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Prepared by JAXA
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JAXA REPORT ON THE STATUS OF CURRENT AND FUTURE SATELLITE SYSTEMS

JAXA currently operates GOSAT, Ibuki and GCOM-W1, Shizuku.

GOSAT was launched on January 23, 2009, and has been operating properly since then. The data products are distributed through the GOSAT User Interface Gateway (GUIG).

GCOM-W1 was launched on May 18, 2012 and entered into the A-train orbit on June 29, then has moved to the regular observation operation on August 10 as scheduled after completion of the initial functional verification. The initial calibration and checkout are being performed, and the observation results are being released through JAXA press releases and its website.

The developments of ALOS-2, GPM/DPR, EarthCARE/CPR and GCOM-C1 are under way.

Both ALOS-2 and GPM core satellite will be launched in JFY2013. EarthCARE will be launched in JFY2015. GCOM-C1 will be launched in JFY2015 or later.

The specifications of current and planned data products are described in this Working Paper.

JAXA Report on the status of current and future satellite systems

1. Status of Current R&D Satellite Systems

Satellites	Space Agency	Equator Crossing Time + Altitude	Launch date	Access to data or products (Links)	Instruments	Status, applications and other information
TRMM	NASA/ JAXA	non-sun-synchronous (35° incl) 402 km	28/11/97	PMM data access page TRMM data products	- PR (Precipitation Radar) - TMI (TRMM MW Imager) - CERES - VIRS - LIS (Lightning Imaging Sensor)	Measures tropical rainfall/precipitation and radiation energy Precipitation Radar (PR) provided by JAXA Satellite bus and other instruments provided by NASA CERES no longer functional
GOSAT (IBUKI)	JAXA & Japan's Ministry of Environment	13:00 (D) 666km	23/01/2009		TANSO/FTS, TANSO/CAI	Greenhouse Gases Observing Satellite monitoring the distribution of the density of carbon dioxide
GCOM-W1 "SHIZUKU"	JAXA	13:30 (A) 700 km	18/05/2012		AMSR-2	Global water and energy circulation. Joining the A-train.

1.1 GOSAT (Ibuki)

The Greenhouse Gases Observing Satellite "IBUKI" (GOSAT) is the world's first spacecraft to measure the concentrations of carbon dioxide and methane, the two major greenhouse gases, from space. The spacecraft was launched successfully on January 23, 2009, and has been operating properly since then.

GOSAT observes infrared light reflected and emitted from the earth's surface and the atmosphere. Column abundances of CO2 and CH4 are calculated from the observational data. The column abundance of a gas species is expressed as the number of the gas molecules in a column above a unit surface area.

GOSAT flies at an altitude of approximately 666 km and completes one revolution in about 100 minutes. The satellite returns to the same point in space in three days. The observation instrument onboard the satellite is the Thermal And Near-infrared Sensor for carbon Observation (TANSO). TANSO is composed of two subunits: the Fourier Transform Spectrometer (FTS) and the Cloud and Aerosol Imager (CAI).

Specifications of FTS

	Band 1	Band 2	Band 3	Band 4
Spectral coverage (μm)	0.758-0.775	1.56-1.72	1.92-2.08	5.56-14.3
Spectral resolution (cm^{-1})	0.2	0.2	0.2	0.2
Polarized light observation	Performed	Performed	Performed	Not Performed
Targeted gases	O_2	$CO_2 \cdot CH_4$	$CO_2 \cdot H_2O$	$CO_2 \cdot CH_4$
Angle of instantaneous field of view	15.8 mrad.(corresponds to 10.5 km when projected on the earth's surface)			
Time necessary for a single scanning (sec.)	4.0 , 2.0 , or 1.1 (depending on the scanning mode being used)			

Specifications of CAI

	Band 1	Band 2	Band 3	Band 4
Spectral coverage (μm)	0.370-0.390 (0.380)	0.664-0.684 (0.674)	0.860-0.880 (0.870)	1.56-1.65 (1.60)
Targeted substances	Cloud and aerosol			
Swath (km)	1000	1000	1000	750
Spatial resolution at nadir (km)	0.5	0.5	0.5	1.5

All types of the GOSAT data products are to be provided for general users. Data users can search and order the Level 1 data (FTS Level 1B, CAI Level 1B, and CAI Level 1B+ data) and the higher level data products (FTS Level 2, CAI Level 2, FTS Level 3, CAI Level 3, Level 4A, and Level 4B data products). Among these, only the

Level 1 data and some of the Level 2 data products whose uncertainties have been evaluated in the instrument calibration and data validation activities are open to the general users so far. Other data products are still under preparation.

The GOSAT data products are distributed through the GOSAT User Interface Gateway (GUIG*), a website for GOSAT data distribution. Prior user registration is required for accessing the data products and can be done on "user authentication" page reached from "product & service" page on GUIG.

GUID:https://data.gosat.nies.go.jp/GosatUserInterfaceGateway/guig/GuigPage/open.do;jsessionid=0F6497855D3B130F97D71E3D2BEC9323?lang=en*

GOSAT Data Products

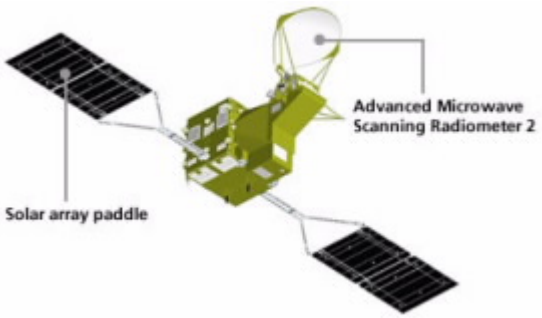
Product Level	Sensor / Band	Product Designation	Description	Product Provision Unit	Data Format
L1B	FTS	FTS L1B data	Radiance spectral data obtained by performing Fourier transform on interferogram data	per FTS scene	HDF5
	CAI	CAI L1B data	Radiance data (band-to-band and geometric corrections applied / data mapping not performed)	per CAI frame	
L1B+	CAI	CAI L1B+ data	Radiance data (band-to-band and geometric corrections applied / data mapping performed)		
L2	FTS SWIR	L2 CO_2 column amount (SWIR)	CO_2 column abandance data retrieved from SWIR radiance spectral data	can be selected	HDF5
		L2 CH_4 column amount (SWIR)	CH_4 column abandance data retrieved from SWIR radiance spectral data		
	FTS TIR	L2 CO_2 profile (TIR)	CO_2 vertical profile data retrieved from TIR radiance spectral data		
		L2 CH_4 profile (TIR)	CH_4 vertical profile data retrieved from TIR radiance spectral data		
	CAI	L2 cloud flag	Cloud coverage data	per CAI frame	
L3	FTS SWIR	L3 global CO_2 distribution (SWIR)	CO_2 column-averaged mixing ratio data projected on a global map	per month (global)	
		L3 global CH_4 distribution (SWIR)	CH_4 column-averaged mixing ratio data projected on a global map		
	FTS TIR	L3 global CO_2 distribution (TIR)	CO_2 concentrations at each vertical level projected on a global map		
		L3 global CH_4 distribution (TIR)	CH_4 concentrations at each vertical level projected on a global map		
	CAI	L3 global radiance distribution	Global radiance distribution data (3 days worth, including data for cloudy segments)	per 3 days (global)	
		L3 global reflectance distribution (clear-sky)	Clear-sky reflectance data (composed only of clear-sky segments selected from a month worth of data)		
		L3 global NDVI	Vegitation index global distribution data (cloudy segments excluded)	per 15 days 30° x 60° (lat. x lon.)	
L4A	-	L4A global CO_2 flux	CO_2 flux per each of 64 global regions (monthly average)	per year (64 regions)	Text
L4B	-	L4B global CO_2 distribution	Three-dimentional global distribution of CO_2 concentration	per month 2.5° x 2.5° grid (lat. x lon.)	NetCDF

References

http://www.gosat.nies.go.jp/eng/gosat/info.htm

1.2 GCOM-W1 (Shizuku)

The Global Change Observation Mission 1st - Water "SHIZUKU" (GCOM-W1) mission aims to establish the global and long-term observation system to collect data, which is needed to understand mechanisms of climate and water cycle variations, and demonstrate its utilization. Advanced Microwave Scanning Radiometer 2 (AMSR2) onboard the GCOM-W1 satellite will continue Aqua/AMSR-E observations of water vapor, cloud liquid water, precipitation, SST, sea surface wind speed, sea ice concentration, snow depth, and soil moisture.



GCOM-W1 was launched from the Tanegashima Space Center at 1:39 am on May 18, 2012 (Japan Standard Time) and entered into the A-train orbit on June 29. The A-Train satellite constellation cross the equator within a few minutes of one another at around 1:30 pm local time, and GCOM-W1 is flying in front of the Aqua satellite, thus it takes the most front position in the A-Train until another NASA satellite, OCO-2 joins the constellation. GCOM-W1 has started the initial observations since July 3, after increasing the antenna rotation of the onboard AMSR2 to 40 rpm, then has moved to the regular observation operation on August 10 as scheduled after completion of the initial functional verification

AMSR2 onboard the GCOM-W1 satellite is a remote sensing instrument for measuring weak microwave emission from the surface and the atmosphere of the Earth. From about 700 km above the Earth, AMSR2 will provide us highly accurate measurements of the intensity of microwave emission and scattering. The antenna of AMSR2 rotates once per 1.5 seconds and obtains data over a 1450 km swath. This conical scan mechanism enables AMSR2 to acquire a set of daytime and night-time data with more than 99% coverage of the Earth every 2 days.

The initial calibration and checkout are being performed, during which acquired data will be compared with observation data on the ground for confirming data accuracy and make some data correction. The observation results are being released through press releases and website (https://gcom-w1.jaxa.jp/auth.html).

Frequency Channels and Resolutions of AMSR2
(Orbit altitude of 700 km and main-reflector size of 2.0m are assumed)

Center frequency [GHz]	Band width [MHz]	Polarization	Beam width [deg.] (Ground resolution [km])	Sampling interval [km]
6.925 / 7.3	350	V and H	1.8 (35 x 62)	10
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 Standard Products

Product	Range	Comments
Brightness temperatures		
Brightness temperatures	2.7-340K	Global, 6 frequency with dual polarizations
Geophysical parameters		
Integrated water vapour	0 - 70kg/m^2	Over global ocean*, columnar integrated value
Integrated cloud liquid water	0 - 1.0kg/m^2	Over global ocean*, columnar integrated value
Precipitation	0 - 20mm/h	Global (except over ice and snow), surface rain rate
Sea surface temperature	-2 - 35℃	Global ocean*
Sea surface wind speed	0 - 30m/s	Global ocean*
Sea ice concentration	0 - 100%	High latitude ocean areas
Snow depth	0 - 100cm	Land surface (except dense forest regions)
Soil moisture	0 - 40%	Land surface (except ice sheet and dense forest regions)

* *Except sea ice and precipitating areas*

References

http://www.jaxa.jp/projects/sat/gcom/index_e.html
http://suzaku.eorc.jaxa.jp/GCOM/index.html

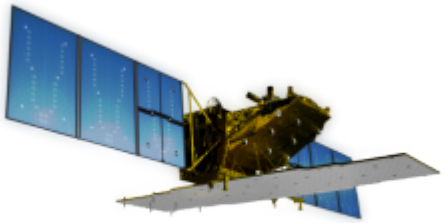
2. Status of Future R&D Satellite Systems

Satellites	Space Agency	Equator Crossing Time + Altitude	Planned Launch Date	Planned access to data or products (Links)	Planned Instruments	Status, applications and other information
ALOS-2	JAXA	12:00 628km	Japan Fiscal Year 2013			PALSAR-2
GPM (Core Observatory)	NASA / JAXA	407 km Non sun-synchronous (65° incl)	Feb 2014	Data access		Global Precipitation Measurement core spacecraft, follow-on and improvement of TRMM Dual-frequency (Ka/Ku) Precipitation Radar (DPR), GPM Microwave Imager (GMI)
EarthCARE	ESA-JAXA	10:30 (D) 450 km	11/2015			ATLID, BBR, CPR, MSI, Cloud, radiation and aerosol interaction processes
GCOM-C1	JAXA	10:30 (D) 798 km	Japan Fiscal Year 2015 or later			Carbon cycle and radiation budget (Atmosphere, Ocean,

						Land and Cryosphere)

2.1 ALOS-2

The Advanced Land Observing Satellite-2 (ALOS-2) is a follow-on mission from the ALOS "Daichi". ALOS had contributed to cartography, regional observation, disaster monitoring, and resource surveys, until May 2011. ALOS-2 will succeed to this mission with enhanced capabilities. Specifically, JAXA is conducting research and development activities to improve wide and high-resolution observation technologies developed for ALOS in order to further fulfil social needs.



These social needs include: 1) Disaster monitoring of damage areas, both in considerable detail, and when these areas may be large 2) Continuous updating of data archives related to national land and infrastructure information 3) Effective monitoring of cultivated areas 4) Global monitoring of tropical rain forests to identify carbon sinks.

The state-of-the-art L-band Synthetic Aperture Radar (PALSAR-2) aboard ALOS-2, which is an active microwave radar using the 1.2GHz frequency range, will, in responding to society's needs, have enhanced performance compared to ALOS/PALSAR. PALSAR-2 is capable of observing day and night, and in all weather conditions.

ALOS-2 will be launched by the H-IIA Launch Vehicle.

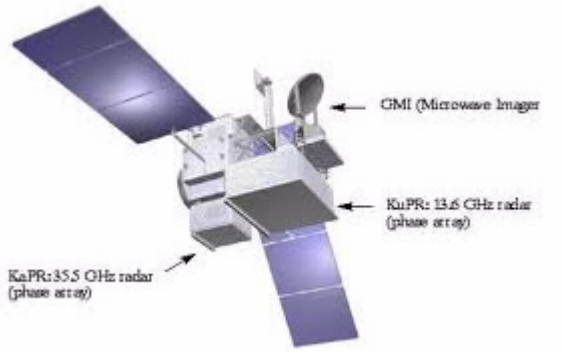
Major characteristics of ALOS-2

Observation mode	Spotlight: 1m~3m resolution, 25km swath Stripmap: 3m~10m resolution, 50km~70km swath ScanSAR: 100m resolution, 350km/490km swath
Orbit	Type: Sun-synchronous sub-recurrent orbit Altitude: 628km Local sun time at Descending Node: 12:00 +/-15min Revisit time: 14 days
Design life	5 years (target: 7 years)
Mass	Approx. 2 ton

References

http://www.jaxa.jp/projects/sat/alos2/index_e.html

2.2 GPM and DPR



The Global Precipitation Mission (GPM) is a satellite program to measure the global distribution of precipitation accurately in a sufficient frequency so that the information provided by this program can drastically improve weather predictions, climate modelling, and understanding of water cycles. Its feasibility has been studied at Goddard Space Flight Center of National Aeronautics and Space Administration (NASA) and JAXA. The accurate measurement of precipitation will be achieved by the Dual-frequency Precipitation Radar (DPR) installed on the GPM core satellite. The DPR on the GPM core satellite is being developed by JAXA and National Institute of Information and Communications Technology (NICT).

NASA and JAXA signed implementation phase MOU in July 2009. DPR Critical Design Review (CDR) completed in October 2009. While, NASA Mission CDR completed in December 2009. DPR flight model was manufactured and tested at JAXA Tsukuba Space Center, and the flight model was delivered to NASA Goddard Space Flight Center on March 2012 The integration of DPR onto the GPM Core Observatory was successfully completed in May 2012.

The GPM Core Observatory carrying DPR (KuPR and KaPR) and GPM Microwave Imager (GMI) is scheduled to be launched in early 2014 from JAXA's Tanegashima Space Center. Its orbit will be non-sun-synchronous with 407km altitude and 65 degrees inclination.

Major characteristics of DPR

Name	KuPR	KaPR
radar type	active phased array radar	
Antenna	slotted waveguide antenna	
Frequency	Ku-band 13.60 GHz	Ka-band 35.55 GHz
peak transmit power	> 1000 W	> 140 W
Swath	245 km	125 km
horizontal resolution	5 km	
range resolution	250 m	250m/500m
observation altitude	surface ~ 19 km	
observation rain rate	0.5 mm/h ~	0.2 mm/h ~
Size	2.4 m x 2.4 m x 0.6 m	1.44 m x 1.07 m x 0.7 m
	< 470 kg	< 336 kg

JAXA GPM Data Products

There are three kinds of products that are Standard product, Research product and Near-real time product. Research products are the ones in research phases; however, those have possibilities to be Standard products. Several candidates for research product are considered at JAXA GPM project, and will be defined later. Near-real time products will be generated using estimated orbital information for prompt data release and distributed to users who need GPM data as soon as possible for their operational purposes.

Current plan of JAXA GPM products is updated. Other than JAXA products listed up in the following Table, some of the GPM standard products processed at NASA will be distributed from JAXA. GPM standard products will be authorized between the U.S. and Japan Joint Precipitation Measuring Mission (PMM) Science Team.

JAXA is responsible for the GPM/DPR algorithm development for engineering values (Level 1) and physical products (e.g. precipitation estimation) (Level 2 and 3) and the quality control of the products as the sensor provider. Furthermore, JAXA is planning to generate the DPR/GMI combined algorithms, which will be based on DPR maximizing the use of DPR information, and Global Precipitation Map product, which will merge multiple satellite information and mapped data with high temporal resolution, considering data needs in some operational areas such as weather forecasts and flood warning. Higher level of DPR and DPR/GMI combined algorithms are jointly developed by Japan and US joint algorithm team.

To meet the GPM objectives, retrieval algorithms will require global applicability, robustness, and long-term stability. Algorithms that can be extended and applied for similar instruments (e.g., PR, and microwave radiometers on board the other satellites) and historical data records are preferable for integrated retrieval. Computationally efficient, fast-processing algorithms are important for the operational applications of the products. Level 2 of the Dual-frequency Precipitation product and the DPR/GMI combined product and Level 3 Global Precipitation Map product, which are denoted in light grey in the table below, are also required to process in near real time. Each near-real-time algorithm will be developed based on the standard algorithm. All near-real-time products have to be produced and distributed within 60 minutes after acquisition of observation data.

JAXA GPM near-real-time products

Level	Algorithm	Product	Major Physical Parameters	Unit	Coverage
1R	Depends on each sensor	Microwave radiometer product	Brightness temperature	arbitrarily	Depends on each sensor
2R	DPR algorithm (Japan-US joint)	Dual-frequency precipitation product	Rain rate profile, drop size distribution, precipitation status (rain/snow), attenuation profile	arbitrarily	245km
	DPR/GMI combined algorithm (Japan-US joint)	DPR/GMI combined product	rain rate profile, surface rain rate	Orbit	125km
3R	Global precipitation map algorithm	Global precipitation map product	Mean rainfall, observation number, rain pixel number	Hourly	Global

JAXA GPM Standard Products

Level	Algorithm	Product	Major physical parameter	Unit	Coverage
1	KuPR algorithm	KuPR product	Received power profile	Orbit	245km (swath)
	KaPR algorithm	KaPR product	Received power profile	Orbit	125km (swath)
2	DPR algorithm (Japan-US joint)	KuPR product	Radar reflectivity profile, normalized radar surface cross section (σ^0), rain type, bright-band height, attenuation corrected radar reflectivity profile, rain rate profile	Orbit	245km (swath)
		KaPR product	Radar reflectivity profile, normalized radar surface cross section (σ^0), rain type, bright-band height, attenuation corrected radar reflectivity profile, rain rate profile	Orbit	125km (swath)
		Dual-frequency precipitation product	Rain rate profile, drop size distribution, precipitation status (rain/snow), attenuation profile	Orbit	245km (swath)
	DPR/GMI combined algorithm (Japan-US joint)	DPR/GMI combined product	rain rate profile, surface rain rate	Orbit	245km (swath)
	DPR latent heating algorithm	DPR latent heating product	Latent heating profile, rain type	Orbit	245km (swath)

JAXA GPM Standard Products (Cont'd)

Level	Algorithm	Product	Major physical parameter	Unit	Coverage
3	DPR algorithm (Japan-US joint)	Dual-frequency precipitation product	Mean surface rainfall, time information, Ascending/Descending flag	Daily	Global
			Mean rainfall (dual), observation number, rain pixel number, mean bright-band height, storm height, rain/snow determination, time information	Daily (Asc/Dsc)	Global
			Mean rainfall (single, dual), observation number, rain pixel number, mean bright-band height, storm height, mean attenuation corrected radar reflectivity profile, mean DSD parameters, histogram	Monthly	Global
	DPR/GMI combined algorithm (Japan-US joint)	DPR/GMI combined product	Mean rainfall, observation number, rain pixel number,	Monthly	Global
	DPR latent heating algorithm	DPR latent heating product	Latent heating profile, number of latent heating pixel	Orbit	Global
				Monthly	Global
	Global precipitation map algorithm	Global precipitation map product	Mean rainfall, observation number, rain pixel number	Hourly	Global
				Monthly	Global

NOTE: Other than these products listed up in this table, some of the GPM standard products processed at NASA will be distributed from JAXA. GPM standard products will be authorized between the U.S. and Japan Joint PMM Science Team.

CEOS Precipitation Constellation

CEOS Precipitation Constellation (PC) is proposed as one of first four virtual constellations, and JAXA and NASA is co-leading CEOS PC activities with other participating agencies.

CEOS PC holds annual meeting (International workshop) to exchange information of the individual satellite projects and specifications of instruments, and to establish annual or biennial Work Plan to implement the broad goals and specific phase objectives outlined in the PC Implementation Plan. The fourth CEOS PC International Workshop was held in 10 November 2011 in Denver, U.S., which was originally scheduled in April 2011 in Brazil, but postponed because of the March Earthquake in Japan. At the forth workshop, CEOS PC 2011-2012 Work Plan and 2009-2011 Accomplishment will be developed. In addition, the relationship of proposed CEOS PC Portal to the proposed CEOS Water Portal will be discussed at the workshop.

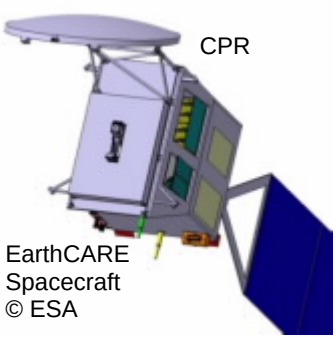
Results of the workshop will be uploaded to the CEOS PC web site (http://ceospc.gsfc.nasa.gov) operated by NASA.

As a follow up to discussion at the 4th workshop, the subsequent 2012 CEOS-GEO Actions Workshop, and the CEOS SIT-27 Meeting, JAXA and NASA, co-chairs of the CEOS PC, are proceeding with the first phase of the PC Data Portal Development. White Paper describing the concept and the implementation approach was distributed to PC members in September 2012. The PC Data Portal with interface to the CEOS Water Portal is a contribution to the GEO Water Strategy and 2012 CEOS-GEO Action WA-01-C1_3.

References

http://www.jaxa.jp/projects/sat/gpm/index_e.html
http://www.eorc.jaxa.jp/GPM/index_e.htm
http://pmm.gsfc.nasa.gov/
http://ceospc.gsfc.nasa.gov/

2.3 EarthCARE and CPR



The Earth Clouds, Aerosols and Radiation Explorer (EarthCARE) is a joint European-Japanese mission addressing the need for a better understanding of the interactions between cloud, radiative and aerosol processes that play a role in climate regulation. Japan (JAXA and NiCT) will provide Cloud Profiling Radar (CPR) to the spacecraft.

CPR is a 94 GHz Doppler Radar which has several characteristics. First point is the high sensitivity. This requirement is divided into large antenna size requirement, low noise figure of receiver requirement and high power of transmitter requirement. Second point is the Doppler capability. To materialize this function with satisfactory accuracy, large diameter of antenna with precise surface figure and high pulse repetition frequency (PRF) are required. To keep accuracy especially at boundary layer region, several other fine characteristics, such as side lobe characteristics of antenna, cross polarization characteristics and so on, are also required for CPR design.

CPR Major Specifications (Draft)

Radar type	94 GHz Doppler Radar
Center frequency	94.05 GHz
Pulse width	3.3 micro second (equivalent to 500m vertical resolution)
Beam width	0.095 deg
Polarization	Circular
Transmit power	> 1.5 kW (Klystron spec.)
Height range	-0.5 ~ 20 km
Resolution	500 m (100 m sample); Vertical, 500m integration; Horizontal
Sensitivity*	-35 ~ +21 dBZ
Radiometric accuracy*	< 2.7 dB
Doppler range*	-10 ~ +10 m/s
Doppler accuracy*	< 1 m/s
Pulse repetition frequency	Variable; 6100~7500 Hz
Pointing accuracy	< 0.015 degree

**; at 10 km integration and 387 km orbit height*

JAXA will produce not only CPR products but also other products from the each sensor and the synergetic use of other sensors.

EarthCARE JAXA Standard Products (1/2)

Standard Products (L1b)

Sensor(s)	Processing Level	Product Name	Primary Parameter	Pixel Integration Length		Pixel Spacing		Release Accuracy	Standard Accuracy	Target Accuracy
				Horizontal	Vertical	Horizontal	Vertical			
CPR	L1b	CPR One-sensor Received Echo Power and Doppler Products	Received Echo Power	0.5km	0.1km	0.5km	0.1km	< 4.7dB	< 2.7dB	-
			Radar Reflectivity Factor					< 4.7dB	< 2.7dB	< 2.7dB
			Surface Radar Cross Section		-		-	-	-	-
			Doppler Velocity		0.1km		0.1km	-	< 1m/s	< 0.2m/s
			Pulse Pair Covariance					-	-	-
			Spectrum Width					-	-	-

Standard Products (L2a)

Sensor(s)	Processing Level	Product Name	Primary Parameter	Pixel Integration Length		Pixel Spacing		Release Accuracy	Standard Accuracy	Target Accuracy
				Horizontal	Vertical	Horizontal	Vertical			
CPR	L2a	CPR One-sensor Echo Products	Integrated Radar Reflectivity Factor	1km 10km	0.1km 0.5km	1km	0.1km	-	-	-
			Integrated Doppler Velocity	1km *10km*	0.1km *0.5km*			-	< 1m/s	< 0.2m/s
			Gas Correction Factor	1km 10km	0.1km 0.5km			-	-	-
CPR	L2a	CPR One-sensor Cloud Products	Cloud Mask	1km *10km*	0.1km *0.5km*	1km	0.1km	±30%	±10%	±5%
			Cloud Particle Type	1km *10km*	0.1km *0.5km*			±100%	±50%	±20%
			Radar Reflective Factor with Attenuation Correction	*1km*	*0.1km*			< 7.6dB	< 5.7dB (*1)	< 4.5dB
			Liquid Water Content					-	±100%	±50%
			Ice Water Content					-	-	-
			Effective Radius of Liquid Water Cloud					-	-	-
			Effective Radius of Ice Water Cloud					-	-	-
			Optical Thickness		-		-	-	±100%	±50%
ATLID	L2a	ATLID One-sensor Cloud and Aerosol Products	Feature Mask	*200m* 1km 10km	*0.1km*	200m 1km 10km	0.1km	±100%	±40%	±10%
			Target Mask	1km *10km*	*0.1km*	1km 10km	0.1km	±100%	±40%	±10%
			Aerosol Extinction Coeff.	*10km*	*0.1km*	10km	0.1km	±60%	±40%	±20
			Aerosol Backscat. Coeff.					±90%	±70%	±50%
			Aerosol Lidar Ratio					±150%	±110%	±70%
			Aerosol Depolarization Ratio					±150%	±130%	±100%
			Cloud Extinction Coeff.	1km *10km*	*0.1km*	1km 10km	0.1km	±50%	±30%	±15%
			Cloud Backscat. Coeff.	1km *10km*	*0.1km*	1km 10km	0.1km	±90%	±70%	±50%
			Cloud Lidar Ratio	1km *10km*	*0.1km*	1km 10km	0.1km	±140%	±100%	±65%
			Cloud Depolarization Ratio	1km *10km*	*0.1km*	1km 10km	0.1km	±150%	±100%	±100%
			Planetary Boundary Layer Height	1km *10km*	*0.1km*	1km 10km	0.1km	±500m	±300m	±100m
MSI	L2a	MSI One-sensor Cloud Poducts	Cloud Flag including Cloud	*0.5km*	-	0.5km	-	±15% Ocean	±15%	±10%
			Optical Thickness of Liquid Water Cloud					±10%	±100% (converting to LWP)	±50% (converting to LWP)
			Effective Radius of Liquid (1.6 μm)					±30%		
			Effective Radius of Liquid (2.2 μm)							
			Cloud Top Temperature					±1K	±3K	±1.5K
			Cloud Top Pressure					-	-	-
			Cloud Top Height					-	-	-

EarthCARE JAXA Standard Products (2/2)

Sensor(s)	Processing Level			Pixel Integration Length		Pixel Spacing		Release Accuracy	Standard Accuracy	Target Accuracy
				Horizontal	Vertical	Horizontal	Vertical			
CPR + ATLID	L2b	CPR-ATLID Synergy Cloud Products	Cloud Mask	1km	0.1km	1km	0.1km	–	root mean square of errors of one-sensor products	–
				10km	0.5km			–		–
			Cloud Particle Type	1km	0.1km			–		–
				10km	0.5km			–		–
			Effective Radius of Liquid Water Cloud	1km	0.1km			–		±2μm
				10km	*0.5km*			–		
			Effective Radius of Ice Water Cloud	1km	0.1km			–		–
				10km	0.5km			–		–
			Liquid Water Content	1km	0.1km			–		±20%
				10km	*0.5km*			–		
			Ice Water Content	1km	0.1km			–		±30%
				10km	*0.5km*			–		
			Optical Thickness	1km	–		–	–		–
CPR + ATLID + MSI	L2b	CPR-ATLID-MSI Synergy Cloud Products	Cloud Mask	1km	0.1km	1km	0.1km	–	root mean square of errors of one-sensor products	–
				10km	0.5km			–		–
			Cloud Particle Type	1km	0.1km			–		–
				10km	0.5km			–		–
			Effective Radius of Liquid Water Cloud	1km	0.1km			–		±2μm
				10km	*0.5km*			–		
			Effective Radius of Ice Water Cloud	1km	0.1km			–		–
				10km	0.5km			–		–
			Liquid Water Content	1km	0.1km			–		±20%
				10km	*0.5km*			–		
			Ice Water Content	1km	0.1km			–		±30%
				10km	*0.5km*			–		
			Optical Thickness	1km	–		–	–		–
				10km				–		–
			Liquid Water Path	1km				–		–
				10km				–		–
			Ice Water Path	1km				–		–
				10km				–		–
CPR ATLID MSI BBR	L2b	Four Sensors Synergy Radiation Budget Products	SW Radiative Flux	*10km*	–	10km	–	–	±25W/m2	±10W/m2
			LW Radiative Flux							
			SW Radiative Heating Rate		0.5km		0.5km	–	–	–
			LW Radiative Heating Rate					–	–	–

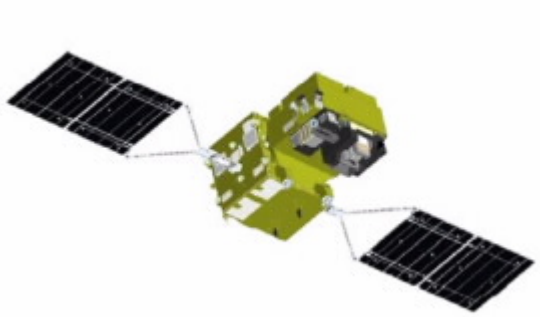
NOTE: The accuracy is defined using the "Pixel Integration Length" in red italic numbers. The accuracies of CPR L1b are defined by 10km integration. Those accuracies except for CPR are assumed under the condition that sensors developed by ESA functioned as expected. The accuracies of ATLID is based on the information before the change of specifications. The length of a scene is defined as the length of an orbit divided equally (default : 1scene = 1 orbit) CPR-ATLID-MSI Synergy Cloud Products and Four Sensors Synergy Radiation Budget Products are the final goal of the EarthCARE mission. Therefore, they are defined as the standard products, although they will be released one year after the start of MOP. Pixel Spacing of CPR-ATLID-MSI product is TBD.

Data Products were decided and the accuracy of them were also decided in Joint Mission Advisory Group consists of European and Japanese scientists

References

http://www.jaxa.jp/projects/sat/earthcare/index_e.html
http://www.eorc.jaxa.jp/EARTHCARE/en/index.html
http://www.esa.int/esaLP/LPearthcare.html

2.4 GCOM-C1



Climate change observation will be performed by the Second-generation Global Imager (SGLI), a multi-wavelength optical radiometer, onboard the GCOM-C (Climate) satellite on clouds, aerosol, seawater color (marine orgasms), vegetation, snow and ice.

The first generation of GCOM-C (called GCOM-C1) is scheduled to be launched in JFY2015 or later. Its orbit will be sun-synchronous with 798km altitude (over the equator), 98.6 degrees inclination and 10:30 local time of descending node.

SGLI Channel Specifications

CH			L_{std}	L_{max}	SNR at Lstd	IFOV
	VN, P, SW: nm T: m		VN, P: $W/m^2/sr/$ m T: Kelvin		VN, P, SW: - T: NE T	m
VN1	380	10	60	210	250	250
VN2	412	10	75	250	400	250
VN3	443	10	64	400	300	250
VN4	490	10	53	120	400	250
VN5	530	20	41	350	250	250
VN6	565	20	33	90	400	250
VN7	673.5	20	23	62	400	250
VN8	673.5	20	25	210	250	250
VN9	763	12	40	350	400	1000
VN10	868.5	20	8	30	400	250
VN11	868.5	20	30	300	200	250
P1	673.5	20	25	250	250	1000
P2	868.5	20	30	300	250	1000
SW1	1050	20	57	248	500	1000
SW2	1380	20	8	103	150	1000
SW3	1630	200	3	50	57	250
SW4	2210	50	1.9	20	211(TBD)	1000
T1	10.8	0.74	300	340	0.2	500
T2	12.0	0.74	300	340	0.2	500

*[*1]Polarization channels (P1 and P2) should have capability to observe at three polarization direction (0,60,120 deg.) and NADIR / Tilt view at +-45 deg.*

GCOM-C1 Standard products

Area	Group	Product	Day/night	Grid size
Common	Radiance	Top-Of-Atmosphere radiance (including system geometric correction)	*TIR and land 2.2mm:* Both *Other VNR,SWI :* Daytime (+special operation)	VNR,SWI Land/coast: 250m, offshore: 1km, polarimetory:1km TIR Land/coast: 500m, offshore: 1km
Land	Surface reflectance	Precise geometric correction	Both	250m
		Atmospheric corrected reflectance (incl. cloud detection)	Daytime	250m
	Vegetation and carbon cycle	Vegetation index		250m
		Above-ground biomass		1km
		Vegetation roughness index		1km
		Shadow index		250m, 1km
		fAPAR		250m
		Leaf area index		250m
	Temperature	Surface temperature	Both	500m
Atmosphere	Cloud	Cloud flag/Classification	Both	1km
		Classified cloud fraction	Daytime	1km (scene),
		Cloud top temp/height	Both	0.1deg (global)
		Water cloud OT/effective radius	Daytime	
		Ice cloud optical thickness		
	Aerosol	Aerosol over the ocean		
		Land aerosol by near ultra violet		
		Aerosol by Polarization		
Ocean	Ocean color	Normalized water leaving radiance (incl. cloud detection)	Daytime	250m (coast)
				1km (offshore)
		Atmospheric correction parameter		4~9km (global)
		Photosynthetically available radiation		
	In-water	Chlorophyll-a concentration		
		Suspended solid concentration		
		Colored dissolved organic matter		
	Temperature	Sea surface temperature	Both	500m (coast)
				1km (offshore)
				4~9km (global)
Cryosphere	Area/ distribution	Snow and Ice covered area (incl. cloud detection)	Daytime	250m (scene)
				1km (global)
		Okhotsk sea-ice distribution		250m
	Surface properties	Snow and ice surface Temperature		500m (scene)
		Snow grain size of shallow layer		1km (global)

Access to GCOM data

To R&D and operational organizations, JAXA can provide GCOM data which includes standard products, processed data and related information which meets users' needs to user organizations, via the JAXA on-line system (free of charge), optionally via a dedicated communication line or media upon users' needs (minimal cost charged) under the cooperative agreements with JAXA after commissioning (launch + 3 months) for Calibration and Validation, keeping the data latency, if required (GCOM-W1 global data: observation time + 150min.).

To general researchers, JAXA will provide GCOM standard product via the JAXA on-line system (free of charge) after Calibration and Validation phase in about one year after the launch. Simple registration and consent to data use conditions are required on the system. Before providing GCOM standard products, AMSR and AMSR-E standard products have been available on the system since August, 2011 (https://gcom-w1.jaxa.jp/).

Direct reception; receiving the real-time observation data from the GCOM satellites at the users' ground station can be available, subject to conditions defined by JAXA in an individual agreement. Actual cost due to the direct reception is charged on users, in principle. (e.g. cost for provision and maintenance of processing software)

Secondary distribution is basically prohibited, but R&D user agencies can distribute GCOM data to third parties, provided that they nominate the third parties to JAXA and make them comply with the 'rights and use conditions' specified in the GCOM data policy.

For commercial purpose, JAXA makes license agreements with commercial purpose users and imposes royalties on them.

References

http://www.jaxa.jp/projects/sat/gcom/index_e.html
http://suzaku.eorc.jaxa.jp/GCOM/index.html