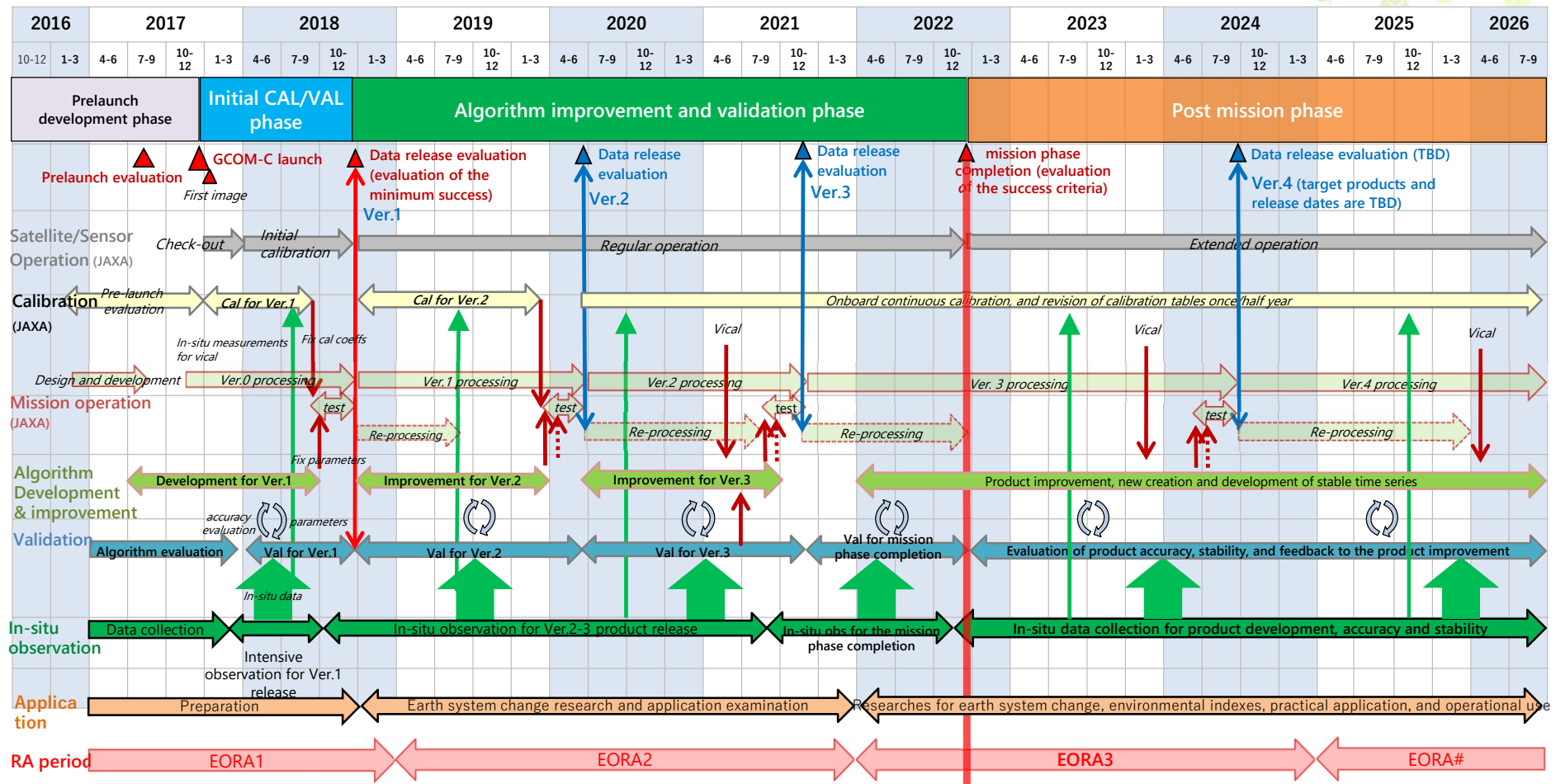# GCOM-C PI workshop JFY 2021
Introduction for PI discussion

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GCOM-C science mission schedule

2016	2017				2018				2019				2020				2021				2022				2023				2024				2025			2026	
10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9

Phases: Prelaunch development phase | Initial CAL/VAL phase | Algorithm improvement and validation phase | Post mission phase

Events / markers:
- Prelaunch evaluation
- GCOM-C launch
- First image
- Data release evaluation (evaluation of the minimum success) — Ver.1
- Data release evaluation — Ver.2
- Data release evaluation — Ver.3
- mission phase completion (evaluation of the success criteria)
- Data release evaluation (TBD)
- Ver.4 (target products and release dates are TBD)

Satellite/Sensor Operation (JAXA): Check-out | Initial calibration | Regular operation | Extended operation

Calibration (JAXA): Pre-launch evaluation | Cal for Ver.1 | Cal for Ver.2 | Onboard continuous calibration, and revision of calibration tables once half year
- In-situ measurements for vical | Fix cal coeffs
- Vical (2021) | Vical (2023) | Vical (2025)

Mission operation (JAXA): Design and development | Ver.0 processing | Ver.1 processing | Ver.2 processing | Ver.3 processing | Ver.4 processing
- test | test | test | test
- Re-processing | Re-processing | Re-processing | Re-processing
- Fix parameters

Algorithm Development & improvement:
- accuracy evaluation | parameters
- Development for Ver.1 | Improvement for Ver.2 | Improvement for Ver.3 | Product improvement, new creation and development of stable time series

Validation:
- Algorithm evaluation | Val for Ver.1 | Val for Ver.2 | Val for Ver.3 | Val for mission phase completion | Evaluation of product accuracy, stability, and feedback to the product improvement

In-situ observation:
- In-situ data
- Data collection | Intensive observation for Ver.1 release | In-situ observation for Ver.2-3 product release | In-situ obs for the mission phase completion | In-situ data collection for product development, accuracy and stability

Application:
- Preparation | Earth system change research and application examination | Researches for earth system change, environmental indexes, practical application, and operational use

RA period: EORA1 | EORA2 | EORA3 | EORA#

✓ Toward the post mission phase, GCOM-C will more focus on the application researches to be recognized the GCOM-C data as fundamental data of the earth environment in addition to deepening the current targets

✓ The key targets will be researches relating to the earth system change, <u>environmental monitoring indexes</u>, practical application, and connection to the operational uses

✓ Researches supporting the applications such as product improvement, development of stable time series, evaluation of product accuracy, stability, and feedback to the product improvement will be continued

GCOM-C science mission schedule

✓ We have to demonstrate results of GCOM-C/SGLI, and explain the expected merits of the operation continuation to have "the Post mission phase"

✓ Establishment of the successor mission of GCOM-C is also important

Coming key events to demonstrate our results:

✓ Ver. 3 release 29 Nov. 2021 (all standard products have been achieved the standard accuracy; done)

• JAXA joint workshop in 17-21 Jan. 2022

    • Representative achievements are introduced in the session on 21 Jan.

    • Discussion for the preparation to the evaluation in Dec. 2022

        ① Targets of time series/research product construction (led by EORC) and Find the collaboration members from PIs

        ② Find opportunity of collaboration among PIs to make additional "the Representative achievements"

        ③ Update the waiting list of the validation instruments

• EORA3 kick-off meeting in 2022 (date: TBD)

• Evaluation meeting of mission phase completion in Dec. 2022

GCOM-C Observation Products

→ Radiation budget by the atmosphere-surface system
→ Carbon cycle in the Land and Ocean

Common

Radiance	• TOA radiance (including system geometric correction)

Land

Surface reflectance	Precise geometric correction
	Atmospheric corrected reflectance
Vegetation and carbon cycle	Vegetation index
	• Above-ground biomass — ECV
	Vegetation roughness index
	Shadow index
	• fAPAR — ECV
	• Leaf area index — ECV
Temp.	• Surface temperature — ECV
Application	Land net primary production
	Water stress trend
	• Fire detection index — ECV
	• Land cover type — ECV
	• Land surface albedo — ECV

Atmosphere

Cloud ECV	• Cloud flag/Classification
	• Classified cloud fraction
	• Cloud top temp/height
	• Water cloud optical thickness /effective radius
	• Ice cloud optical thickness
	Water cloud geometrical thickness
Aerosol ECV	• Aerosol over the ocean
	• Land aerosol by near ultra violet
	• Aerosol by Polarization
Radiation budget ECV	• Long-wave radiation flux
	• Short-wave radiation flux

Ocean

Ocean color	• Normalized water leaving radiance ECV
	Atmospheric correction parameter
	Photosynthetically available radiation
	Euphotic zone depth
In-water	• Chlorophyll-a conc. ECV
	Suspended solid conc.
	Colored dissolved organic matter
In-water	Inherent optical properties
Temp.	• Sea surface temp. ECV Target areas
Application	Ocean net primary productivity
	Phytoplankton functional type
	Redtide
	multi sensor merged ocean color
	multi sensor merged SST

Cryosphere

| distribution	• Snow and Ice covered area ECV
	Okhotsk sea-ice distribution
	Snow and ice classification
	Snow covered area in forest and mountain
Surface properties	• Snow and ice surface Temperature
	Snow grain size of shallow layer ECV
	Snow grain size of subsurface layer
	Snow grain size of top layer
	• Snow and ice albedo ECV
	Snow impurity
	Ice sheet surface roughness
Boundary	Ice sheet boundary monitoring

Blue: standard products
Red: research products

✓ Identify three or four multi-sensor decadal time series with uncertainty information
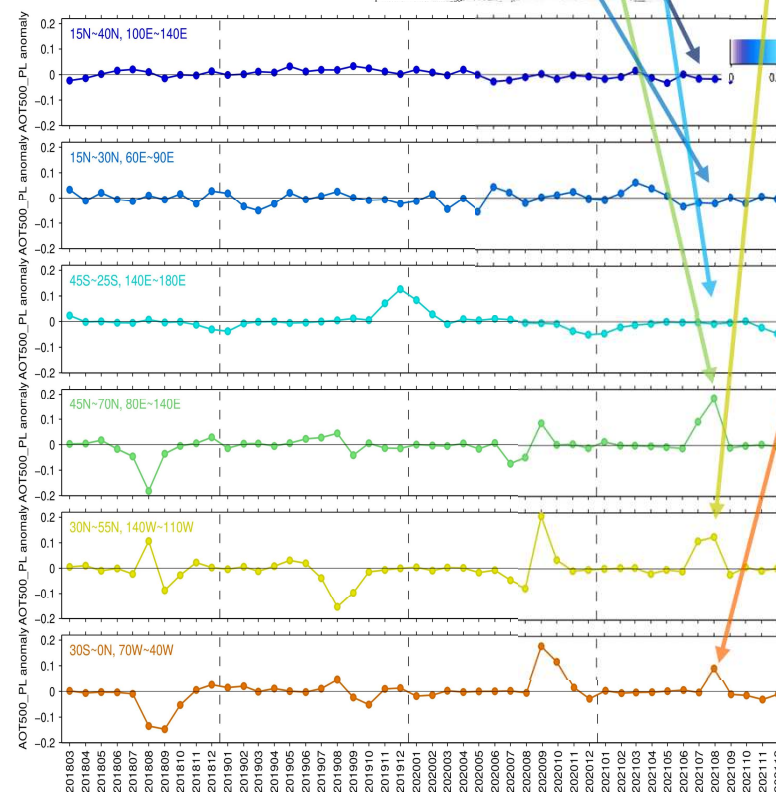✓ They should be made by using the merit of SGLI effectively

Example of SGLI time series

✓ Aerosols estimated by different SGLI channels: non-polarization and polarization

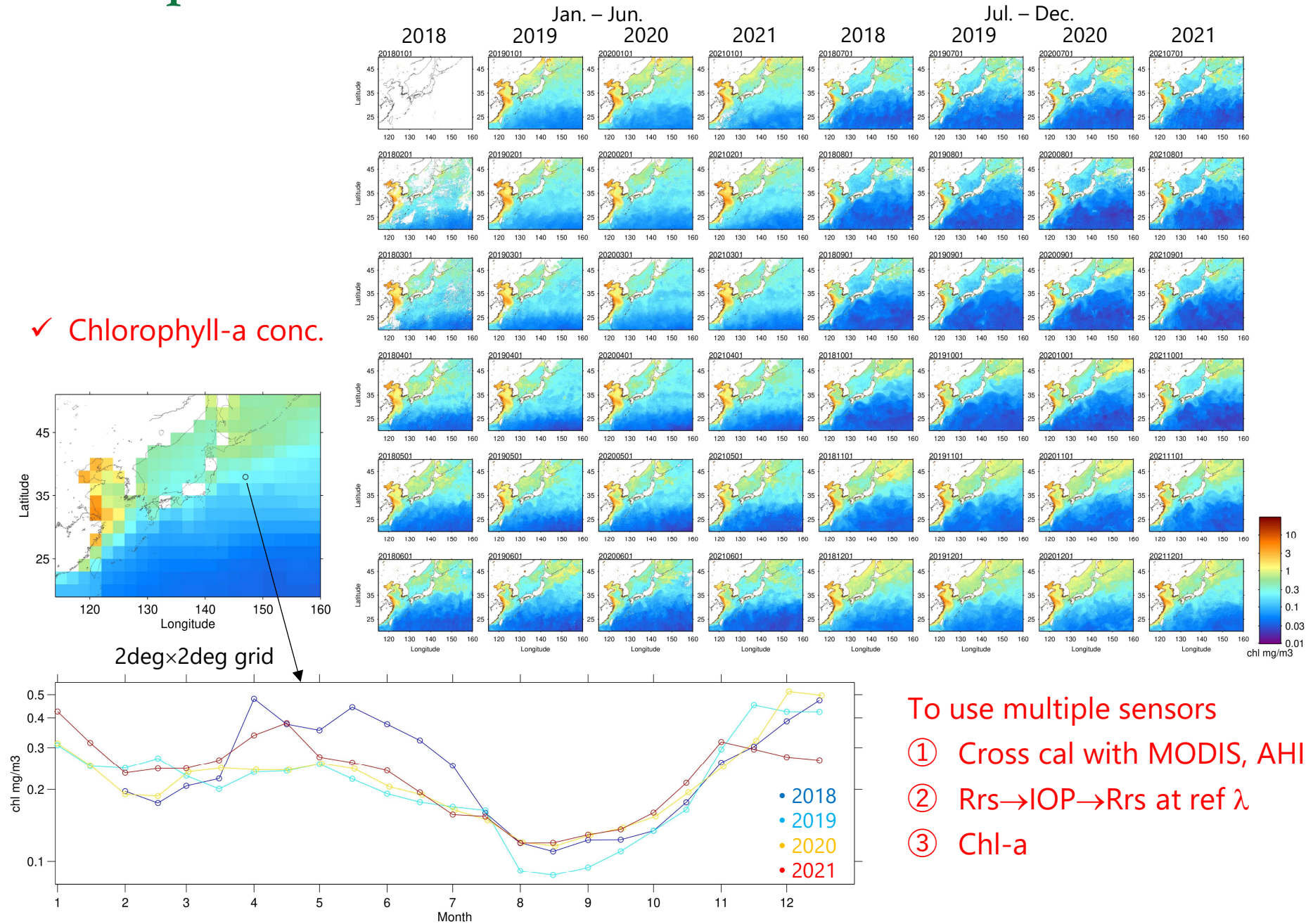Monthly AOT@500nm by SGLI polarization channels in Aug. 2021

GCOM–C/SGLI AOT500_PL, 20210801D01D
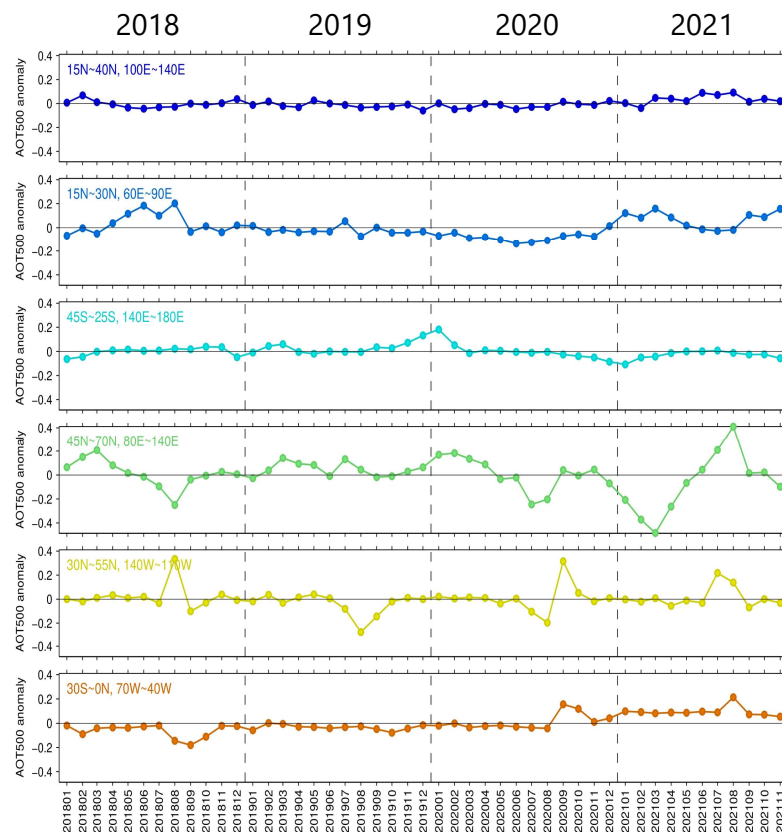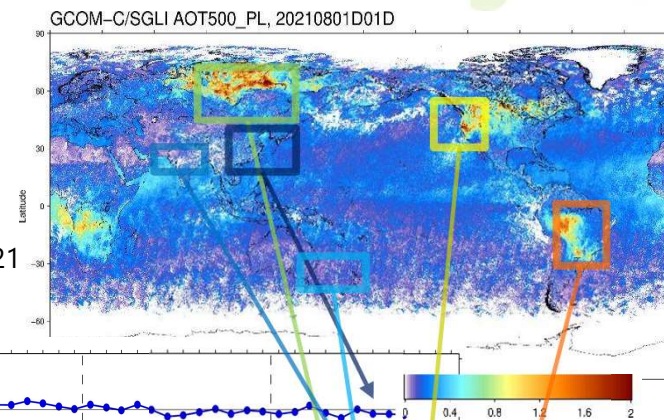
Monthly anomaly of AOT@500nm by SGLI non-polarization channels (Ver.2 ARNP)

Monthly anomaly of AOT@500nm by SGLI polarization channels

Example of SGLI time series

✓ Chlorophyll-a conc.

2deg×2deg grid

To use multiple sensors
① Cross cal with MODIS, AHI
② Rrs→IOP→Rrs at ref λ
③ Chl-a

Example of SGLI time series

✓ NDVI

2deg×2deg grid

To use multiple sensors
① Cross cal
② Rs→IOP?→Rs at ref λ
③ NDVI
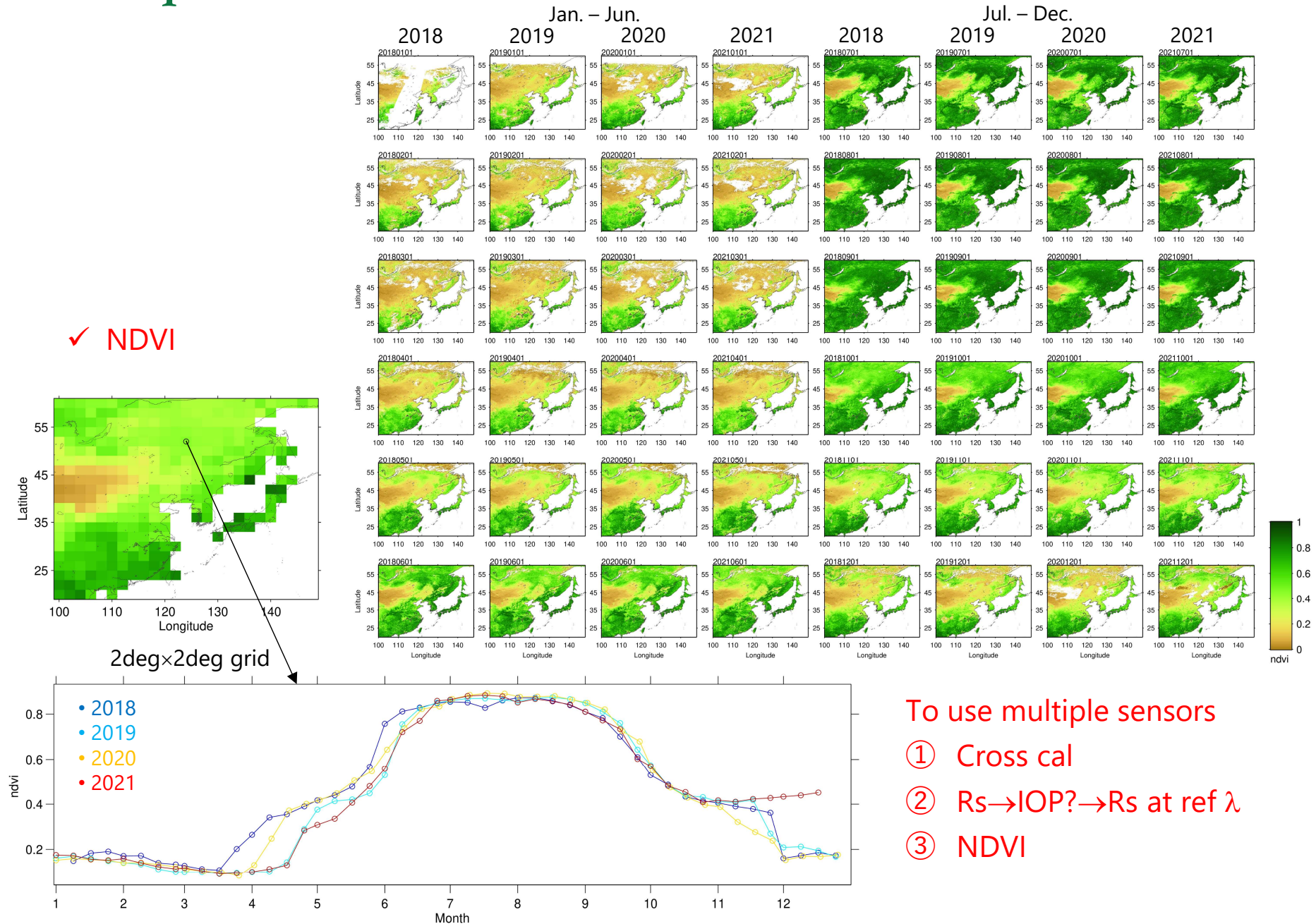
Agenda of the workshop discussion

1. Introduction about the GCOM-C Version 3 product homepage : 10 min

2. Status of GCOM-C science mission and discussion items : 10 min

3. Parallel discussion for science outcome : 100 min
   ① Land (led by Honda)
   ② Atmosphere (led by Nakajima)
   ③ Ocean (led by Toratani)
   ④ Cryosphere (led by Aoki)

11:10-

1. Report of discussion results from Area Leaders (Dr. Honda, Dr. Nakajima, Dr. Toratani, Dr. Aoki) : 10 min x 4 = 40 min

2. Wrap-up report for the workshop (JAXA/EORC) : 10 min

Status of SGLI Land products (will be updated in the workshop)

-	Product	S/R	Algorithm	Validation	Status
Land	Geometric corr. & tile mosaic	Standard	JAXA		No major change after v2006
	Atm corrected reflectance		JAXA	Honda, Nasahara	Improvement of cloud contamination and irregular outputs Include 2 band of polarization reflectance (1km)
	Vegetation index		JAXA		NA
	Shadow index		Moriyama		·Added Cosine_of_solar_incidence from slope normal to Geometry_data ·Modified SDI calculation parameters
	Above-ground biomass		Honda, Kajiwara	Nasahara, Nagai	Updated LUT with using satellite vegetation LIDAR "GEDI"
	Veg. roughness index		Honda		
	Fraction of Absorbed PAR		JAXA, Kobayashi (JAMSTEC)	Nasahara, Nagai	·Modified estimation algorithm, LUT, and parameters ·Changed base map to SGLI forest structure map
	Leaf area index				
	Surface temperature		Moriyama		·Modified cloud screening level using QA_flag
	Land surface albedo	R	JAXA, Susaki	Honda, Nasahara, Susaki	Coefficients to calculate albedo from RSRF will be open in HP
	Water stress trend	R	NA		Developing the processing code in JAXA a candidate to be open from JASMES
	Crop/ET index	C	Tasumi	Nasahara	
	Fire detection index	R	JAXA		Developed by JAXA; and open from JASMES
	Volcano monitoring	C	Kaneko, JAXA(SAOC)		Developed and open from PI homepage and JAXA/SAOC
	Land cover type	R	JAXA, Soyama, Takagi		Developed by PI Nasahara (Kobayashi) with EORC cross cutting research and PI Soyama; to be open from JASMES
	Phenology	C	Yang	Nasahara	open after the paper acceptation; a candidate as a new research product
	Model, NPP	R	Yang, Tachiiri	Nasahara, Nagai	open after the paper acceptation; Main parameter will be GPP and NEP which can be validated by the flux sites; NPP is derived for reference of the success criteria and validated by historical data
	Global desert monitor	C	Kimura		To be pen from PI
	AHI/SGLI fusion data	C	Kajiwara		Depend on the research progress

C: Candidates for the future research products

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Status of SGLI atmosphere products (will be updated in the workshop)

-	Product	S/R	Algorithm/Validation		Status
Atmosphere	Cloud flag/Classification	Standard	Nakajima, Stamnes, JAXA	JAXA, Nakajima, Kuji	·Improved classification accuracy of cloud, snow, and heavy aerosol by deep nural detwork method
	Classified cloud fraction		Nakajima, Iwabuchi	Nakajima, Yamazaki, Irie, Kuji, Khatri	Improvement of validation scheme
	Cloud top temp/height				
	Water cloud COT/R_{eff}				
	Ice cloud optical thickness				
	Water cloud geom. thickness	R	Kuji		Validation by FALCON; Algorithm (2020?)
	Aerosol over the ocean	S	JAXA, Mukai Sekiguchi (RTM), Ishimoto (Ash)	Irie,Yamazaki, Aoki (Toyama U), Mukai, Kobayashi (Yamanashi)	·Merged land and ocean data ·Merged polarized and non-polarized algorithms
	Land aerosol by NUV	S			
	Aerosol by Polarization	S			
	Long-wave radiation flux	R	Kuji	Khatri, Yamazaki	Under development using the cloud geometrical thickness by Kuji
	Short-wave radiation flux	R	JAXA		SWR is included in the Ver.2 RSRF file
	Model application	C	Suzuki (AORI), Yumimoto, Goto (NIES), Tanaka (MRI)		Comparing with numerical models Evaluating data assimilation

Status of SGLI Ocean products (will be updated in the workshop)

-	Product	S/R	Algorithm	Validation	Status
Ocean	Normalized water leaving radiance	Standard	Toratani, Frouin, JAXA, Stamnes	Toratani, Frouin, Hirawake, Ishizaka, Suzuki, Kobayashi (Yamanashi), Khahru, Antoine, Kuwahara, Isada, Higa, Hirata	・Modified aerosol LUT ・Modified estimation method of near-infrared reflectance ・Modified vicarious calibration parameters ・Added correction form negative NWLR ・Added correction function for TAUA_670, TAUA_865
	Atmospheric corr. parameter				
	PAR		JAXA, Frouin		NA (improved through improvement of the atmospheric correction)
	Chlorophyll-a conc.		JAXA		
	Suspended solid conc.		Toratani		
	CDOM				
	Inherent optical properties	R	Hirata		Investigated by IOP workshop in 2021 lded by Higa
	Euphotic zone depth	R			Developing by PI; to be open from JASMES
	APAR	C	Frouin		investigating for NPP by APAR
	Phytoplankton functional type	R	Hirawake, Hirata		Improved with progress of IOP algorithm; to be open from JASMES after enough evaluation and publication
	Sea surface temp.	S	JAXA		・Improved atmospheric correction method for SST estimation ・Modified cloud mask process ・Added L1B filtering process to remove stripe noise
	Ocean net primary productivity	R	Ishizaka, Hirawake, Tachiiri (model)		Developing VGPM-type and APAR-type algorithms; to be open from JASMES
	Redtide	R	Ishizaka, Kobayashi (Yamanashi), Higa		to be open from JASMES after validation
	multi sensor merged OC	R	JAXA, Wang		Under comparison with other sensors; model assimilation in the future
	multi sensor merged SST	R	JAXA		Assimilated by JAMSTEC JCOPE-T DA
	Model application	C	Tachiiri		Comparing with the JAMSTEC earth system model
	POC, DOC	C	Matsuoka		Candidate for the new research product; Under discussion
	Floating algae index	C	JAXA		Opened by JASMES; to be defined as a research product?

Status of SGLI Cryosphere products (will be updated in the workshop)

-	Product	S/R	Algorithm	Validation	Status
Cryosphere	Snow and Ice covered area	S	Stamnes	Aoki	▪ Updated training dataset
	Okhotsk sea-ice distribution	S	Stamnes		
	Snow and ice classification	R	Stamnes, Aoki		Under algorithm development and collection of in-situ data
	Snow cover in forest and mountain	R	JAXA, Stamnes		
	Ice sheet bare ice area	C	Aoki, JAXA		Greenland data is open from JASMES
	Snow and ice surface Temperature	S	Stamnes		・Updated training dataset ・Added snow and ice blue-sky albedo (SALB) to Image_data
	Snow grain size of shallow layer	S			
	Snow grain size of subsurface layer	R	Stamnes, Aoki		The algorithms have been provided by PI; validation observation will be in 2021
	Snow grain size of top layer	R			
	Snow impurity	R			The algorithms have been provided by PI; under validation
	Snow and ice albedo	R	Stamnes, Kokhanovsky		The algorithms have been provided by PI; it will be included in the "Snow grain size of shallow layer" data file
	Ice sheet surface roughness	R	Aoki		Developing algorithm in PI
	Micro algae concentration	C	Aoki, JAXA		validation observation will be in 2021?
	Aerosol over snow ice	C	Stamnes		Developing algorithm in PI
	Ice sheet boundary monitoring	R	JAXA		Algorithm and validation scheme are being investigated
	Ice cover of Lake Suwa	C	Nonaka		

Back-up slides

1. Mission objectives:

GCOM Objectives	GCOM-C Targets
• Build a long-term observation system for the global climate change and water cycle	• Produce and distribute the GCOM-C standard products
• Improve the prediction accuracy of long-term climate change	• Improve prediction accuracy of the climate change and the environmental response by assimilating the data and improving model parameters
• Establish an Earth-observation satellite system which can be integrated with other observation systems	• Provide satellite data to the data integration and analysis system
• Contribute to operational fields by distributing data to operational organizations	• Improve fishery management by providing data to the JAFIC
• Develop new products	• Produce research products

1. Mission objectives:
GCOM-C mission success criteria

Assessment condition / Success level		Minimum success	Full success	Extra success
data production	*Standard product*1 (Set release threshold, standard, and target accuracies)	Complete the calibration and validation phase and start data distribution of more than 20 products (*3) achieving the release threshold accuracy (*2) about one year after launch.	Achieve standard accuracies of all standard products, five years after launch,	Achieve the target accuracy of one or more products in five years after launch.
	*Research product*1 (Set only target accuracy)	NA	*We have to achieve them!* NA	Achieve the target accuracy of one or more products in five years after launch or add new important products for climate change research.
data distribution	*Real-time availability*	When the products achieve the release threshold accuracy, confirm ability to distribute the data within the required time.	Continue required-time data distribution during the operation period from confirmation of release threshold accuracy to five years after launch.	NA
	Continuity	When the products achieve the release threshold accuracy, confirm ability to continuously observe and distribute products.	Continue observation (*4) and data distribution from confirmation of release threshold accuracy to five years after launch.	NA

*1 The standard products are defined as products especially important for achieving the mission goal, sufficiently confirm the application reality from ADEOS-II results etc., and suitable for operational data distribution. Research products are defined as products still in the research phase of development and application, or unsuitable for operational data distribution.
*2 Release threshold accuracy: Minimum accuracy for release as available for climate research
*3 The threshold number of products, 20, corresponds to the number of ADEOS-II GLI standard products in the GCOM-C1 standard products.
*4 This means to obtain observation data continuously during the planned Earth-observation operation period