Overview of AMSR3 on the Global Observing SATellite for Greenhouse gases and Water cycle (GOSAT-GW)

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SUMMARY

- JAXA has been developed series of passive microwave imagers called Advanced Microwave Scanning Radiometer (AMSR). Currently, AMSR2 on the GCOM-W satellite has been operated in orbit since 2012.
- JAXA has started development of AMSR3 on the GOSAT-GW satellite since December 2019. The GOSAT-GW satellite will carry AMSR3 and TANSO-3 (GHG mission led by MOE & NIES) and is to be launched in JFY2023.
- AMSR3 will have 21 channels from 6.9 to 183.3 GHz with 2.0 m antenna including new high-frequency channels (165.5V, 183+-3V, & 183+-7V) and additional 10 GHz V/H with wider band width and improved NEDT to develop higher resolution sea surface temperature especially for fisheries around 30km offshore from the coast.

GOSAT-GW SATELLITE AND ITS ORBIT

- GOSAT-GW will carry two instruments, AMSR3 and TANSO-3
  - AMSR3, led by JAXA, will succeed AMSR series observations
  - TANSO-3, led by Japanese Ministry of Environment (MOE) and National Institute of Environment Studies (NIES), will improve observation capability of greenhouse gases from GOSAT-2/TANSO-2
  - Orbit specification is decided to satisfy requirements of both missions
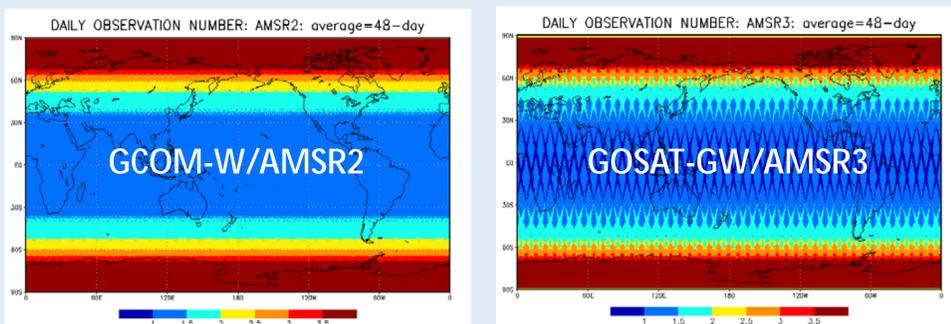 - Target launch is JFY2023 (Apr. 2023 – Mar. 2024)

GOSAT-GW (JFY 2023) — AMSR3, TANSO-3

Figure 1. Daily Observation Number by AMSR2 (left) & AMSR3 (right)

Table 1. GOSAT-GW Satellite Specifications

	Type	Sun-synchronous, Sub-recurrent orbit
Orbit	Altitude	666 , recurrent cycle 3 days
	MLTAN	13:30±15 min
Design life		> 7 years
Mission data downlink rate		X-band: 400 Mbps
		S-band: 1 Mbps (only for AMSR3)
Instrument		TANSO-3 (for GHG)
		AMSR3 (for Water Cycle)

AMSR3 MISSIONS

- Mission Targets of AMSR3
  - To produce long-term continuous data record
  - To enhance operational utilization of near-real time data weather forecast including hurricane analysis
  - Fishery in coastal area (30km+ off-shore)
  - Navigational assistance on arctic shipping route
  - New geophysical parameter products
- Same specifications to AMSR2 except;
  - New high-frequency channels for snowfall retrieval and water vapor analysis in NWP
  - Additional 10 GHz channels with improved NEDT to mitigate random noises in SST retrievals found in AMSR2 10GHz SST

Table 2. AMSR3 Sensor Characteristics

Sensor type	Conical scanning total power microwave radiometer
Antenna	Off-set parabolic antenna (φ2.0m aperture)
Swath width	> 1530m
Quantization	12 bit
Incidence angle	55 deg. except 89GB, 166G,183G
X-polarization	< -20dB
Beam efficiency	> 90%
Range	2.7-340K
Sampling interval	5-10km
Data rate	87.4 kbps (average)
Life time	7 years

* Red indicates differences from AMSR2

Table 3. AMSR3 Channel Sets

Center frequency [GHz]	Polari-zation	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 (TBD)	H/V	500 (TBD)	< 0.34 K (TBD)	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)
36.5	H/V	1000	< 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 (TBD)	0.3° (TBD) (6km× 10km)
183.31± 7	V	2000× 2	< 1.50 K (TBD)	0.28° (TBD) (5km× 9km)
183.31± 3	V	2000× 2	< 1.50 K (TBD)	0.28° (TBD) (5km× 9km)

* Red indicates additional channels to AMSR2

AMSR3 Products

- In addition to snowfall, some research products in AMSR2 are promoted to standard products in AMSR3
- SST using multi-frequency channels in 6 & 10 GHz will be demonstrated in AMSR2 Ver.4, to be released in 2020.
- Enhanced spatial resolution brightness temperature for 6-10GHz (Maeda, 2020, IEEE TGRS) and SST using above as input (Maeda et al., 2020, IEEE GRSL) are proposed as research products and currently evaluated by applying AMSR2 as potential candidates of AMSR3 standard product.
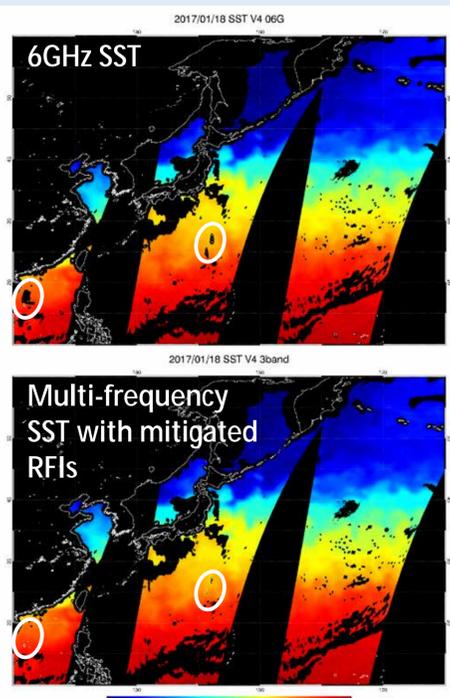

2017/01/18 SST V4 06G — 6GHz SST

2017/01/18 SST V4 3band — Multi-frequency SST with mitigated RFIs

Figure 2. Comparison of AMSR2 6GHz (upper) & 3-frequency (bottom) SSTs

Table 4. List of AMSR3 Products

Standard Product	Research Product
Brightness Temperature (6-183GHz) (L1B)	Enhanced spatial resolution Brightness Temperature (6-10GHz) (L1H)
Resampled Brightness Temperature (6-183GHz) (L1R)	Enhanced spatial resolution Sea Surface Temperature (20km res.)
Total Precipitable Water (over ocean & land)	Sea Ice Motion Vector
Integrated Cloud Liquid Water Content (over ocean)	Land Surface Temperature
Precipitation (liquid & solid)	Vegetation Water Content
Sea Surface Temperature (6GHz & multi-frequency)	Thin Ice Detection
Sea Surface Wind Speed	Soil Moisture Content & Vegetation Water Content by Land Data Assimilation (L4)
All Weather Sea Surface Wind Speed	
Sea Ice Concentration	Climate Data Record (CDR) for each parameter by multi-passive microwave imagers
High-resolution Sea Ice Concentration	
Soil Moisture Content	* Red indicates differences from AMSR2
Snow Depth (snow depth & SWE)	

(List as of Dec. 2019)