Global Change Observatin Mission (GCOM)

IOVWST

Kailua Kona

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EORC, JAXA

Background

- **Minister of MEXT committed at Earth Observation Summit on Apr. 2004**
  - **Global Warming, Carbon Cycle**
  - **Climate Change, Water Cycle**
  - **Disaster mitigation**
- **Future Earth Observation system must reflect**
  - **Reliability**
  - **Continuity**
  - **User oriented**

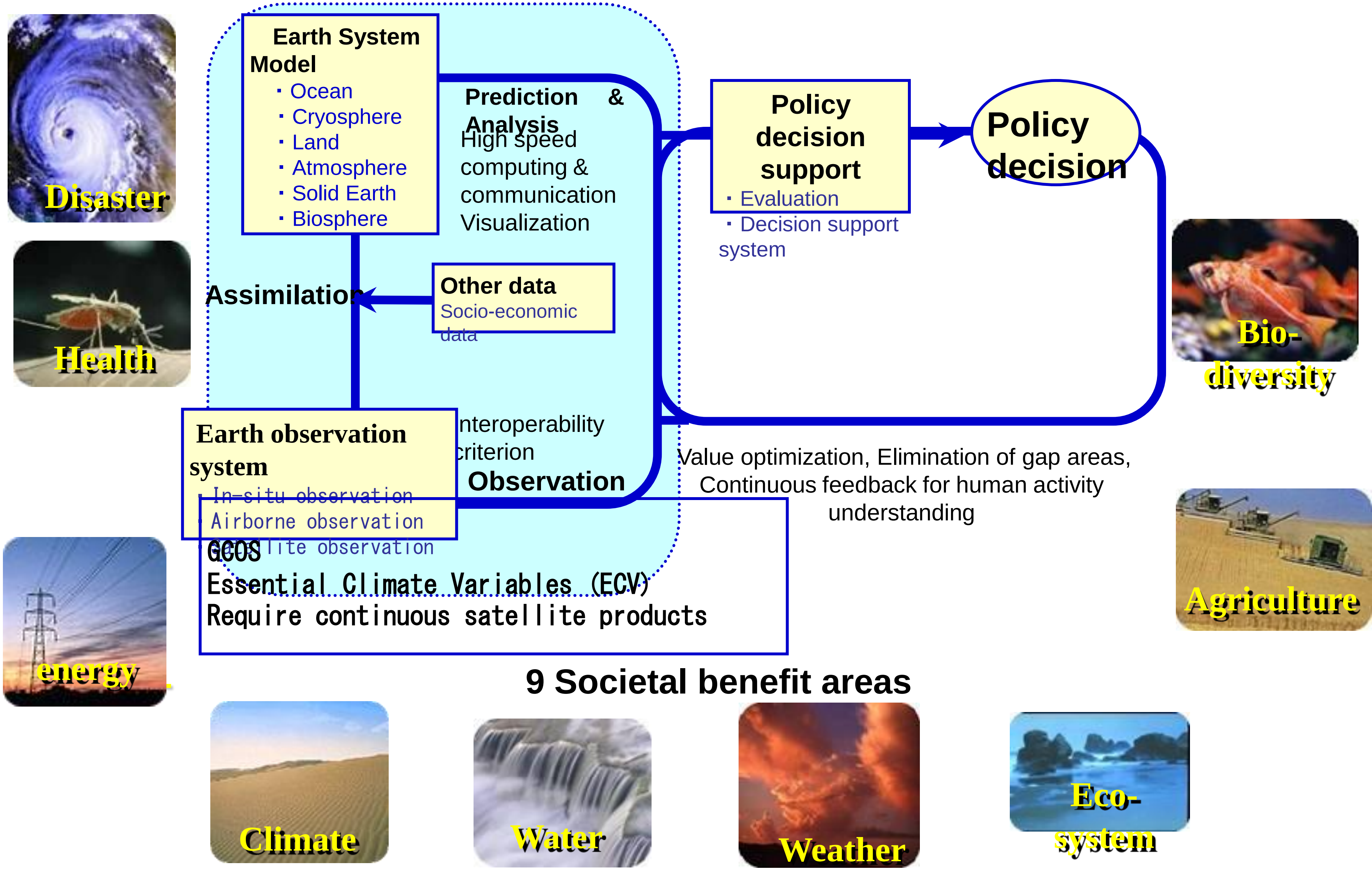
  “Stable and continuous social infrastructure”

  Contribution to GEOSS

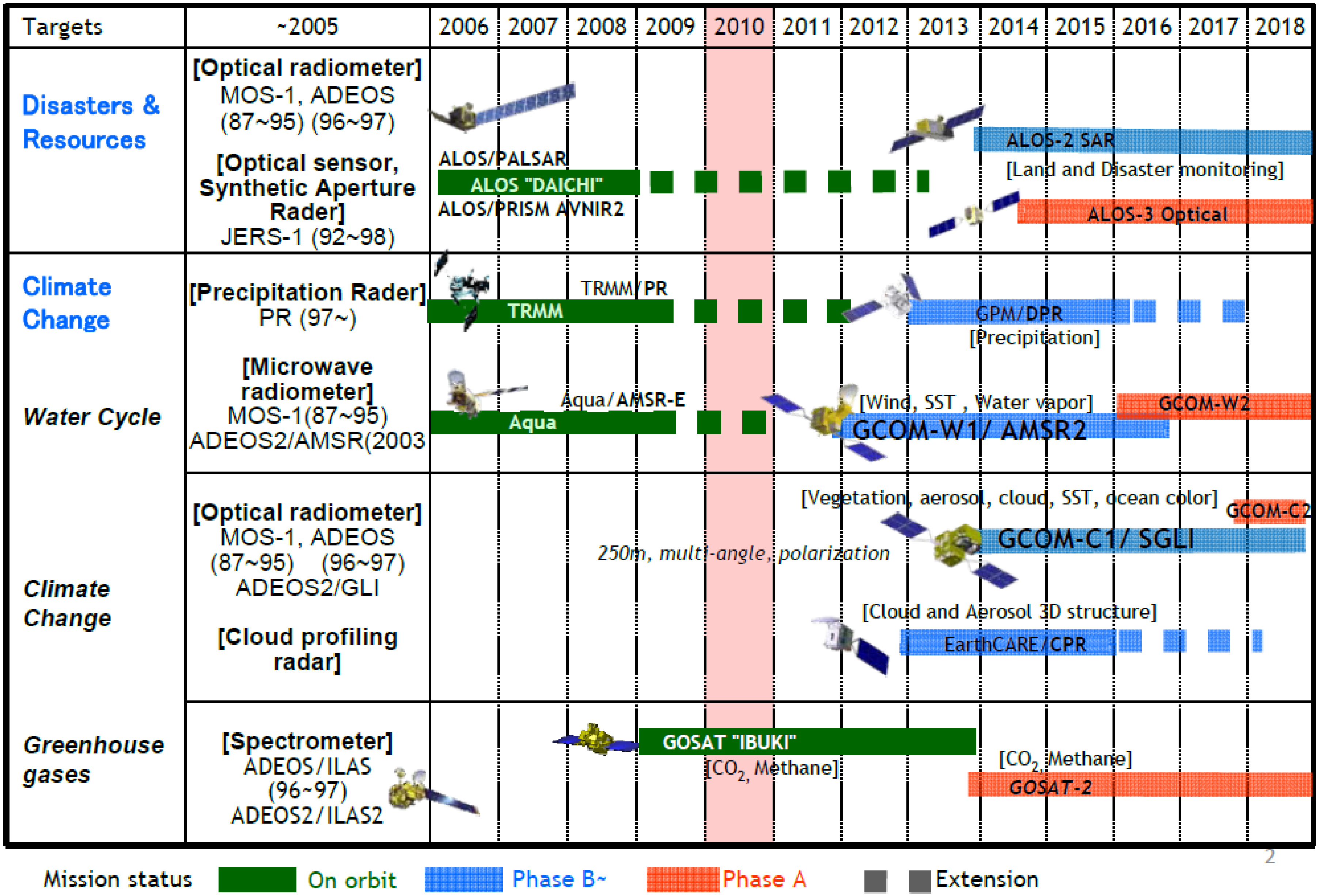
Council for Science and Technology Policy (CSTP)

- 3rd Science and Technology Basic Plan
- Total budget of $240B in 5 years
- Strategic fields : Environment, Life science, Information/communication, Nano-technology
- Ocean-Earth Observation Exploration System
- One of the 5 national critical technology

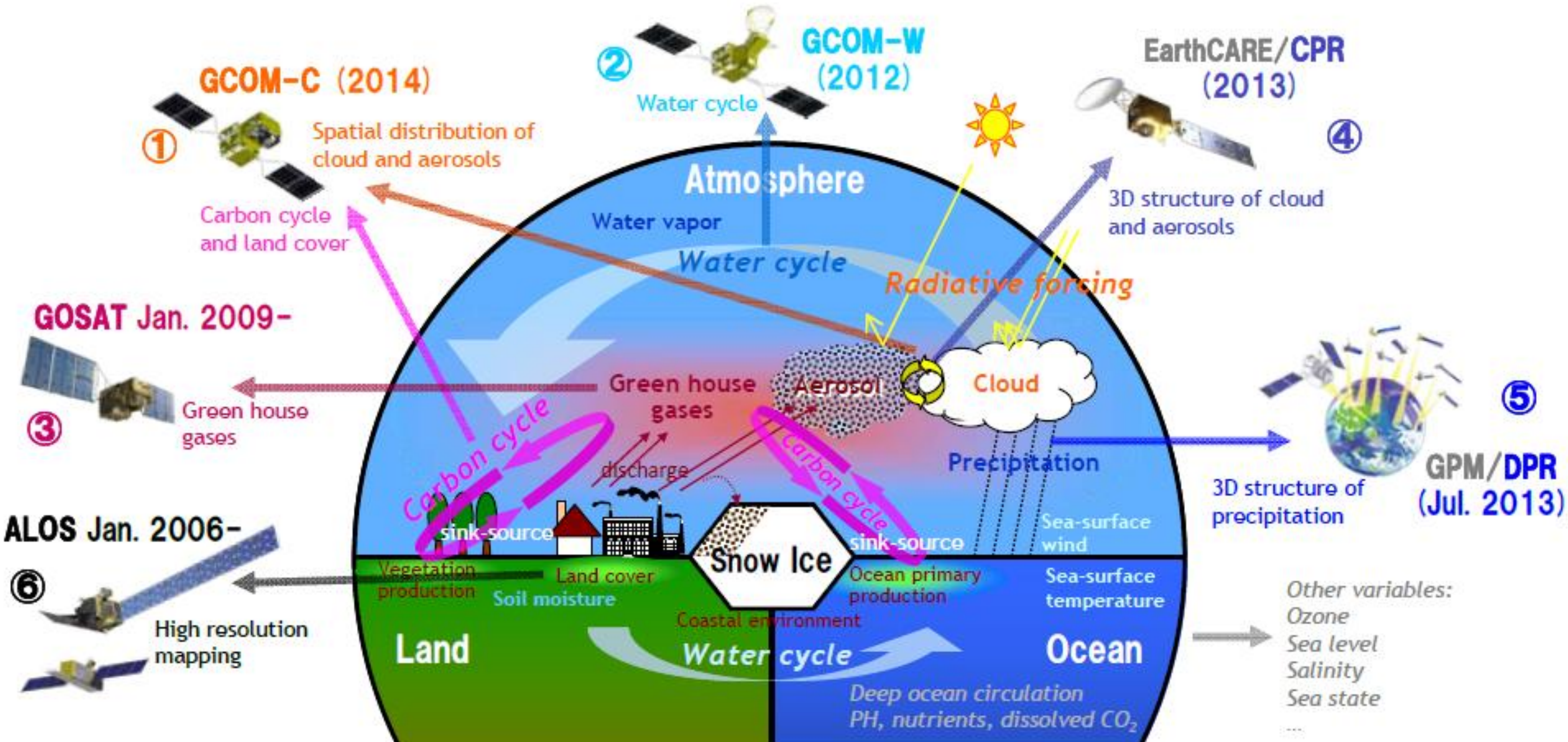
GEOSS 10 year implementation plan



JAXA's Long-Term Plan of Earth Observation



JAXA Future Environment Missions



① **GCOM-C**: Long-term observation of the horizontal distribution of aerosol, cloud, and ecosystem CO_2 absorption and discharge

② **GCOM-W**: Long-term observation of water-cycle such as the snow/ice coverage, water vapor, and SST

③ **GOSAT**: Observation of distribution and flux of the atmospheric greenhouse gases, CO_2 and CH_4

④ **EarthCARE/CPR**: Observation of vertical structure of clouds and aerosols

⑤ **GPM/DPR**: Accurate and frequent observation of precipitation with active and passive sensors

⑥ **ALOS**: Fine resolution mapping by optical and SAR instruments

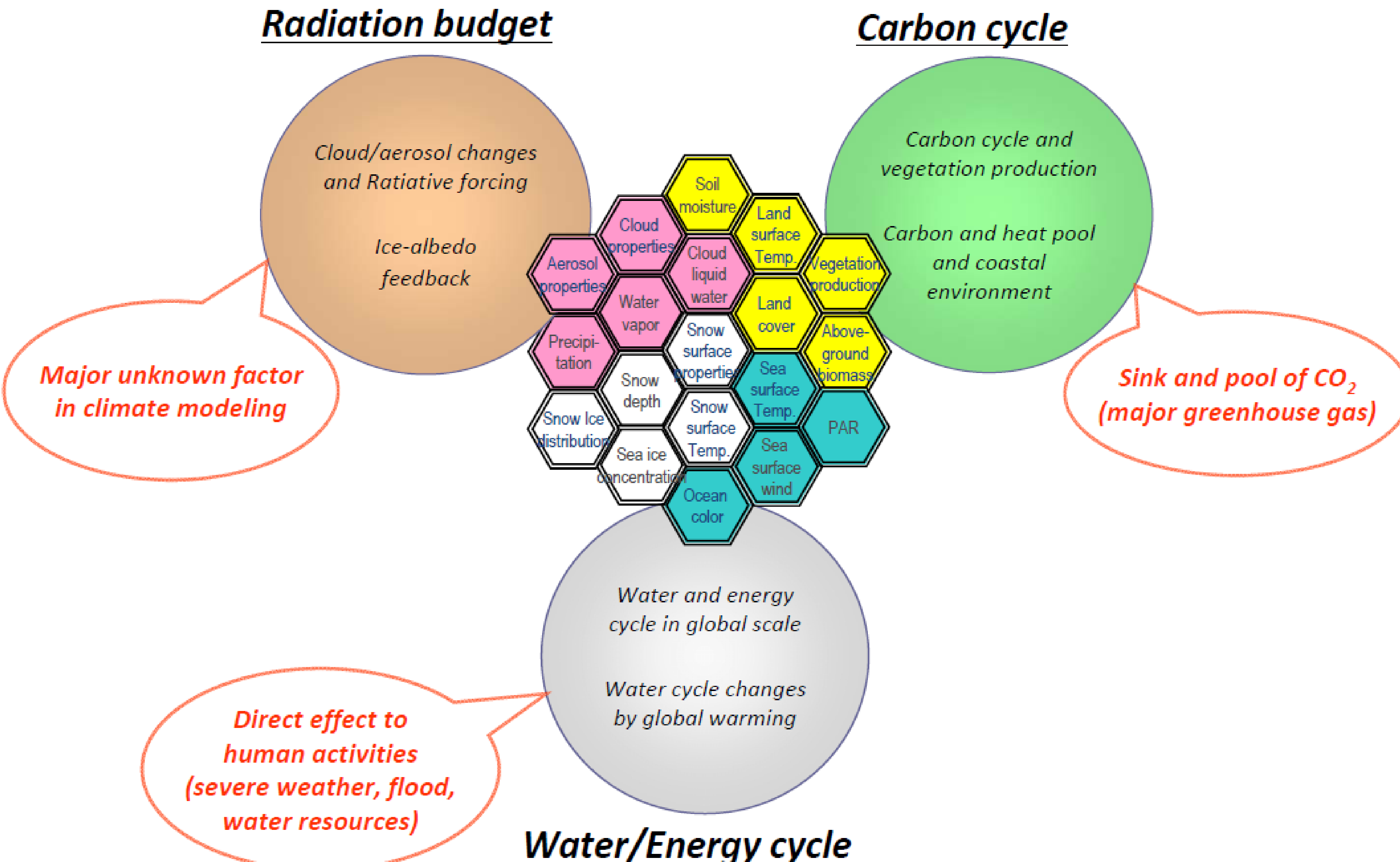
GCOM Mission

- **Continuation of ADEOS Ⅱ**
- **Contribution to GEOSS**
- **Climate, Weather, Water, Ecosystem, Agriculture, etc. in GEOSS 9 areas**
- **Focus on Climate change / Global warming and Water cycle committed in Summit**
- **Contribution to operational fields like weather forecast, fisheries, etc.**
- **Long term continuous measurements**

Scientific Targets

- **Accurate estimation of aerosol radiative forcing**
- **Validation of climate models**
- **Accurate estimation of primary production**
- **Better understanding of coastal phenomena**
- **Better understanding of sea ice trend**

GCOM Observation Targets



Operational Applications

- **Input to NWP**
- **Extreme weather forecasting**
- **Fisheries**
- **Navigation**
- **Coastal management**
- **Crop yield estimation**
- **Monitoring forest decrease**
- **Monitoring volcano eruptions**
- **Monitoring forest fire**

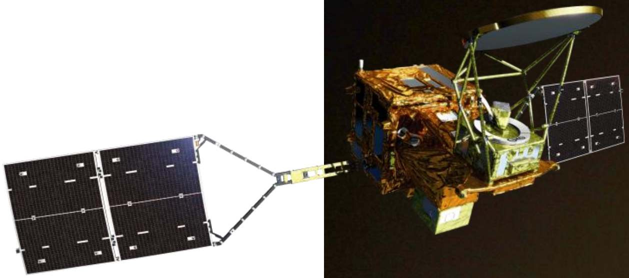
GCOM satellites

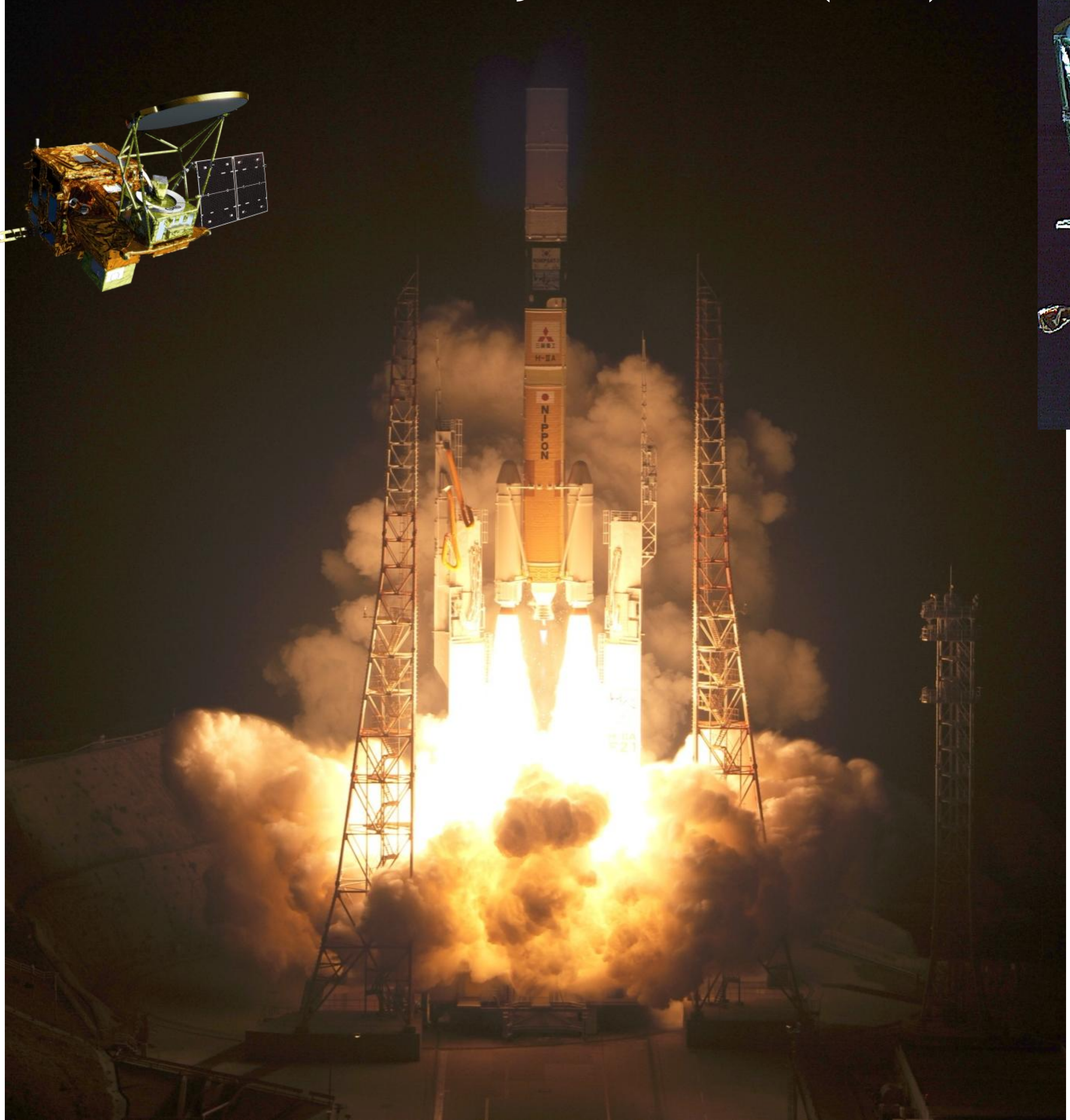
- **GCOM-W1**
  - **AMSR2 (Advanced Microwave Scanning Radiometer 2)**
  - **Launched on 18, May., 2012**
- **GCOM-C1**
  - **SGLI (Second generation Global Imager)**
  - **Planned to be launched in fiscal 2016**
- **Plan for the 2nd and 3rd generations**
  - **GCOM-W2 (in 2017), GCOM-W3 (in 2021)**
  - **GCOM-C2 (in 2020), GCOM-C3 (in 2024)**

GCOM-W1 Launch

- GCOM-W1 was launched at 1:39, 18, May, 2012.
- GCOM-W1 was accurately put into the orbit.
- GCOM-W1 finished its critical phase including AMSR2 rotation at 4rpm.
- GCOM-W1 was put into A-train orbit on 1, July.
- AMSR2 has been operational from 6, July.
- AMSR-E is rotating from Dec. 2012 at 2rpm for cross calibration.

GCOM-W1 "SHIZUKU" was successfully launched on May 18, 2012 (JST).



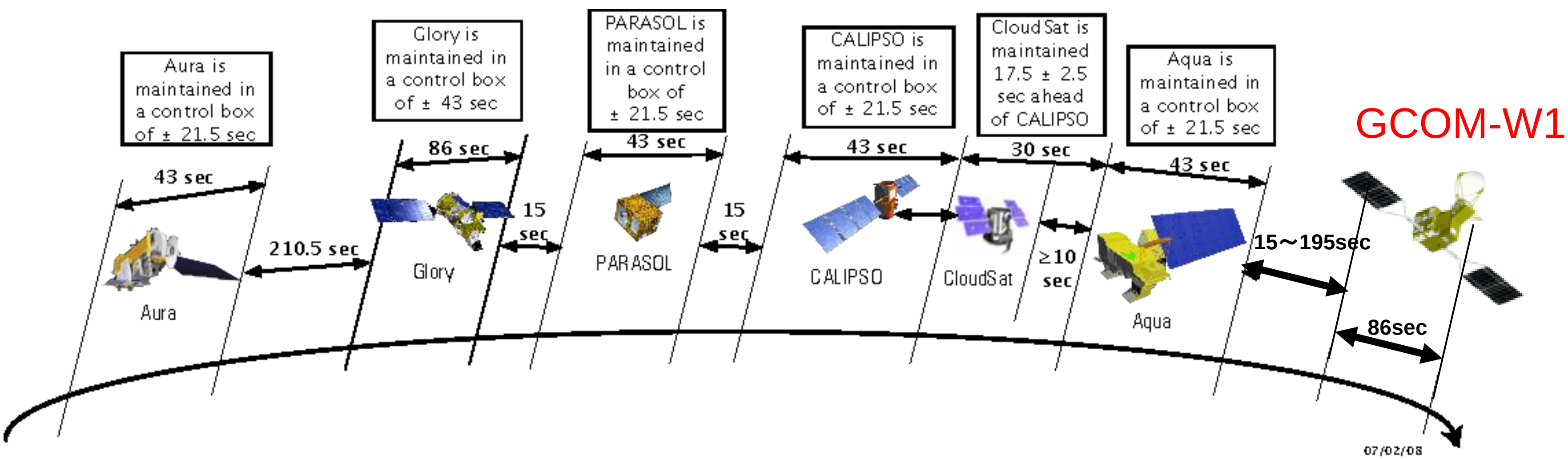


GCOM-W1

- Orbit
  - Sun synchronous orbit
  - Height: about 700km
  - Local time of ascending node: 13:30
- Weight: about 1.99t
- Power : about 3.9kW
- Lifetime: 5 years
- Data transmission
  - Global observation data are stored and transmitted every orbit period
  - Observed data are transmitted to ground stations in real time

A-Train and GCOM-W1

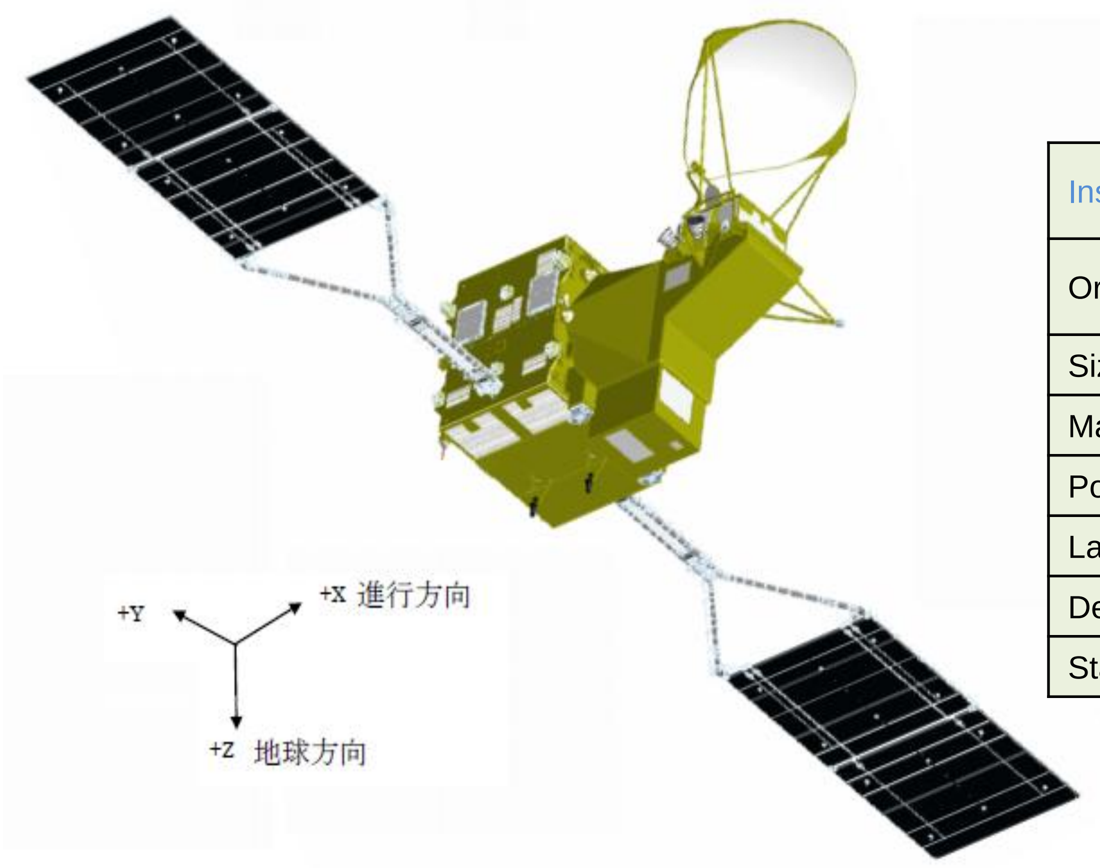
- After invitation to A-Train constellation from NASA, JAXA and A-Train members studied the possibility of participation of GCOM-W1 to A-Train.
- Participation of GCOM-W1 to A-Train was approved by A-Train members last October. The position of GCOM-W1 is ahead of Aqua.
- Benefits of joining the A-train are:
  - Precise inter-calibration between AMSR-E and AMSR2; and
  - Synergy with A-Train instruments for new Earth science research.



Downlink

- Freq : 8245MHz
- Polarization : RHCP
- Modulation : OQPSK
- Data Rate : 10Mbps (20Msps)
- Coding : CCSDS, Reed-Solomon, convolution

GCOM-W1 satellite



GCOM-W (Water)

Instrument	Advanced Microwave Scanning Radiometer-2
Orbit	Sun Synchronous orbit Altitude：699.6km (over the equator)
Size	5.1m (X) * 17.5m (Y) * 3.4m (Z)
Mass	1880kg
Power	Over 4050W
Launch	JFY2011 (CY2012 Winter)
Design Life	5-years
Status	Preliminary Design started in JFY2007

– *GCOM-W1/AMSR2 will contribute to long-term observation of global water and energy cycle.*
– *Continue AMSR-E observation (high spatial resolution, low-frequency channels,etc.).*
– *Construct reliable long-term dataset to contribute for understanding and monitoring of climate change.*
– *Contribute to operational use by providing continuous cloud-through SST, frequent and quantitative storm observation to maintain precipitation forecast accuracy.*

Basic requirements for AMSR 2

- Minimum modifications from AMSR on ADEOS-II to reduce risks/cost and keep the earliest launch date.
- Several essential improvements.
  - Improvement of calibration system including warm load calibration target.
  - Consideration to C-band radio frequency interference (RFI).

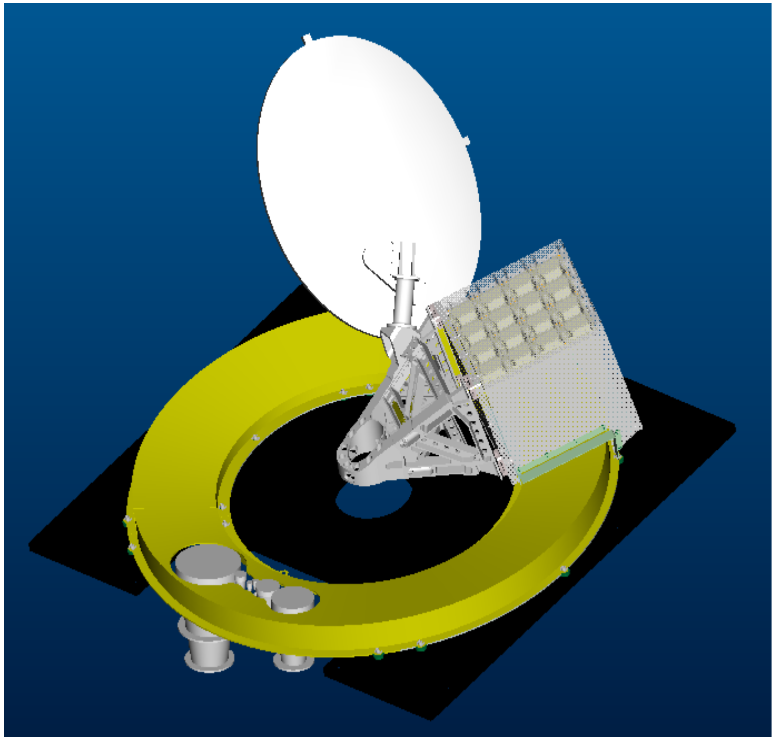
Basic requirements for AMSR 2

- Antenna : 2.0m, offset parabolic antenna
- Channel sets
  - Identical to AMSR-E (no O_2 band channels)
  - 6.925,7.3, 10.65, 18.7, 23.8, 36.5, 89.0GHz
  - Dual polarization
- Calibration
  - Improvements of hot load etc.
  - Enhance pre-launch calibration testing
- Orbit
  - A-Train
- Mission life
  - 5 years

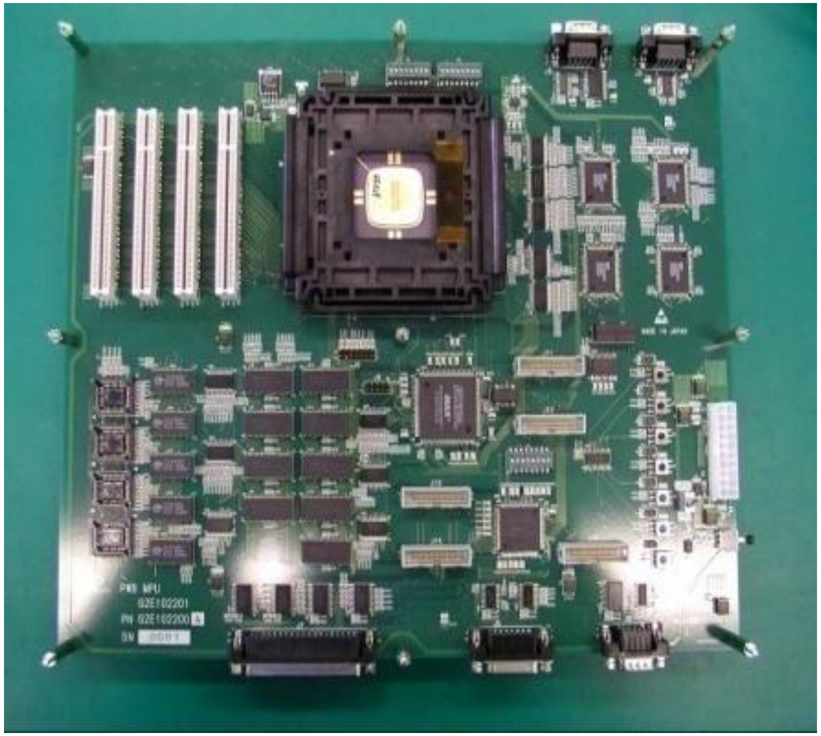
Improvement of hot load

- Adoption of temperature controlled reflector over hot load
- Minimize the effect of thermal interference
- Design results shows the maximum temperature difference less than 2K
- Brightness temperature accuracy will be around 0.1K

Prototyping and testing



Calibration Assembly

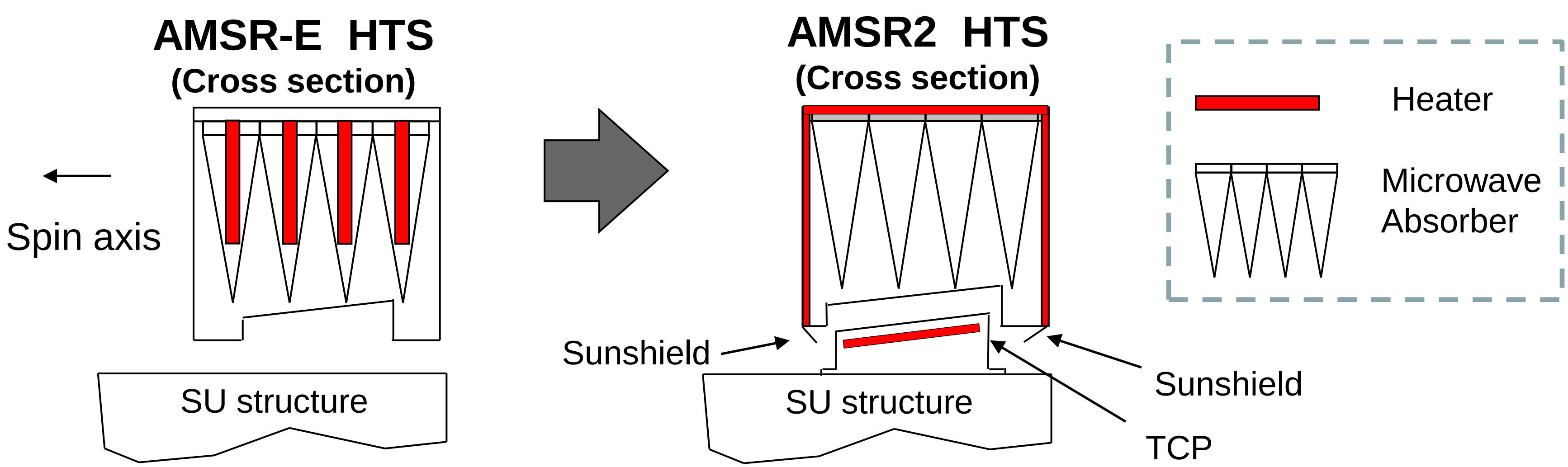


MPU testing board

Improvement of HTS(Hot Load)

(1) Temperature inside HTS is kept constant (= 20 degrees C) using heaters on 5 walls of HTS and TCP.
(2) Sunshields attached to HTS and TCP minimize the sun light reflection into HTS.
(3) TCP thermally isolates HTS from SU structure (much colder than HTS).

HTS: High Temperature noise Source, TCP: Thermal Control Panel, SU: Sensor Unit

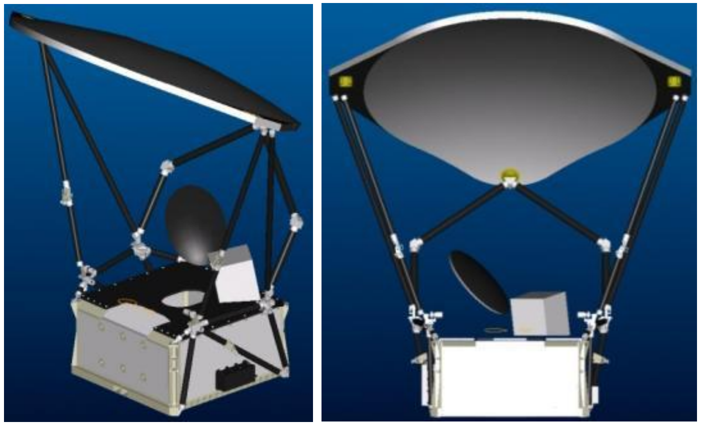


- **Maximum temperature difference inside HTS : less than 2K**
- **Estimated brightness temperature accuracy :**
  - **0.2 K (Variable bias during orbit, season, design life)**
  - **0.1 K (Random due to quantization)**

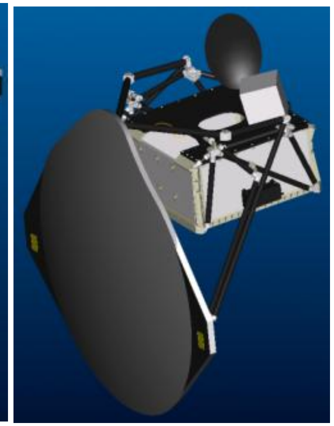
Temperature Resolution

Frequency	Resolution(target)
6.925	<0.34(0.3)
7.3	<0.43
10.65	< 0.7(0.6)
18.7	< 0.7(0.6)
23.8	< 0.6(0.55)
36.5	< 0.7(0.65)
89.0	< 1.2(1.1)

Overview of AMSR2 instrument



Deployed



Stowed

- Deployable main reflector system with 2.0m diameter.
- Frequency channel set is identical to that of AMSR-E except 7.3GHz channel for RFI mitigation.
- Two-point external calibration with the improved HTS (hot-load).
- Deep-space maneuver will be considered to check the consistency between main reflector and CSM.

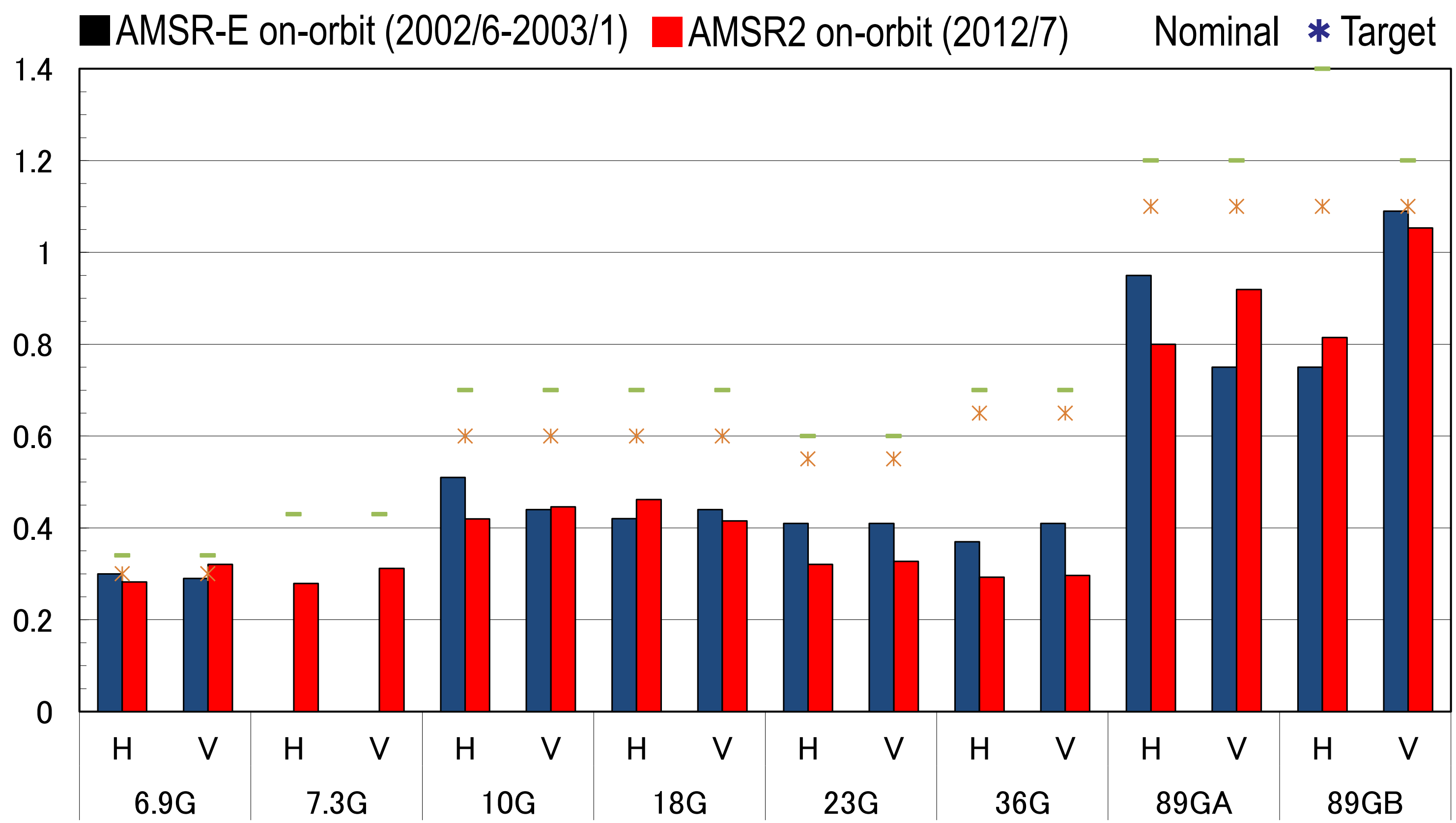
GCOM-W1/AMSR2 characteristics	
Orbit	Sun Synchronous with 699.6km altitude (over the equator)
Launch	JFY2011
Design-Life	5-years
Local time	13:30 LTAN
Swath width	1450km
Antenna	2.0m offset parabola
Incidence angle	Nominal 55 degree

AMSR2 Channel Set

Center Freq. [GHz]	Band width [MHz]	Polarization	Beam width [deg] (Ground res. [km])	Sampling interval [km]
6.925 / 7.3	350	V and H	1.8 (35 x 62)	10
			1.7 (34 x 58)	
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

On-Orbit Radiometer Sensitivity

All channels meet the requirements of radiometer sensitivity.



Radiometer sensitivities were computed as follows.

- Use center 2-points among 16-points (4-points among 32-points for 89GHz) and consecutive 10-scans (in total, 2*10=20 samples for lower frequencies, 4*10=40 samples for 89GHz) to compute standard deviation of radiometer counts, and then convert to temperature scale.
- Compute radiometer sensitivities for HTS (approx. 290K) and CSM (approx. 3K) temperatures, and then interpolate those values to derive radiometer sensitivities at150K temperature.
- Average those instantaneous values during the period indicated in the chart.

Summary of TMI intercalibration

- Intercalibration coefficients (slope/intercept) were derived by linear regression (no physical meaning of straight-line approximation). Calibration differences at typical Tbs are also shown in table below based on the intercalibration coefficients.
- Characteristics of the difference sometimes differ for ocean/land and ascending/descending (see next slide). Coefficients below were determined by using both ocean and rainforests values, and averaged over ascending and descending. Separated coefficients for ascending and descending are provided in Appendix.

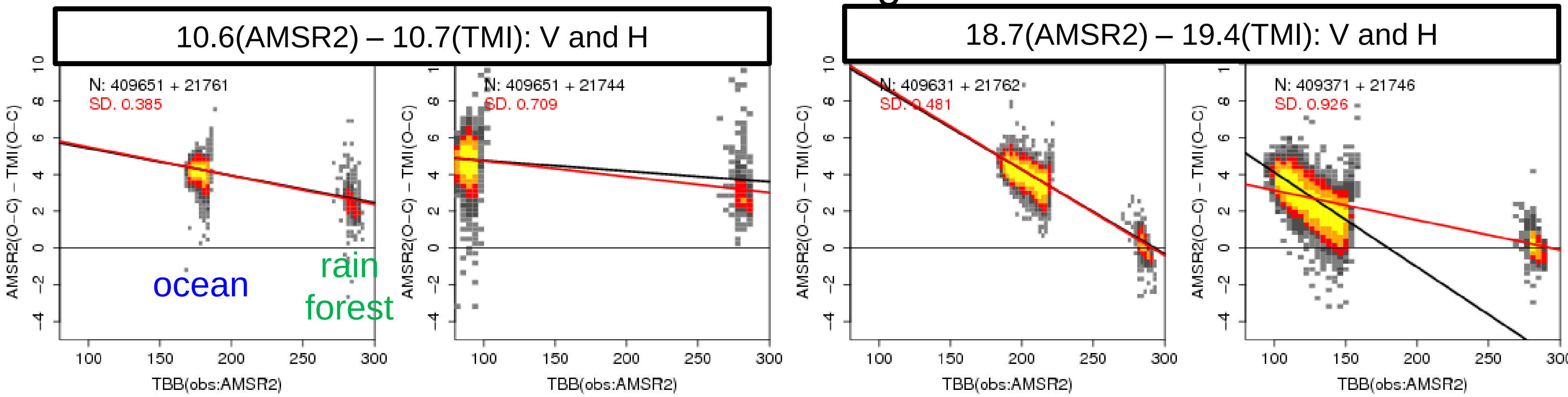
Asc+Dsc	slope	intercept	TB@ocean	ΔT@ocean	TB@land	ΔT@land
10V	-0.01662	6.99952	179	+4.0	285	+2.3
10H	-0.00975	5.61573	91	+4.7	283	+2.9
18V	-0.05124	13.80014	205	+3.3	286	-0.8
18H	-0.01944	4.62348	131	+2.1	284	-0.9
23V	-0.03970	13.47956	237	+4.1	288	+2.0
23H	-	-	-	-	-	-
36V	-0.02711	9.66059	224	+3.6	285	+1.9
36H	-0.02108	7.84445	160	+4.5	284	+1.9
89AV	-0.00141	1.75392	270	+1.4	287	+1.3
89AH	-0.00975	4.97772	242	+2.6	287	+2.2
89BV	-0.00618	3.37024	269	+1.7	287	+1.6
89BH	-0.00545	3.80564	241	+2.5	287	+2.2

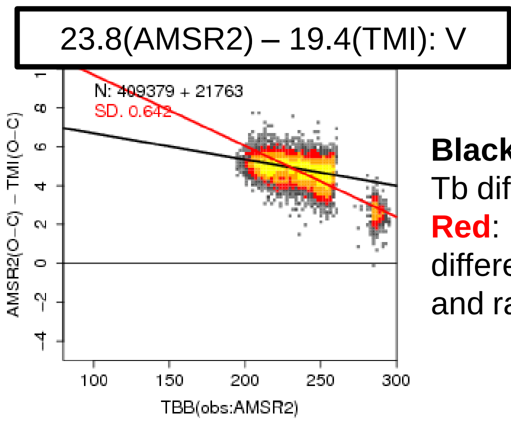
$$\Delta Cal_{AMSR2-TMI}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{TMI-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

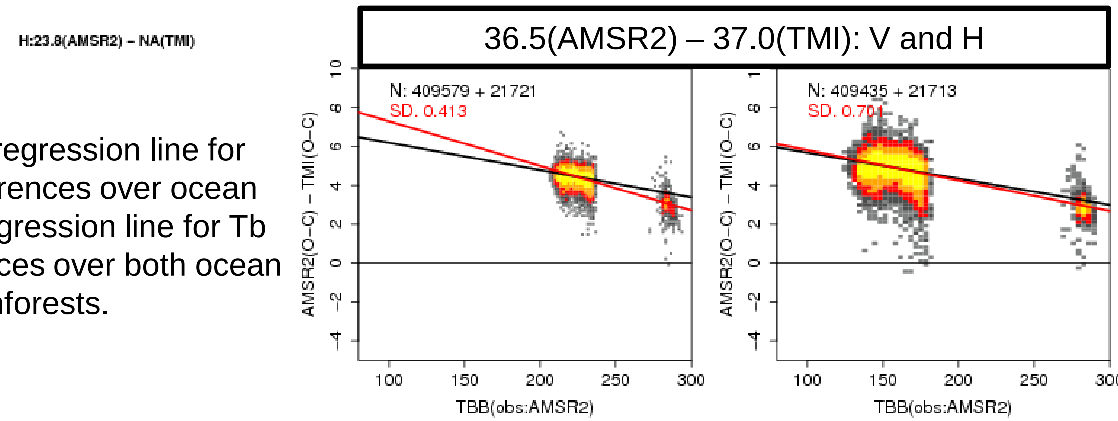
Tb-dependent calibration differences

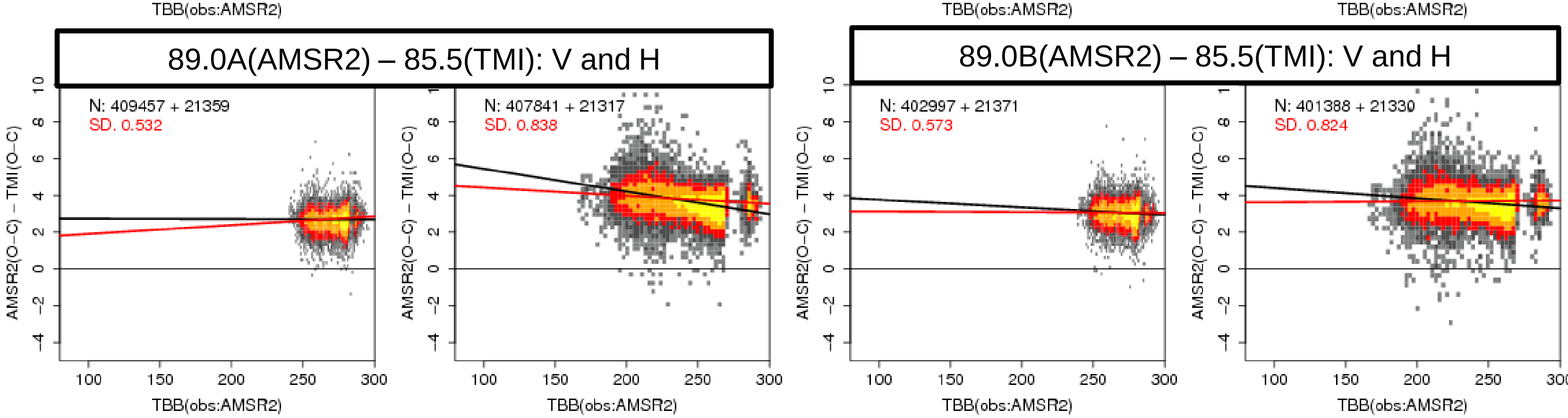
AMSR2 Ascending Passes





Black: regression line for Tb differences over ocean
Red: regression line for Tb differences over both ocean and rainforests.





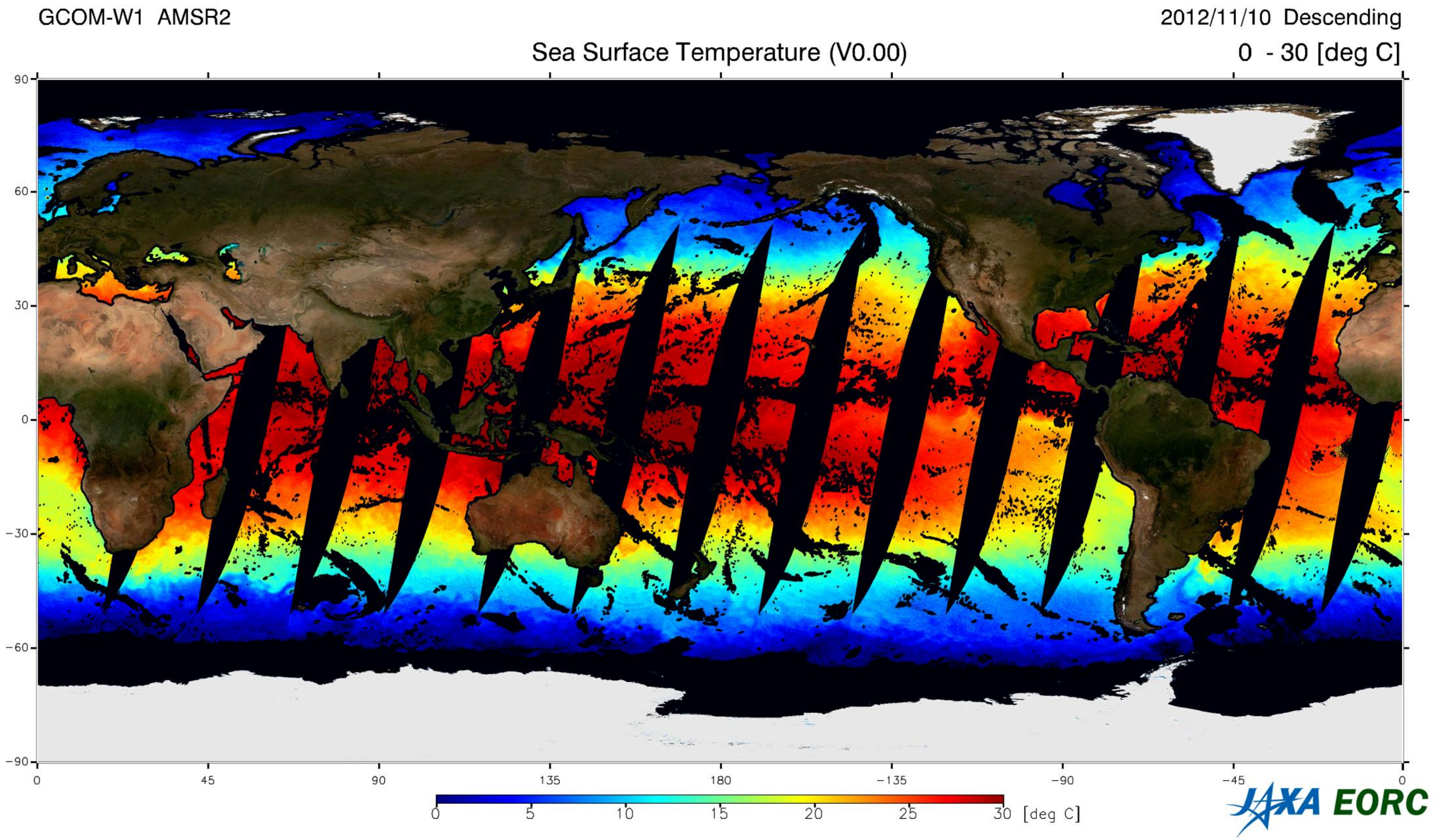
Summary of AMSR-E intercalibration

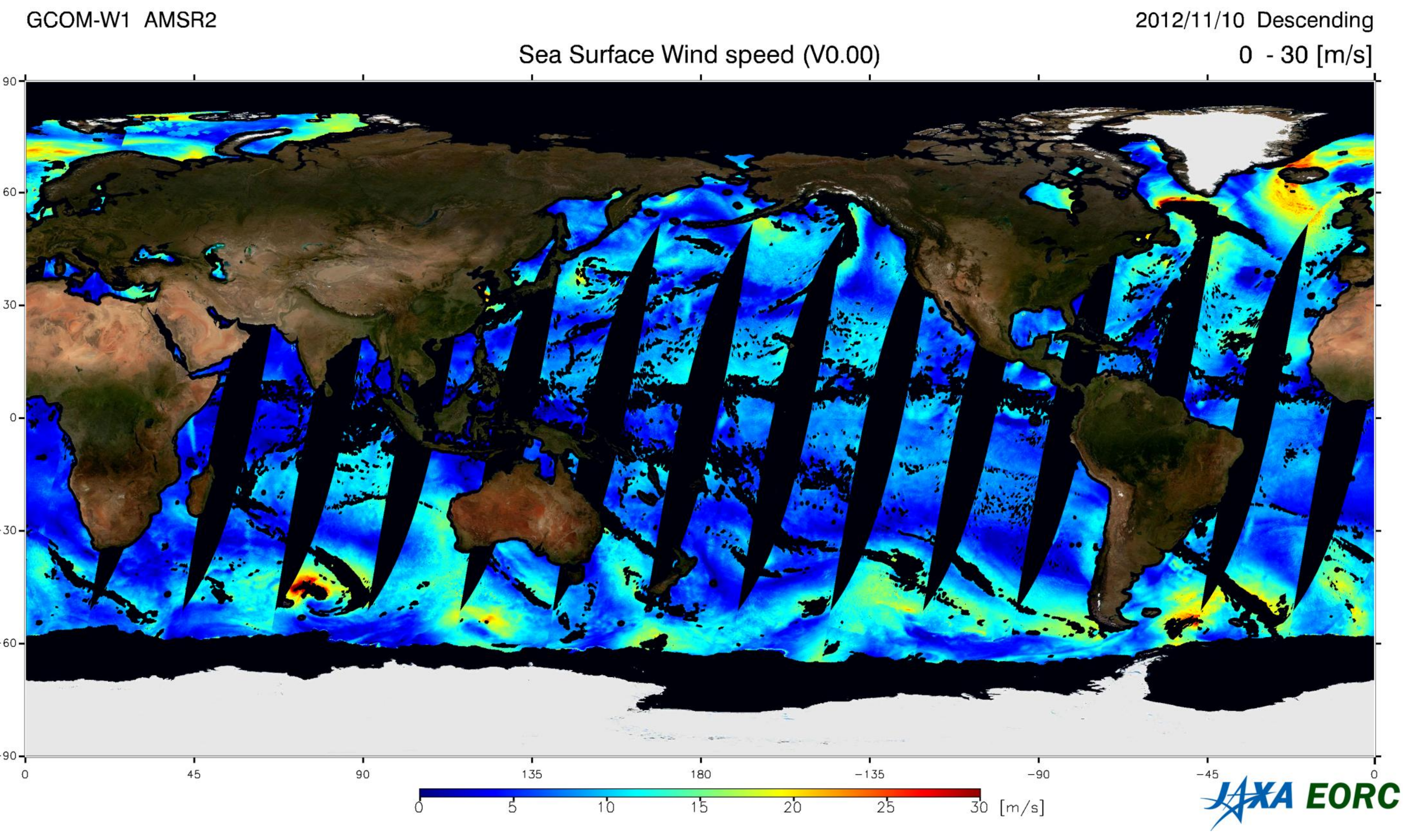
- Intercalibration coefficients (slope and intercept) provided below are those of lines passing through two O-C values over ocean and rainforest (no physical meaning for straight-line approximation). Calibration differences at typical Tbs are shown based on the coefficients.
- Averaged over ascending and descending passes. Separated coefficients for ascending and descending orbits are provided in Appendix.

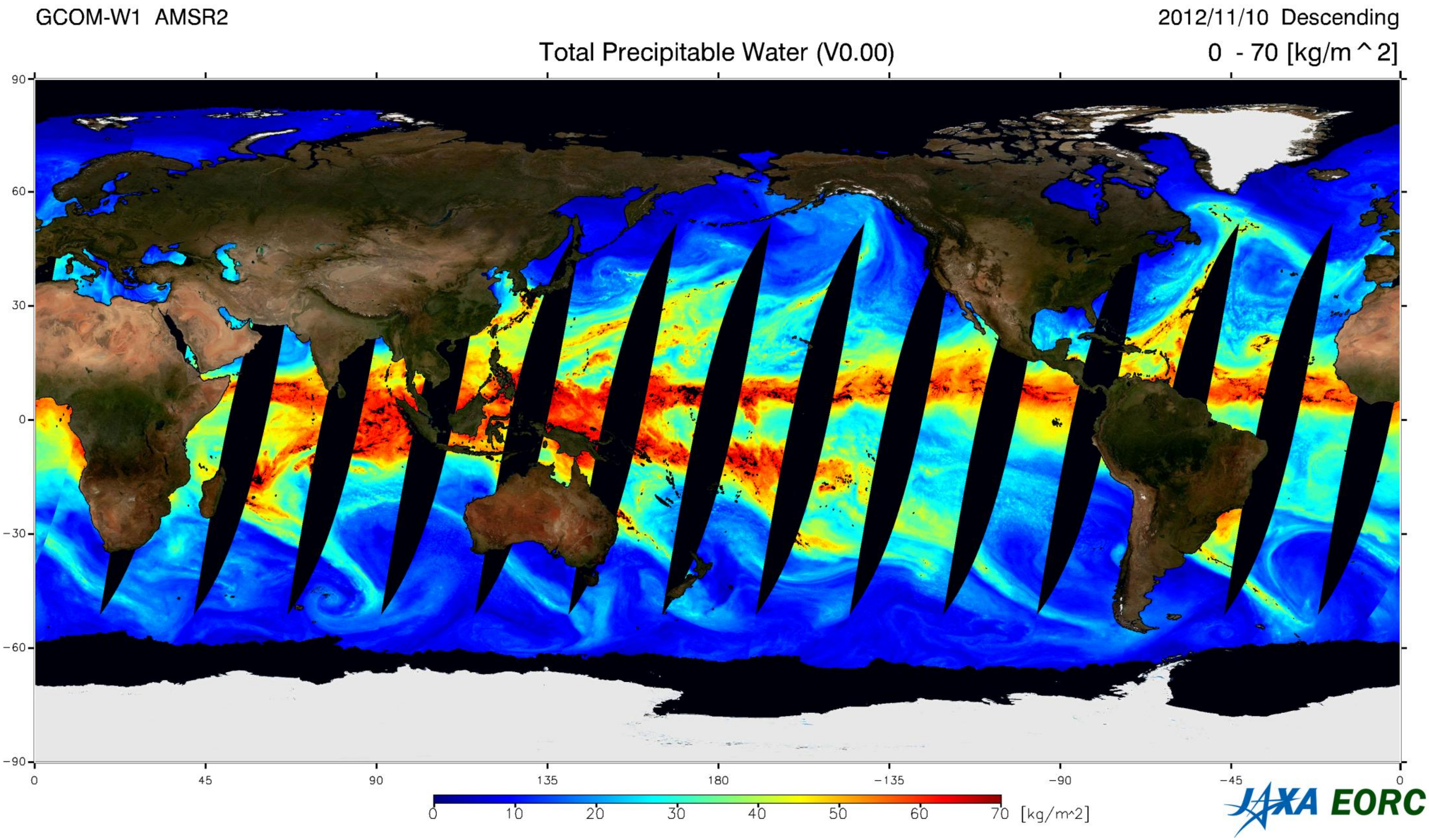
Asc+Dsc	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		Ocean		Land	
	Ocean	Land	Ocean	Land	Slope	Intercept	TB	ΔT	TB	ΔT
06V	-1.8	-2.6	-0.3	-2.7	-0.01412	3.89494	167	+1.5	282	-0.1
06H	+0.3	-3.3	+2.3	-3.3	-0.00982	2.83897	82	+2.0	281	+0.1
07V	NA	NA	-0.1	-1.1	-0.00203	2.08485	168	+1.7	284	+1.5
07H	NA	NA	+2.8	-2.3	-0.00805	3.30649	83	+2.6	282	+1.0
10V	-1.6	-3.9	+2.6	-1.1	-0.01351	6.70216	175	+4.3	284	+2.9
10H	+0.3	-4.0	+3.4	-1.5	-0.00293	3.42724	87	+3.2	282	+2.6
18V	+0.7	-1.5	+4.4	-2.1	-0.04960	13.49461	195	+3.8	284	-0.6
18H	+3.1	-1.5	+3.8	-2.3	-0.00945	1.82686	113	+0.8	283	-0.8
23V	+1.5	-1.6	+4.0	+0.1	-0.01237	5.29143	217	+2.6	287	+1.7
23H	+3.9	-1.6	+6.5	-0.4	-0.01114	4.49098	155	+2.8	286	+1.3
36V	-0.5	-1.5	+2.9	+1.1	-0.01103	5.78519	216	+3.4	283	+2.7
36H	+2.1	-1.2	+5.1	+1.3	-0.00440	3.78759	144	+3.2	283	+2.5
89AV	NA	NA	+3.1	+0.2	-0.01578	5.71765	257	+1.7	286	+1.2
89AH	NA	NA	+7.1	+0.2	-0.01738	5.61016	213	+1.9	286	+0.6
89BV	+1.6	-0.9	+3.4	+0.6	-0.01304	5.33198	257	+2.0	286	+1.6
89BH	+5.4	-0.4	+6.9	+0.3	-0.01133	4.04361	213	+1.6	286	+0.8

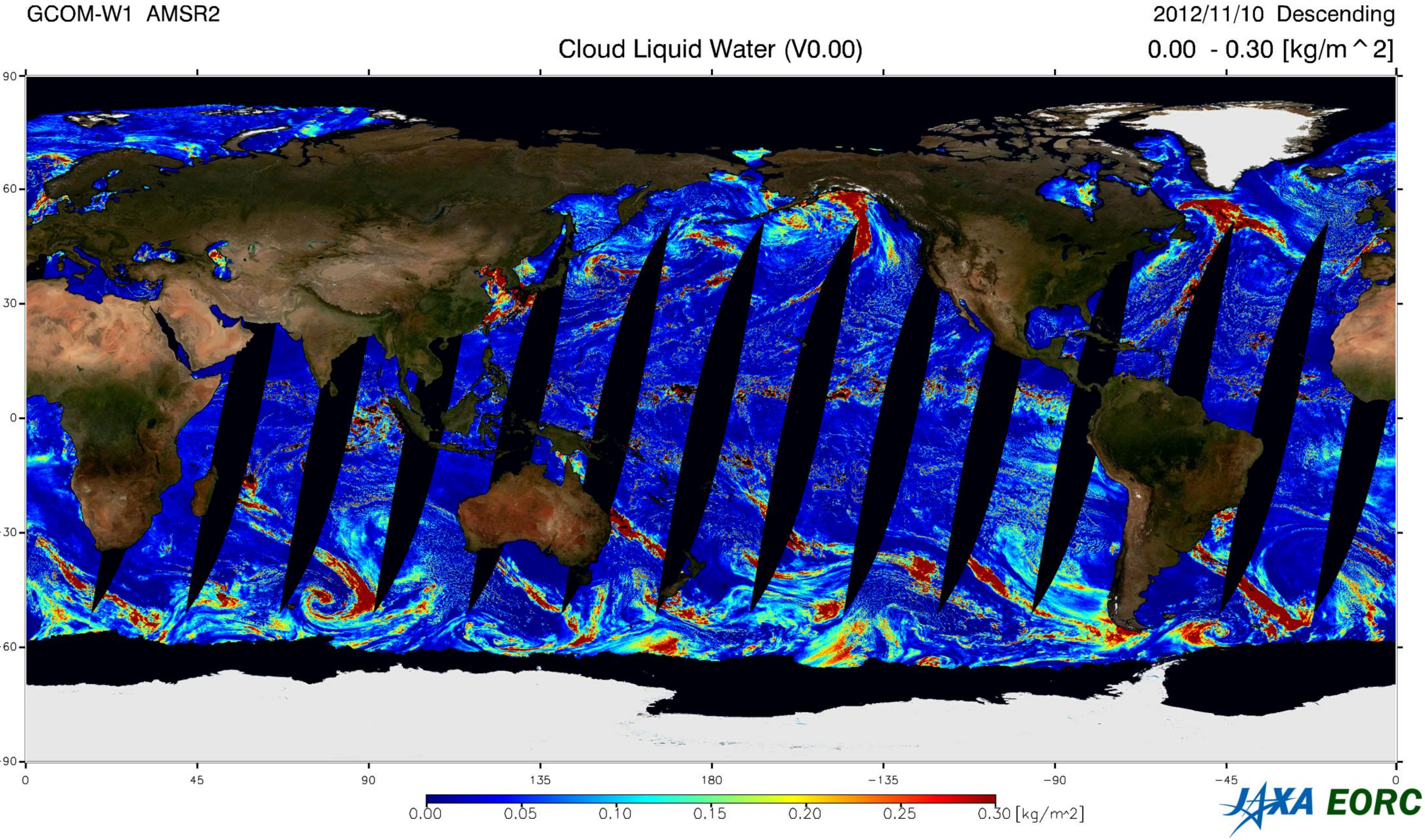
$$\Delta Cal_{AMSR2-AMSRE}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{AMSRE-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

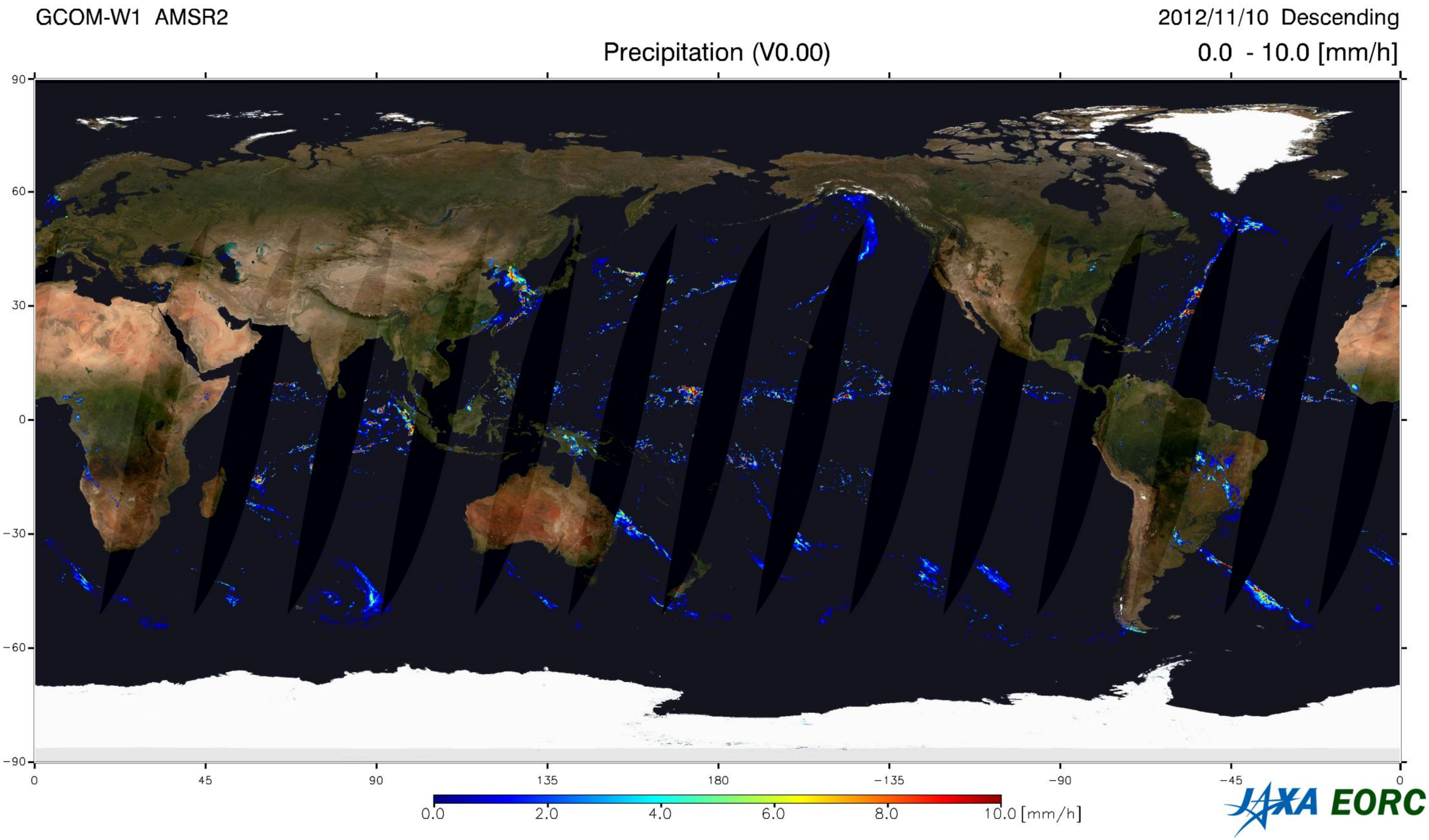

GCOM-W1 AMSR2
2012/11/10 Descending
Sea Surface Temperature (V0.00)
0 - 30 [deg C]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0
5
10
15
20
25
30 [deg C]
JAXA EORC


GCOM-W1 AMSR2
2012/11/10 Descending
Sea Surface Wind speed (V0.00)
0 - 30 [m/s]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0
5
10
15
20
25
30
[m/s]
JAXA EORC


GCOM-W1 AMSR2
2012/11/10 Descending
Total Precipitable Water (V0.00)
0 - 70 [kg/m^2]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0
10
20
30
40
50
60
70
[kg/m^2]
JAXA EORC

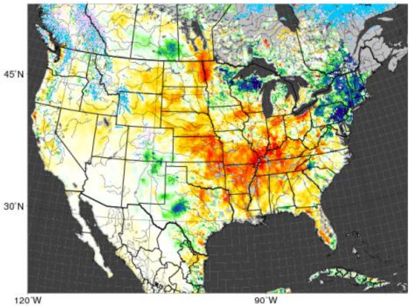


GCOM-W1 AMSR2
2012/11/10 Descending
Cloud Liquid Water (V0.00)
0.00 - 0.30 [kg/m ^ 2]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30 [kg/m^2]
JAXA EORC

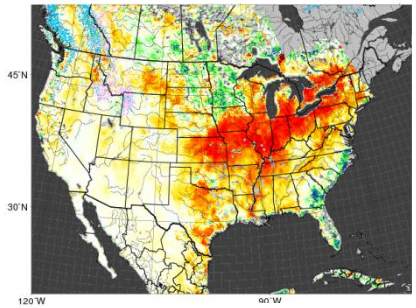

GCOM-W1 AMSR2
2012/11/10 Descending
Precipitation (V0.00)
0.0 - 10.0 [mm/h]
90
60
30
0
−30
−60
−90
0
45
90
135
180
−135
−90
−45
0
0.0
2.0
4.0
6.0
8.0
10.0 [mm/h]
JAXA EORC

Soil Moisture Anomaly over North America

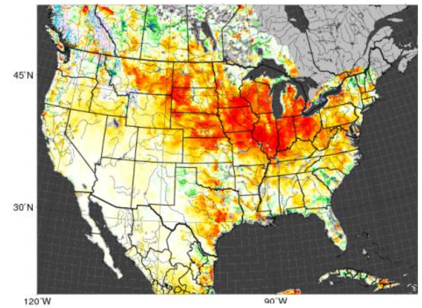
May 1-15, 2012



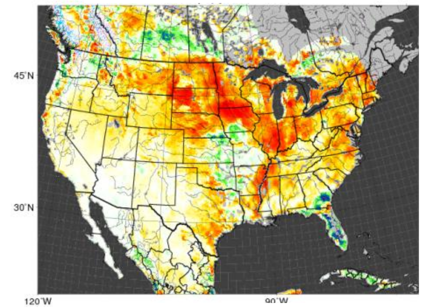
May 16-31, 2012



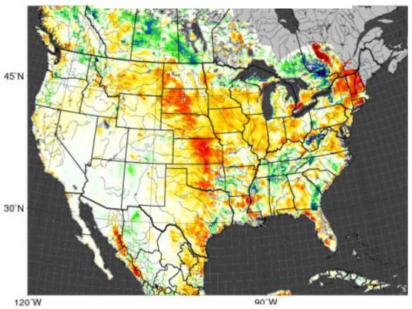
June 1-15, 2012



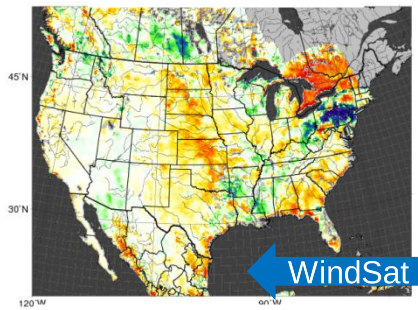
June 16-31, 2012



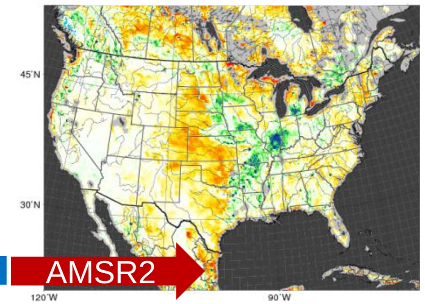
July 1-15, 2012



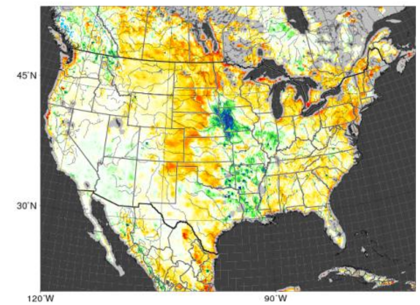
July 16-31, 2012



August 1-15, 2012

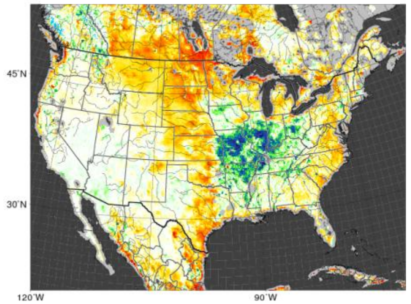


August 16-31, 2012

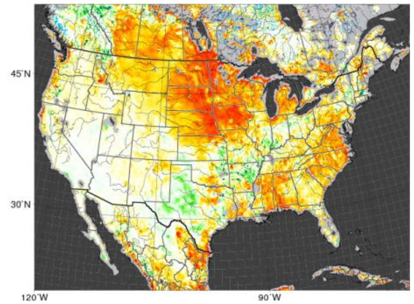


WindSat ← → AMSR2

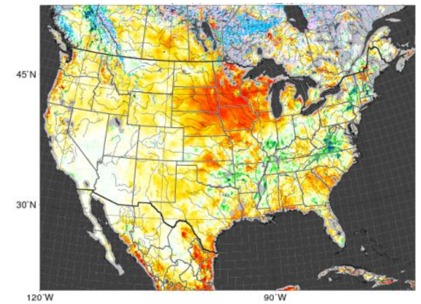
September 1-15, 2012



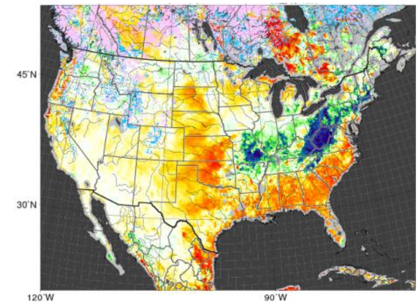
September 16-30, 2012



October 1-15, 2012



October 16-31, 2012



Snow Area by MODIS

Dry Snow

Wet Snow

Soil Moisture Anomaly Ratio by Microwave

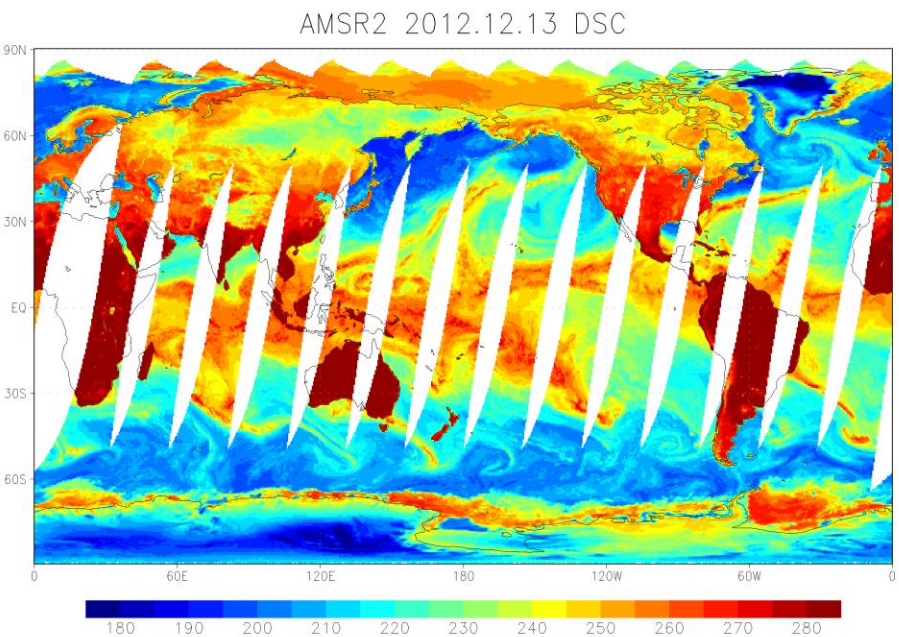
Wet 300 200 150 120 100 90 70 30 0 [%] **Dry**

Cross Calibration with AMSR-E

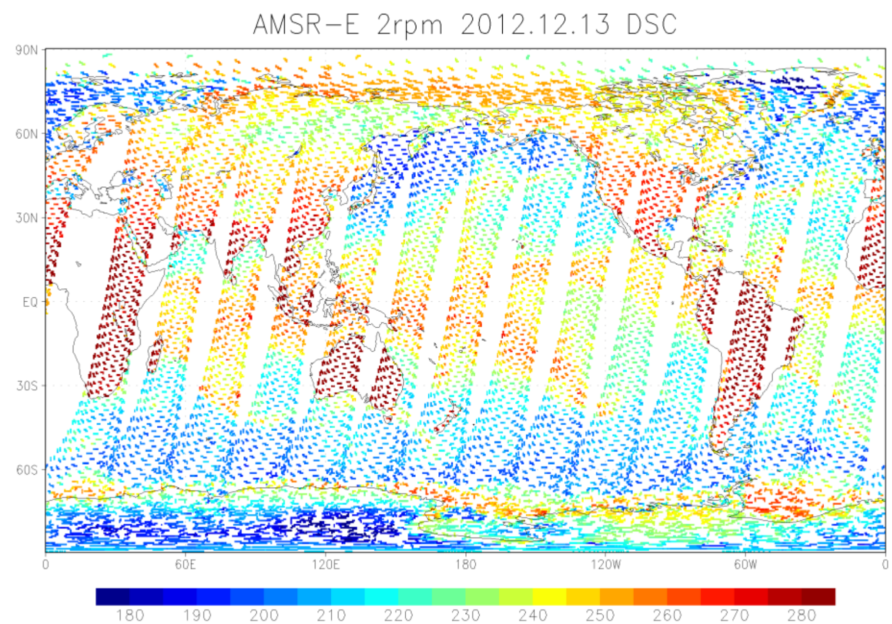
- AMSR-E is now rotating at 2rpm.
- AMSR-E and AMSR2 will remain in A-train at least 1 year.
- Cross calibration will be conducted during this 1 year period.
- New calibration parameters of AMSR-E will be determined.
- The whole AMSR-E products will be reprocessed using this new parameters.

Direct comparison with AMSR-E

- Orbits and frequency channel sets are almost identical: no corrections are needed for center frequency, incidence angle, and observing local time. It enables cross calibration in wide range of Tbs over land, ice, and ocean.
- AMSR-E observations resumed from December 4, 2012 with 2rpm rotation speed. Geolocation and Tbs are computed by modified software.
- Observation is sparse, but reasonable for global-scale comparison.
- Calibration improvement of 2rpm mode data is underway.



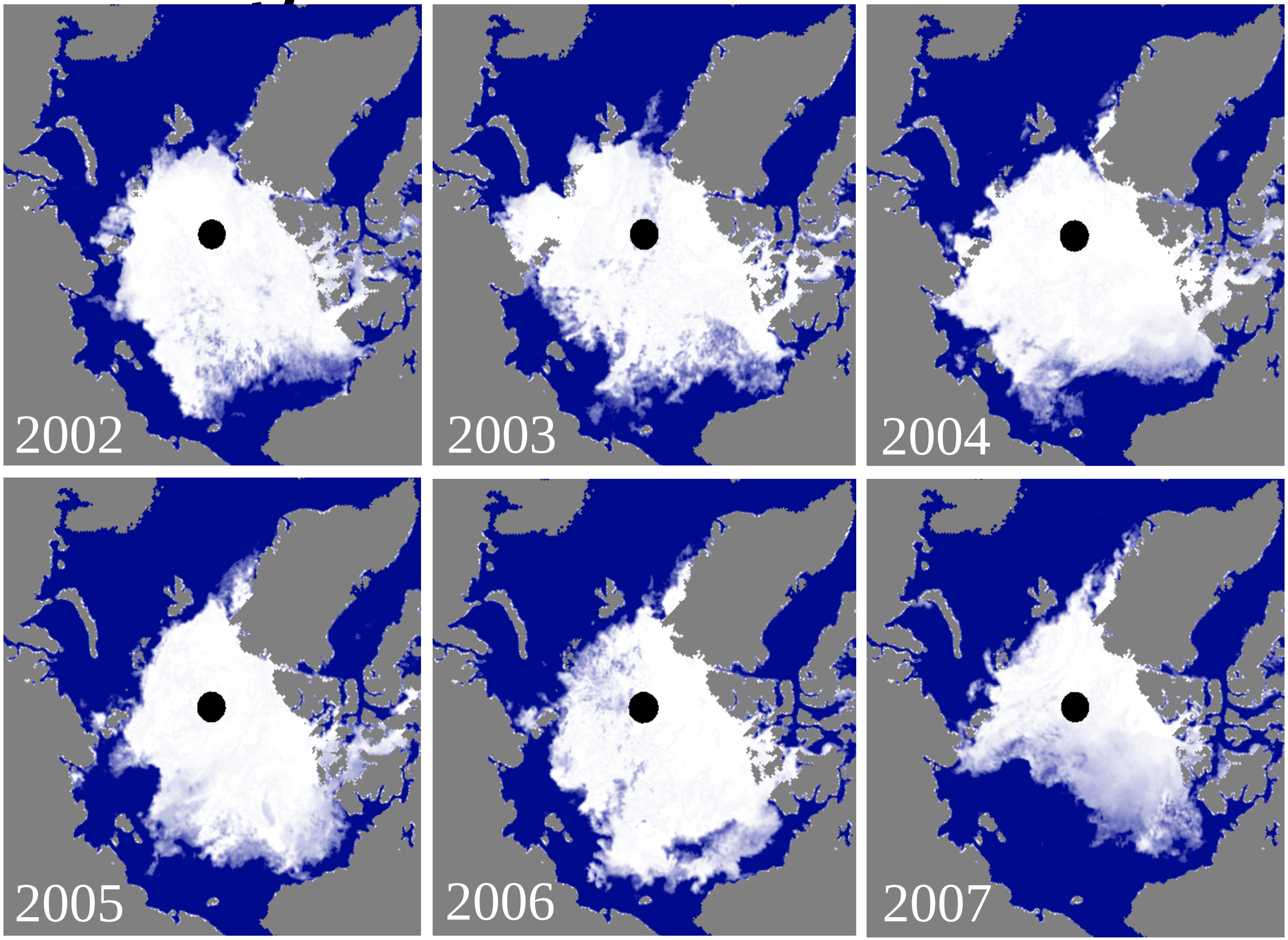
AMSR2 23V Descending



AMSR-E 2rpm 23V Descending

products	IFOV	std. accr.	dynamic range
brightness temp.	5-50km	±1.5K	2.7-340K
total prec. water	15km	±3.5kg/m^3	0-70kg/m^3
cloud liq. water	15km	±0.05kg/m^2	0-1.0kg/m^2
precipitation	15km	Ocean: 50% Land:±120%	0-20mm/h
SST	50km	±5 ˚C	-2-35˚C
sea surf. winds	15km	±1m/s	0-30m/s
sea ice conc.	15km	±10%	0-100%
snow depth	30km	±20cm	0-100cm
soil moisture	50km	±10%	0-40%

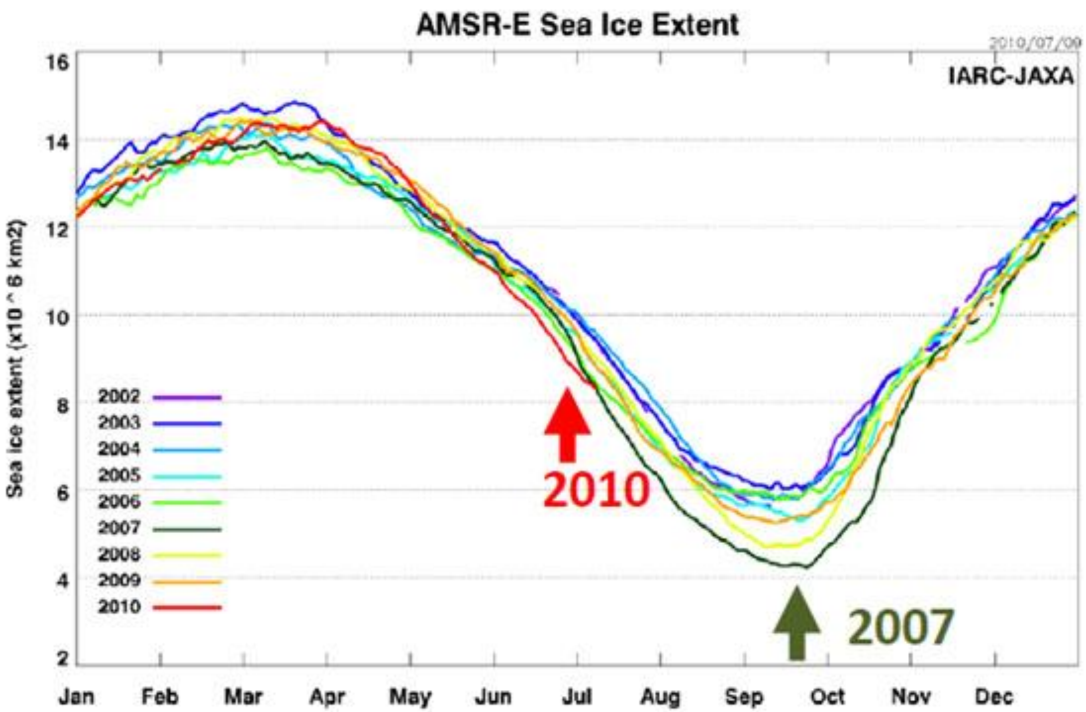
Changes in AMSR-E sea ice

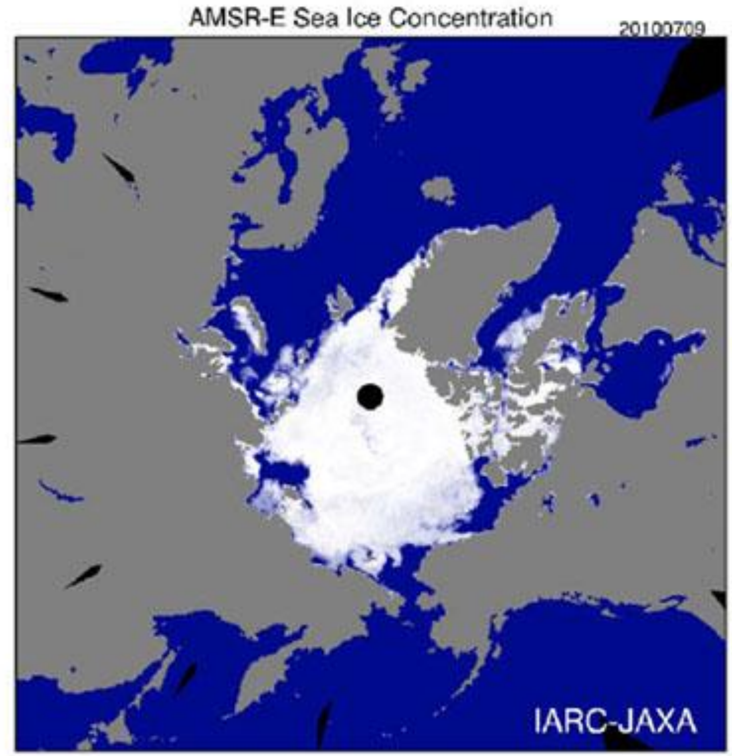


AMSR-E sea ice extent over northern polar region on August 20 of recent 6 years (2002-2007). Images were obtained from the Arctic Sea-Ice Monitor site maintained by the International Arctic Research Center (http://www.ijis.iarc.uaf.edu/en/index.htm).

Recent Status of Ice Extent

Sea Ice Extent : 8,314,219 km^2 (July 9, 2010)





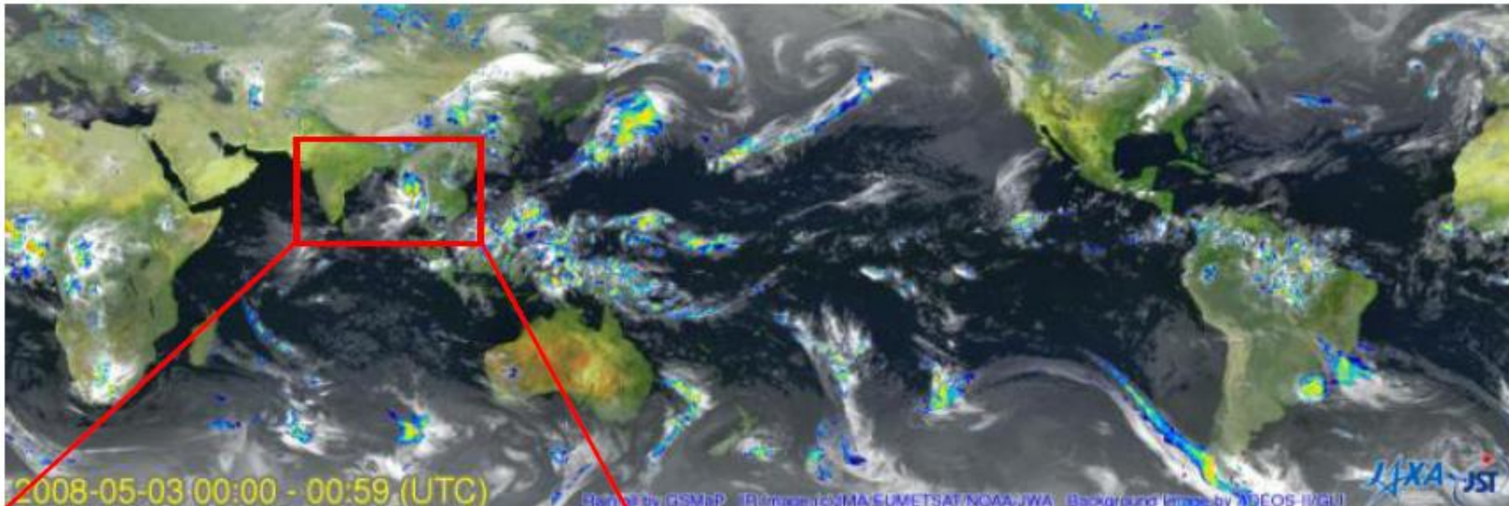
Time series of AMSR-E sea ice extent over Arctic Oceans. Daily updates are available at the Arctic Sea-Ice Monitor site maintained by the International Arctic Research Center (http://www.ijis.iarc.uaf.edu/en/index.htm).

Global Rainfall Map in Near Real Time

- Displaying global rainfall map merging TRMM. AMSR-E and other satellite information
- Available 4-hr after observation
- Browse images, 24-hr animation, displaying by Google Earth
- 0.1-degree lat/lon grid, hourly products
- Data are also available via password protected ftp site
- Based on JST/CREST GSMaP algorithm

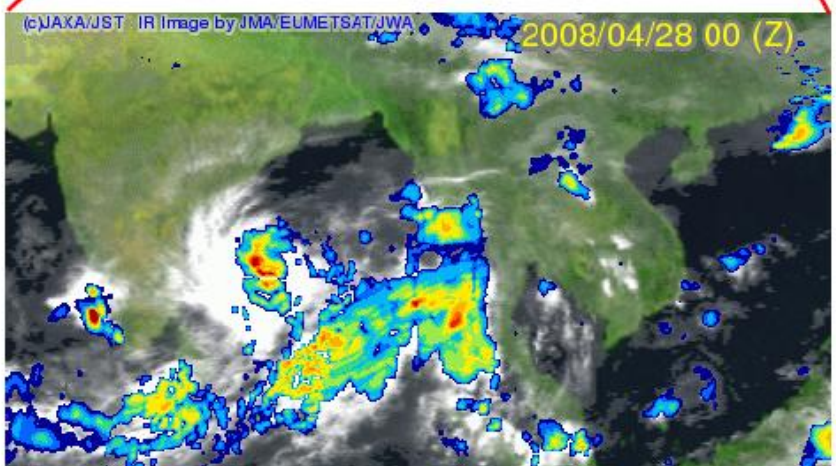
http://sharaku.eorc.jaxa.jp/GSMaP/

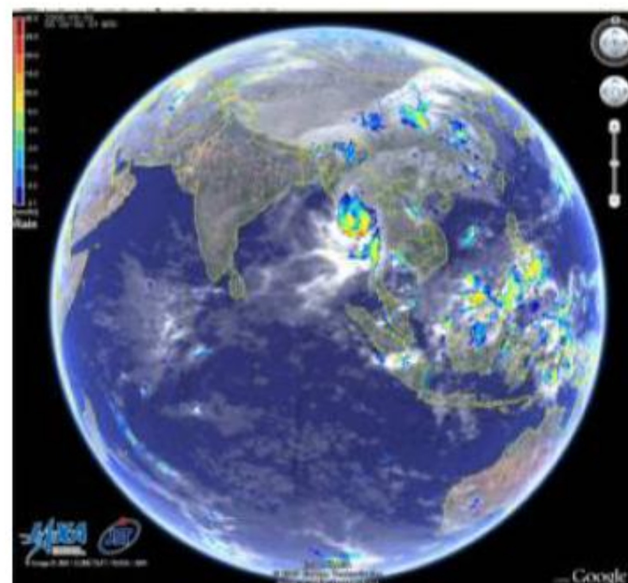
GSMaP_NRT Observed Cyclone Attack in Myanmar (May 2008)



00Z
May 3,
2008

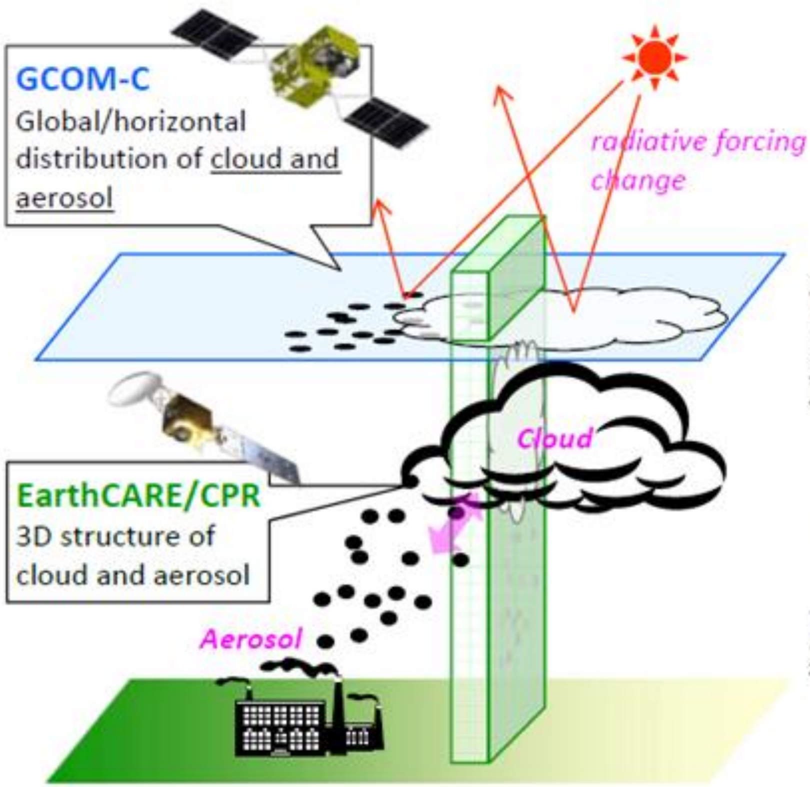
April 28〜May 3





GCOM-C Science Targets

Radiation budget of the atmosphere-surface system



Today's the most significant factor: atmospheric CO_2

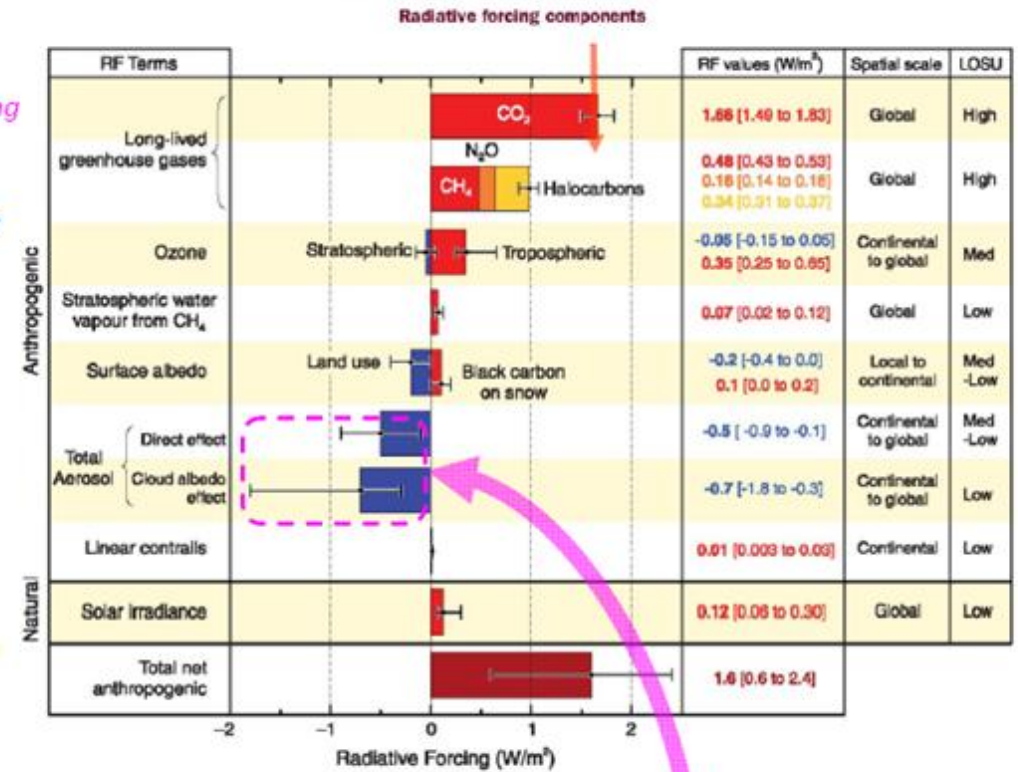


Figure 2.4. Global average radiative forcing (RF) in 2005 (best estimates and 5 to 95% uncertainty ranges) with respect to 1750 for CO_2, CH_4, N_2O and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). Aerosols from explosive volcanic eruptions contribute an additional episodic cooling term for a few years following an eruption. The range for linear contrails does not include other possible effects of aviation on cloudiness. (WGI Figure SPM.2)

Monitoring and process investigation about
<u>cloud and aerosol by GCOM-C & EarthCARE</u>

Improvement

Evaluation of model outputs and process parameterization

<u>Climate models</u>
present and future cloud and aerosol roles in the global warming scenarios

Today's the most significant <u>uncertainty</u> of radiative forcing is direct/indirect role of cloud-aerosol system

CGOM-C1

- Orbit
  - Sun synchronous orbit
  - Height: about 800km
  - Local time of descending node: 10:30
- Weight: about 2.1t
- Power : about 4kW
- Lifetime: 5 years
- Data transmission
  - Global observation data are stored and transmitted every orbit period
  - Observed data over Japanese islands are transmitted to JAXA ground station in real time

SGLI

- Wide spectrum coverage
- Near UV, VIS, NIR, SWIR, TIR
- Polarization measurements
- Multiple angle observation
- Multiple telescopes

VNR

- Composed of 3 telescopes to cover the total swath
- Each telescope covers 24 degree achieving 70 degree in total

Polarization

- Composed of 1 telescope for each channel
- IFOV is 55 degree
- Looking fore, nadir & aft
- One camera with tilt or two cameras?

Ch.	central wavelength [nm]	IFOV [m]	⊿λ [nm]	Lλ [W/m²/str/µm]	L_{max}. [W/m²/str/µm]	S/N
VN1	380	250	10	60	210	250
VN2	412	250	10	75	250	400
VN3	443	250	10	64	400	300
VN4	490	250	10	53	120	400
VN5	530	250	20	41	350	250
VN6	565	250	20	33	90	400
VN7	673.5	250	20	23	62	400
VN8	673.5	250	20	25	210	250
VN9	763	1000	12	40	350	400
VN10	868.5	250	20	8	30	400
VN11	868.5	250	20	30	300	200

Polarization channels (3 directions)

Ch.	central wavelength [nm]	IFOV [m]	$\Delta\lambda$ [nm]	$L\lambda$ [W/m²/str/µm]	L_{max}. [W/m²/str/µm]	S/N
673-P1	673.5	1000	20	25	250	250
673-P2	673.5	1000	20	25	250	250
673-P3	673.5	1000	20	25	250	250
868-P1	868.5	1000	20	30	300	250
868-P2	868.5	1000	20	30	300	250
868-P3	868.5	1000	20	30	300	250

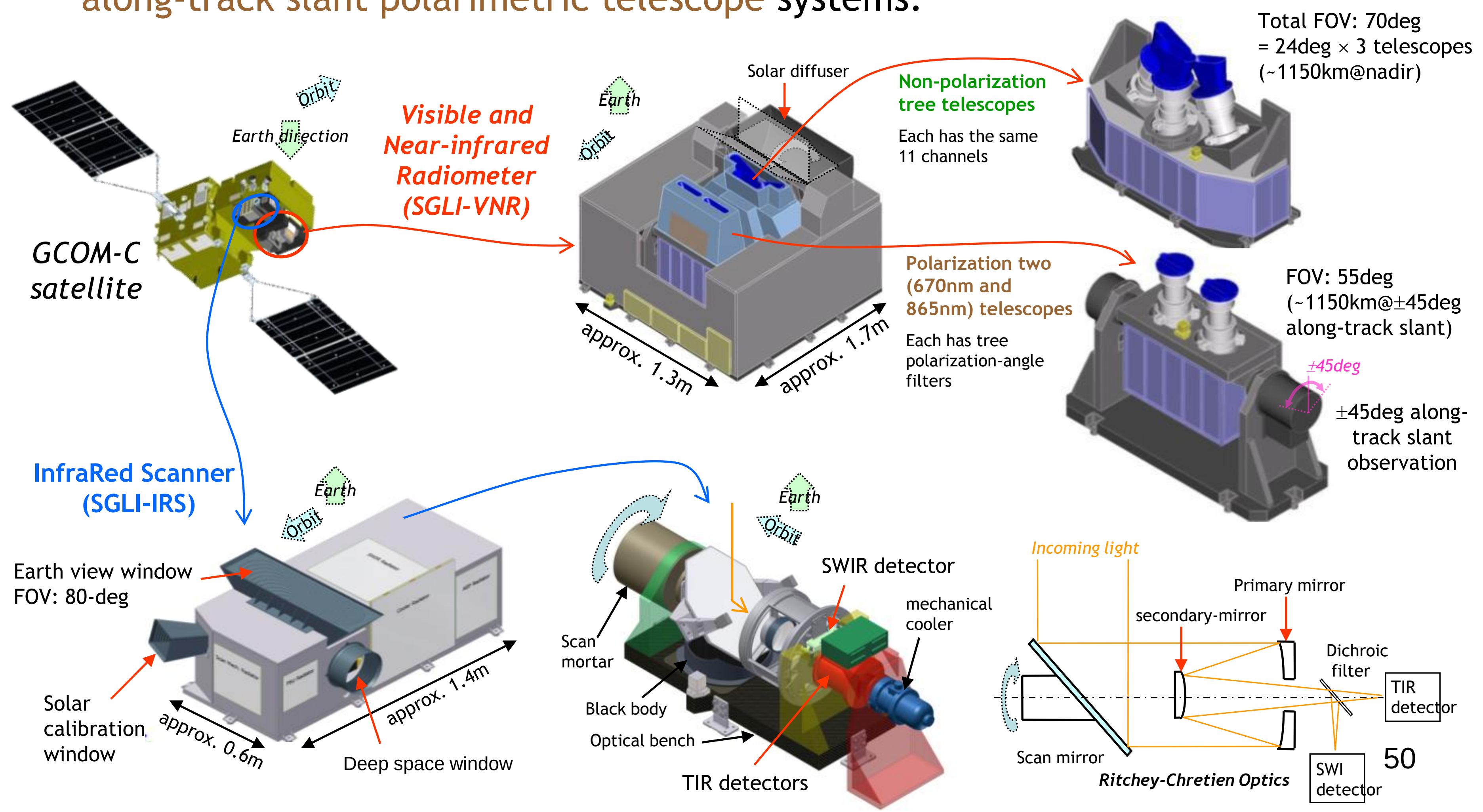
IRS

Ch.	central wavelength [μm]	IFOV[m]	⊿λ[μm]	L_λ[W/m²/str/μm] or Tstd[K]	L_{max}[W/m²/str/μm] or T_{max}[K]	S/N or NEdT@300[K]
SW1	1.05	1000	0.02	57	248	500
SW2	1.38	1000	0.02	8	103	150
SW3	1.63	250	0.2	3	50	57
SW4	2.21	1000	0.05	1.9	20	211
T1	10.8	500	0.7	300	340	0.2
T2	12.0	500	0.7	300	340	0.2

2. GCOM-C products and SGLI design

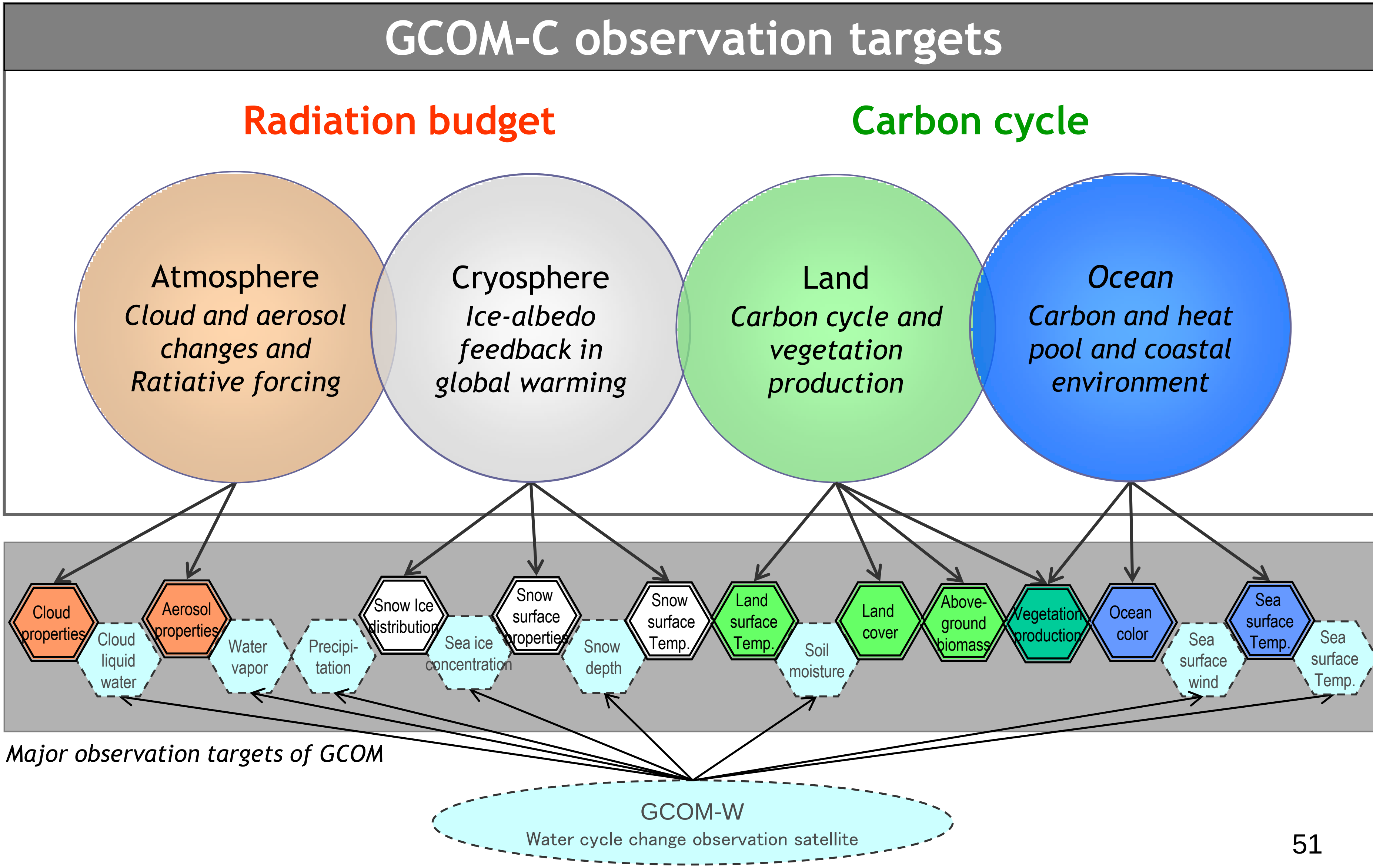
- 2.8 SGLI design (VNR and IRS)

- SGLI system consists of two components: SGLI-VNR and SGLI-IRS to optimize optics for each wavelength range
- SGLI-VNR consists of 11-channel non-polarimetric telescope and 2-channel along-track slant polarimetric telescope systems.



2. GCOM-C products and SGLI design

- 2.1 mission target and product groups



Major observation targets of GCOM

Standard products (land)

products	GSD	accuracy
radiance	250/1000m	5%, 0.5K
geom. corr. rad.	250m	0.5pixel
land surface refl.	250m	5%/10%*1
veg. index	250m	20%/15%*2
veg. roughness. index	1km	20%/15%*2
shadow index	1km	20%/15%*2
land surf. temp	500m	2.5K
fAPAR	250m	30%/20%*2
LAI	250m	30%
above ground biomass	1km	30%

*1 : >443nm / ≤443nm

*2 : grass land / forest

Research products (land)

products	GSD	accuracy
net primary prod.	1km	TBD
veg. water stress index	500m	TBD
fire	500m	TBD
land cover class.	250m	TBD
land surface albedo	1km	TBD

Standard products (atmosphere)

products	GSD	accuracy
cloud flag/type	1km	
cloud type & amount	1km/0.1°	15%
cloud top temp/altitude	1km/0.1°	3k/2km
opt. thick. of water cloud	1km/0.1°	100%
opt. thick. of cirrus	1km/0.1°	70%
aerosol over ocean	1km/0.1°	0.1
aerosol over land UV	1km/0.1°	0.15
aerosol over land pol.	1km/0.1°	0.15

Research products (atmosphere)

products	GSD	accuracy
geom. thickness of water clouds	1km/0.1°	N/A
land surface long wave radiant flux	1km/0.1°	N/A
land surface short wave radiant flux	1km/0.1°	N/A

Standard products (ocean)

products	GSD	accuracy
normalized water leav. rad.	250m/1km/4-9km *1	50%
atm. corr. parameter	250m/1km/4-9km	50%
PAR	250m/1km/4-9km	15%
chlorophyll-a	250m/1km/4-9km	-60-+150%
SS	250m/1km/4-9km	-60-+150%
CDOM	250m/1km/4-9km	-60-+150%
SST	500m/1km/4-9km	0.8K

***1 : 250m:coastal, 1km : open ocean, 4-9km : global**

Research products (ocean)

products	GSD	accuracy
euphotic zone depth	250m/1km/4-9km	N/A
intrinsic opt. char. of seawater	250m/1km/4-9km	N/A
primary production	500m/1km/4-9km	N/A
phytoplankton type	250m/1km/4-9km	N/A
red tide	250m/1km/4-9km	N/A
sensor fusion ocean color	250m/1km	N/A
sensor fusion SST	500m/1km	N/A

Standard products (cryosphere)

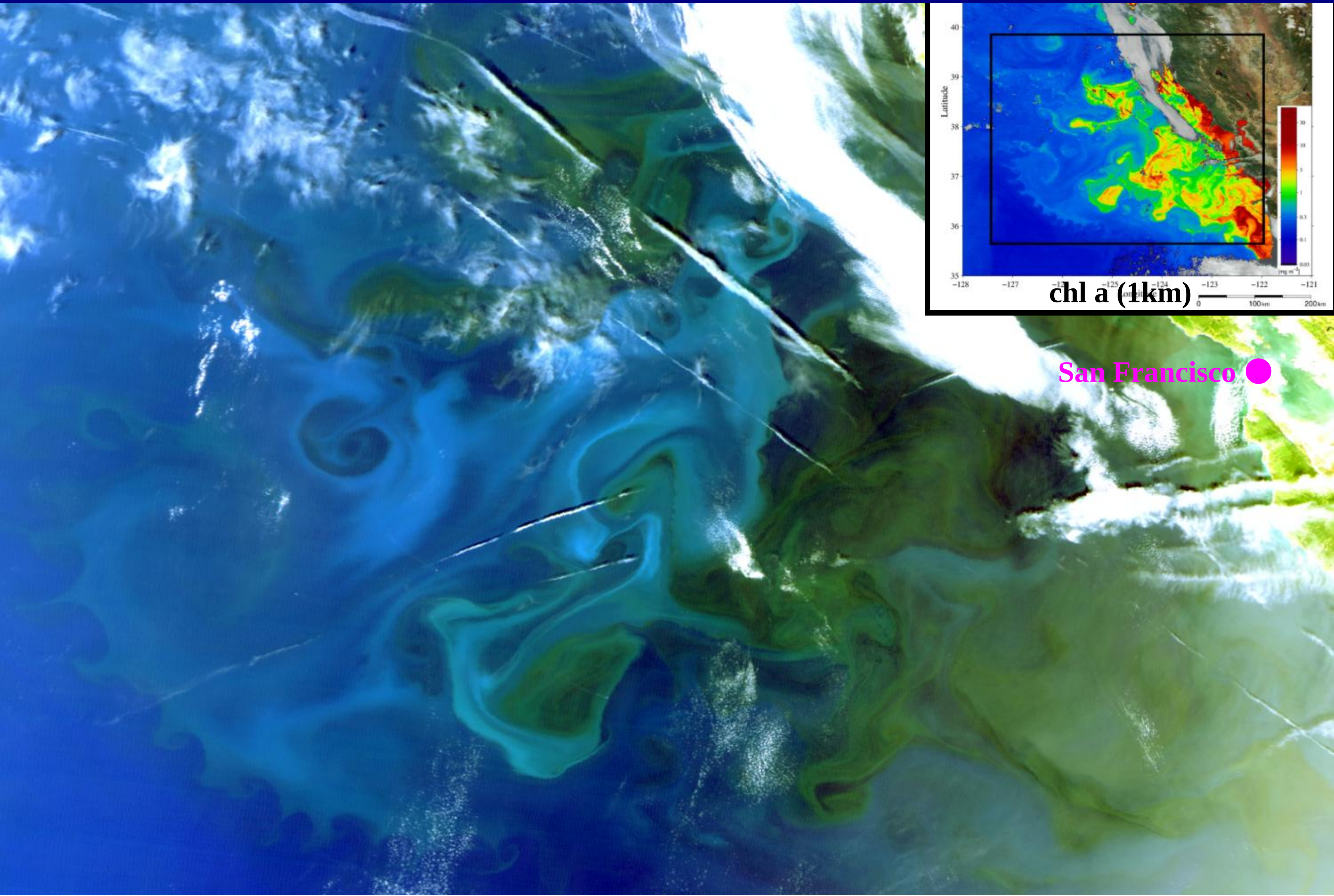
products	GSD	accuracy
snow & ice cover	250m/1km	7%
sea ice dist. in Okhotsk sea	250m	5%
snow/ice surface temp.	500m/1km	2K
snow particle size	250m/1km	50%

Research products (cryosphere)

products	GSD	accuracy
snow/sea ice class.	1km	N/A
snow cover over mountains	250m	N/A
snow particle size of semi surface	1km	N/A
surface snow particle size	250m/1km	N/A
snow/ice surface albedo	1km	N/A
snow impurity	250m/1km	N/A
ice sheet roughness	1km	N/A
ice sheet edge monitor	250m	N/A

250m ocean

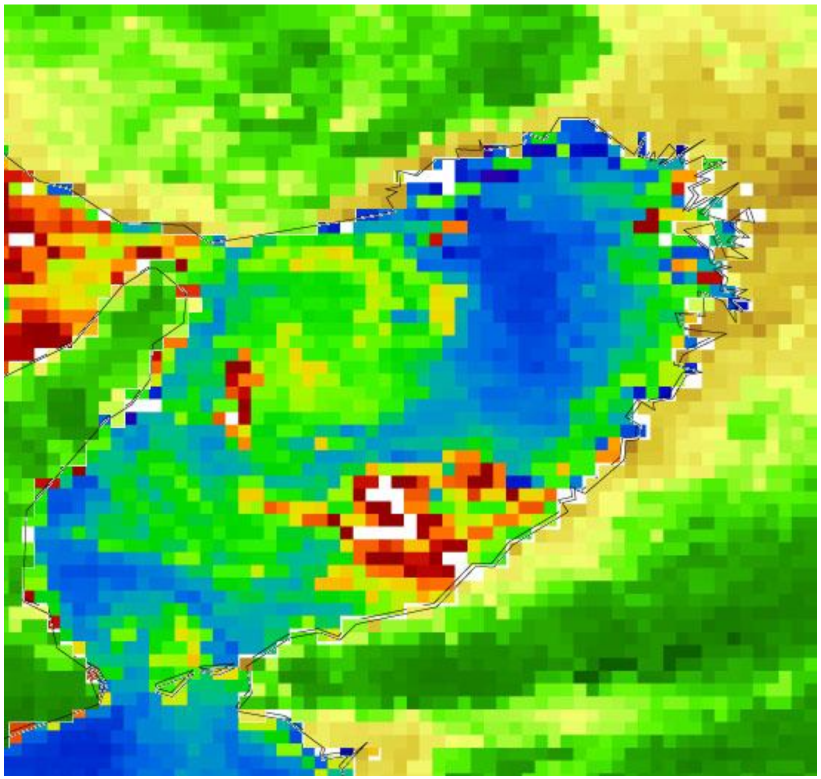
GLI 250m RGB:22/21/20, 2003.5.26



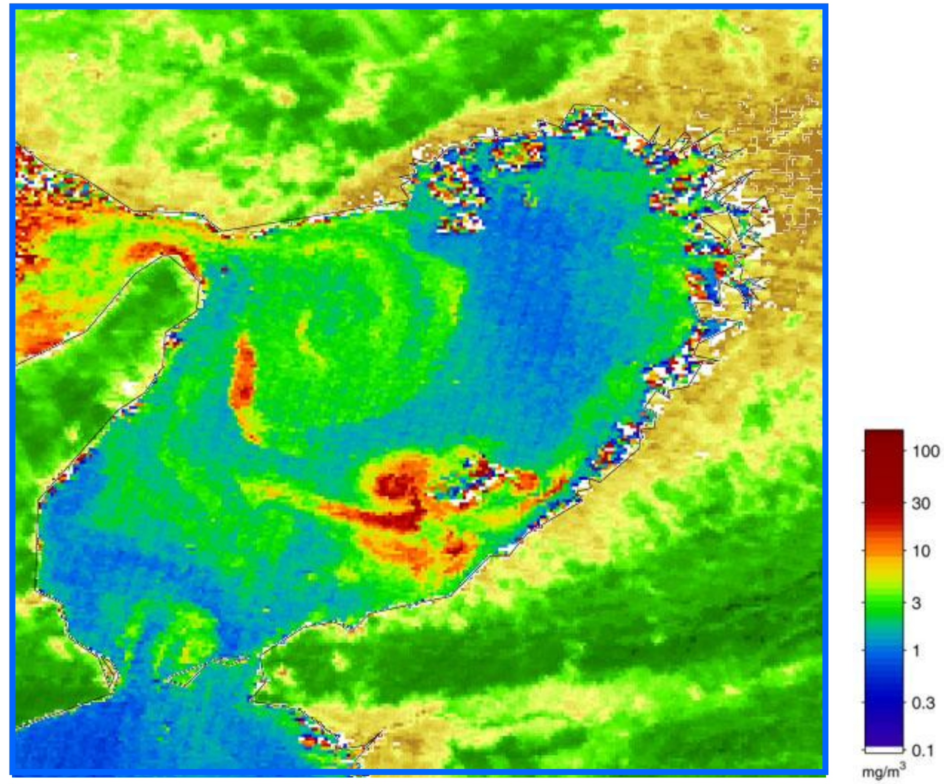
3. Examples of expected GCOM-C product

- 3.4 VNR 250m land and coastal observation

250m Ocean color chlorophyll-a and NDVI 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)

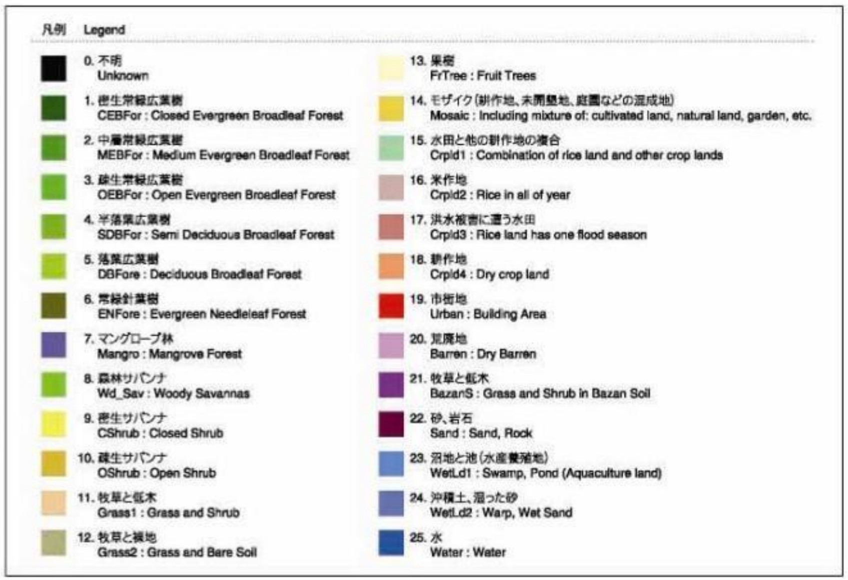
SGLI 250m resolution will enable to detect more fine structure in the coastal area such as river outflow, regional blooms, and small current.

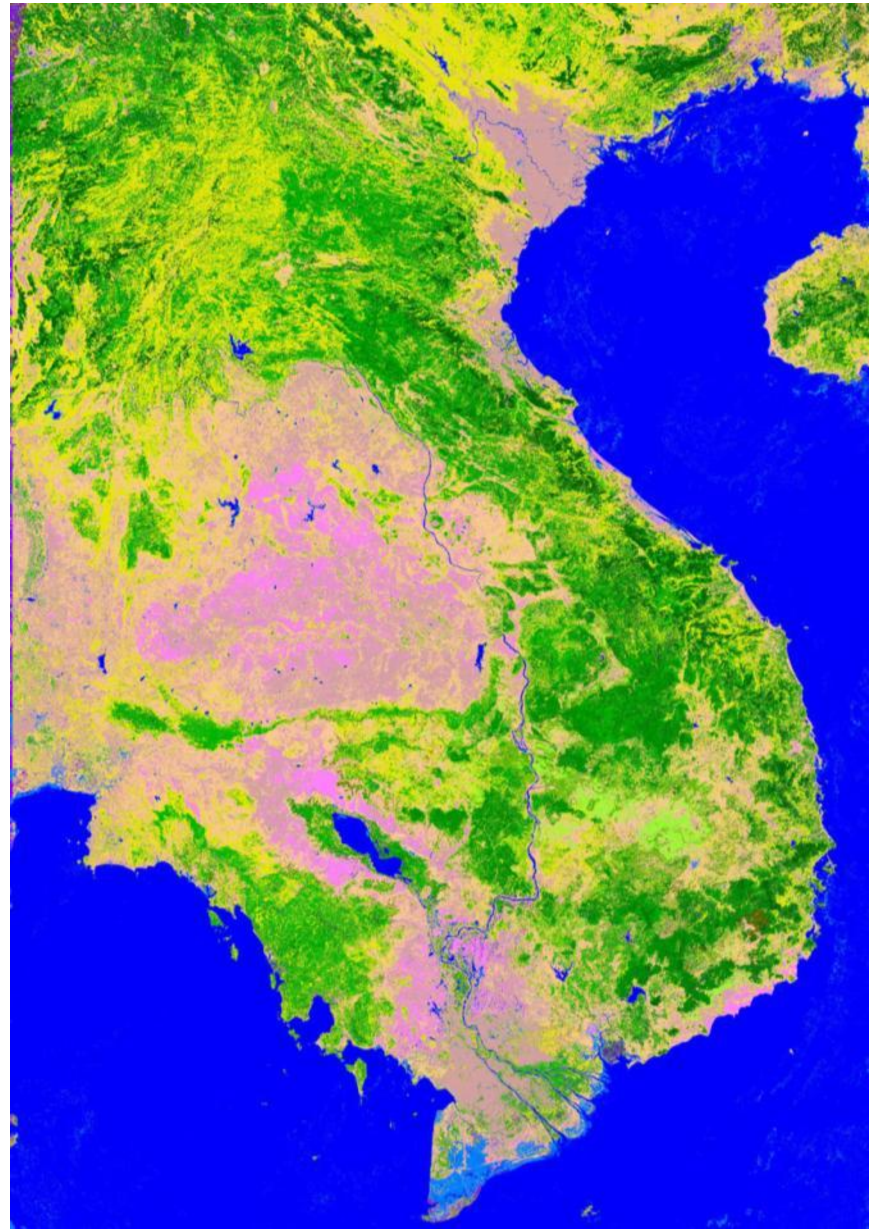
Hiroshi Murakami, Mitsuhiro Toratani and Hajime Fukushima, **Satellite ocean color observation with 250 m spatial resolution using ADEOS-II GLI**, Remote Sensing of the Marine Environment, Proceedings of SPIE, Volume 6406-05, Nov. 28, 2006

3. Examples of expected GCOM-C product

- 3.3 VNR 250m land cover classification

- SGLI's 250m channels (11CHs from 380nm to 1640nm) and once/2-day observation and can improve the land cover classification.

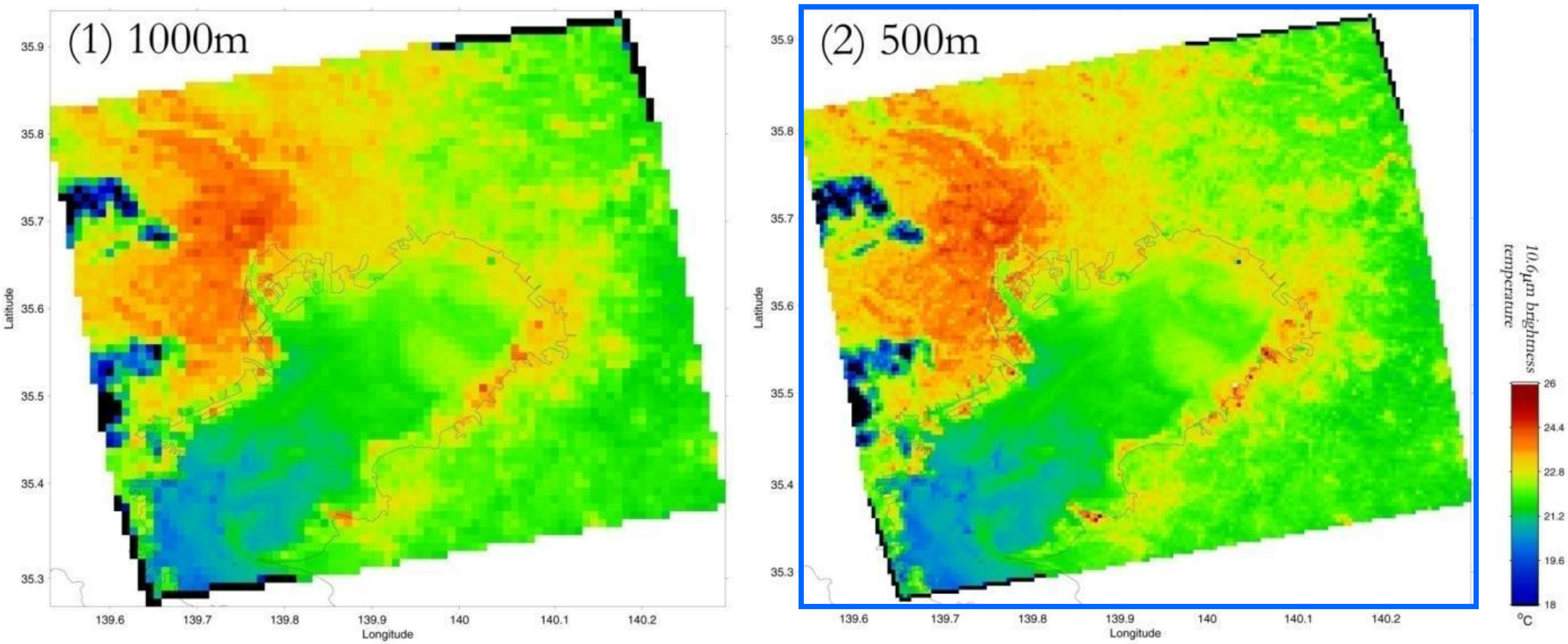




Classification to 25 class (IGBP: International Geosphere-Biosphere Program) using GLI 39 scenes (2003/04~2003/10)
(provided by Dr. Nguyen Dinh Duong, VAST(Vietnamese Academy of Science and Technology)

3. Examples of expected GCOM-C product

- 3.5 Thermal infrared 500m land and coastal observation

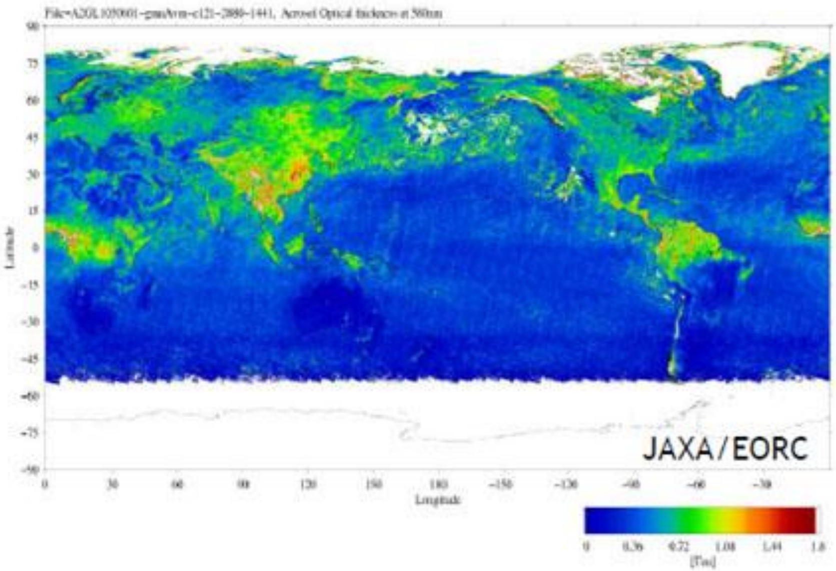


- The 500m and 1000m spatial resolution thermal infrared images are simulated using ASTER data (original resolution is 90m) (Tokyo Bay in the night on August 4, 2003).
- *SGLI 500m-resolution thermal infrared channels will enable detection of fine structures such as land and coastal surface temperature influenced by the city and the river flows.*

Examples of expected GCOM-C product

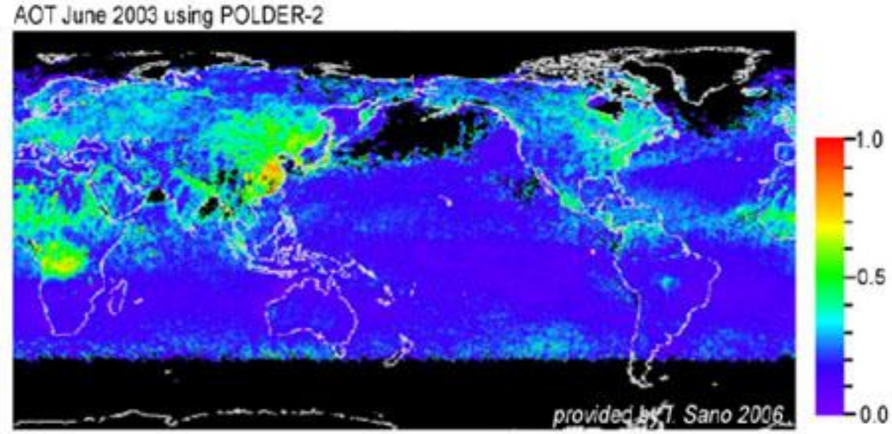
- 6. Land aerosol by Near-UV and polarization

- ***Near-UV aerosol***



Global aerosol optical thickness in June 2003 using the GLI Near-UV (380nm) channel (NIR is used for the ocean area)

- ***Polarization aerosol***

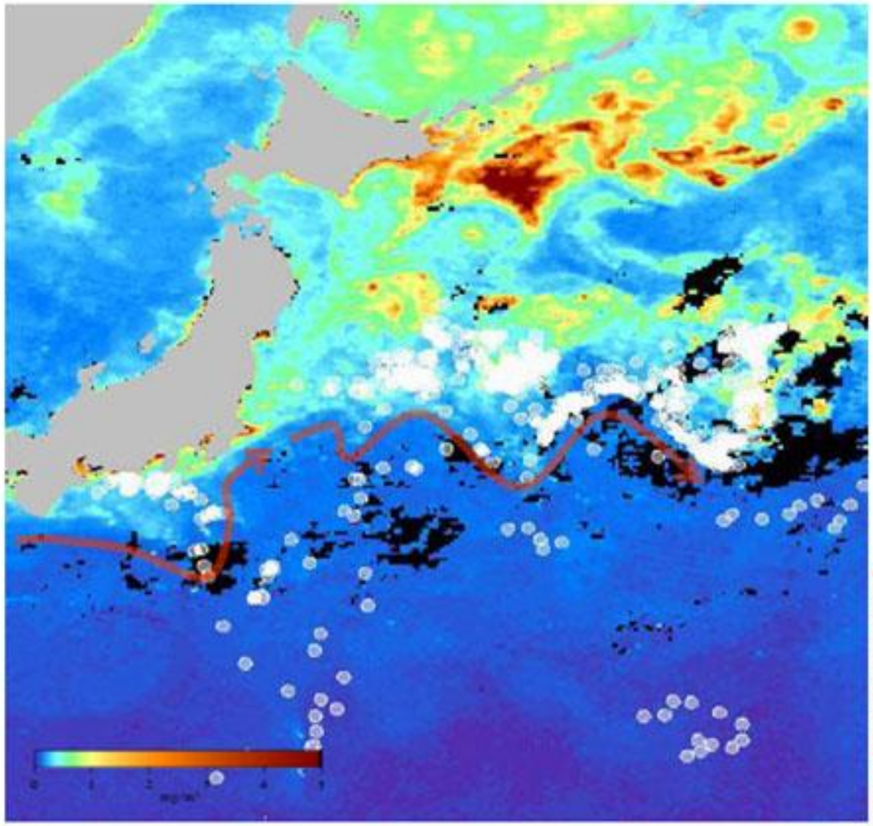


Global aerosol optical thickness in June 2003 using POLDER-2 polarization reflectance

- Not only over the ocean, SGLI will estimate land-area aerosols using near-UV (380nm) and polarization channels which are more sensitive to atmosphere scattering rather than land surface reflection.
- Combination of aerosol absorption by Near-UV and fine-mode aerosol properties by polarization.

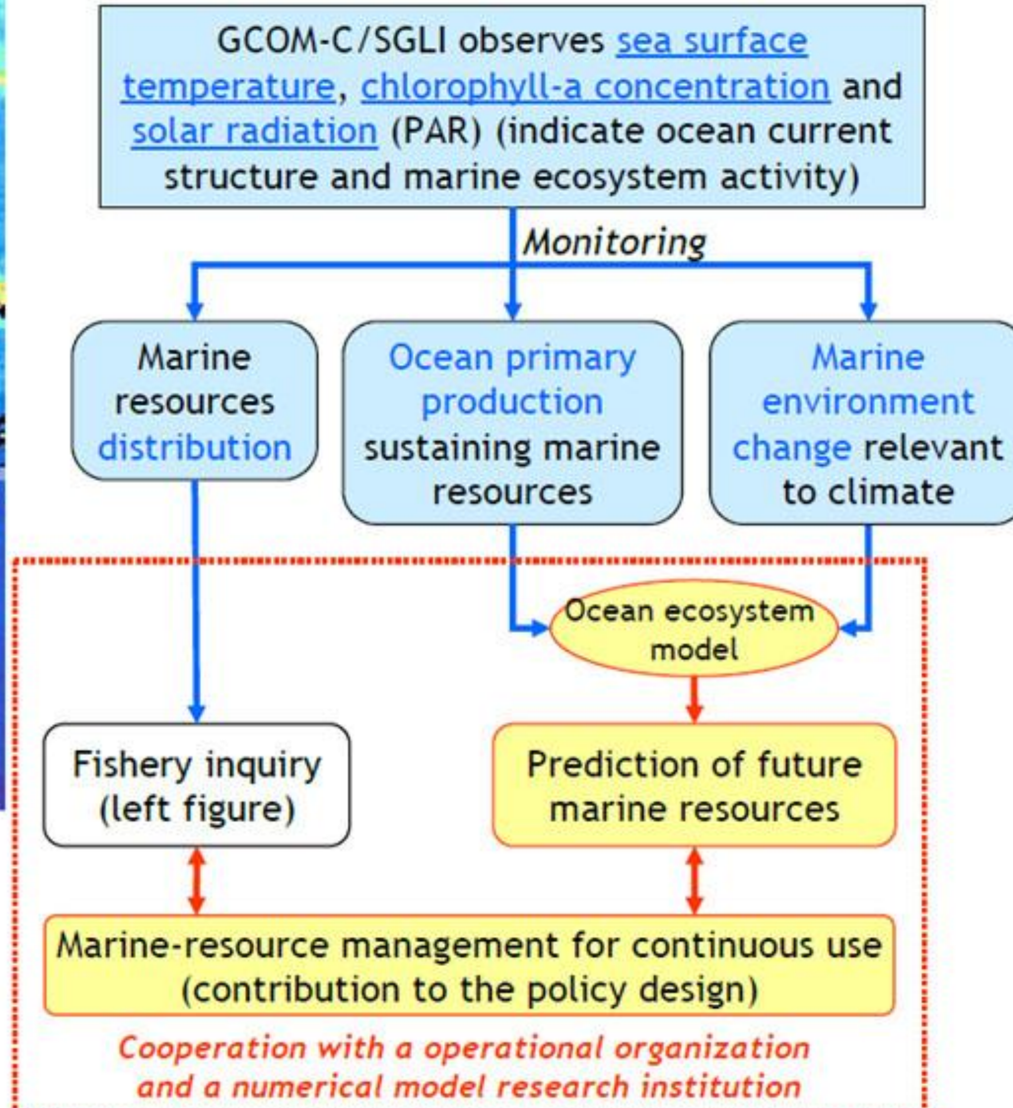
Examples of expected GCOM-C product

- 9. Marine resource monitoring and management



Chlorophyll-a concentration in the northwestern Pacific in June 2003 overlaid on fisheries of skipjack and tuna.

The fisheries of skipjack and tuna, warm-water migratory fish, appear to be influenced by the Kuroshio warm current and its extensions offshore Sanriku.



Recent status of GCOM-C1

- GCOM-C1 is under CDR.

Research Announcements

- First RA for GCOM-W1 was issued on Jan. 2008.
- 35 PIs were selected.
- First GCOM Symposium/Workshop was held on 13-15, Jan. 2009 in Yokohama.
- First GCOM-C1 RA was issued on January, 2009. 28 PIs were selected.
- PI workshop including GPM & EarthCare PIs was held on Jan., 2013.
- PIs of Second RA were selected.

International Cooperation

- Discussions on the cooperation with JPSS is underway with NOAA
- JAXA is proposing a joint science activity with NASA
- Provision of a scatterometer on GCOM-W2 is under discussion with JPL, NASA and ISRO.

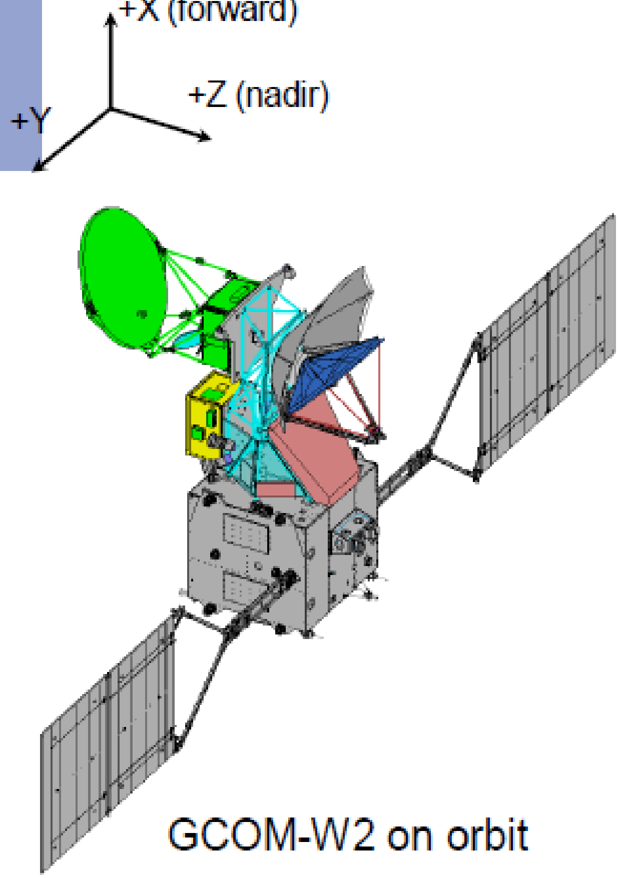
New Scatterometer on GCOM-W2

- Dual Frequency Scatterometer (DFS)
- Ku band and Ka band
- around 2m aperture
- High resolution wind fields measurements

AMSR3 on GCOM-W2

- Addition of scatterometer
- Addition of high frequency channels (150-190GHz) for solid precipitation and water vapor sounding
- Also, join the A-train at least 1 year

GCOM-W2 Overview

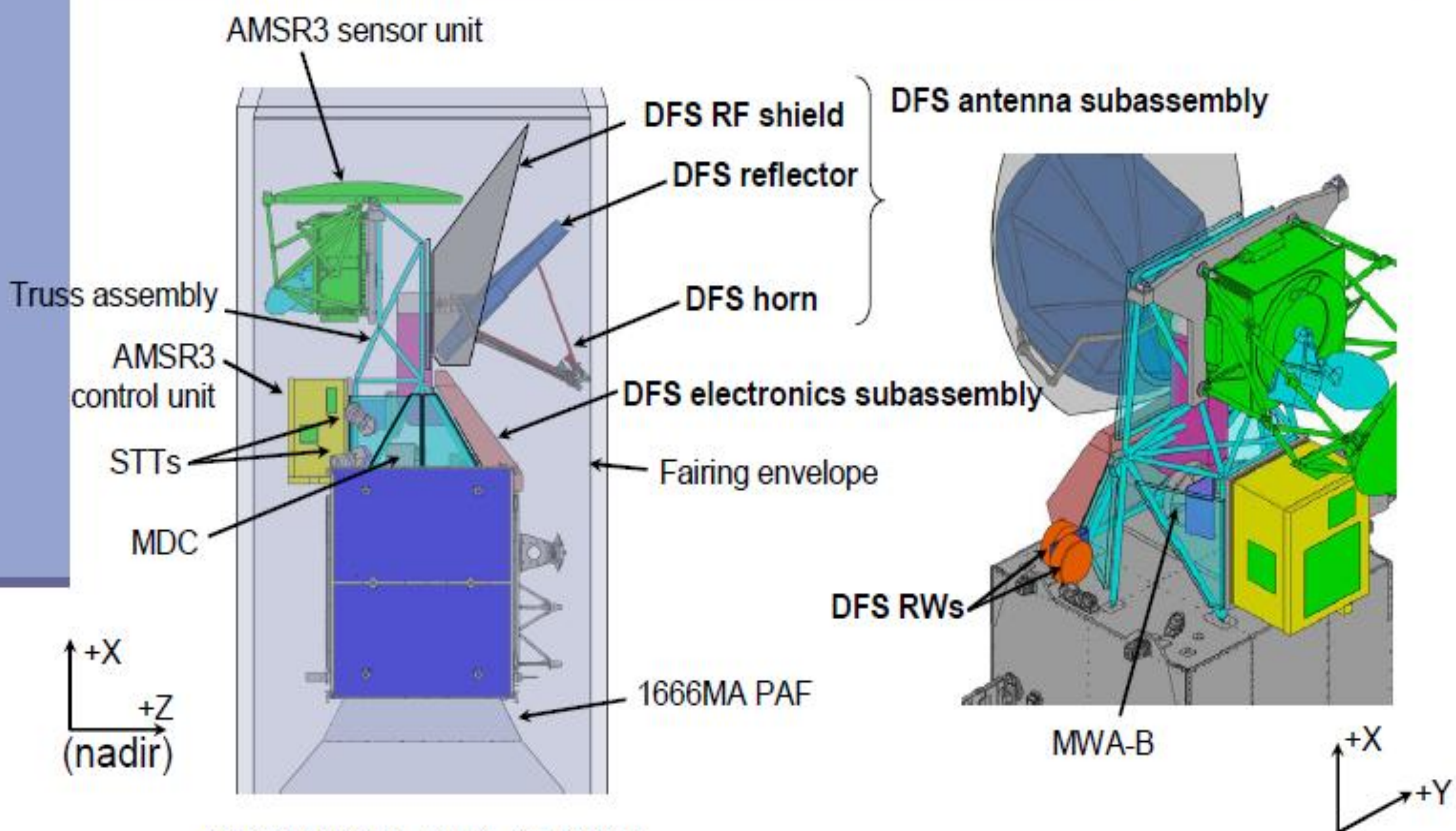


GCOM-W2 on orbit

GCOM-W2 Overview

Mission instruments	• Advanced Microwave Scanning Radiometer 3(AMSR3) • Dual Frequency Scatterometer (DFS)
Observation orbit	Sun Synchronous Orbit (A-train orbit) Altitude 699.6km, Inclination 98.186deg
Local sun time	13:30 (ascending)
Dimensions	5.6m(X), 17.6m(Y), 5.2m(Z)
Spacecraft mass	2515kg (BOL)
Generation power	4050W (EOL, two wings)
Launch year and launcher	January 2016 / H-IIA
Design lifetime	Five years

GCOM-W2 Configuration



GCOM-W2 in H-IIA 4S fairing

Conclusions

- AMSR2 will have the highest calibration capability within microwave imager.
- AMSR-E products will be reprocessed after the cross calibration with AMSR2.
- Long term high accuracy microwave imager products will be obtained.

Basic Law on Space

- Basic Law on Space has passed the Parliament last June
- Strategic Headquarters has been established (Minister level)
- All the space activities will go under the Cabinet Office
- Restructuring of JAXA
- Increased budget?