JAXA updates since CGMS-50 and report on the medium to long-term future plans

Presented to CGMS-50 Plenary, agenda item 2

Coordination Group for Meteorological Satellites

Executive summary of the WP

- The major updates since CGMS-50 is that the project team of Precipitation Measuring Mission (PMM), targeting the launch of JFY2028 (April 2028 to March 2029), was organized in JAXA on 1st June 2023. JAXA would appreciate the supports by CGMS and IPWG.
- GCOM-C has achieved the 5-year nominal mission phase and been in the post-mission phase since Jan. 2023.
- EarthCARE (a joint Japanese-European mission) will be launched in 2024, which observes clouds, aerosols, and radiation on a global scale to improve the accuracy of climate change predictions. JAXA is developing the CPR on the EarthCARE, which will be the world's first W-band (94GHz) Doppler radar aboard a satellite.
- GOSAT-GW, joint mission of GOSAT-2 follow-on (TANSO-3) and GCOM-W/AMSR2 follow-on (AMSR3), is scheduled to be launched in JFY2024.
- JAXA contributes to the WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) Project by providing Global Satellite Mapping of Precipitation (GSMaP) rainfall product with climate normal. In June 2022, JAXA started to distribute the GSMaP real time data (GSMaP_NOW) to the SWCEM members, corresponding to the recommendation from the Steering Group.
- GOSAT and GOSAT-2 provides a decade long GHG observation globally. JAXA contributes to develop the concept of WMO coordinated Global Greenhouse Gas Watch (G3W) in defining the role of satellite products.

Current and future JAXA Earth Observation Missions contributing to Science and Societal Benefits

Current

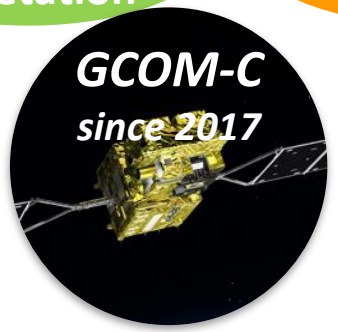
Greenhouse gases

Water Cycle

Precipitation

Disaster/ Forest

Cloud/ Aerosols/ Vegetation



Greenhouse gases

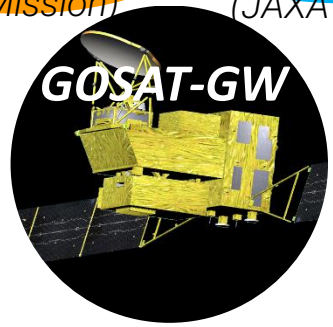
Future

Cloud/Aerosol Radiation Budget

EarthCARE
CPR:
Cloud Profiling Radar

Greenhouse gases *(MOE Mission)*

Water Cycle *(JAXA Mission)*



Disaster/ Forest

Coordination Group for Meteorological Satellites

JAXA CGMS

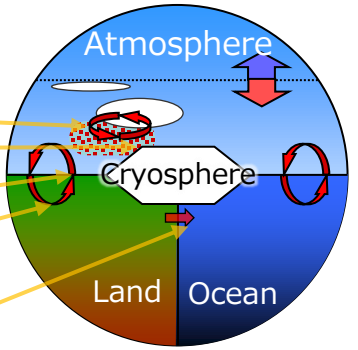
GCOM-C has achieved the 5-year nominal mission phase and been in the post-mission phase since Jan. 2023.

GCOM-C/SGLI characteristics:

- ✓250-m spatial resolution with >1150km swath
- ✓19 channels from Near-UV to thermal infrared wavelengths
- ✓Polarimetry

Examples of the current focus:

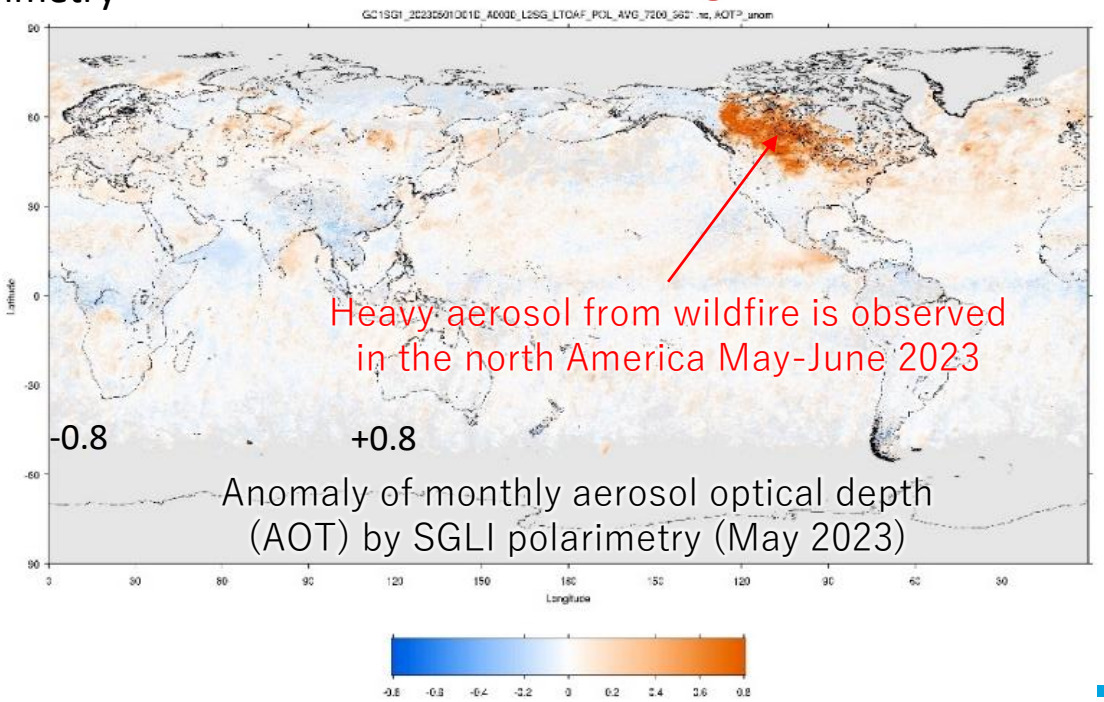
- ✓ Aerosol, cloud, and solar radiation
- ✓ Arctic change including Greenland ice sheet
- ✓ Wildfire processes including land cover change and aerosol emission
- ✓ Seasonal and year-to-year change of the vegetation
- ✓ ocean ecosystem and carbon cycle including land-ocean interface



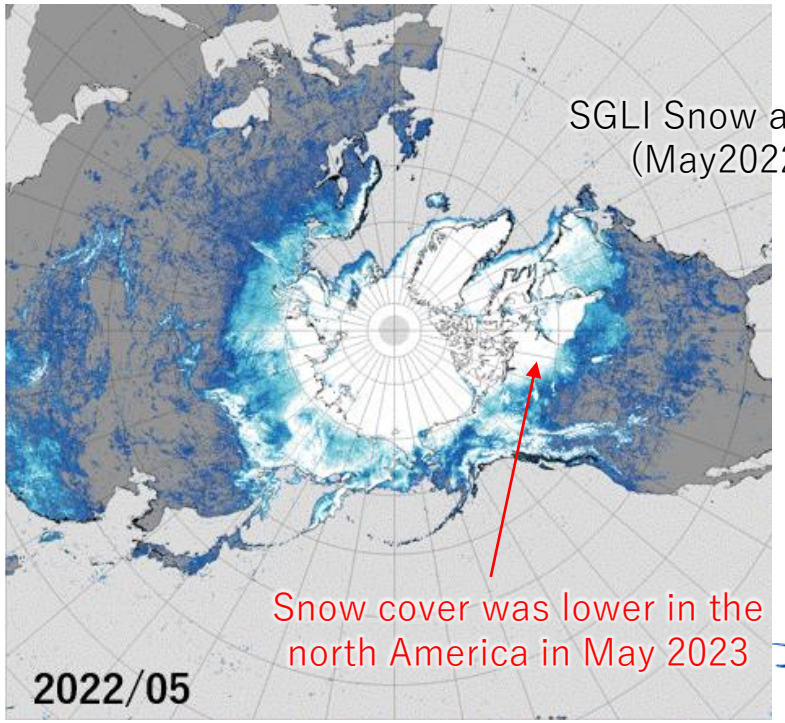
Earth system model

Collaboration with earth system model researches

Aerosol monitoring



Polar area monitoring



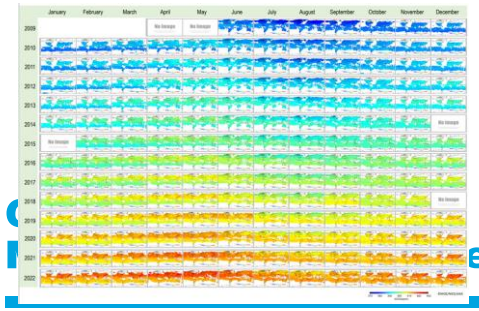
SGLI Snow and Ice covered area (May2022 and May 2023)

A-decade-long GHG observation by GOSAT series: Greenhouse gases Observing SATellite (GOSAT) & GOSAT-2

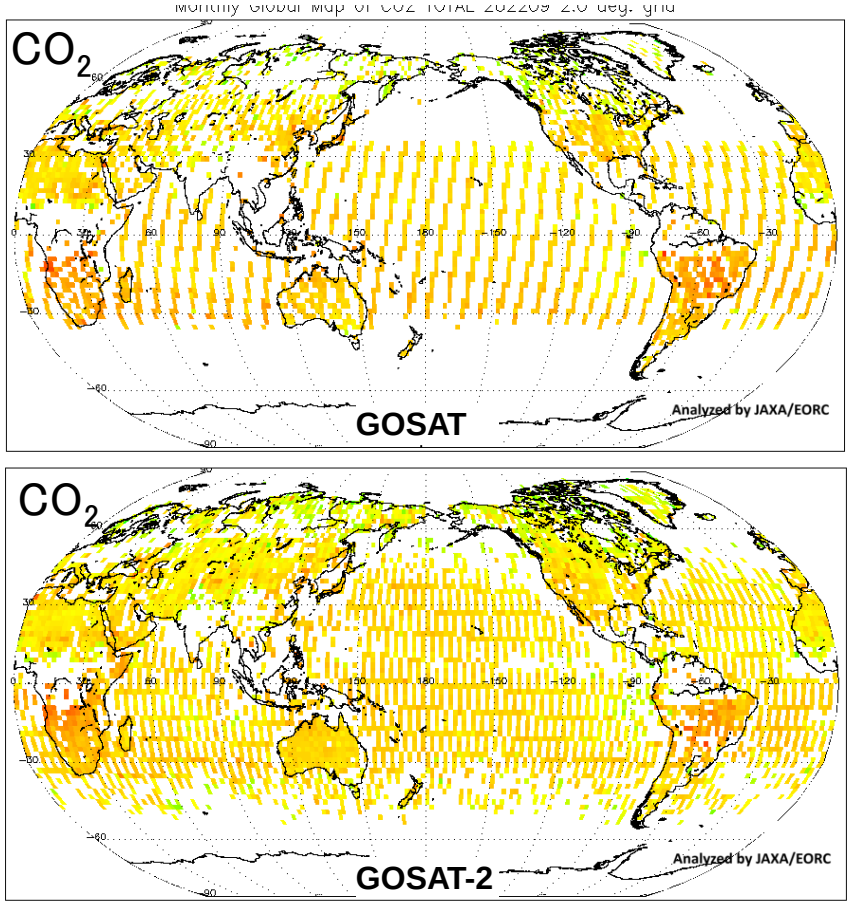
Carbon & Material Cycle

2009-Now

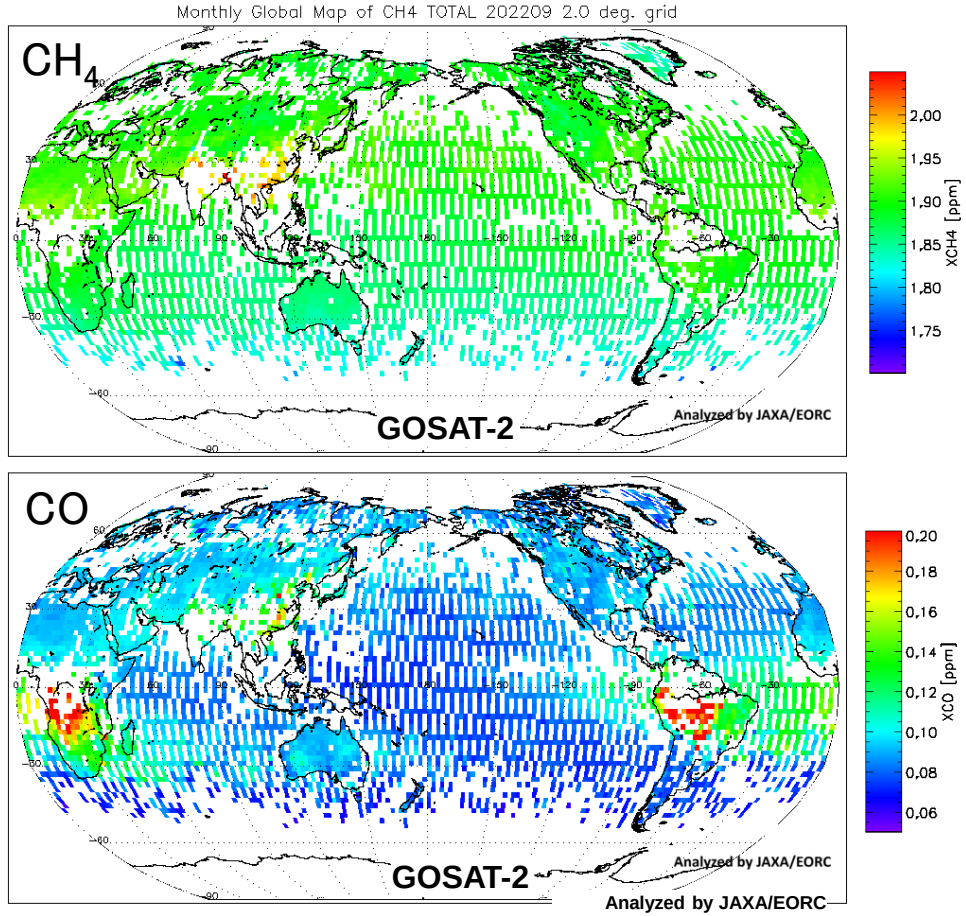
2018-Now



CO_2 Observation



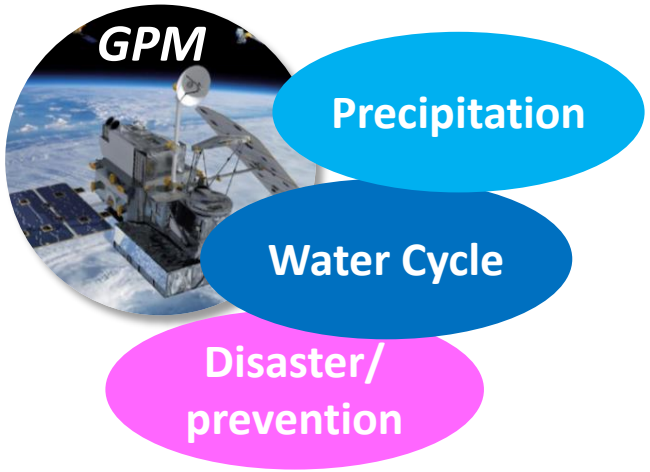
CH_4 (upper) & CO (lower) Observation



Global CO_2 concentrations observed by GOSAT and GOSAT-2, CH_4 and CO (September 2022)

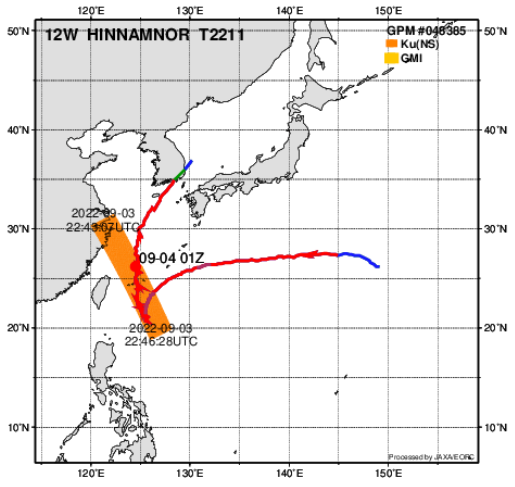
2009-2022 seasonal variation and year-to-year increase of global CO_2 observed by GOSAT.

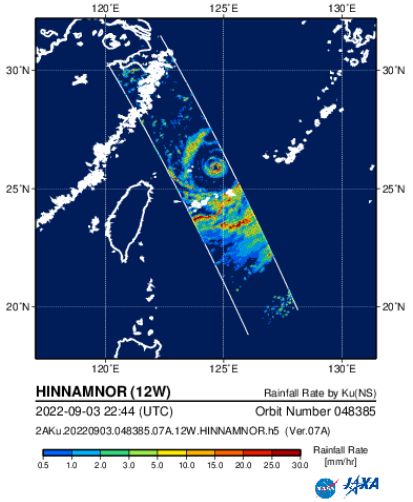
Utilization of Precipitation Radar in NWP: Assimilation of 3D information derived by GPM/DPR in JMA

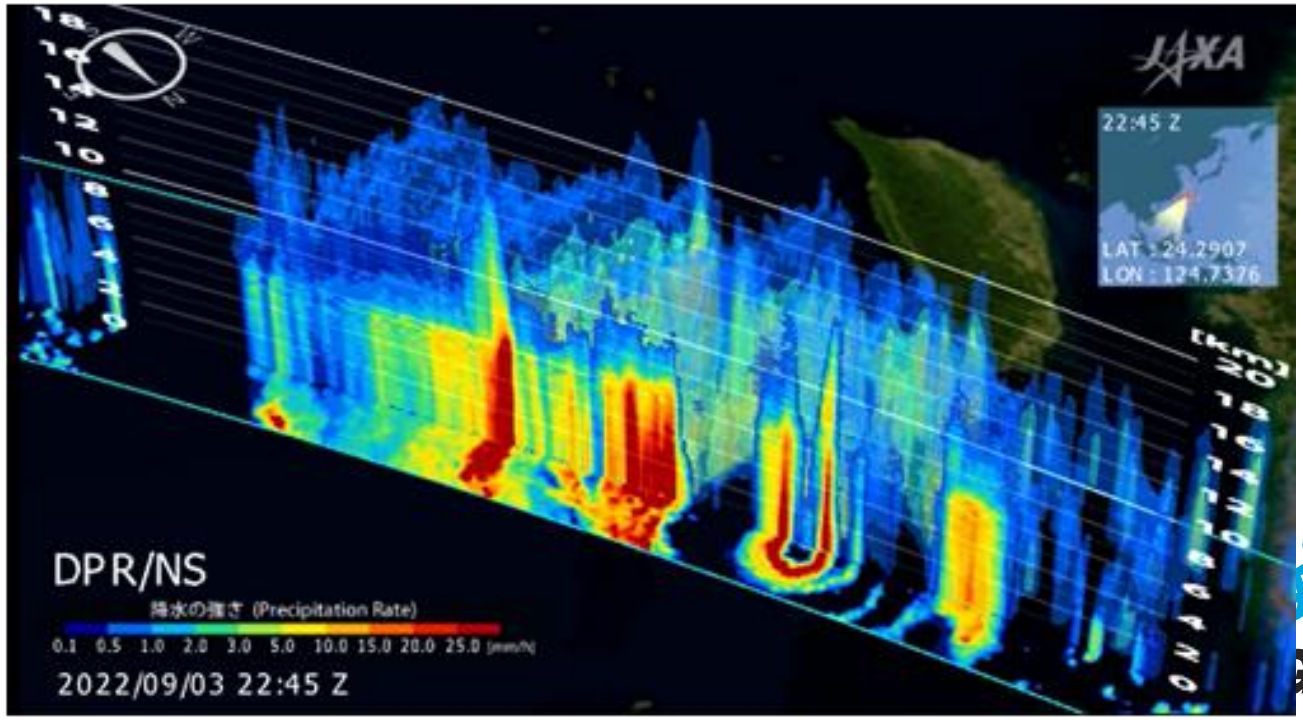


- The Japan Meteorological Agency (JMA) started the Global Precipitation Measurement Mission (GPM) / Dual-frequency Precipitation Radar (DPR) assimilation in the meso-NWP system on March 24, 2016 (https://doi.org/10.1002/qj.3950).
- The assimilation technique for the DPR by the JMA was improved on 30th June 2022. This included an improvement related to the scan pattern change of the DPR in May 2018.

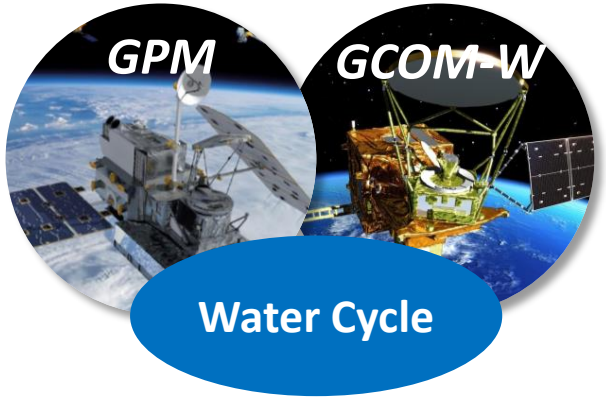
3-D precipitation of the typhoon (Super Typhoon HINNAMNOR) by GPM/DPR in 3rd Sep.2022







WMO Space- based Weather and Climate Extremes Monitoring (SWCEM)



- **Global Satellite Mapping of Precipitation (GSMaP)** is the Japanese precipitation product, and Graphical User Interface of the "JAXA Global Rainfall Watch" website (https://sharaku.eorc.jaxa.jp/GSMaP/index.htm) is available based upon the GSMaP product.

- JAXA attends WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) project and provide the GSMaP product with about 22yr-climate data to National Meteorological and Hydrological Service in Asia and Pacific regions.

- In June 2022, JAXA started to distribute the GSMaP real time data (GSMaP_NOW) to the SWCEM members, corresponding to the recommendation in the Steering Group meeting (SG-SWCEM-EAWP-4) held on March 2022.
- JAXA is preparing the release of the reprocessing GSMaP data and will re-calculate the climate normal again for the WMO project by the end of July 2023.

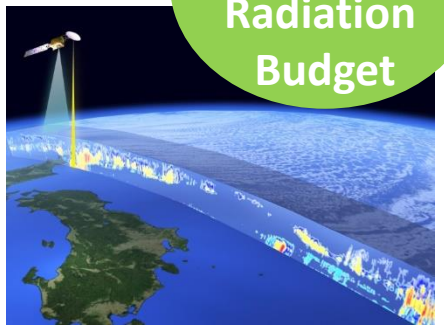
Coordination Group for Meteorological Satellites

CGMS

Future Missions for Climate & Water: EarthCARE (2024) & GOSAT-GW (2024)

To be launched in 2024

Cloud/ Aerosol Radiation Budget



- Europe-Japan joint mission
- 3 dimensional global distributions of cloud and aerosol to contribute to precise understanding of climate change
- JAXA and NICT provides world's first satellite-based cloud vertical motion by the Clod Profiling Radar (CPR) with 94 GHz with Doppler Capability at 0.8 km spatial resolution.

Orbit	Sun-synchronous sub-recurrent orbit Altitude: approx. 400km Inclination angle: 97.05˚ Local Sun Time at Desc.: 14:00 Revisit time: 25 days
Instruments	**- Cloud Profiling Radar (CPR)** by NICT & JAXA - Atmospheric Lidar (ATLID) by ESA - Multi-Spectral Imager (MSI) by ESA - Broad-Band Radiometer (BBR) by ESA
Mass	Approx. 2.2 tons at launch
Designed lifetime	3 years

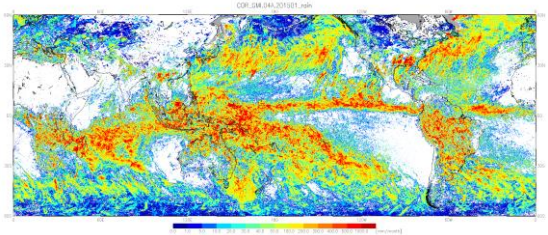
To be launched in JFY2024

Water Cycle

Green-house gases

- Carrying two instruments, AMSR3 and TANSO-3.
  - AMSR3 (JAXA) will succeed AMSR series observations with adding new high frequency channels (166 & 183 GHz) for snow fall retrievals and water vapor analysis for numerical weather prediction.
  - TANSO-3 (led by Ministry of Environment in Japan) uses imaging spectrometer technology to measure CO2, CH4 and NO2 globally with medium and locally with high spatial resolution.

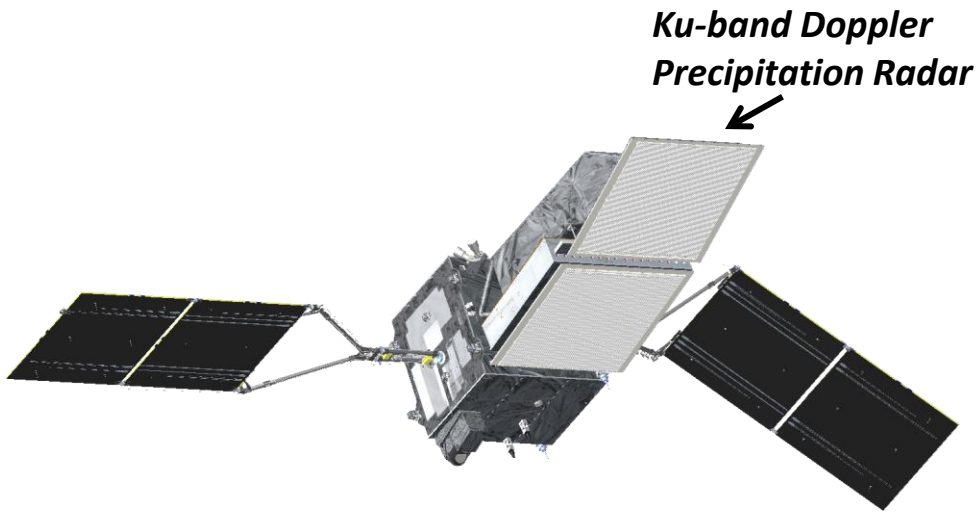
AMSR3 for both snow & rain



Orbit	Sun-synchronous sub-recurrent orbit Altitude: approx. 666km Inclination angle: 98.06˚ Local Sun Time at Desc.: 1:30 +/- 15 min Revisit time: 3 days
Instruments	**- Advanced Microwave Scanning Radiometer 3 (AMSR3)** **- Total Anthropogenic and Natural emissions mapping SpectrOmeter-3 (TANSO-3)** (for Ministry of Environment in Japan (MOE))
Mass	Approx. 2.6 tons at launch
Designed lifetime	**7 years**

Next Generation Precipitation Radar planned in JAXA: Precipitation Measuring Mission (PMM)

- **In June 2023, JAXA's Precipitation Measuring Mission (PMM) Project Team was established on for the Spacecraft carrying the Ku-band Doppler Precipitation Radar, with participation in NASA Atmosphere Observing System (AOS) mission.**
  - **International collaboration with NASA AOS missions will enable us integrated understanding of Aerosol~Cloud~Precipitation processes**
  - **It also enhances the mission value for improving weather/climate models in the context of international collaboration.**
- **In December 2022, Implementation Plan of the "Basic Plan on Space Policy" noting the Precipitation Radar Satellite Phase B activity targeting the launch of JFY2028 (April 2028 to March 2029) was released from Cabinet Office of the Japanese government.**



(a design life of 5 years)

Major characteristics

Frequency	13.6 GHz
Observation modes	・Doppler obs. mode ・Dense sampling obs. mode ・Normal scan obs. mode

The Ku-band Doppler Precipitation Radar (KuDPR) will be two-antenna system that adopts Displaced Phase Center Antenna (DPCA) approach (Durden et al. 2007, Tanelli et al. 2016).

→ The DPCA approach can lead to **more accurate Doppler measurement.**

Coordination Group for Meteorological Satellites

CGMS

Key issues of relevance to CGMS:

- The major updates since CGMS-50 is that the project team of Precipitation Measuring Mission (PMM), targeting the launch of JFY2028 (April 2028 to March 2029), was organized in JAXA on 1st June 2023. JAXA would appreciate the supports by CGMS and IPWG.
- In the WMO project for monitoring extremes, JAXA contributes to the SWCEM Project by providing GSMaP rainfall product. In June 2022, JAXA started to distribute the GSMaP_NOW to the SWCEM members, corresponding to the recommendation from the Steering Group.
- JAXA also contributes to the Global Greenhouse Gas Watch (G3W) by defining the role of satellite products. In May 2023, JAXA started to distribute the latest version of JAXA/GHG products.

- The medium to long-term future plans of JAXA
  - GCOM-C has achieved the 5-year nominal mission phase and been in the post-mission phase
  - EarthCARE (a joint Japanese-European mission) will be launched in 2024, which observes clouds, aerosols, and radiation on a global scale to improve the accuracy of climate change predictions.
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