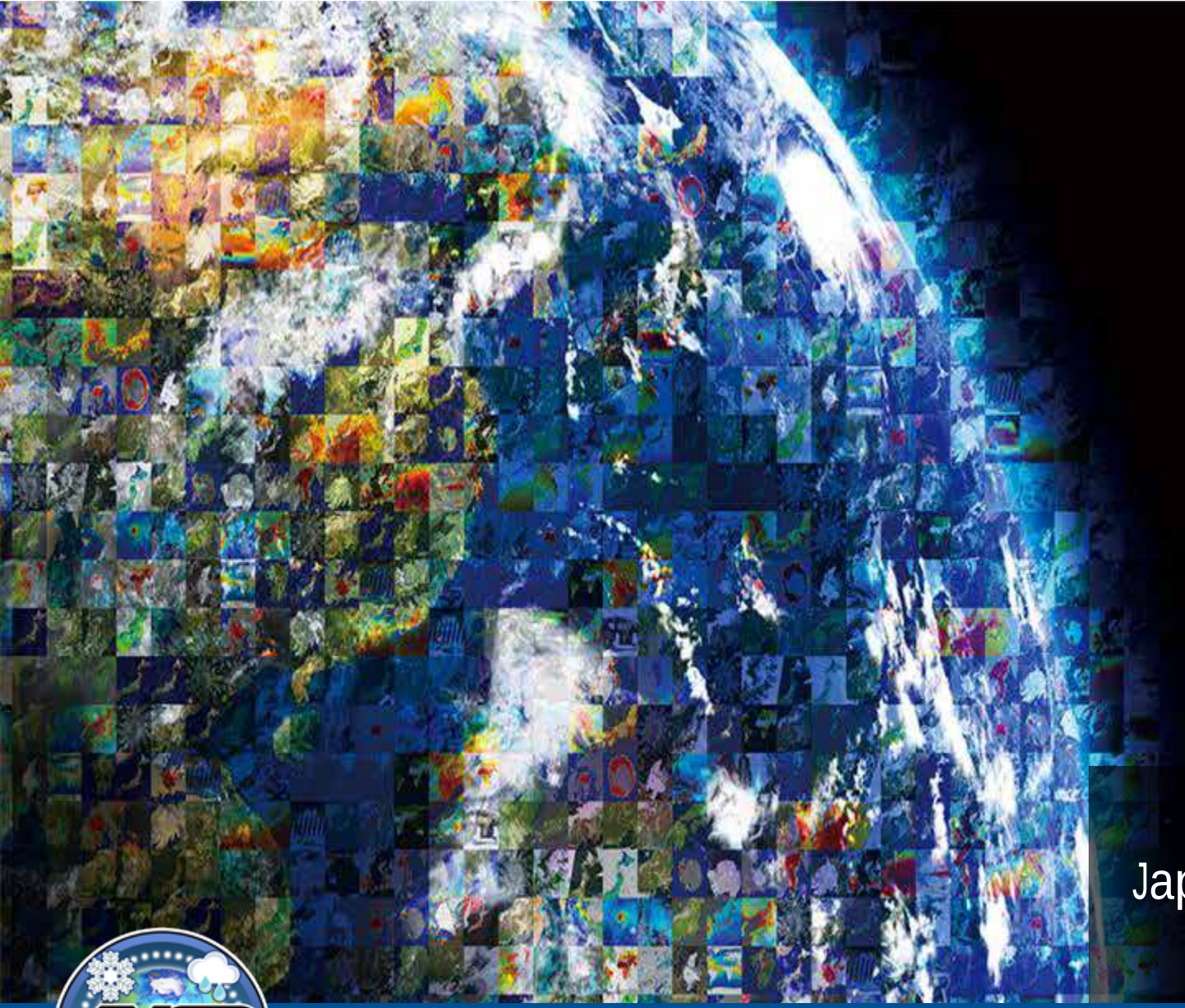


AMSR3 Status

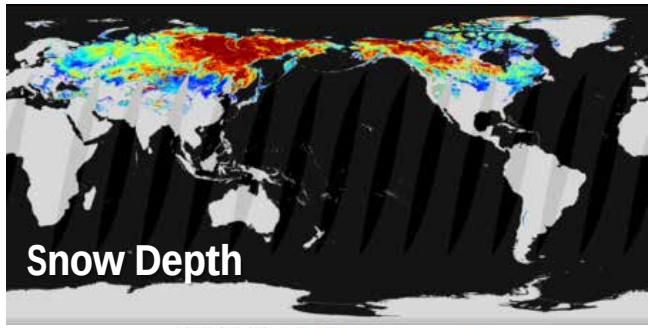
Misako KACHI
Japan Aerospace Exploration Agency (JAXA)

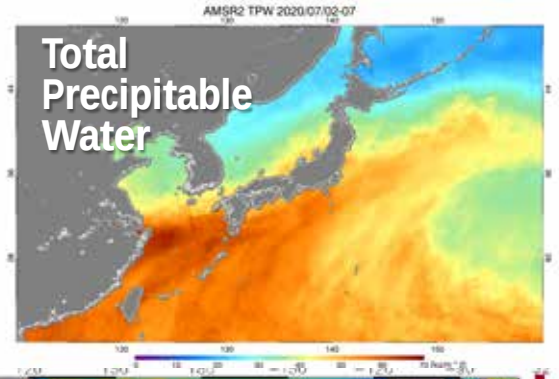
GSICS GSICS Annual Meeting@19 Mar. 2025

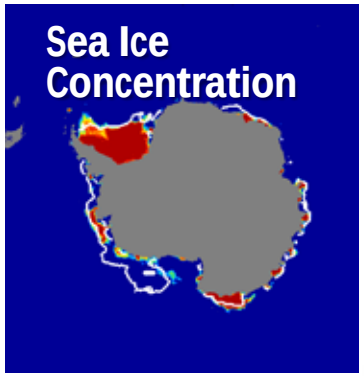
Advanced Microwave Scanning Radiometer (AMSR) Series

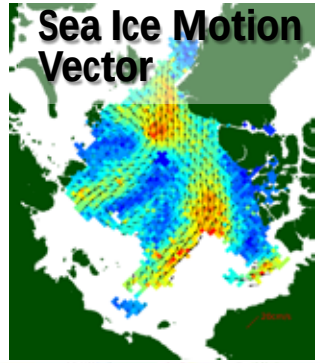
https://www.eorc.jaxa.jp/AMSR/

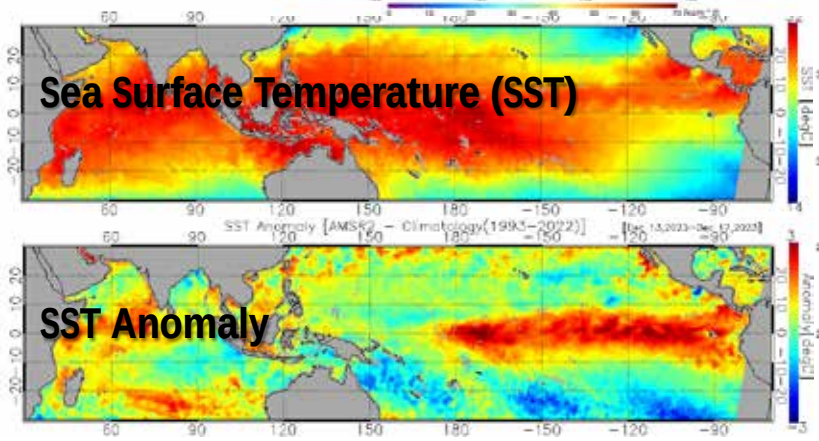
- A series of Japanese passive microwave radiometers with the world best capability
  - Microwave channels of 6.9-89GHz (additional 166-183GHz channels in AMSR3) enable to observe “water-related” geophysical parameters in all-weather without sun-light
- Widely used in operational applications (c.f., numerical weather prediction, tropical cyclone analysis, SST analysis, sea ice analysis and fisheries) as well as water cycle variation & climate change studies

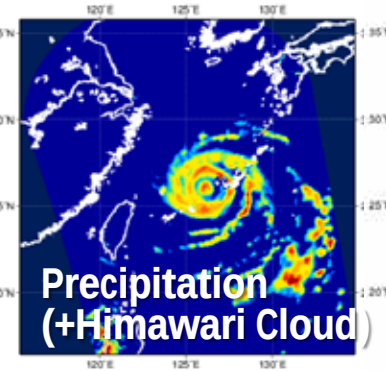


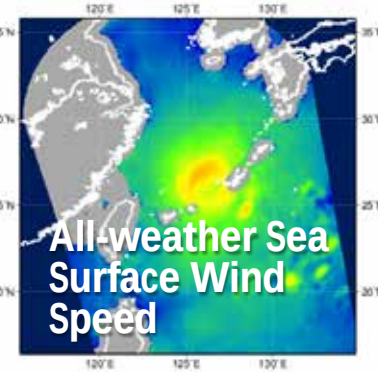












[End Users] / [Partners]

[End Users]	[Partners]
Users of Weather Forecasts	Japan Meteorological Agency
Users in Fishery	Japan Fisheries Information Service Center
Sea status, sea ice information, navigation safety	Japan Coast Guard
Climate projection, agricultural prediction, sea ice prediction, polar navigation support, etc.	Research Institutes, Universities, etc.

JAXA GSMaP

NOAA, EUMETSAT, NWP agencies

NWP & hydrological users in Asis-Pacific

GOSAT-GW: Global Observation SATellite for Greenhouse gases and Water cycle

- GOSAT-GW system development is in the final stage of Phase D to be launched in the first half of JFY2025.
  - Completed Post Qualification Test Review (PQR) of the AMSR3 proto-flight model in Mar. 2025
  - Completed development of AMSR3 Level 1 processing software, and has been installed to the AMSR3 Mission Operation System
  - Completed review after End-to-End test of AMSR3 Mission Operation System in Dec. 2024
  - After the PQR of satellite system and Development Completion Review, we will move on to the launch operation at the launch site, Tanegashima Space Center
  - Launch date of the GOSAT-GW is scheduled in the first half of JFY2025

GOSAT-GW Satellite Specifications

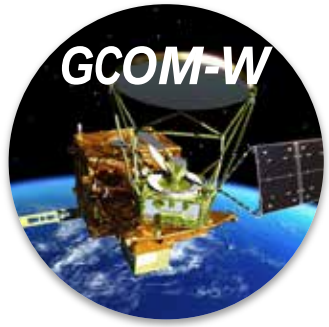
Mission Instruments		AMSR3 (JAXA) TANSO-3 (MOE/NIES)
Orbit	**Type**	Sun-synchronous, Sub-recurrent orbit
	Altitude	666km, recurrent cycle 3days (same as GOSAT)
	Local sun time at ascending	13:30±15min (same as GCOM-W)
	Revisit time	3 days
Satellite Mass		2.6 tons (including propellant)
Designed lifetime		> 7 years
Launch		First half of JFY2025 by H-IIA rocket

Sensor Comparison of the AMSR Series

- ü **Multi-frequency in6.9-89 GHz**
- ü **Fine resolution with large size antenna**
- ü **Global observation**

Demonstration of operational utilization

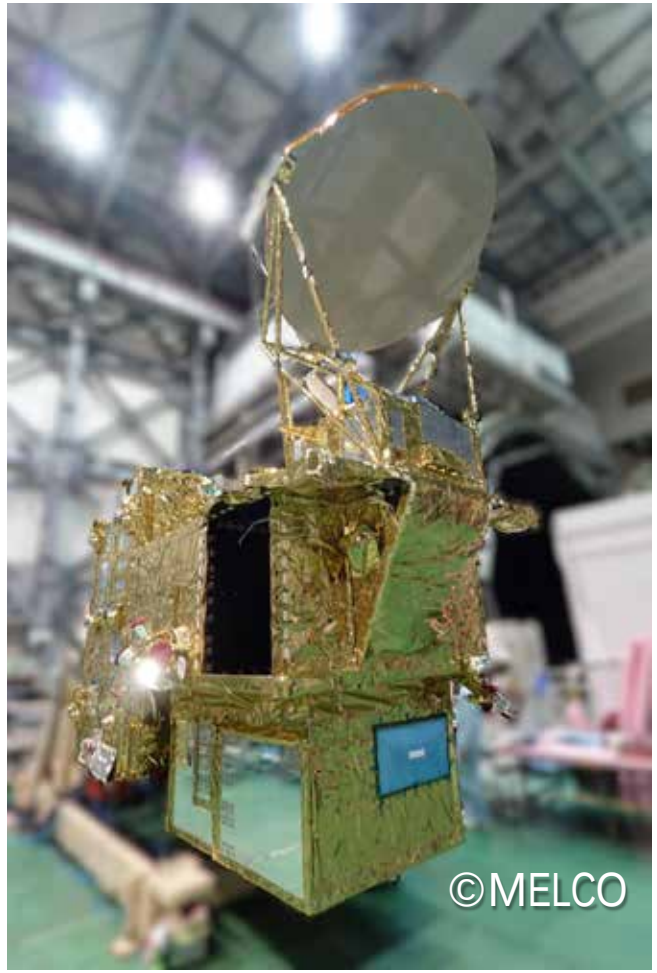
Establish operational utilization & long-term archive



Continue & expand past AMSR series

Sensor	AMSR	AMSR-E	AMSR2	AMSR3
Mission Period	2002.12-2003.9	2002.5-2011.10	2012.5-present	JFY2024
Altitude	803 km	705 km	700 km	666 km
Swath Width	1600 km	1450 km	1617 km	> 1530 km
Frequency (GHz)	6.9,10, 18,23,36,50,52,89	6.9,10, 18,23,36,89	6.9/7.3,10.65, 18,23,36,89	6.9/7.3,10.25/10.65, 18,23,36,89,166,183
Antenna Size	2.0 m	1.6 m	2.0 m	2.0 m
Spatial Resolution	40x70 km@6.9GHz 8x14 km@36GHz	43x75 km@6.9GHz 8x14 km@36GHz	35x62 km@6.9GHz 7x12 km@36GHz	34x58 km@6.9GHz 7x11 km@36GHz
LTAN	10:30	13:30	13:30	13:30

GOSAT-GW/AMSR3 Sensor Specification



Feature of the GOSAT-GW satellite with AMSR3 Main Reflector deployed

Center frequency [GHz]	Polari-zation	Band width [MHz]	NEDT (1σ)	Beam width (spatial resolution)
6.925	H/V	350	< 0.34 K	1.8 ° (33km x 57km)
7.3			< 0.43 K	
10.25	**H/V**	**500**	**< 0.33 K**	**1.2 ° (22km x 38km)**
10.65	H/V	100	< 0.70 K	1.2 ° (22km x 38km)
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 ° (6km 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)**

Red: Changes from AMSR2 including additional CHs

Add to improve temperature resolution (NEDT) in high-resolution SST

Modify to reduce possible risks of RF interferences from the 5G communication systems

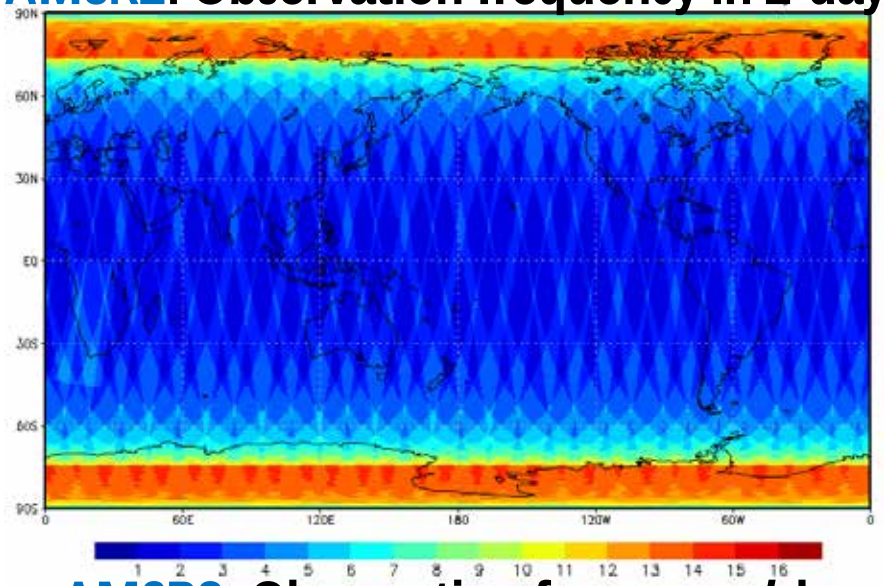
Add to get snowfall and water vapor in higher levels

① Additional **166 & 183 GHz** channels to enable monitoring of global precipitation (rain & snow) and contribute to water vapor analysis in NWP

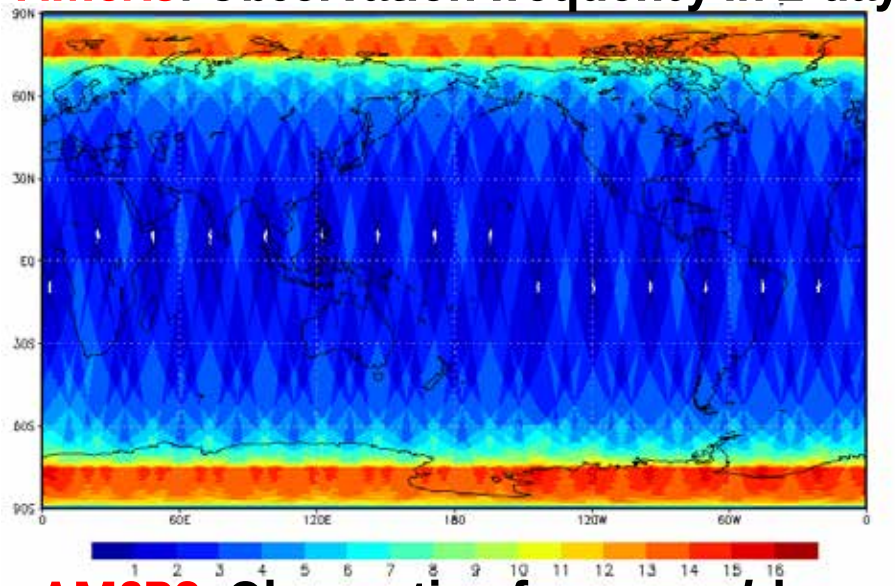
② Additional **10.25 GHz channels with improved NEDT** to enable robust SST retrievals in higher spatial resolution

Comparison of Observation Frequency

AMSR2: Observation frequency in 2-day

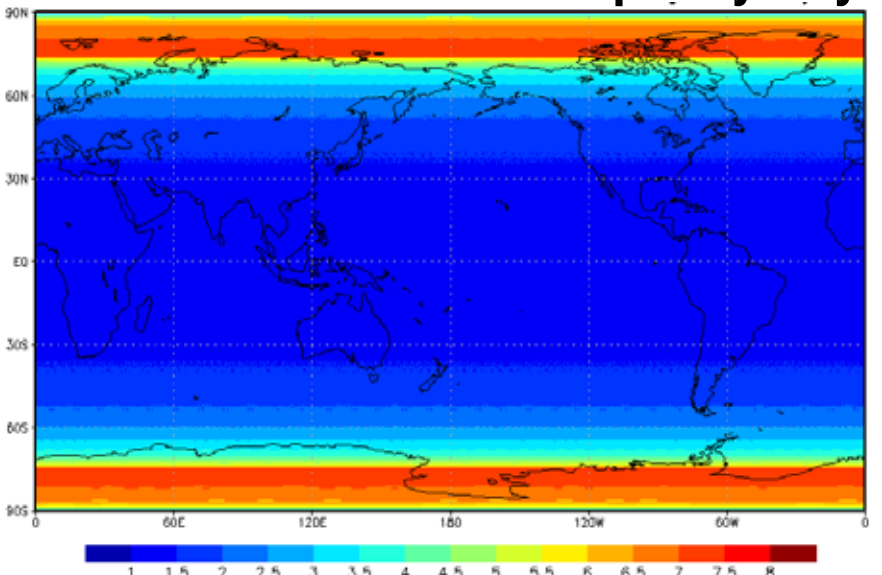


AMSR3: Observation frequency in 2-day

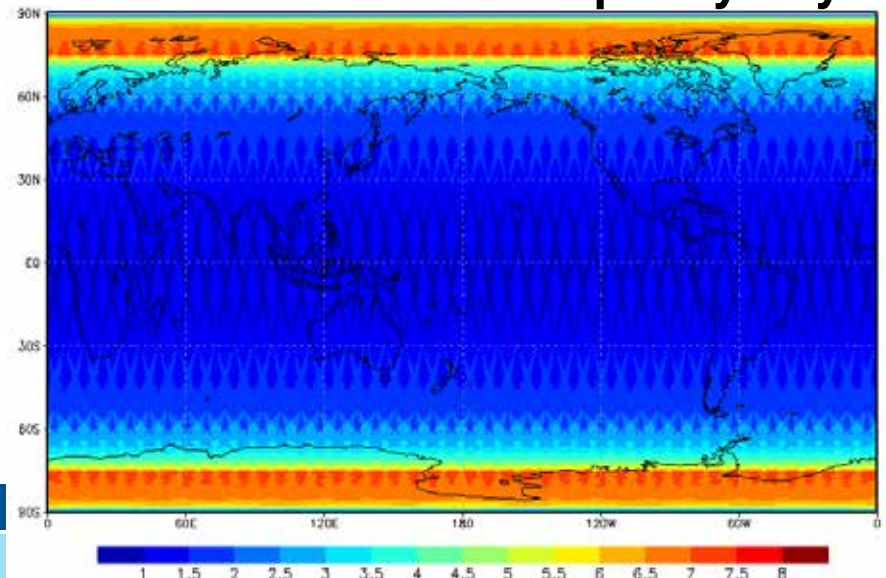


Unlike AMSR2, **AMSR3 cannot cover global area within 2-day** and small missing areas (white) are remained.

AMSR2: Observation frequency/day



AMSR3: Observation frequency/day



Observation frequency of AMSR3 is **NOT homogeneous** for every longitude and there are fixed areas less than 1 observation/day (blue).

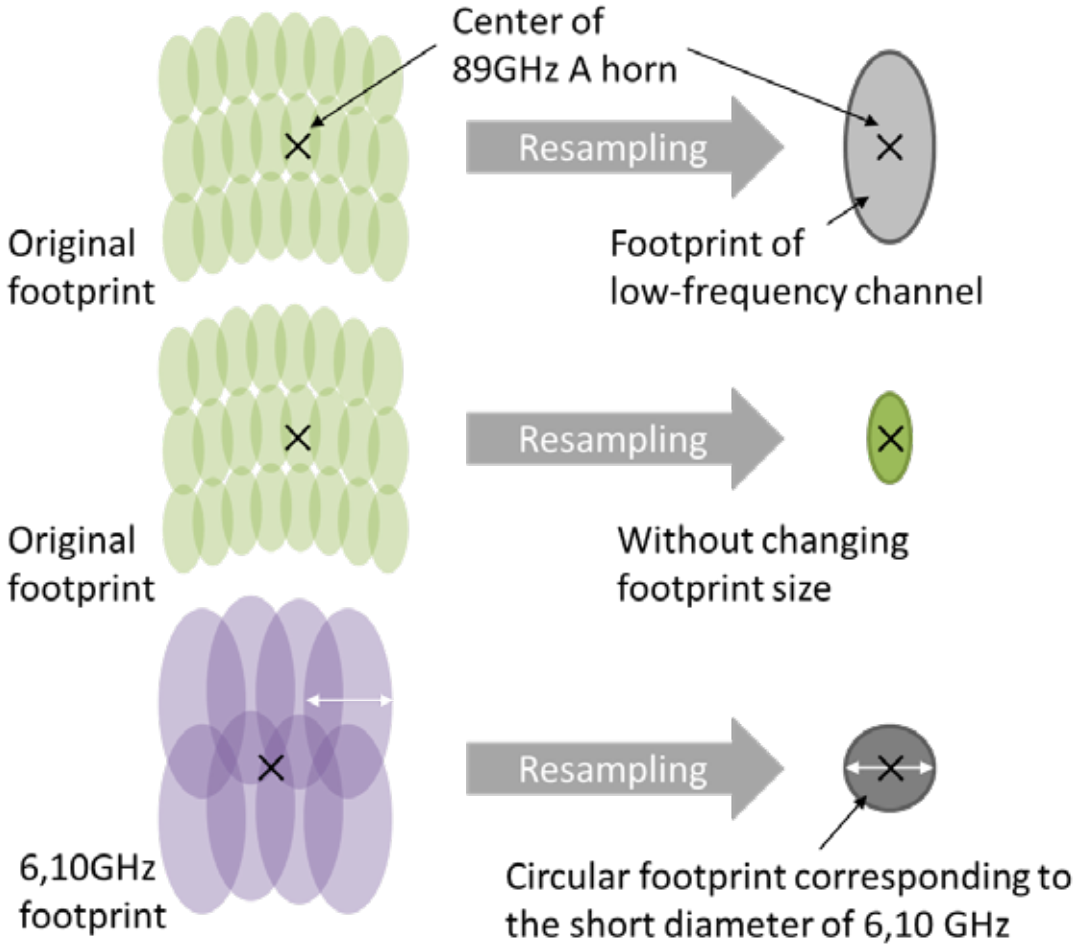
List of AMSR3 Standard Products (as of Mar. 2025)

Product	Area	Status in AMSR2
Brightness Temperature (L1B)	Global	Released (V2.2)
Resampled Brightness Temperature (L1R)	Global	Released (V2.2)
Integrated Water Vapor Content (ocean & land)	Global Ocean & Land (except vegetation/ice area)	Ocean: Released (V2.2) by H. Murata & M. Kazumori Land: Released (V1) as research product by H. Murata & M. Kazumori
Integrated Cloud Liquid Water Content	Global Ocean	Released (V2.2) by H. Murata & M. Kazumori
Precipitation (rainfall & snowfall) * to be consistent to GSMaP	Global	Rainfall: Released (V3.11) by K. Aonashi Snowfall: Under development for AMSR3 by G. Liu
Sea Surface Temperature (6GHz, 10GHz, multi-band)	Global Ocean	6GHz: Released (V4.11) by A. Shibata 10GHz & multi-band: Released (V4.11) as research product
Sea Surface Wind Speed	Global Ocean	Released (V4) by A. Shibata
All-weather Sea Surface Wind Speed	Global Ocean	Released (V3) as research product by A. Shibata
Sea Ice Concentration	High-lat. Ocean	Released (V3) by K. Cho & J. Comiso
High-resolution Sea Ice Concentration	High-lat. Ocean	Released (V1) as research product by G. Spreen & G. Heygster
Snow Depth	Global Land	Released (V2) by R. Kelly * New version for AMSR3 was released as research product
Soil Moisture Content	Global Land	Released (V3) by H. Fujii & T. Koike * New version for AMSR3 was released as research product

* Sea Ice Motion Vector by K. Shimada is being considered to upgrade from research to standard product in AMSR3.

Development of L1 Resampling Filter for AMSR3

- We will produce three resampling products from AMSR3 Level 1B based on heritage from AMSR2
- **L1R (standard)**：L1 Tb product resampled to be centered at the 89 GHz A-horn (odd-numbered) with the same footprint size as the low-frequency channel.
  →Optimization of resampling parameters and evaluation using AMSR2 real observations were performed.
- **L1C (research)**：L1 Tb product resampled to be centered at the 89 GHz A-horn (odd-numbered) without changing the footprint size.
  → Optimization of resampling parameters and evaluation using AMSR2 real observations were performed. Precipitation (PRC) products using L1C are now being evaluated.
- **L1H (research)**：L1 Tb product resampled so that the center position is the same as 89 GHz with a circular footprint which corresponds to a short radius of 6,10 GHz.
  →Optimization of resampling parameters and evaluation of using AMSR2 real observations is currently being performed. Evaluation of high-resolution sea surface temperature (HST) products using L1H is also ongoing.



Planning of Calibration/Validation

- Calibration strategy of AMSR3 brightness temperature is maximum utilization of practical methods, which were adopted for the previous AMSR series instruments.

BEFORE LAUNCH

- Identified sensor specifications related to calibration and reflected those to ground tests and analysis items.
- Reflected those into development of sensor model for radiometric and geometric conversions used as inputs of Level 1 processing algorithm.

INITIAL CALIBRATION/VALIDATION

- Initial calibration and validation phase will start after the initial checkout (3M after the launch)
- Radiometric calibration of Tb: on-board calibration with two radiation sources (CSM, HTS), inter-satellite calibration, and evaluation of sensor specification and data quality
- Geometric calibration: Comparing with coastlines and/or islands

EARLY DATA RELEASE

- Distribution of early L1 to partner agencies before the completion of initial CAL/VAL phase.
- Also provide them to selected PIs for algorithm tuning before the public release.

PUBLIC DATA RELASE

- Planned 1-year after the launch from the JAXA G-Portal system (https://gportal.jaxa.jp/gpr/).

Preparation toward Cross-Calibration of High-frequency Channels

1. Double Difference

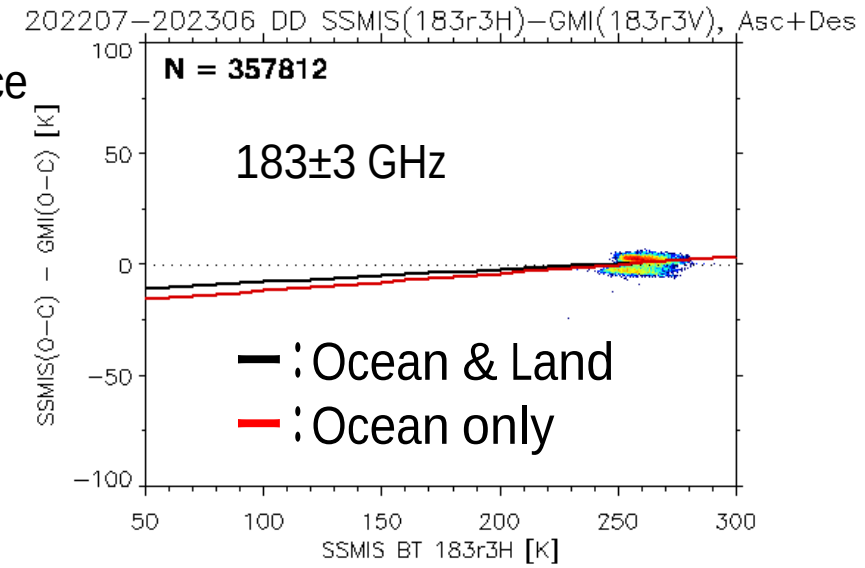
- Inter-satellite calibration using GMI (& SSMIS for polar regions).
- This method has been used for low-frequency cross-calibration during AMSR-E/2.

2. Calibration method using radiosonde observations

- Calibration is performed by comparing the GMI observed Tb with the Tb simulated by the radiative transfer model (RTTOV ver.13) using radiosonde observations (temperature, water vapor, and pressure profiles) as input
- Only data with sufficient water vapor (TPW > 20 kg/m2) are used for calibration to eliminate the influence of land surface radiation.
- Only data with Tb within 3σ are used for calibration to eliminate the influence of scattering by clouds and precipitation.

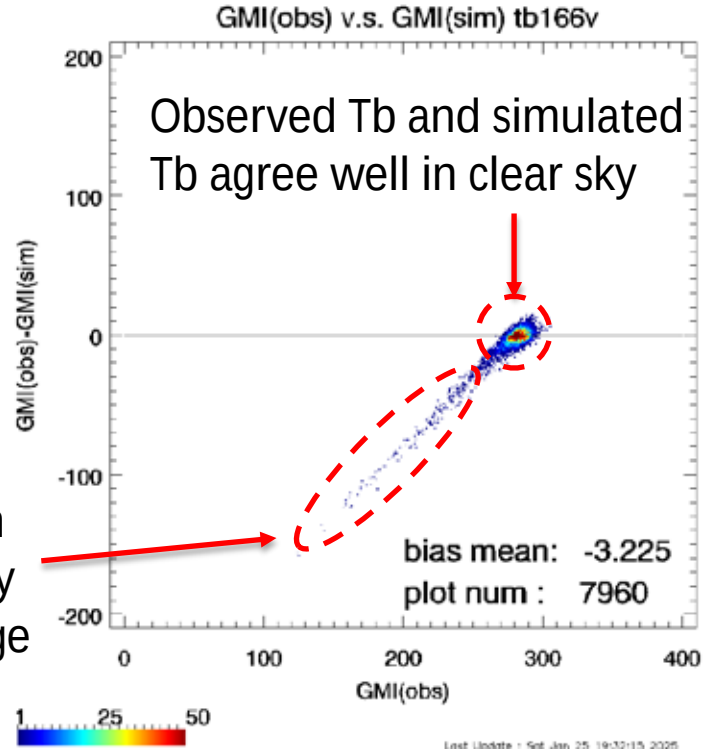
Method 1

Double Difference between GMI and SSMIS



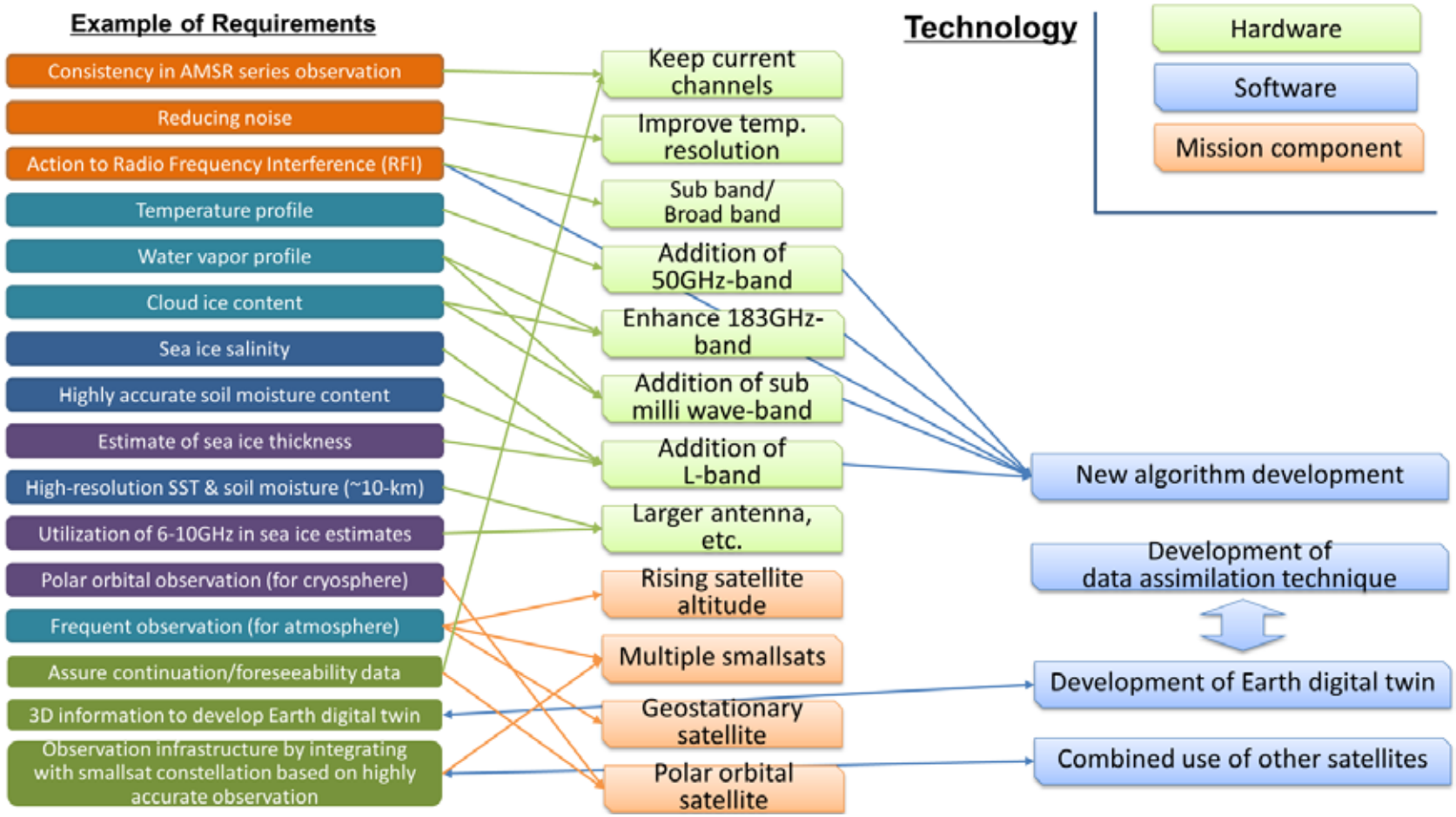
Method 2

Comparison of GMI Tb and simulated Tb from sonde observation



AMSR3 Follow-On Discussions Ongoing

- Discussions on AMSR3 follow-on mission started since Mar. 2021
  - AMSR user committee (domestic) & science team (international) for requirements
  - JAXA internal studies for HW feasibility
  - Iteration among science users, stakeholders, and engineers
- Consortium for Satellite Earth Observation (CONSEO) of Japan newly established the Microwave Radiometer Observation Working Group in Sep. 2024
  - To discuss what future microwave radiometer observation will be needed in Japan among government-academic-commercial communities
  - Discussion is not limited to “AMSR3 follow-on”
  - Discussion during JFY2024-2025 to develop proposal for the government



Summary

- AMSR series -- A series of Japanese passive microwave radiometers with the world best capability: AMSR/AMSR-E, AMSR2, and AMSR3 (https://www.eorc.jaxa.jp/AMSR/)
- The upcoming AMSR3 will be installed on the GOSAT-GW satellite
  - GOSAT-GW system development is in the final stage of Phase D to be launched in the first half of JFY2025
  - AMSR3 - Additional G-band (166 & 183 GHz) to enable monitoring of global precipitation (rain & snow) and contribute to water vapor analysis in NWP, and additional 10.25 GHz channels with improved NEDT for robust SST with higher spatial resolution
  - Development of Level 1 Resampling Filter for AMSR3 has been conducted.
  - Preparation of initial CAL/VAL activities are underway. Cross-calibration with AMSR2 and/or GMI Tb is planned after the initial check-out phase. Preparation for cross-calibration of high-frequency channels completed.
  - All AMSR3 standard products will be released to the public about one year after the launch. Early data access will be available to the selected PIs by the research announcement (RA) and partner agencies during CAL/VAL phase.

- AMSR3 F/O Discussions -- Ongoing with requirements from domestic & international users, along with discussion on what future microwave radiometer observation will be needed in Japan among government-academic-commercial communities.