around the world.


Image: JAXA

Global Mangrove Watch, mapping the extent of mangroves from 1996 to present using observation data by JERS-1, ALOS and ALOS-2, with the advantage of being able to obtain data on the ground surface regardless of weather conditions