14p.02

JMA and JAXA

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JMA

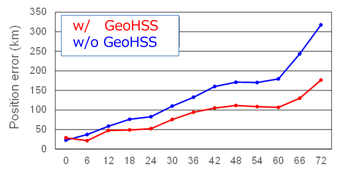
- Himawari-8/9
  - Switch the operational satellite from Himawari-8 to Himawari-9 on 13 Dec. 2022
  - AHI (Advanced Himawari Imager) on Himawari-8/9 performs very well
    - Image navigation errors < 600m at the sub-sat point
      - Image Navigation and Registration (INR) monitoring: https://www.data.jma.go.jp/mscweb/data/monitoring/navigation.html
    - Radiometric calibration biases < 5% for VNIR bands (bands 1 to 6), and 0.3 K for IR bands (bands 7 to 16)
      - Calibration portal: https://www.data.jma.go.jp/mscweb/en/oper/calibration/calibration_portal.html
  - HimawariRequest: Target area obs (1,000km^2, every 2.5 min) on request from NMHSs
    - 22 NMHSs registration, 155 requests implemented for TC, volcanic eruption, wild fires, etc. (as of Jan.2023)
  - User support info: https://www.data.jma.go.jp/mscweb/en/support/support.html

- Himawari-10: Himawari follow-on program
  - Plan to launch in JFY2028, start operation in JFY2029
    - JFY2022: RFI, RFP and Start of manufacturing
  - Design lifetime: 15 years (10-y in-orbit operation & 5-y in-orbit storage)
  - AHI-class VIS/IR imager (with optional improved capability)
  - Hyperspectral IR sounder (HSS)
    - Global and Regional OSSE for HSS (Okamoto et al. 2020, sola)
      - Assimilate clear-sky radiances in global OSSE and temperature & relative humidity profiles from 1DVar in regional OSSE
      - Simulate IRS-like synthetic observations: full disk scan every hour, 30km spatial spacing
      - Apply the nearly operational processing (ch selection, obs error assignment, bias correction, thinning)
    - Significant improvement in forecasts of Typhoon track and heavy precipitation in many cases from 2018-2021

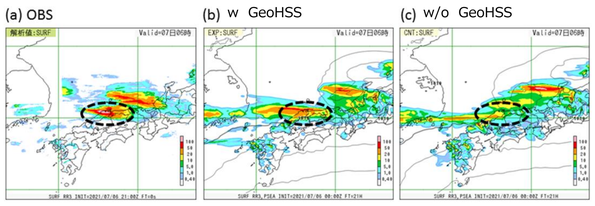
Himawari-8,9/AHI Channel Set

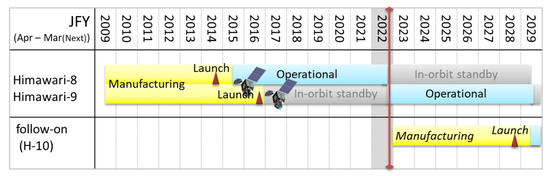
Band	Central Wavelength [μm]	Spatial Resolution
1	0.43 - 0.48	1km
2	0.50 - 0.52	1km
3	0.63 - 0.66	0.5km
4	0.85 - 0.87	1km
5	1.60 - 1.62	2km
6	2.25 - 2.27	2km
7	3.74 - 3.96	2km
8	6.06 - 6.43	2km
9	6.89 - 7.01	2km
10	7.26 - 7.43	2km
11	8.44 - 8.76	2km
12	9.54 - 9.72	2km
13	10.3 - 10.6	2km
14	11.1- 11.3	2km
15	12.2 - 12.5	2km
16	13.2 - 13.4	2km

Global OSSE: Averaged track forecast errors (4 typhoons) making landfall in Japan, 2018



Regional OSSE: Three-hour accumulated rainfall (mm) valid at 2100 UTC 06 July 2021

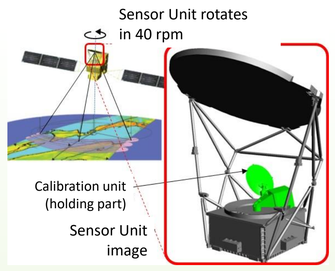




JAXA

AMSR3 on GOSAT-GW JFY2024 (Apr.2024~Mar.2025)

- Succeed AMSR series
  - Oct. 2021: Critical Design Review (CDR) of AMSR3 system
  - Currently, AMSR3 flight components are manufactured and tested
- Additional channels
  - 166 & 183 GHz channels to enable monitoring of global precipitation (rain & snow) and contribute to water vapor analysis in NWP
  - 10 GHz channels with improved NEDT to enable robust SST retrievals in higher spatial resolution

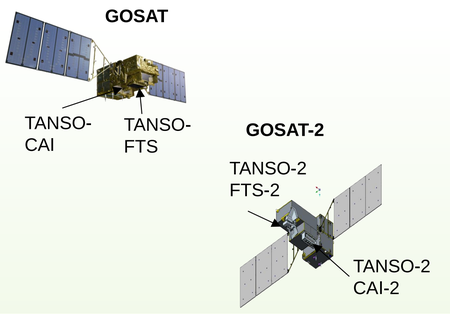


AMSR3

frequency [GHz]	Polarization	Band width [MHz]	NEDT (1σ)	Beam width (spatial resolution)
6.925, 7.3	H/V	350	< 0.34 K	1.8° (34km x 58km)
10.25	**H/V**	**500**	**< 0.34 K**	**1.2° (22km x 39km)**
10.65	H/V	100	< 0.70 K	1.2° (22km x 39km)
18.7	H/V	200	< 0.70 K	0.65° (12km x 21km)
23.8	H/V	400	< 0.60 K	0.75° (14km x 24km)
36.42	H/V	**840***	< 0.70 K	0.35° (7km x 11km)
89.0 A/B	H/V	3000	< 1.20 K	0.15° (3km x 5km)
165.5	**V**	**4000**	**< 1.50 K**	**AZ=0.23° / EL=0.30° (4km x 9km)**
183.31±7	**V**	**2000×2**	**< 1.50 K**	**AZ=0.23° / EL=0.27° (4km x 8km)**
183.31±3	**V**	**2000×2**	**< 1.50 K**	**AZ=0.23° / EL=0.27° (4km x 8km)**

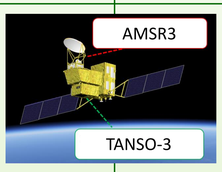
GOSAT Jan. 2009~, GOSAT-2 Oct. 2018~

- Joint projects of JAXA, MOE (Ministry of the Environment) and NIES (National Institute for Environmental Studies)
- GOSAT (Green house gases Observing SATellite)
  - The world's first spacecraft to measure the concentrations CO2 and CH4: Long term (14-y) calibrated validated dataset
  - Enough fuel to operate for at least another 10-y, healthy all 4 batteries
- GOSAT-2
  - Calibration: In Feb. 2021, anomaly in the solar diffuser panel mechanism. The solar irradiance calibration has been suspended since then.



GOSAT-GW

JFY 2024~



GOSAT-GW

Orbit	Type	Sun-synchronous, Sub-recurrent orbit
	Altitude	666km, recurrent cycle 3days (same as GOSAT)
	MLTAN	13:30±15min (same as GCOM-W)
Mass		2.6 ton (Including propellant)
Power		> 5.3 kW
Design life		> 7 years
Launch vehicle		H-IIA rocket
Mission data downlink rate		Direct transmission with X-band: 400 Mbps Direct transmission with S-band: 1 Mbps (Only for AMSR3)
Instrument		TANSO-3 (for GHG) AMSR3 (for Water Cycle)

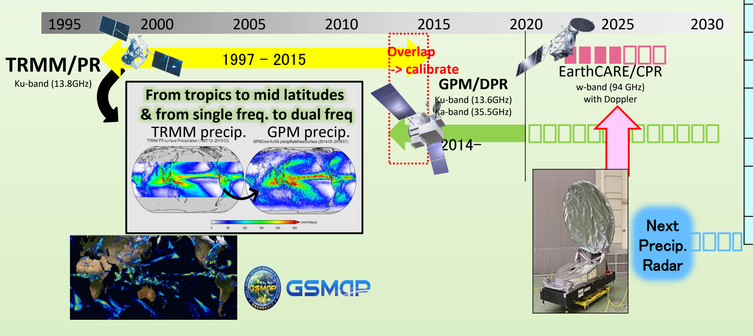
TANSO-3 on GOSAT-GW JFY2024

- Gratings were chosen instead of FTS to realize smaller footprint and wider swath
- Band 1 (~ 0.45 μm) for NO2, Band 2 (0.76 μm) for O2, and Band 3 (1.6 μm) for CO2 and CH
- Cloud detection (band 1,2), surface pressure, and Solar Induced chlorophyll Fluorescence (SIF, band2)
- 2 imaging mode
  - Wide mode (default): push-broom, footprint 10 km and swath 911 km
  - Focus mode: footprint 3 km and swath 90 km, agile pointing (±40 deg in the along-track direction and ±34.4 deg in the cross-track direction)

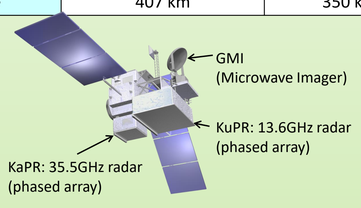
	GOSAT	GOSAT-2	GOSAT-GW
Launch, Life Time	2009, 5 years	2018, 5 years	JFY2024, 7years
Sat mass, power	1.75t, 3770W	1.8t, 5000W	2.9t, 5200W
Orbit	666 km, 3 days, 13:00, descending	613 km, 6 days, 13:00, descending	666 km, 3 days, 13:30, ascending
Spectrometer	TANSO-FTS	TANSO-FTS-2	TANSO-3 (Grating)
Major targets	CO2, CH4	CO2, CH4, CO	CO2, CH4, NO2
Spectral bands	0.7,1.6, 2μm, TIR	0.7,1.6, 2μm, TIR	0.45, 0.7,1.6, μm
spectral resolution (sampling interval)	0.2 cm-1 (≈ 0.01 nm @ 0.7 μm, ≈ 0.05 nm @ 1.6 μm)		< 0.5 nm @ 0.45 μm, <0.05 nm @ 0.7μm, < 0.2 nm @ 1.6 μm
swath	discrete, 1-9 points	discrete, 5 points	Selectable, 911 km (Wide) or 90 km(Focus)
footprint size	10.5 km	9.7 km	Selectable, 10 km (Wide) or 1 – 3 km(Focus)
pointing	±20 /±35 deg(AT/CT)	±40 /±35 deg (AT/CT)	±40 /±34.4 deg (AT/CT)
other instruments	CAI (Cloud and Aerosolmager)	CAI-2 (Cloud and Aerosolmager 2)	AMSR3

Precipitation and Cloud Profiling Radar

- JAXA has large heritage of the TRMM/PR and GPM/DPR, and the data record of spaceborne precipitation radars is more than 20 years.
- JAXA and NICT (National Institute of Information and Communication Technology) are developing Cloud Profiling Radar (CPR) with doppler capability, onboard EarthCARE satellite
- The JAXA has studied a feasibility of a next generation precipitation radar with Japanese science team and user community.
- → The targets for the next generation precipitation radar in the Precipitation Measuring Mission (PMM) will be Doppler observations, and higher sensitivity measurements with scanning capability.
  - JAXA has participated in NASA's Atmosphere Observing System (AOS) Pre-Phase A activities.
- JAXA's PMM Pre-Project Team was established on for the spacecraft carrying the Ku-band Doppler Precipitation Radar (KuDPR) in January 2022.



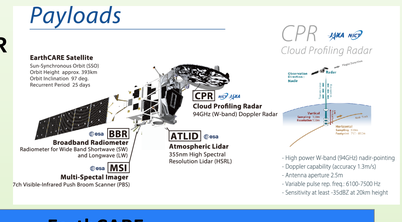
Satellite	GPM core		TRMM
Radar	KuPR	KaPR	PR
Observation frequency	13.597 & 13.603 GHz	35.547 & 35.553 GHz	13.796 & 13.802 GHz
Swath width	245 km	125 km	215 km
Horizontal resolution	5 km	5 km	4.3 km
Range resolution	125 m	125/250 m	250 m
Minimum Ze and rain rate	18 dBZ 0.3 mm/h	12 dBZ 0.5 mm/h	18 dBZ 0.7 mm/h
Launch date (JST)	28 Feb. 2014		28 Nov. 1997
Orbit (inclination)	Non-sun-synchronous (65 deg)		Non-sun synchronous (35 deg)
Altitude	407 km		350 km



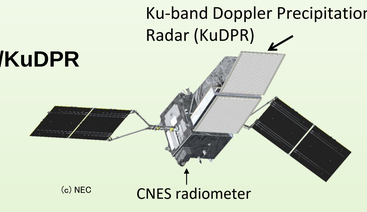
- **EarthCARE/CPR** JFY2024
  - An earth observation satellite that Japan and ESA have been jointly developing to observe clouds, aerosols and radiation (Illingworth et al. 2015, Wehr et al. 2023).
  - The Cloud Profiling Radar (CPR) will provide observations of not only cloud but also snowfall and light rainfall
  - Measuring Doppler velocities by the CPR is very challenging, but it is expected to advance cloud/precipitation science

- **PMM/KuDPR** JFY2028
  - Observation modes: Doppler obs mode, Dense sampling obs mode, Normal scan obs mode
  - KuDPR will be two-antenna system that adopts Displaced Phase Center Antenna (DPCA) approach (Durden et al. 2007, Tanelli et al. 2016). → more accurate Doppler measurement.

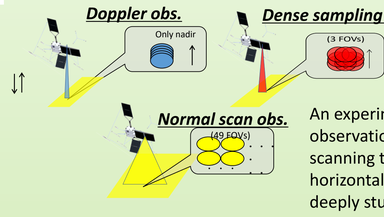
EarthCARE/CPR



PMM/KuDPR



EarthCARE	
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



An experimental observation of doppler beam scanning to measure horizontal winds has been deeply studied in the Japan.