Status of the Global Change Observation Mission (GCOM)

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Japan Aerospace Exploration Agency (JAXA) started the long term observation mission named GCOM (Global Change Observation Mission) in 2006. The GCOM is the Earth observation mission by two kinds of satellite series, that are GCOM-W (Water) and GCOM-C (Climate) series. To realize the long term observation for more than 10 years, 3 generations of satellites will be launched in each satellite series. The GCOM aims to monitor climate variability, focusing on the radiation budget, carbon cycle and water-energy cycle. The GCOM geophysical observation products are shown in Figure 1. Changes of cloud and aerosol and the radiative forcing are the major uncertainties in the climate modeling. Providing the information on carbon dioxide sources and sinks is necessary for complete understanding of the global warming. Cooperation with numerical prediction models will make the future climate change prediction more precise. This mission will contribute not only to more precise climate change prediction, but also to the efficient usage of the Earth observation data by the operational users, ex. metrological agency or fishery information service. For short-term weather forecasting, the satellite observation is becoming an indispensable data source to generate better initial values through data assimilation techniques.

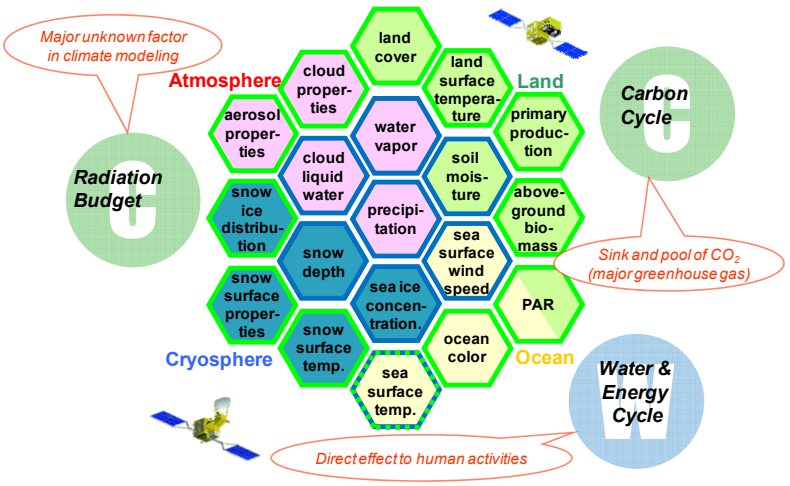

Figure 1. GCOM geophysical observation products

GCOM-W1 (nicknamed “SHIZUKU”) and GCOM-C1 are the first generation of satellite series. Each one is a medium-size, polar-orbiting satellite with a single observing instrument. The in orbit configurations of both satellites are illustrated in Figure 2 and Figure 5, respectively. GCOM-W1 carries the Advanced Microwave Scanning Radiometer 2 (AMSR2) and GCOM-C1 is equipped with the Second-generation Global Imager (SGLI). AMSR2 follows the observation of AMSR-E on-board Aqua, which stopped the observation in October, 2011. AMSR2 is a multi-frequency, total-power microwave radiometer system with dual polarization channels for all frequency bands. The basic function is almost identical to that of AMSR-E. The frequency bands include 6.925, 7.3, 10.65, 18.7, 23.8, 36.5, and 89.0 GHz, shown in Table 1. The 7.3 GHz channels are new channels to help to mitigate the radio-frequency interference from the ground in 6.925 GHz channels. The SGLI instrument consists of the Visible and Near-infrared Radiometer (VNR) and the Infrared Scanner (IRS). VNR has the unique features of 250 m spatial resolution for most of the visible channels and polarization/multidirectional observation capabilities. The 250 m spatial resolution will provide enhanced observation capability over land and coastal areas where the influences of human activity

are most evident. The polarization observation will enable us to retrieve aerosol information over land. The IRS has 500m resolution for thermal channels. From the information gathered by the 19 channels of SGLI, considerable number of products will be produced. The SGLI characteristics are shown in Table 2.

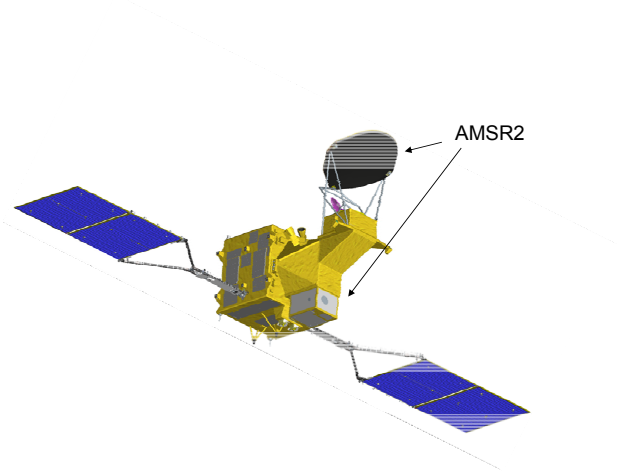

Figure 2. GCOM-W1 configuration in orbit

Table 1. AMSR2 observation channels

AMSR2 Channel Set				
Center Freq. [GHz]	Band width [MHz]	Polarization	Beam width [deg] (Ground res. [km])	Sampling interval [km]
6.925/ 7.3	350	V and H	1.8 (35 x 62)	10
			1.7 (34 x 58)	
10.65	100		1.2 (24 x 42)	
18.7	200		0.65 (14 x 22)	
23.8	400		0.75 (15 x 26)	
36.5	1000		0.35 (7 x 12)	
89.0	3000		0.15 (3 x 5)	5

GCOM-W1 was launched on May 18th (Japanese standard time), 2012 by H-IIA launch vehicle at Tanegashima Island. After launch GCOM-W1 deployed and rotated the solar paddles, deployed the antenna of AMSR2 and rotated it in 4 rpm, during about 1 day. The Figure 4 shows the photograph of the deployed AMSR2 antenna taken by onboard camera. The attitude control system and propulsion system were checked and then the maneuvers to enter the A-Train started on May 24th. The 6 maneuvers were performed and GCOM-W1 was successfully entered into the specified position of the A-Train, about 3 minutes earlier than Aqua (See Figure 3). After entering the A-Train AMSR2 was spun up to 40 rpm and its observation started on July 3rd. In parallel the commissioning of the satellite system was performed and all satellite functions turned out to be normal. The satellite went forward from the commissioning phase to the steady operational phase on August 10th. The observation data was received at the Svalbard Station every 100 minutes in order to improve the data latency. The calibration and validation work has been performed. The Level 1 products (brightness temperatures) were released on January 25th, 2013 and Level 2 products (8 geophysical products) are planned to be released in May, 2013. The observation data are available to general researchers in the website of GCOM-W1 data provision service (https://gcom-w1.jaxa.jp).

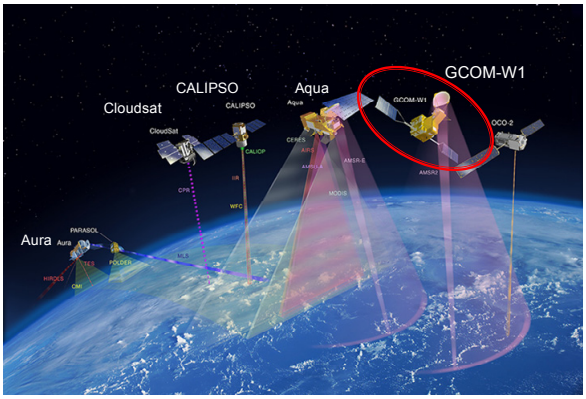

Figure 3. Afternoon constellation (A-Train)

Figure 4. Deployed AMSR2 antenna

GCOM-C1 started the development in JFY (Japanese Fiscal Year) 2009 and is under critical design phase. Testing of the

GCOM-C1 satellite mechanical and thermal models was finished. The instrument level test of SGLI EM was over and the electrical and optical performances were confirmed before/after or during environmental tests. The critical design review of the satellite system will be held in February, 2013 at the target to launch in JFY 2015.

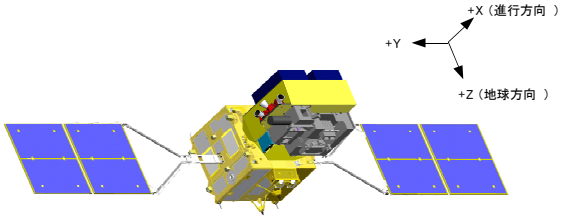

Figure 5. GCOM-C1 configuration in orbit

Table 2. SGLI observation channels

SGLI channels					
CH	λ	Δλ	L_{std}	L_{max}	IFOV
	VN, PL, SW: nm T: μm		VNR, SWI: W/m²/sr/μm T: Kelvin		m
VN1	380	10	60	210	250/1000
VN2	412	10	75	250	250/1000
VN3	443	10	64	400	250/1000
VN4	490	10	53	120	250/1000
VN5	530	20	41	350	250/1000
VN6	565	20	33	90	250/1000
VN7	673.5	20	23	62	250/1000
VN8			25	210	250/1000
VN9	763	12	40	350	250/1000
VN10	868.5	20	8	30	250/1000
VN11			30	300	250/1000
PL1	673.5	20	25	250	1000
PL2	868.5	20	30	300	1000
SW1	1050	20	57	248	1000
SW2	1380	20	8	103	1000
SW3	1630	200	3	50	250/1000
SW4	2210	50	1.9	20	1000
T1	10.8	0.74	300	340	500/1000
T2	12.0	0.74	300	340	500/1000

The international cooperation is inevitable to enhance the global Earth observation. Scientific cooperation of GCOM-W1 will be expanded among the A-Train satellites. The cooperation between GCOM and the Joint Polar Satellite System (JPSS) of the National Oceanic and Atmospheric Administration (NOAA) is on-going.