



**Status of SGLI project on  
GCOM-C**

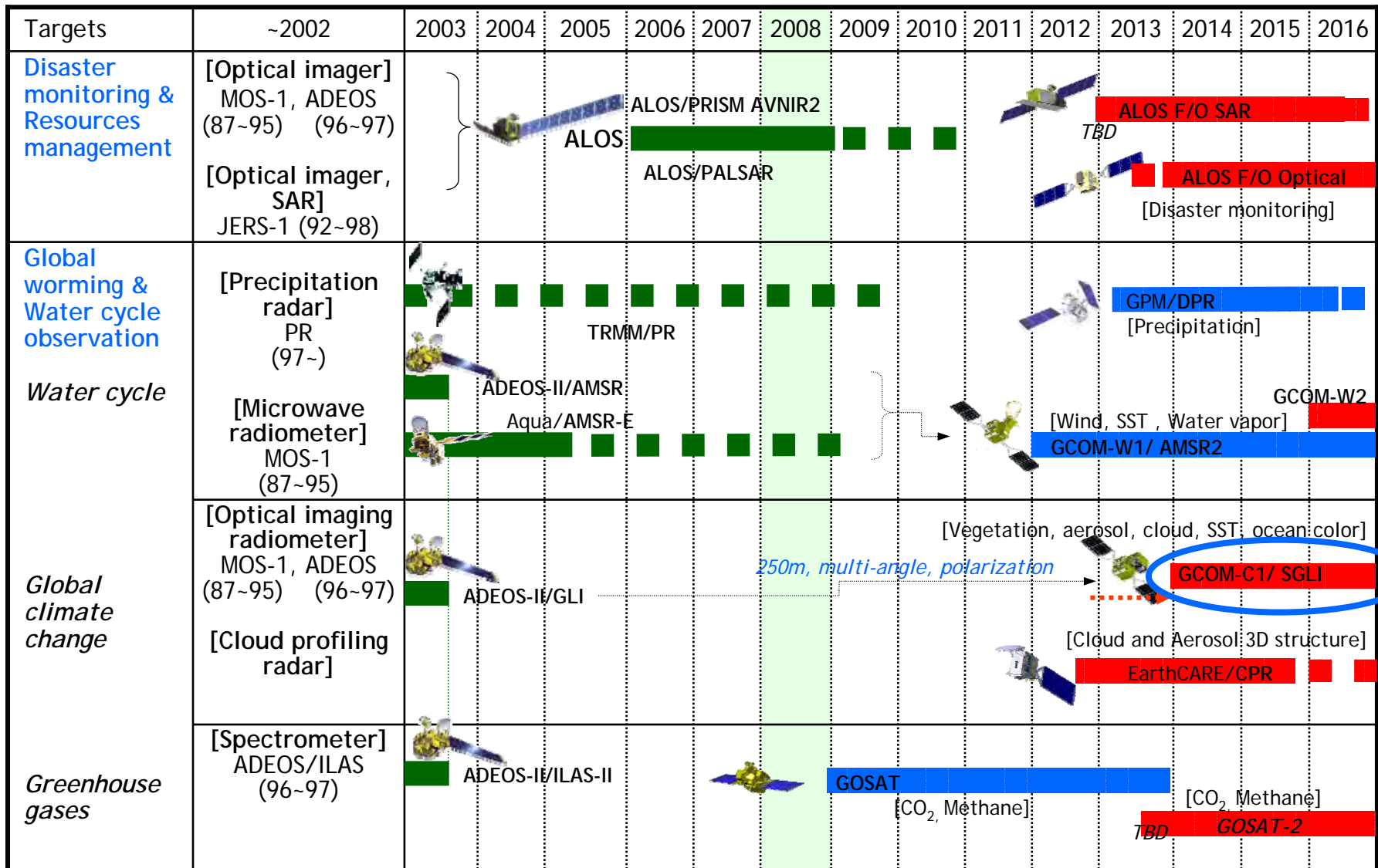
*Japan Aerospace Exploration Agency  
(JAXA)*

# 1. Introduction of GCOM and SGLI

## 1.1 Mission target

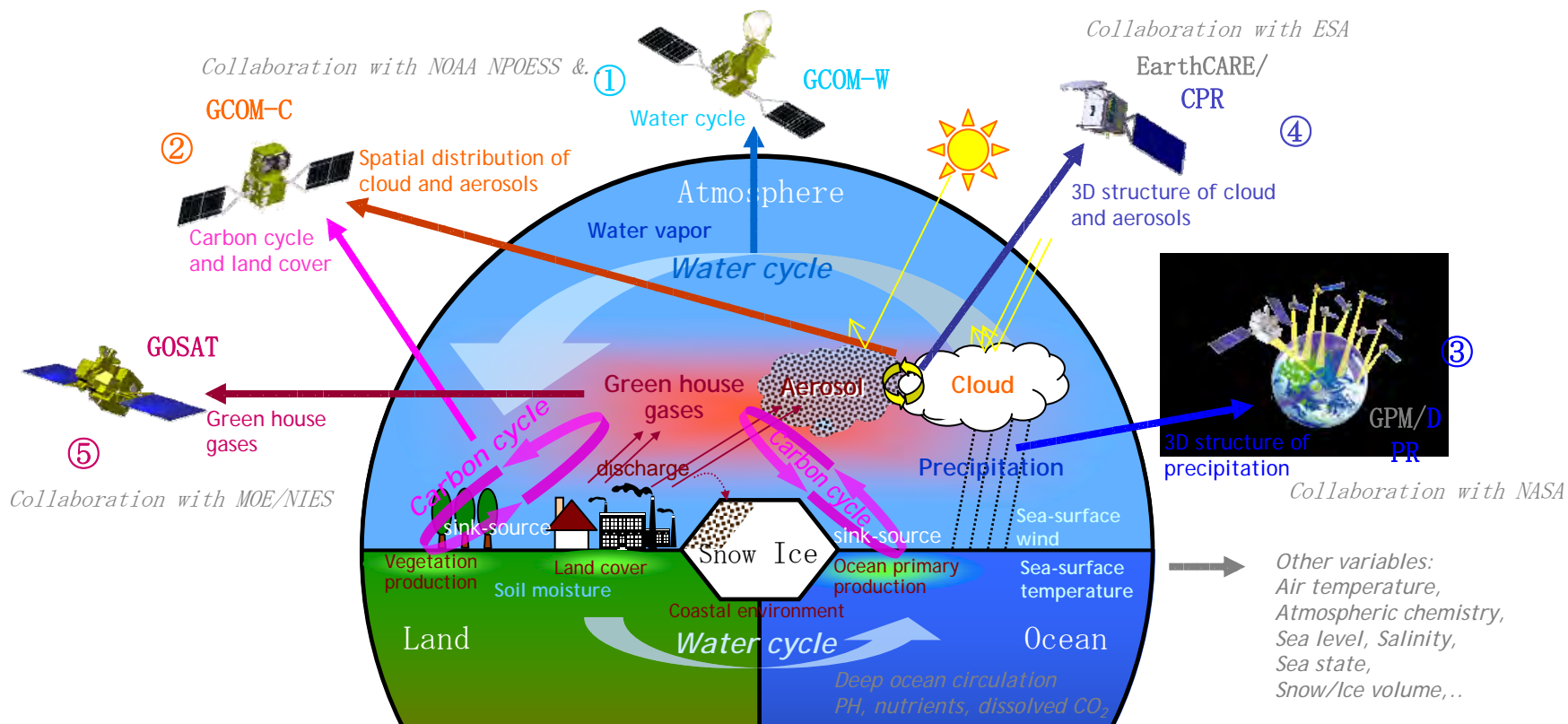
- **Global Climate Observation Mission (GCOM)** is a JAXA's next Earth environmental observation mission, which consists of **GCOM-W1-3** and **GCOM-C1-3** satellite series (~13 years observation by three satellites for every C and W).
- GCOM-W (water) satellite will be launched in Jan. 2012, and carry AMSR-2 which is a follow-on sensor of AMSR-E on Aqua;
- GCOM-C (climate) satellite will be launched in early 2014 (JFY2013) (TBD) and carry **Second generation Global Imager (SGLI)** which is a radiometer of 375-12000nm, 250m-1km resolution and 1150-1400km swath, as a follow-on mission of ADEOS-II/GLI.
- Targets of GCOM are followings.
  - Long-term observation system (more than 10 years)
  - Integrative use with other earth observation systems
  - Contribution to numerical climate models
  - Contribution to operational use (weather forecast, disaster monitoring, fishery..)
  - Enhancement of new satellite data usability

# 1.2 JAXA's earth observation scenario



Mission status ■ On orbit ■ Approved plan ■ Research ■ Extension

Contribution to study and prediction of global warming and water cycle change by three satellites + two sensors

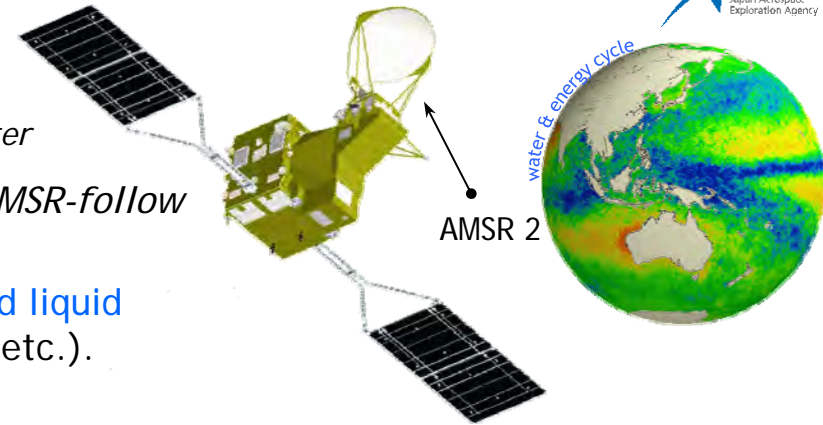


- ⑤ **GOSAT**: direct observation of distribution of CO<sub>2</sub> in the atmosphere which brings about global warming
- ② **GCOM-C**: Long-term observation about ecosystem absorption and discharge of CO<sub>2</sub> which is one of the main error factors of climate change prediction
- ④ **EarthCARE/CPR & GCOM-C**: observation of the distribution of clouds and aerosol and their interaction which brings about a cooling and is another main error factor
- ① **GCOM-W**: Long-term observation about water cycle change such as reduction of the snow and sea-ice coverage accompanying a climate change, an increase of water vapor, and a sea-surface temperature rise
- ③ **GPM/DPR**: Accurate and frequent observation of precipitation including condensation latent heat of rain and 3D structure



# 1.4 GCOM-W/ AMSR-2

GCOM: Global Change Observation Mission  
 AMSR2: Advanced Microwave Scanning Radiometer-2;  
 Multi frequency and dual polarized passive microwave radiometer

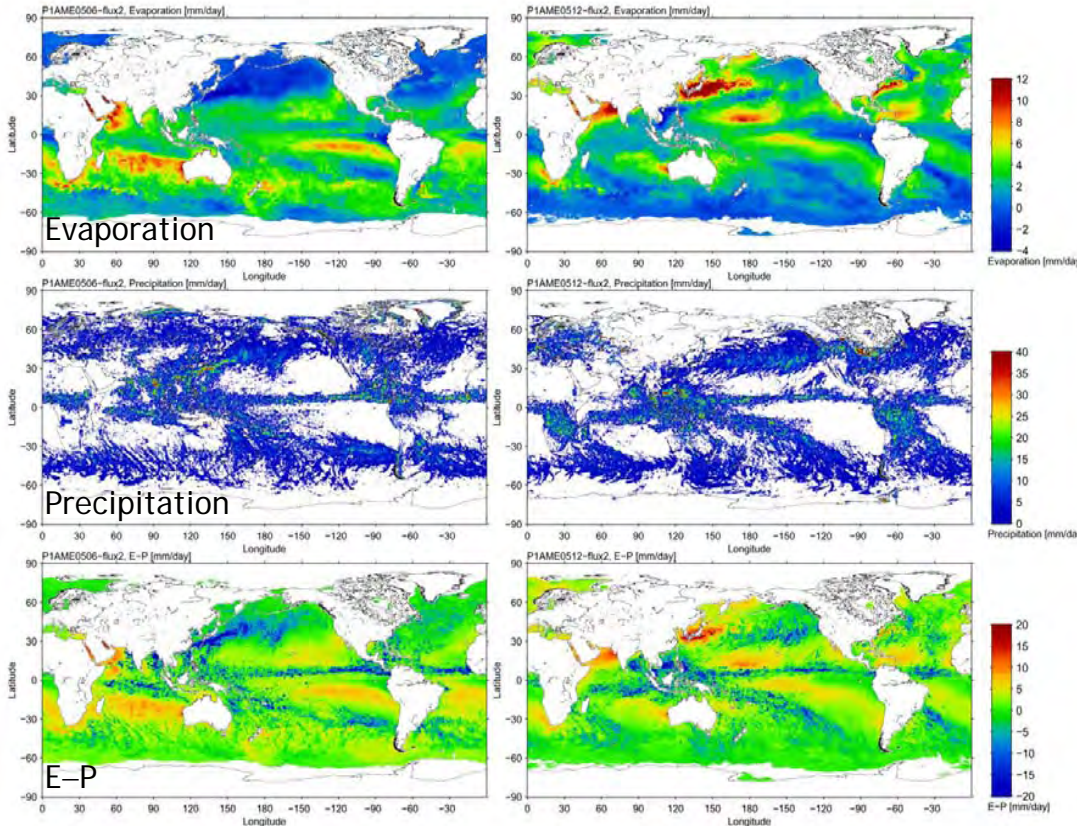


Targets of GCOM-W are water-energy cycle, and will carry AMSR-follow on, AMSR-2. (SeaWinds follow-on are TBD for GCOM-W2-3)

AMSR-2 will continue AMSR-E observations (water vapor, cloud liquid water, precipitation, SST, wind speed, sea ice concentration etc.).

June 2005

December 2005



### GCOM-W AMSR-F/O characteristics

Orbit (TBD)	Sun-synchronous (ascending local time: 13:30) Altitude: 699.6km, Inclination: 98.19deg
Launch Date	Jan. 2012
Mission Life	5 years (3 satellites; total 13 years)
Scan	Conical scan microwave radiometer
Swath width	1450km
Antenna	2.0m offset parabola antenna
Digitalization	12bit
Incident angle	Apporox. 55 degree
Polarization	Vertical and Horizontal
Dynamic range	2.7-340K

Band (GHz)	Band width (MHz)	Polarization	Beam width [deg] (Ground resolution [km])	Sampling interval [km]
6.925	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)	5
89.0	3000	0.15 (3 x 5)		

Sea surface fresh water flux estimated using AMSR-E data

# 1.5 GCOM-C/ SGLI

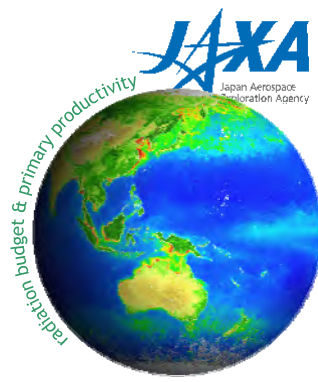
SGLI : Second Generation Global Imager

- Targets of GCOM-C are carbon cycle and radiation budget, and will carry SGLI.
- SGLI will continue almost of the GLI observations (sea surface temperature, ocean colour, aerosols, cloud, vegetation, snow/ ice, and so on).
- The new SGLI features (250m (VN) and 500m (T) channels and two polarization/ multi-direction channels (P)) will enable improvement of land and coastal monitoring and retrieval of land aerosols.

shortwave & thermal InfraRed Scanner (IRS)

Polarization multi-angle radiometer (VNI-P)

push-broom Visible & Near infrared Imager (VNI)



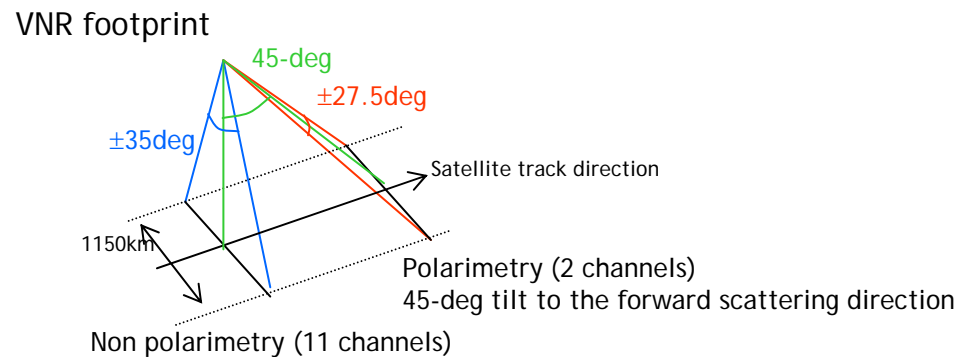
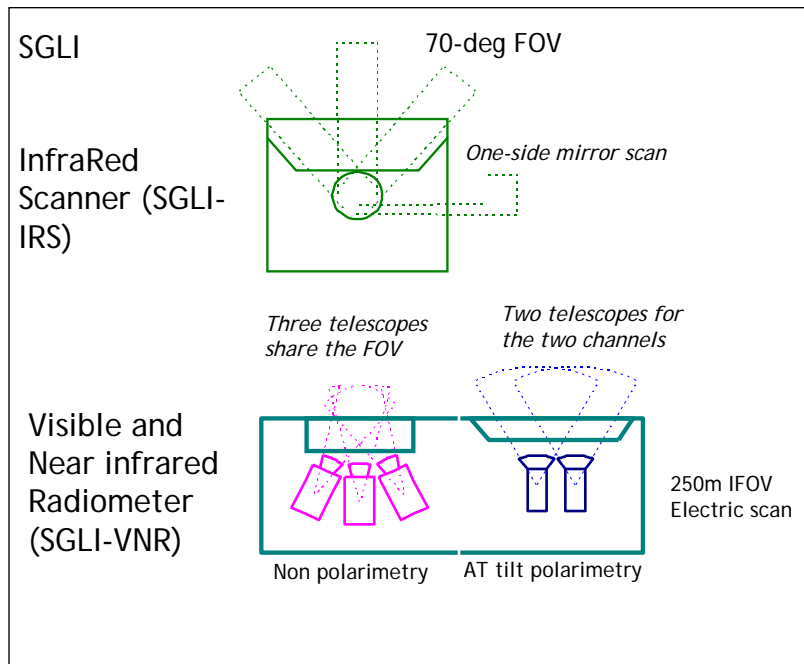
Narrow  $\Delta\lambda$  and relatively high SNR for ocean products

New features of SGLI from ADEOS-2/GLI

GCOM-C SGLI characteristics	
Orbit (TBD)	Sun-synchronous (descending local time: 10:30) Altitude: 798km, Inclination: 98.6deg
Launch Date	early 2014 (JFY2013)
Mission Life	5 years (3 satellites; total 13 years)
Scan	Push-broom electric scan (VN & P) Wisk-broom mechanical scan (SW & T)
Scan width	1150km cross track (VN & P) 1400km cross track (SW & T)
Digitalization	12bit
Polarization	3 polarization angles for P
Along track direction	+45 deg and -45 deg for P Nadir for VN, SW and T

SGLI channels						
CH	$\lambda$	$\Delta\lambda$	$L_{std}$	$L_{max}$	SNR at Lstd	IFOV
	VN, P, SW: nm T: $\mu\text{m}$		VN, P: W/m <sup>2</sup> /sr/ $\mu\text{m}$ T: Kelvin		VN, P, SW: - T: NE $\Delta$ 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	670	10	23	62	400	250
VN8	670	20	25	210	250	250
VN9	763	8	40	350	400	1000
VN10	865	20	8	30	400	250
VN11	865	20	30	300	200	250
P1	670	20	25	250	250	1000
P2	865	20	30	300	250	1000
SW1	1050	20	57	248	500	1000
SW2	1380	20	8	103	150	1000
SW3	1640	200	3	50	57	250
SW4	2210	50	1.9	20	211	1000
T1	10.8	0.7	300	340	0.2	500
T2	12.0	0.7	300	340	0.2	500

- Two components: SGLI-VNR and SGLI-IRS
  - Optimize optics for each wavelength range
  - Polarimetric and multi-angle observation
  - Diversification of risks
- Push-broom system for the SGLI-VNR
  - 70-deg FOV for non-polarimetry, and 55-deg (almost same footprint-width with along-track 45deg tilt) for polarimetry
- One-side (45-deg) mirror scanning system for SGLI-IRS
  - 80-deg FOV

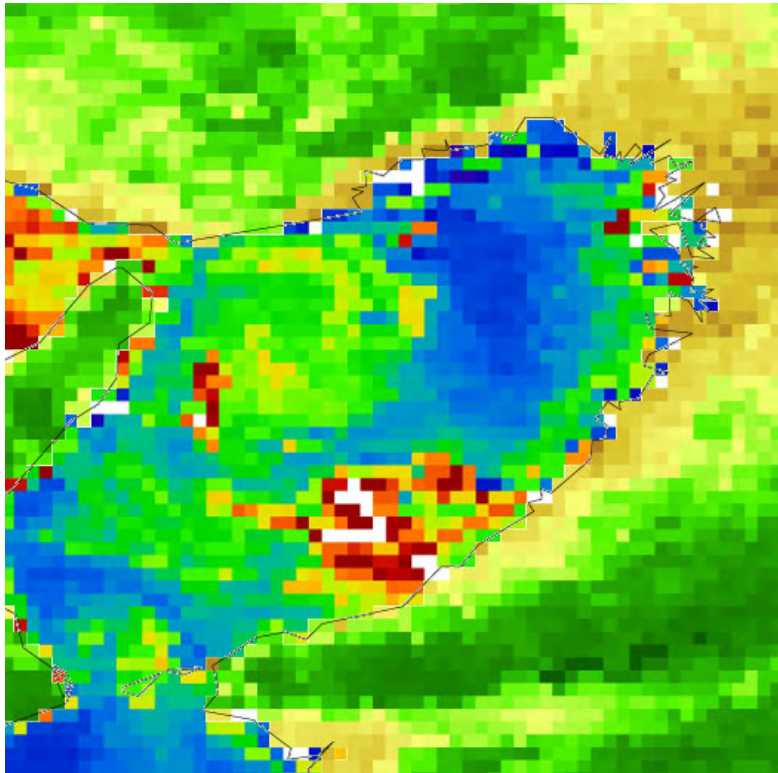




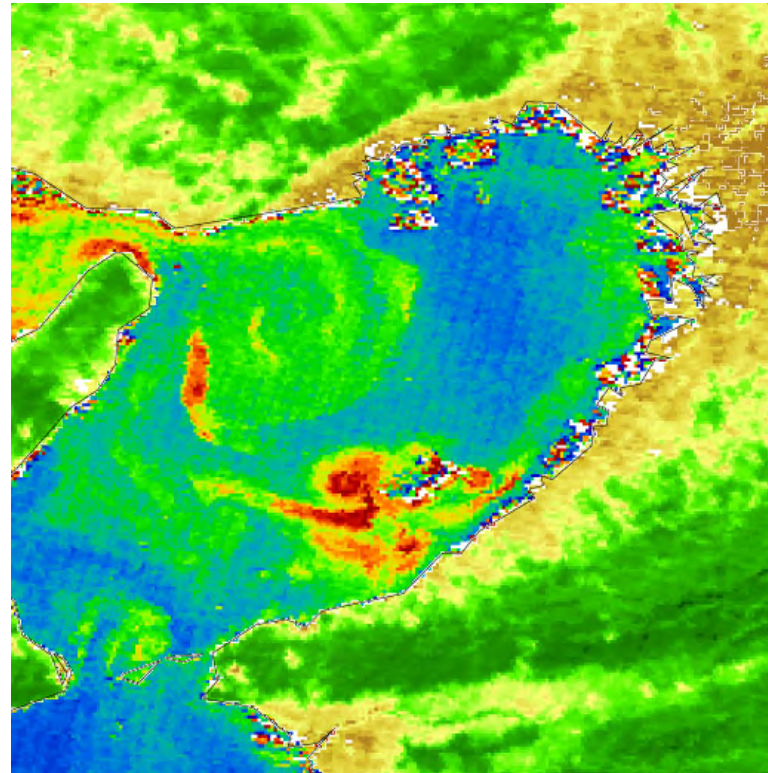
# 1.6 Features of SGLI ocean observation

## Ocean colour

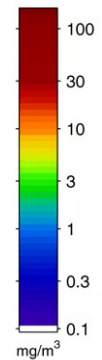
250m Ocean colour product simulated using GLI 250m channels



(a) GLI 1km Osaka Bay  
(1 Oct. 2003, CHL by LCI)



(b) GLI 250m Osaka Bay  
(1 Oct. 2003, CHL by LCI)

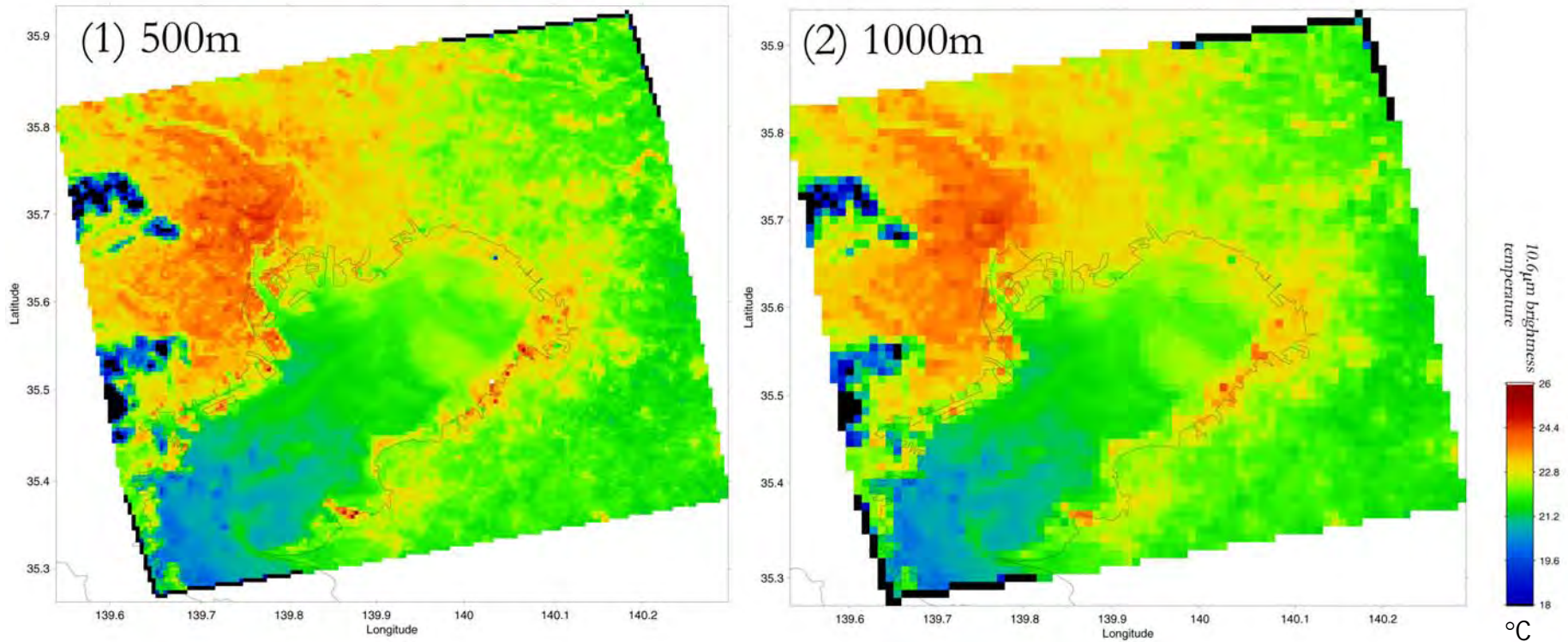


*SGLI 250m resolution will enable to detect more fine structure in the coastal area such as river outflow, regional blooms, and small current.*



# 1.7 Features of SGLI ocean observation

## Sea surface and land surface temperature



- **500m and 1000m spatial resolution thermal infrared** images are simulated using ASTER data (original resolution is 90m) (Tokyo Bay in the night on August 4, 2003).
- The land surface and the coastal water temperature influenced by the city or the river flow will be captured by the GCOM-C 500m thermal infrared channels.



SGLI radiance product (L1B)

S: Standard products, R: Research products

Category	Product	Type*	File unit	Resolution	Threshold for data release	Standard accuracy*1	Target accuracy*1
radiance	Radiometric corrected radiance with geometric information	S	Scene, global (day)	250m (land and coast) 1km (offshore)	TBD	VN/SWIR 5% <sup>2</sup> , 1% (relative) TIR: 0.5K(@300K)	VN/SWIR 3% <sup>2</sup> , 0.5% (relative)

SGLI Ocean products

Category	Product	Type	File Unit	Resolution	Threshold for data release	Standard accuracy*1	Target accuracy*1
Atmospheric correction	Normalized Water Leaving Radiance	S	scene, global (day/8 day/month)	250m (coast) 1km (offshore) 4-9km (global bin)	60% (443-565nm)	50% (<600nm) 0.5W/m <sup>2</sup> /sr/um (>600nm)	30% (<600nm) 0.25W/m <sup>2</sup> /sr/um (>600nm)
	Atmospheric Correction Parameters	S			80% ( $\tau_a=865$ )	50% ( $\tau_a=865$ )	30%
	Photosynthetically Available Radiation	S			20% (10km/month)	15% (10km/month)	10% (10km/month)
	Euphotic Zone Depth	R	scene, global (day/8 day/month)		N/A	N/A	30%(TBD)
In-water parameters	Chlorophyll-a Concentration	S	scene, global (day/8 day/month)	250m (coast) 1km (offshore) 4-9km (global bin)	-60~+150% (offshore)	-60~+150%	-35~+50% (offshore), -50~+100% (coastal)
	Suspended Solid concentration	S			-60~+150% (offshore)	-60~+150%	-50~+100%
	Colored Dissolved Organic Matter	S			-60~+150% (offshore)	-60~+150%	-50~+100%
	Inherent Optical Properties	R	scene, global (day/8 day/month)		N/A	N/A	a(440): RMSE<0.25, bbp(550): RMSE<0.25
Temperature	Sea Surface Temperature	S	scene, global (day/8 day/month)	500m (coast) 1km (offshore) 4-9km (global bin)	0.8K (daytime)	0.8K	0.6K
Application	Ocean Primary Productivity	R	scene, global (day/8 day/month)	500m (coast) 1km (offshore) 4-9km (global bin)	N/A	N/A	TBD
	Phytoplankton Functional Type	R	scene, global (day/8 day/month)	250m (coast) 1km (offshore) 4-9km (global bin)	N/A	N/A	correct judgment rate of large/ small phytoplankton dominance>80%; correct judgment rate of the dominant phytoplankton functional group >60%
	Redtide	R			N/A	N/A	correct judgment rate >80%
	Multi-sensor Ocean Color	R	scene, global (day/8 day/month)	250m (coast) 1km (offshore)	N/A	N/A	Same as the original
	Multi-sensor SST	R	scene, global (day/8 day/month)	500m (coast) 1km (offshore)	N/A	N/A	Same as the original



- **Normalized Water Leaving Radiance (NWLR) and Atmospheric Correction Parameters (ACP)**
  - Definition: Standardized radiance of the SGLI spectral channels leaving from a sea surface in the case of atmospheric transmittance 1.0 , the solar zenith angle zero and the sun-earth distance 1AU. The reflective ingredient of a sea surface is not included ( $\text{mW}/\text{cm}^2/\text{str}/\mu\text{m}$ ). This is same as OCTS, GLI, SeaWiFS, and MODIS.
- **Photosynthetically Available Radiation (PAR)**
  - Definition: daily average of the light at wavelengths from 400nm to 700nm which phytoplankton uses for photosynthesis by  $\text{Ein}/\text{m}^2/\text{day}$ .
- **CHLorophyll-A concentration (CHLA)**
  - Definition: phytoplankton chlorophyll-a concentration by  $\text{mg}/\text{m}^3$
- **Suspended Solid concentration (SS)**
  - Definition: Filter dry weight by  $\text{g}/\text{m}^3$  (total suspended matter)
- **absorption of Colored Dissolved Organic Matter (CDOM)**
  - Definition: attenuation coefficient ( $\text{m}^{-1}$ ) of the colored dissolved organic matter at 440nm (TBD)
- **Sea Surface Temperature (SST)**
  - Definition: bulk sea surface temperature (observed by drifting buoy at 1-m) by degree C

- Euphotic Zone Depth (EZD)

- Definition: Total direction illumination (observation is cosine) defines by PAR as depth which becomes 1% (denominator: E0-).

- Inherent Optical Properties (IOP)

- Meaning: It can be used for the primary productivity model, plankton classification presumption, etc.

- multi sensor Merged Ocean Color parameters (MOC)

- Definition: Data sets which combined with the product of other satellites and improved time resolution

- IOCCG can be the principal investigator (?)

- multi sensor Merged Sea Surface Temperature (MSST)

- Definition: Data sets which combined with the product of other satellites and improved time resolution

- Ocean Net Primary Productivity (ONPP)

- Definition: Net primary productivity by phytoplankton (breathing respiration is not taken into consideration)

- PHYtoplankton Functional Type (PHFT)

- Definition: The phytoplankton existence rate for every functions, such as nitrogen fixation, silicon fixation, and carbon dioxide discharge. It grasps what kind of function plankton with exists, and it is used for climate change analyses, such as cloud nucleus formation.

- Red TiDe (RTD)

- Definition: The coloring phenomenon which man distinguishes from red tide

### 3. Summary and *topics*

- JAXA is planning the GCOM, which consists of GCOM-W/AMSR-2 and GCOM-C/SGLI satellite/sensor series.
- GCOM-C/SGLI is still under evaluation (this year).
- GCOM (both W and C) data policy is the free-of-charge for online-get science users (but user registration is requested).
- JAXA and NOAA have started discussion about GCOM(-W and C) and NPOESS collaboration (data receiving/exchange, and science activities..) from the last winter.
  - We hope to collaborate with Sentinel-3 and Korean geostationally ocean-colour mission
- JAXA and CNES are making a collaboration plan about future (maybe after 10years) geostationally missions (candidates are disaster, atmospheric chemistry, and ocean colour; TBD)