Summary of the SGLI products Validation results (Ver. 3.00)

Earth Observation Research Center
Japan Aerospace Exploration Agency
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History

23 Dec. 2017	GCOM-C (SHIKISAI) launched from Tanegashima Space Center
01 Jan. 2018	Release of the SGLI First-light images
28 Mar. 2018	Initial function verification completed
20 Dec. 2018	Public release of first version Level- 1 and Level- 2 SGLI products
Aug. 2019	GCOM-C Science team decided version-up products
Jun. 2020	Public release of second version Level- 1 and Level- 2 SGLI products
30 Aug. 2021	Online mini-workshop
07 Sep. 2021	SGLI user committee meeting
29 Nov. 2021	Public release of third version Level- 2 SGLI products
Late 2022	Final review for the full/extra success of GCOM-C mission

Validation summary of the SGLI L1/L2 products

GCOM-C Success criteria (*data production aspect only*)

Success Level	Minimum Success [L + 1 yr]	Full Success [L + 5 yr]	Extra Success [L + 5 yr]
Standard Products	Complete the Cal. & Val. phase and start data distribution of <u>more than 20 products</u> achieving the <u>release accuracy thresholds</u>	Achieve <u>standard accuracy thresholds</u> of <u>all standard products</u>	Achieve <u>target accuracy thresholds</u> of one or more standard products

Results of the version-upgrade validation

Level/Area [The number of products]	L1 [1]	Land [9]	Atmosphere [8]	Ocean [7]	Cryosphere [4]	Total [29]
Release accuracy	1	9	8	7	4	29
Standard accuracy	1	9 (+5)	8 (+3)	7 (+2)	4 (+2)	29 (+12)
Target accuracy*	0	0	2	1 (±0)	0	3 (±0)

*the number of products achieved standard and target accuracy threshold
The numbers in parentheses are the differences of achieved product number from Ver.1.
Confirmation of achievement of standards and target accuracy will take place five years after launch.

Twelve products achieved newly standard accuracy through version-upgrade validation.

Standard products version up summary

-	Product	Algorithm	Validation	Ver.3 Major changes
L1	Level-1	JAXA		Correction for sensor sensitivity aging Reduction of linear noise (VNR) and horizontal stripes (TIR)

-	Product	Algorithm	Validation	Ver.3 Major changes
Land	Precise geometric correction	JAXA		NA
	Atmospheric corrected reflectance (incl. cloud detection)	JAXA	Land PIs	Revise of BRDF estimation and update QA
	Vegetation Index			NA
	Shadow Index	Land PI		Brush up the estimation coefficient and validation method and added solar altitude data
	Above-ground biomass	Land PIs	Land PIs	Update LUTs based on GEDI's observed data
	Vegetation roughness index	Land PI		NA
	fAPAR	JAXA, Land PI	Land PIs	Update of forest structure map using SGLI
	Leaf area Index			
	Land surface temperature	Land PI		Revise of cloud screening using *CLFG*

-	Product	Algorithm	Validation	Ver.3 Major changes
Atmosphere	Cloud flag/Classification	Atmosphere PIs	JAXA, Atmosphere PIs	Add the cloud and heavy aerosol screening using machine learning method focused on the snow region and night-time
	Classified cloud fraction	Atmosphere PIs	Atmosphere PIs	NA
	Cloud top temp/height			
	Water cloud optical thickness/effective radius			
	Ice cloud optical thickness			
	Aerosol over the ocean	JAXA, Atmosphere PIs	Atmosphere PIs	Integrated of aerosol retrieval algorithms using polarization channels and non-polarization channels
	Land aerosol by near ultra-violet			
	Aerosol by polarization			

Standard products version up summary

-	Product	Algorithm	Validation	Ver.3 Major changes
Ocean	Normalized water leaving radiance (incl. cloud detection)	Ocean PIs, JAXA	Ocean Pis	Algorithm and QA improvements, including modification of aerosol model and addition of underwater model.
	Atmospheric correction parameters			
	Photosynthetically available radiation	JAXA, Ocean PI		NA
	Chlorophyll-a concentration	JAXA		
	Suspended solid concentration	Ocean PI		NA
	Colored dissolved organic matter	Ocean PI		NA
	Sea surface temperature (incl. cloud detection)	JAXA		Revised cloud detection

-	Product	Algorithm	Validation	Ver.3 Major changes
Cryosphere	Snow and ice covered area (incl. cloud detection)	Cryosphere PI	Cryosphere PI	Revised training data set
	Okhotsk sea-ice distribution			
	Snow and ice surface temperature			Updated emissivity table Revised training data set Add the Snow Albedo as a research product
	Snow grain size of shallow layer			

Evaluation Status(1/2)

Ver.1/Ver.2 already achieved

	Products	Ver.3 Accuracy	Release Accuracy	Standard Accuracy	Target Accuracy
Land	Precise geometric correction	VNR:0.15-0.21,IRS:0.15-0.29	<1pixel	<0.5pixel	<0.25pixel
	Atmospheric corrected reflectance (incl. cloud detection)	**0.022 (<=443nm)** **0.035 (>443nm)**	0.3 (<=443nm), 0.2 (>443nm)	**0.1 (<=443nm), 0.05 (>443nm)**	0.05 (<=443nm), 0.025 (>443nm)
	Vegetation Index* NDVI EVI	Grass:8.4%, Forest:11.8% Grass:16.0%, Forest:14.7%	Grass: 25%, Forest: 20%	Grass: 20%, Forest: 15%	Grass: 10%, Forest: 10%
	Shadow Index	**14.0%**	30%	20%	10%
	Above-ground biomass	Grass:18.2%, Forest:31.9%	Grass : 50%, Forest : 100%	Grass : 30%, Forest : 50%	Grass : 10%, Forest : 20%
	Vegetation roughness index	**18.5%**	40%	20%	10%
	fAPAR	Grass:26.1%, Forest:8.5%	Grass: 50%, Forest: 50%	**Grass: 30%, Forest: 20%**	Grass: 20%, Forest: 10%
	Leaf area Index	Grass:28.5%, Forest:28.8%	Grass: 50%, Forest: 50%	Grass: 30%, Forest: 30%	Grass: 20%, Forest: 20%
	Land surface temperature	**1.996 K**	3.0 K	**2.5 K**	1.5 K
Atmosphere	**Cloud flag/Classification**	10.2%	10% (with whole-sky camera)	Incl. below cloud amount	Incl. below cloud amount
	Classified cloud fraction	10.2%	20% (on solar irradiance)	15% (on solar irradiance)	10% (on solar irradiance)
	Cloud top temp/height	-	1K	3K/2km	1.5K/1km
	Water cloud optical thickness/effective radius	**82%**	10%/30% (CloutOT/raduis)	100% (as cloud liquid water)	50%/20%
	Ice cloud optical thickness	**56%**	30%	70%	20%
	Aerosol over the ocean	**670nm:0.072 865nm:0.051**	0.1 (monthly ta_670,865)	0.1 (Scene ta_670,865)	0.05 (Scene ta_670,865)
	Land aerosol by near UV	**0.137**	0.15 (monthly ta_380)	**0.15 (scene ta_380)**	0.1 (scene ta_380)
	Aerosol by polarization	**0.137**	0.15 (monthly ta_670,865)	0.15 (scene ta_670,865)	0.1 (scene ta_670,865)

V3 updated algorithms

Ver.3 newly achieved

In principle, the numerical values of accuracy targets are defined in terms of root mean square error (RMSE), which has the same units as physical quantities. Note that the accuracy value described in the unit of ratio (%) is evaluated by the ratio between RMSE and the average value of field data. For the flag type product (cloud flag / type), the error rate (%) of the flag is statistically evaluated using the in-situ.
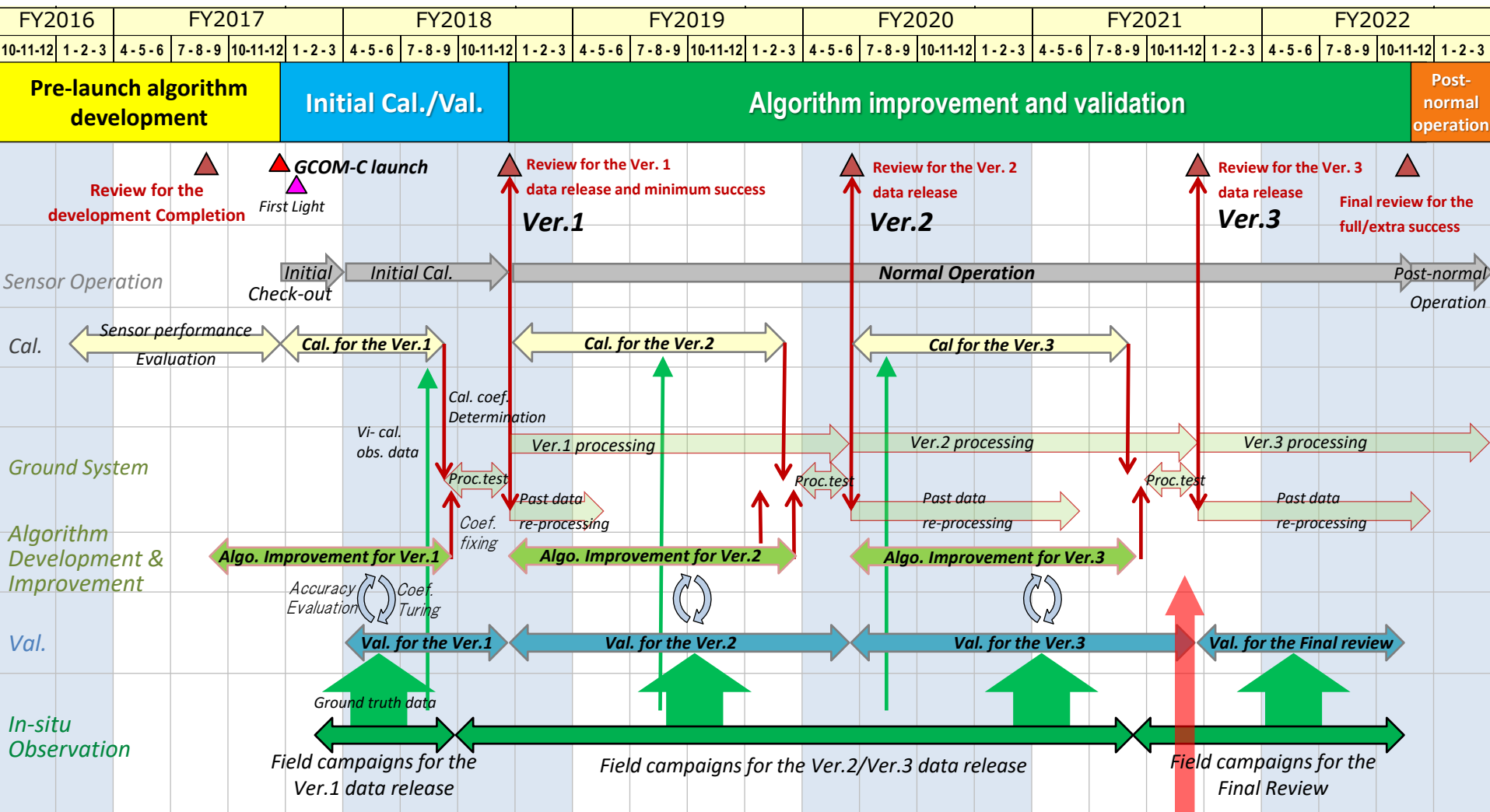
Ver.1/Ver.2 already achieved

	Products	Ver.3 Accuracy	Release Accuracy	Standard Accuracy	Target Accuracy
Ocean	**Normalized water leaving radiance (incl. cloud detection)**	**23~45% (<600nm) 0.50W/m²/sr/um(>600nm)**	60% (443~565nm)	50% (<600nm)	30% (<600nm)
				0.5W/m²/str/um (>600nm)	0.25W/m²/str/um (>600nm)
	Atmospheric correction parameters	**46%**	80% (ta_865nm)	50% (ta_865nm)	30% (ta_865nm)
	Photosynthetically available radiation	**8.9%**	20% (10km/month)	15% (10km/month)	**10% (10km/month)**
	Chlorophyll-a concentration	**-55~+121%**	-60~+150% (offshore)	**-60~+150%**	-35~+50% (offshore) -50~+100% (coast)
	Suspended solid concentration	**-59-+141%**	-60~+150% (offshore)	**-60~+150%**	-50~+100%
	Colored dissolved organic matter	**-54~+119%**	60% (443~565nm)	**-60~+150%**	-50~+100%
	Sea surface temperature (incl. cloud detection)	**Day:0.4 K,Night:0.4 K**	0.8K (daytime)	0.8K (day/night)	0.6K (day/night)
Cryosphere	**Snow and Ice covered area (incl. cloud detection)**	**6.5%**	10% (vicarious val. with other sat. data)	7%	5%
	Okhotsk sea-ice distribution	**5.0%**	10% (vicarious val. with other sat. data)	5%	3%
	Snow and ice surface Temperature	**1.6 K**	5K (vicarious val. with other sat. data and climatology data)	2K	1K
	Snow grain size of shallow layer	**50%**	100% (vicarious val. with climatology between temp-size)	**50%**	30%

V3 updated algorithms

Ver.3 newly achieved

In principle, the numerical values of accuracy targets are defined in terms of root mean square error (RMSE), which has the same units as physical quantities. Note that the accuracy value described in the unit of ratio (%) is evaluated by the ratio between RMSE and the average value of field data. For the flag type product (cloud flag / type), the error rate (%) of the flag is statistically evaluated using the in-situ.

Schedule for the GCOM-C mission