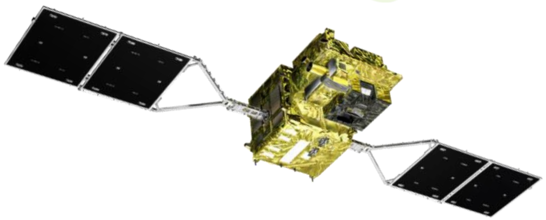


1.0 Agency Updates: New and Emerging Initiatives

1.1 JAXA: Update on GCOM-C/SGLI

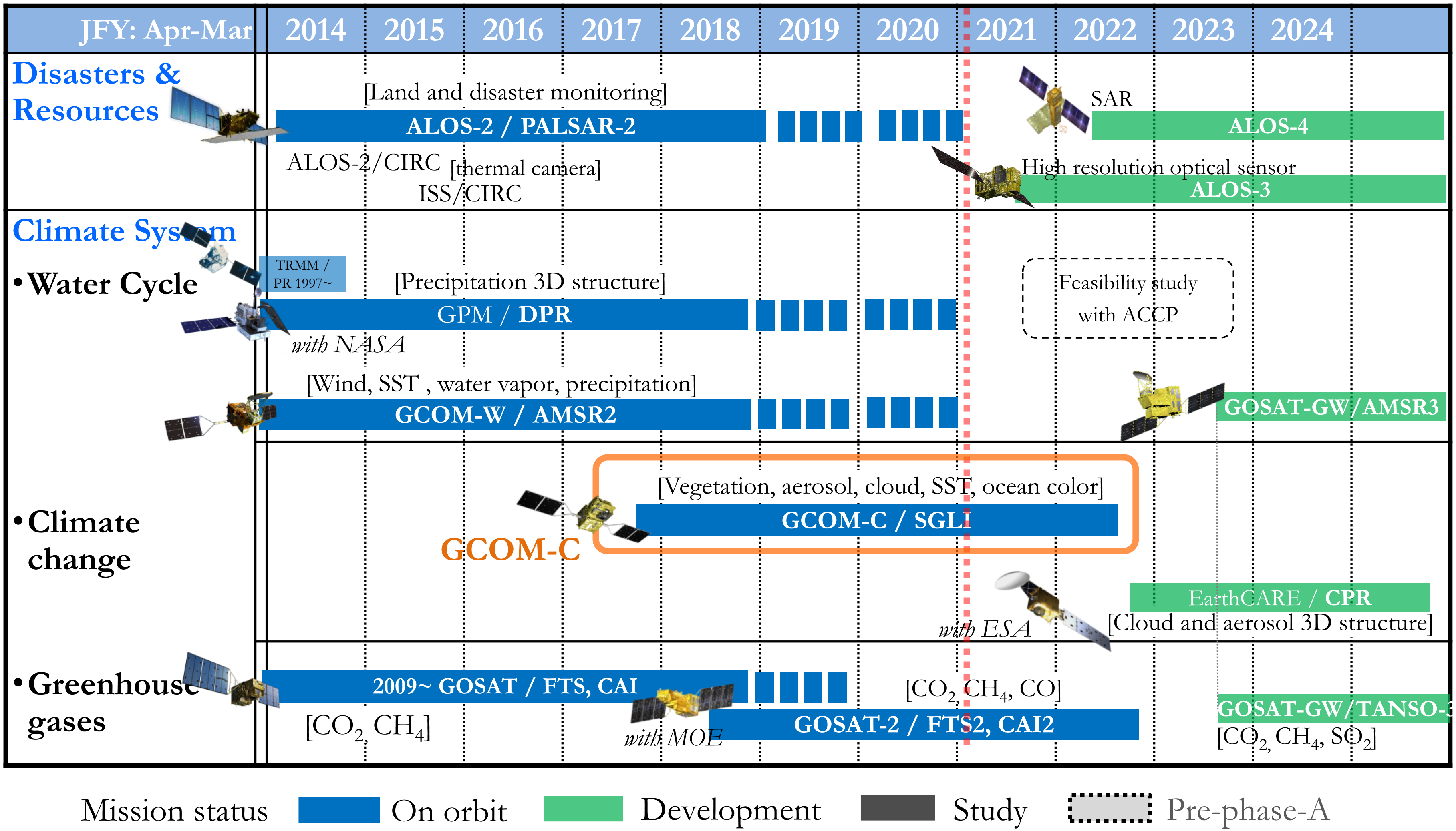
Hiroshi Murakami

JAXA/EORC

IOCCG-25 Virtual Committee Meeting

13 May 2021

1. JAXA Earth observation satellite missions



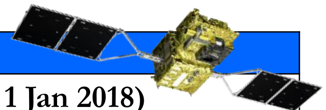
Ref: Advanced Land Observing Satellite-3: ALOS-3

ALOS-3 Specifications	
Mission instrument	Wide-swath and high-resolution optical imager 1. Panchromatic band (black and white) Ground resolution: 0.8 m / Swath width: 70 km at nadir Wavelength: 0.52 - 0.76 μm 2. Multi-band (color) Ground resolution: 3.2 m / Swath width: 70 km at nadir Band 1 0.40 - 0.45 μm (Coastal) Band 2 0.45 - 0.50 μm (Blue) Band 3 0.52 - 0.60 μm (Green) Band 4 0.61 - 0.69 μm (Red) Band 5 0.69 - 0.74 μm (Red Edge) Band 6 0.76 - 0.89 μm (Near-Infrared)
Data transmission method	Direct transmission to the ground (Ka band, X band) Optical data transmission via the optical data relay satellite
Size	5.0 m × 16.5 m × 3.6 m (after the solar paddle deployed)
Mass	Approx. 3 tons
Design life	7 years
Operational orbit	Sun-synchronous sub-recurrent orbit at an altitude of 669 km Revisit time 35 days (Sub-cycle: about 3 days) Local solar time at descending node: 10:30 (a.m.) +/- 15 minutes
Launch Vehicle	H3
Launch Date	JFY2021

✓ This mission is not dedicated for OC but can be used for coastal area research

2. GCOM-C/SGLI

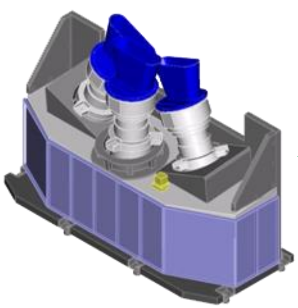
Global Change Observation Mission – Climate, named "SHIKISAI"



GCOM-C SGLI characteristics	
Launch Date	**23 Dec. 2017 (data since 1 Jan 2018)**
Weight	**2,000kg**
Orbit	Sun-synchronous (descending local time: 10:30), Altitude: 798km, Inclination: 98.6deg
Mission Life	5 years (3 satellites; total 13 years)
Scan	Push-broom electric scan (VNR: VN & P) Wisk-broom mechanical scan (IRS: SW & T)
Scan width	**1150km** cross track (VNR: NP & POL) **1400km** cross track (IRS: SWIR & TIR)
Spatial resolution	**250m, 500m, 1km**
Polarization	**3 polarization angles for POL**
Along track tilt	Nadir for VN, SW and TIR, & +/-45 deg for POL

Specification of SGLI spectral bands

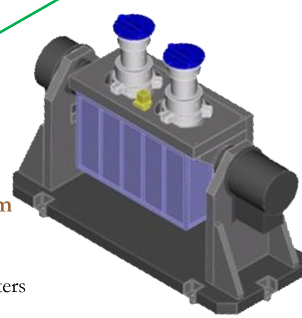
CH	λ	Δλ	L_{std}	L_{max}	SNR@L_{std}	IFOV
	nm		W/m²/sr/μm K: Kelvin		- K: NEΔT	m
VN1	380	10	60	210	250	**250** /1000
VN2	412	10	75	250	400	**250** /1000
VN3	443	10	64	400	300	**250** /1000
VN4	490	10	53	120	400	**250** /1000
VN5	530	20	41	350	250	**250** /1000
VN6	565	20	33	90	400	**250** /1000
VN7	673.5	20	23	62	400	**250** /1000
VN8	673.5	20	25	210	250	**250** /1000
VN9	763	12	40	350	1200*	250 /**1000***
VN10	868.5	20	8	30	400	**250** /1000
VN11	868.5	20	30	300	200	**250** /1000
POL1	673.5	20	25	250	250	**1000**
POL2	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** /1000
SW4	2210	50	1.9	20	211	**1000**
TIR1	10800	700	300K	340K	0.2K	250/**500**/1000
TIR2	12000	700	300K	340K	0.2K	250/**500**/1000



VNR-NP

Non-polarization three telescopes

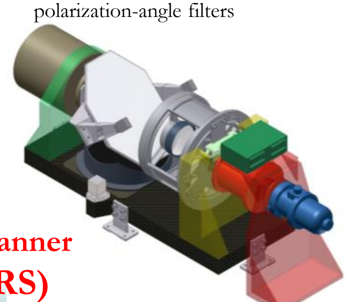
Each has the same 11 channels



VNR-POL

Polarization two telescopes (670nm and 865nm)

Each has three polarization-angle filters



InfraRed Scanner (SGLI-IRS)

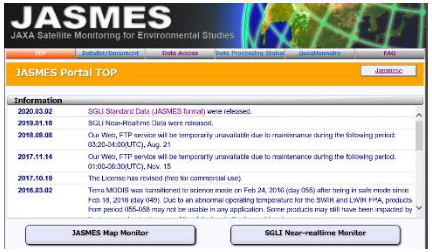
https://suzaku.eorc.jaxa.jp/GCOM_C/data/prelaunch/index.html

3. GCOM-C product distribution

- ✓ Ver.2 standard products (Level-1, 2, and 3) have been open to the public via JAXA data portal, "G-Portal" (data search and direct FTP)
- ✓ Some products are open via JAXA multi-sensor data site, JASMES
- ✓ GCOM-C products are evaluated by using in-situ observations and other satellite data

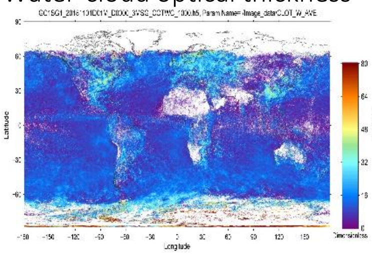
https://suzaku.eorc.jaxa.jp/GCOM_C/data/validation.html

https://gportal.jaxa.jp/gpr/

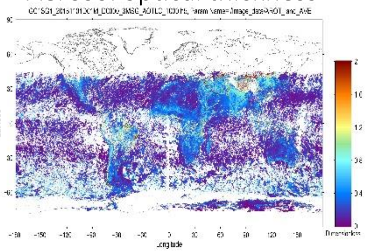


https://kuroshio.eorc.jaxa.jp/JASMES/index.html
https://www.eorc.jaxa.jp/cgi-bin/jasmes/sgli_nrt/index.cgi

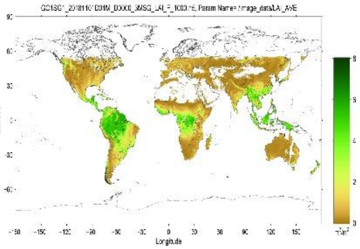
Water-cloud optical thickness



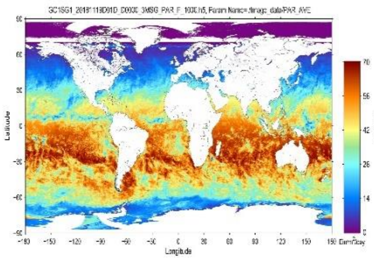
Aerosol optical thickness



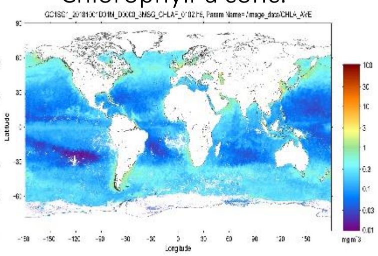
Leaf area index



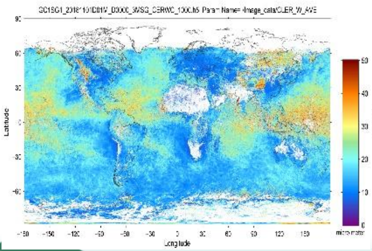
PAR



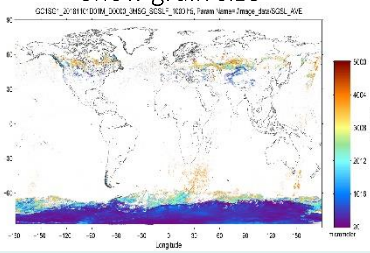
Chlorophyll-a conc.



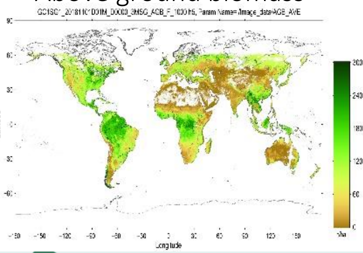
Water-cloud effective radius



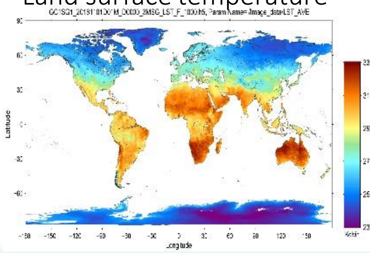
Snow grain size



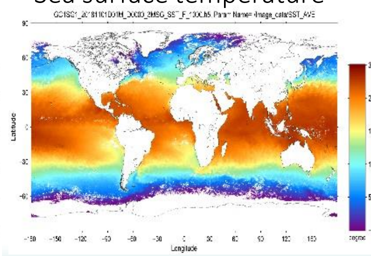
Above ground biomass



Land surface temperature



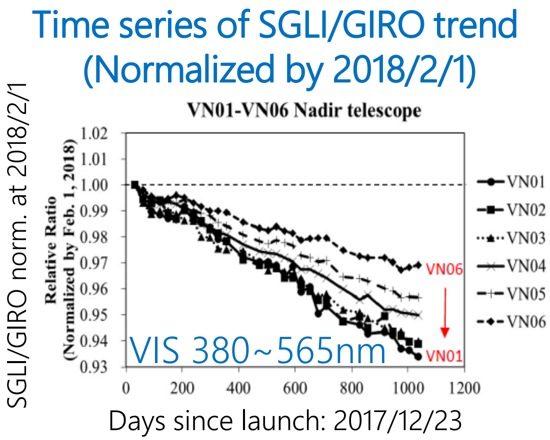
Sea surface temperature

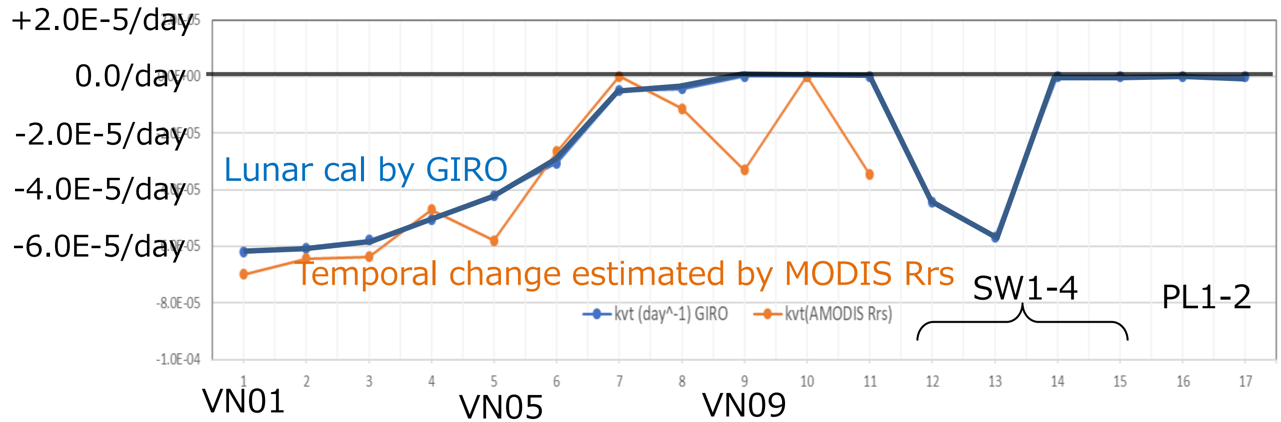


4. SGLI calibration (Lunar cal)

- After the launch, the temporal change of SGLI gain has been evaluated by the lamp and solar light through the on-board diffusers (Urabe et al., Remote Sensing, 2020) and monthly lunar calibration with GIRO (Urabe et al., Proc. of IEEE/IGARSS, 2019)

✓ <u>The temporal change of the gain has been corrected in the processing of Ver.2 Level-1B data</u>





Channel	VN01	VN02	VN03	VN04	VN05	VN06	VN07	VN08	VN09	VN10	VN11
λ (nm)	380	412	443	490)	530	566	672	672	763	867	867
k_t (day^{-1})	-6.204E-05	-6.059E-05	-5.793E-05	-5.049E-05	-4.202E-05	-3.063E-05	-5.042E-06	-4.339E-06	0.0	0.0	0.0

$L_{corr}(\lambda) = L_{orig}(\lambda) / (1.0 + k_t(\lambda) \cdot D)$,

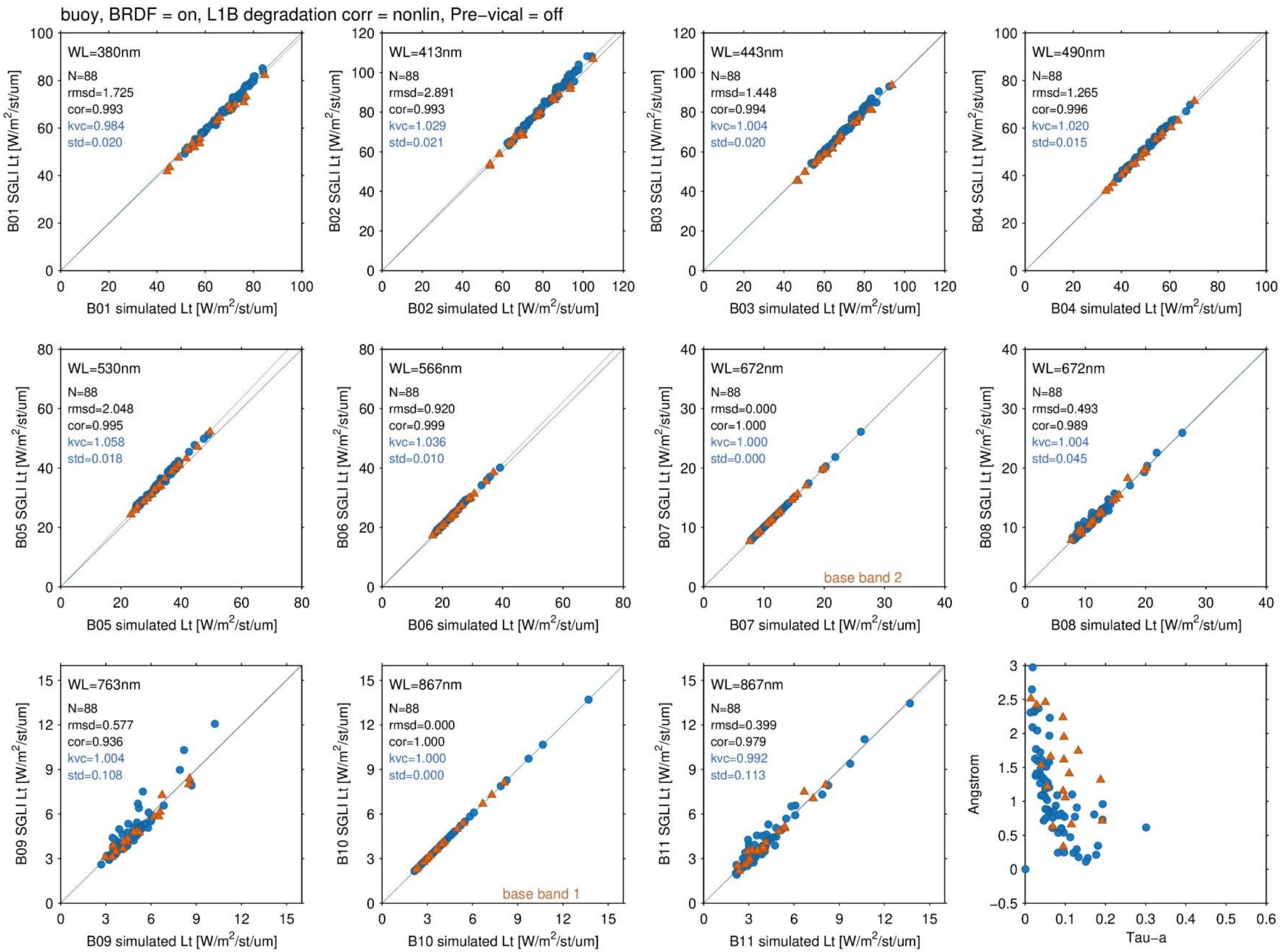
D: days from 00:00 1st Jan 2018 (D=0)

https://suzaku.eorc.jaxa.jp/GCOM_C/data/prelaunch/index_cal.html

4. SGLI cal/val

- MOBY and BOUSSOLE

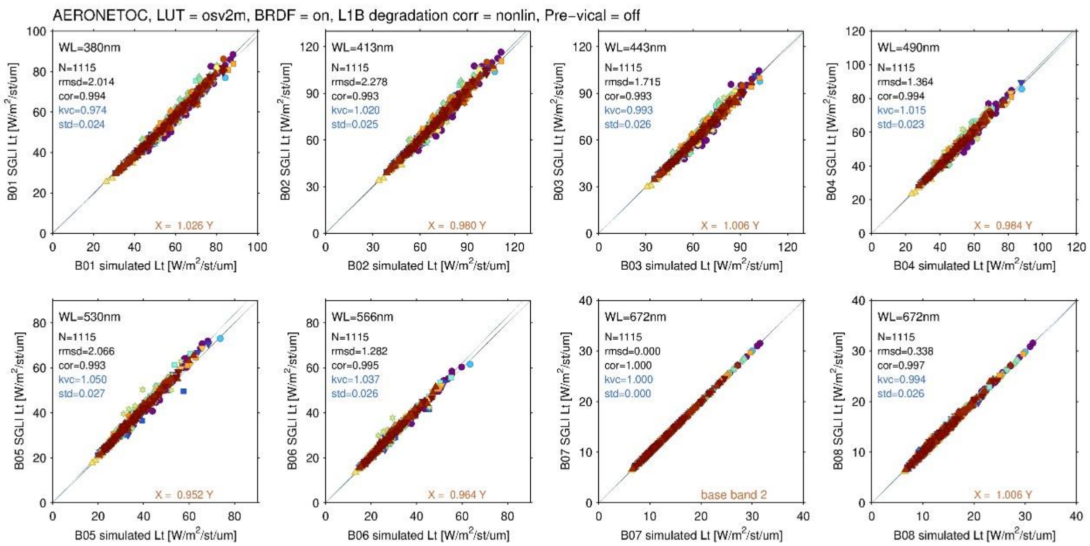
MOBY (Clark et al., 2003)
BOUSSOLE (Antoine et al., 2006; Antoine et al., 2008)

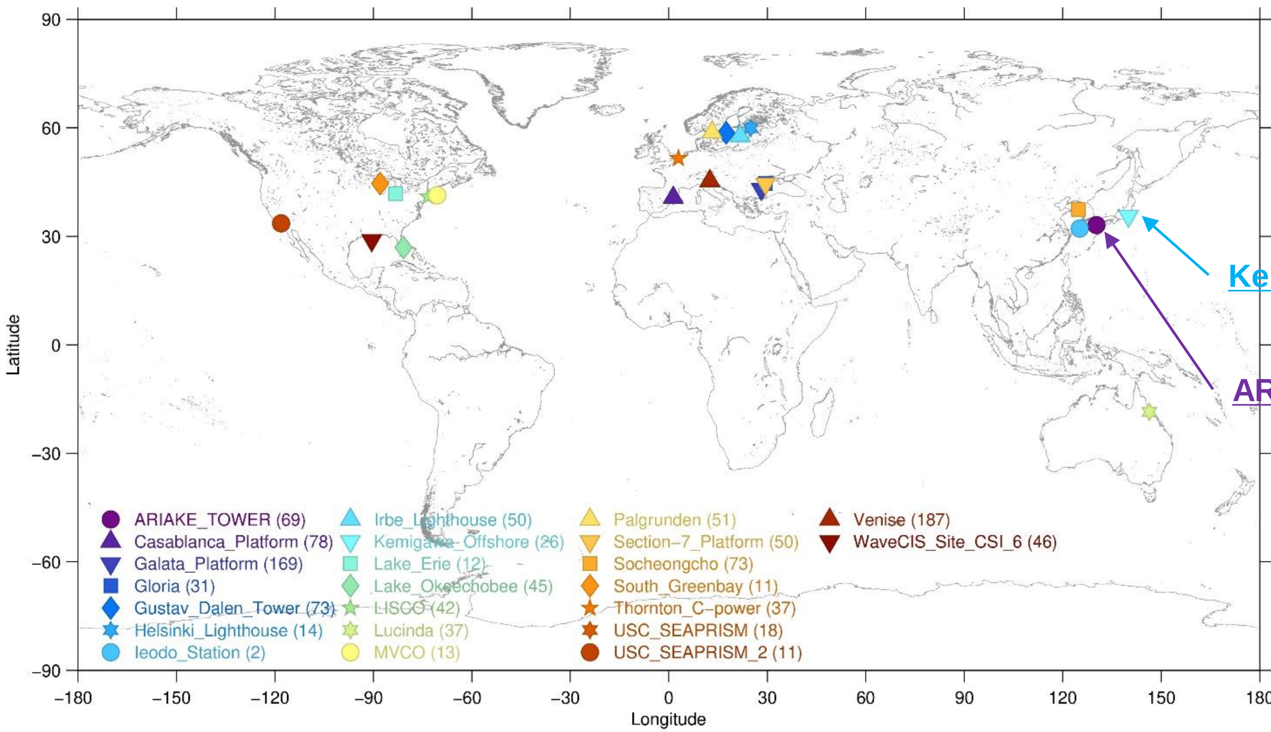


4. SGLI cal/val

Aeronet-OC

- ARIAKE_TOWER: JAXA supported
- Kemigawa_Offshore



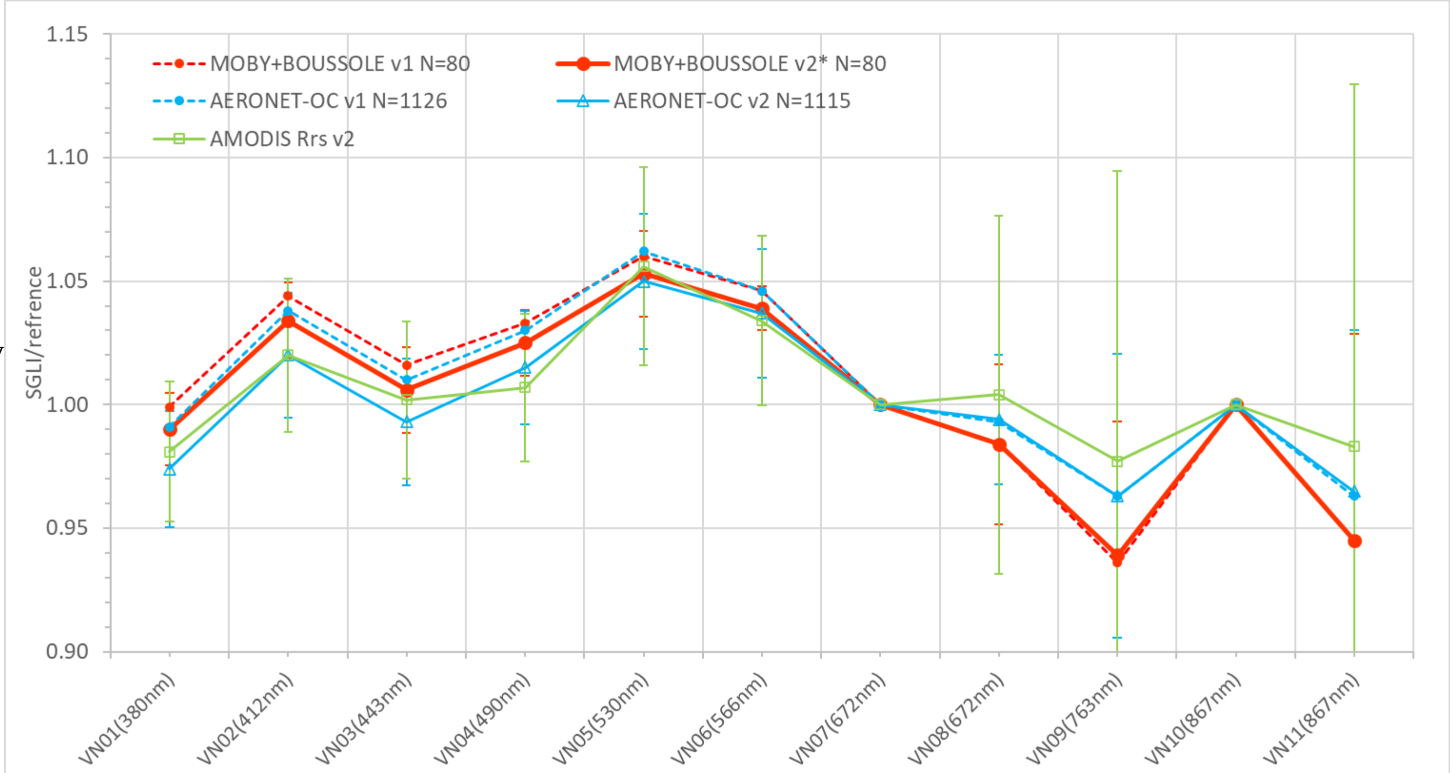


Kemigawa_Offshore (35.611N,140.023E)

ARIAKE_TOWER (33.104N,130.272E)

4. SGLI cal/val (vical summary)

k_v

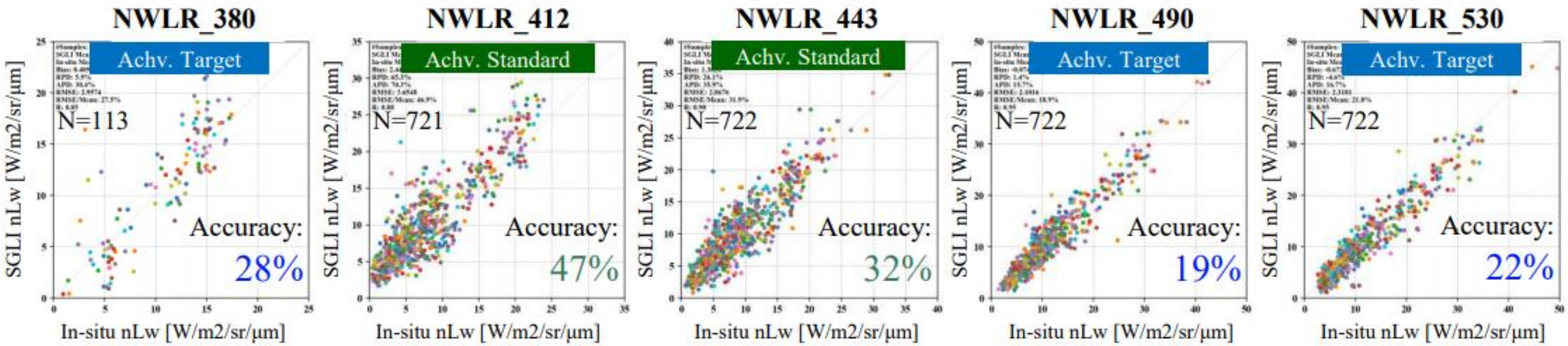


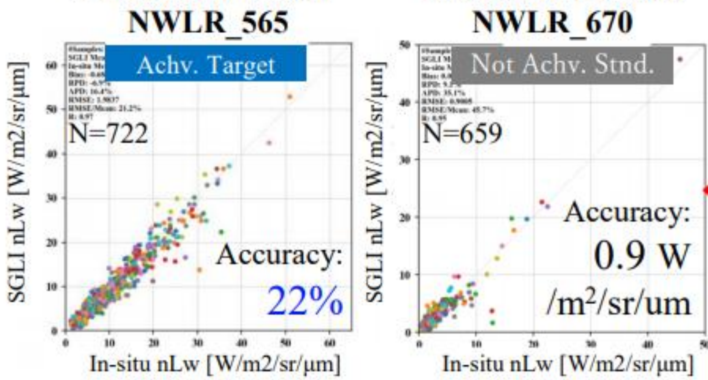
Reference data	VN01 (380nm)	VN02 (412nm)	VN03 (443nm)	VN04 (490nm)	VN05 (530nm)	VN06 (566nm)	VN07 (672nm)	VN08 (672nm)	VN09 (763nm)	VN10 (867nm)	VN11 (867nm)
MOBY+BOUSSOLE v1 N=80	0.999	1.044	1.016	1.033	1.060	1.046	1.000	0.984	0.936	1.000	0.945
MOBY+BOUSSOLE v2 N=80	0.990	1.034	1.006	1.025	1.053	1.039	1.000	0.984	0.939	1.000	0.945
AERONET-OC v1 N=1126	0.991	1.038	1.010	1.030	1.062	1.046	1.000	0.993	0.963	1.000	0.963
AERONET-OC v2 N=1115	0.974	1.020	0.993	1.015	1.050	1.037	1.000	0.994	0.963	1.000	0.965
Aqua MODIS Rrs v2	0.981	1.020	1.002	1.007	1.056	1.034	1.000	1.004	0.977	1.000	0.983

- The different aerosol LUTs caused about 1% difference of k_v.
- Difference from reference datasets are <2%

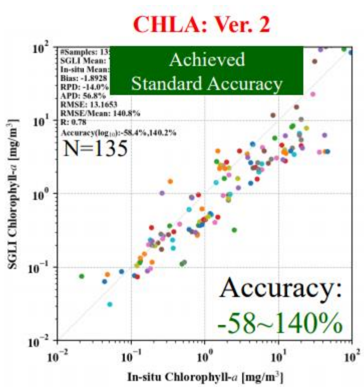
V1: aerosol LUT by Shettle and Fenn 1975
V2: aerosol LUT by Aeronet climatology

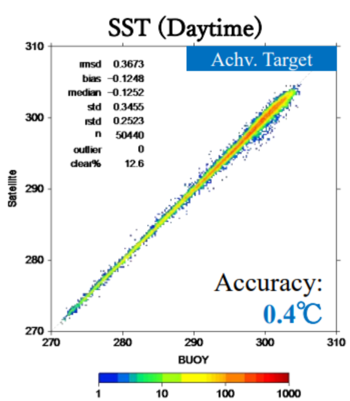
- **Ver. 2: Validation Results**

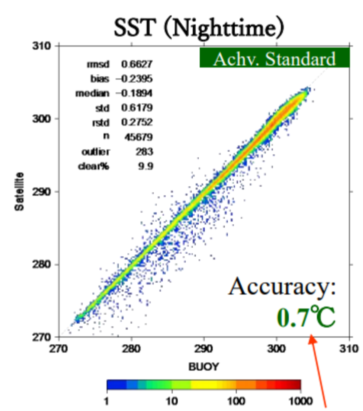




- NWLR(380nm, 490-565nm) achieved the target accuracies, NWLR(412-443nm) achieved the standard accuracies 。
- NWLR(670 nm) didn't achieved the standard accuracy on coastal regions. It is a issue to be solved by version 3. However, version 2 accuracy improved than version 1 (1.2→0.9W/m2/sr/um).
- Number of In-situ points increased than the validation result at version 1 release (ver.1 release: 14-102 points → ver.2 release: 113-722 points).







Due to cloud contamination in nighttime

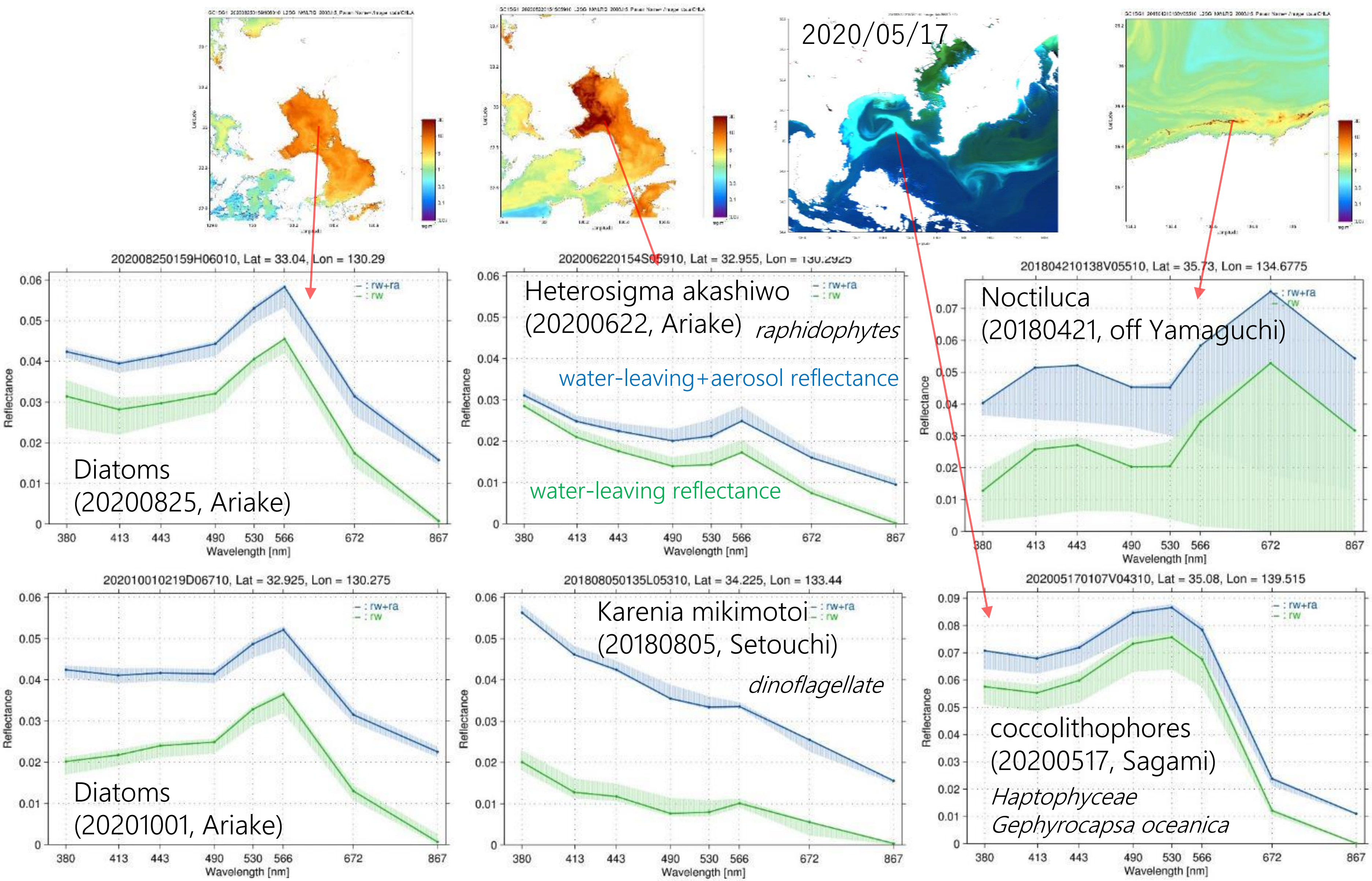
- ✓ In-situ OC data are provided by GCOM-C Pis
- ✓ SST is validated by NOAA iQuam data

5. Next version (Ver.3) of GCOM-C ocean product

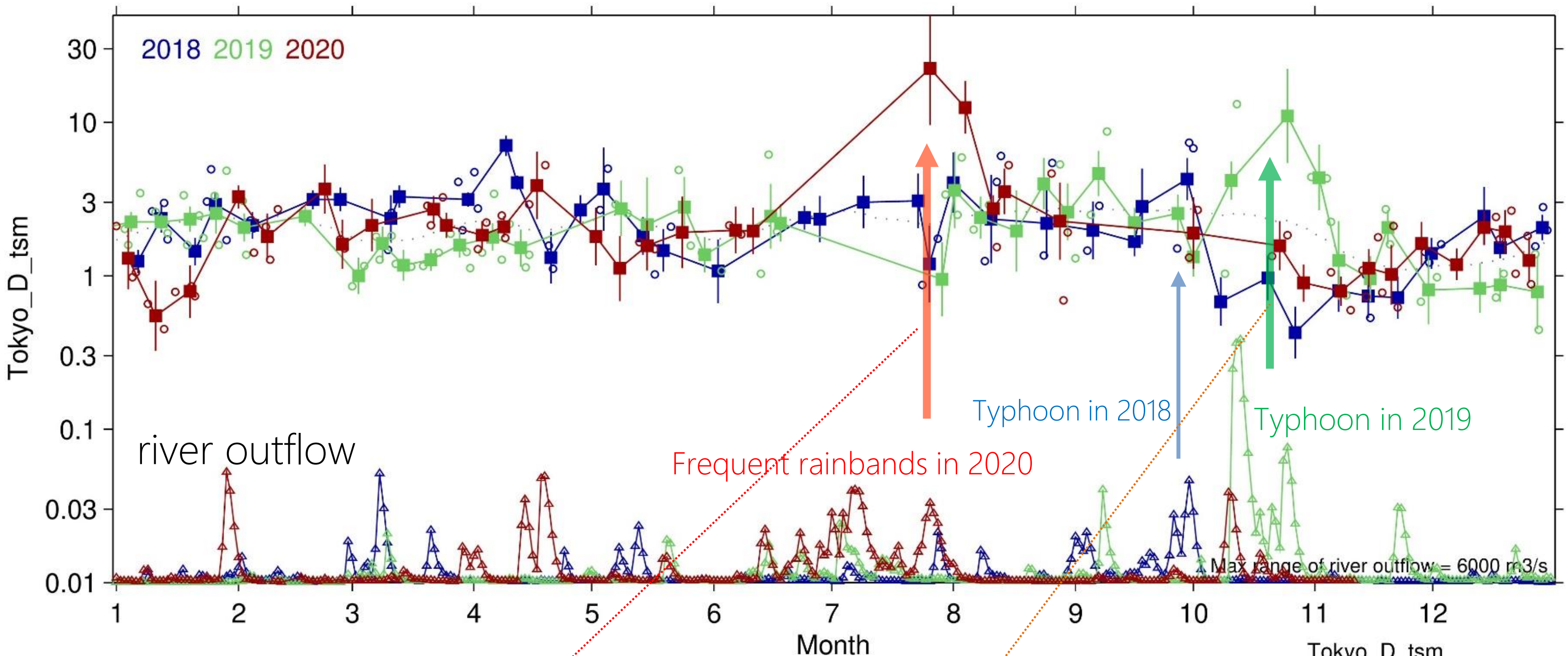
S/R	Product	Algorithm	Validation	Status
Standard	Normalized water leaving radiance	Toratani, Frouin, JAXA, Stamnes	Toratani, Frouin, Hirawake, Ishizaka, Suzuki, Kobayashi, Khahru, Antoine, Kuwahara, Isada, Higa, Hirata	• NIR estimation, sunglint estimation will be revised
	Atmospheric corr. parameter			
	PAR	JAXA, Frouin		• No change (improved through improvement of the atmospheric correction)
	Chlorophyll-a conc.	JAXA		
	Suspended solid conc.	Toratani		• Revised by collected in-situ data (TBD)
	CDOM	Hirata		• No change (improved through improvement of the atmospheric correction)
Research	Inherent optical properties			• Investigated through the PI team workshop (FY2020-2021)
	Euphotic zone depth			• Developing by PI; to be open from JASMES
	Phytoplankton functional type	Hirawake, Hirata		• Improved with progress of IOP algorithm; to be open from JASMES after enough evaluation and publication
S	Sea surface temp.	JAXA		• Minor revision of the cloud flag
Research	Ocean net primary productivity	Ishizaka, Hirawake, Tachiiri (model)		• Developing VGPM-type and APAR-type algorithms; to be open from JASMES
	Redtide	Ishizaka, Kobayashi (Yamanashi), Higa		• Developing for Ariake bay; to be open from JASMES after validation
	multi sensor merged OC	JAXA, Wang		• Under comparison with other sensors; model assimilation in the future
	multi sensor merged SST	JAXA		• Assimilated by JAMSTEC JCOPE-T DA
New	APAR	Frouin		• investigating absorption of PAR for NPP estimation
	POC, DOC, ..	Matsuoka		• Candidate for the new research product
	Floating algae index	JAXA		• Opened by JASMES around Japan

✓ Ver.3 standard products (Level-2, and 3) will be released around the end of Nov. 2021

SGLI water-leaving reflectance spectra at redtides

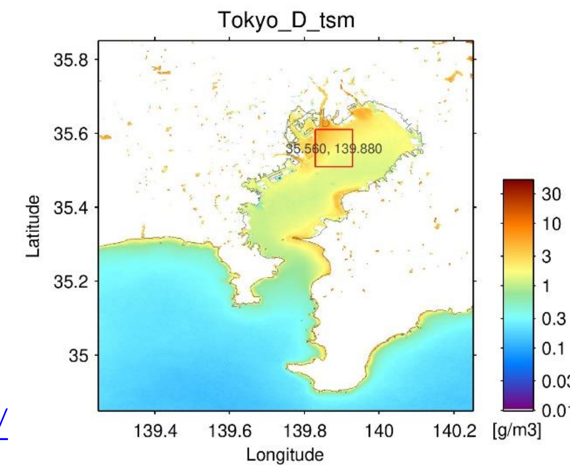


6. Examples of 2020 obs: TSM time series in Tokyo Bay



Ocean color (Total suspended matter concentration, TSM) in Tokyo bay seems influenced by the river outflow increased by heavy rainfall in the drainage basin, e.g., the end of Sep. 2018, Oct. 2019, and the end of Jul. 2020

The river outflow data is obtained from JAXA's land surface & river simulation system, "**Today's Earth (TE)**": https://www.eorc.jaxa.jp/water/

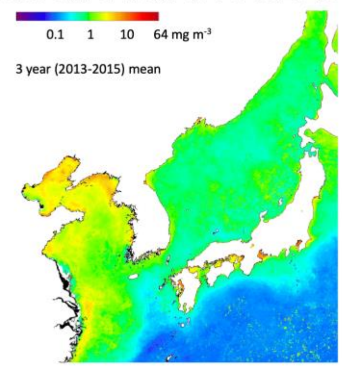


- ✓ **NASA/ESA/JAXA Earth Observing Dashboard (https://eodashboard.org/)**

Related activity:
Near Real-Time Monitoring System for Marine Coastal Eutrophication Using Google Earth Engine (GEE)

- The "Development of a Near Real-Time Monitoring System for Marine Coastal Eutrophication Using Google Earth Engine" was awarded as a winning project by the Group on Earth Observations (GEO) and Google Earth Engine (GEE) in July 2020
- The project aims to use a 250 m resolution satellite dataset on Chlorophyll-a to assess potential eutrophication areas at the global scale.
- The project will last for two years. It will produce an interactive map of potential eutrophication area over the global ocean to help the NOWPAP (https://www.unep.org/nowpap/) Member States and countries around the world to manage eutrophication and report their progress under the 2030 UN Sustainable Development Agenda.
- The project will be led by Professor Joji Ishizaka, Nagoya University, in collaboration with the Northwest Pacific Region Environmental Cooperation Center (NPEC), the Japan Aerospace Exploration Agency, GOOGLE, Limited Liability Company (LLC), the United Nations Environment Programme (UNEP), the Northwest Pacific Action Plan (NOWPAP), and the Japan Association for the UNEP.

Assessment of eutrophication in the Northwest Pacific Region with satellite Chl-a from 1998 to 2015 using NEAT



7. Summary

- ✓ GCOM-C/SGLI data since 1st Jan. 2018 have been open(freely) through G-portal (https://gportal.jaxa.jp/gpr/)
- ✓ Temporal change of SGLI (about 2%/year degradation in the blue channels detected by GIRO) has corrected in Ver.2 L1B (released June 2020; under reprocessing until summer 2021)
- ✓ Vicarious calibration is updating by MOBY and BOUSSOLE
- ✓ Ver.3 OC products will be released in Nov. 2021
- ✓ NASA/ESA/JAXA Earth Observing Dashboard
- ✓ GEO-GEE Eutrophication Watch Project
- ✓ The next research announcement (starts from April 2022) will be open in this summer-autumn