GCOM Science Overview

IOVWST 2016
Sapporo, Japan
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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**

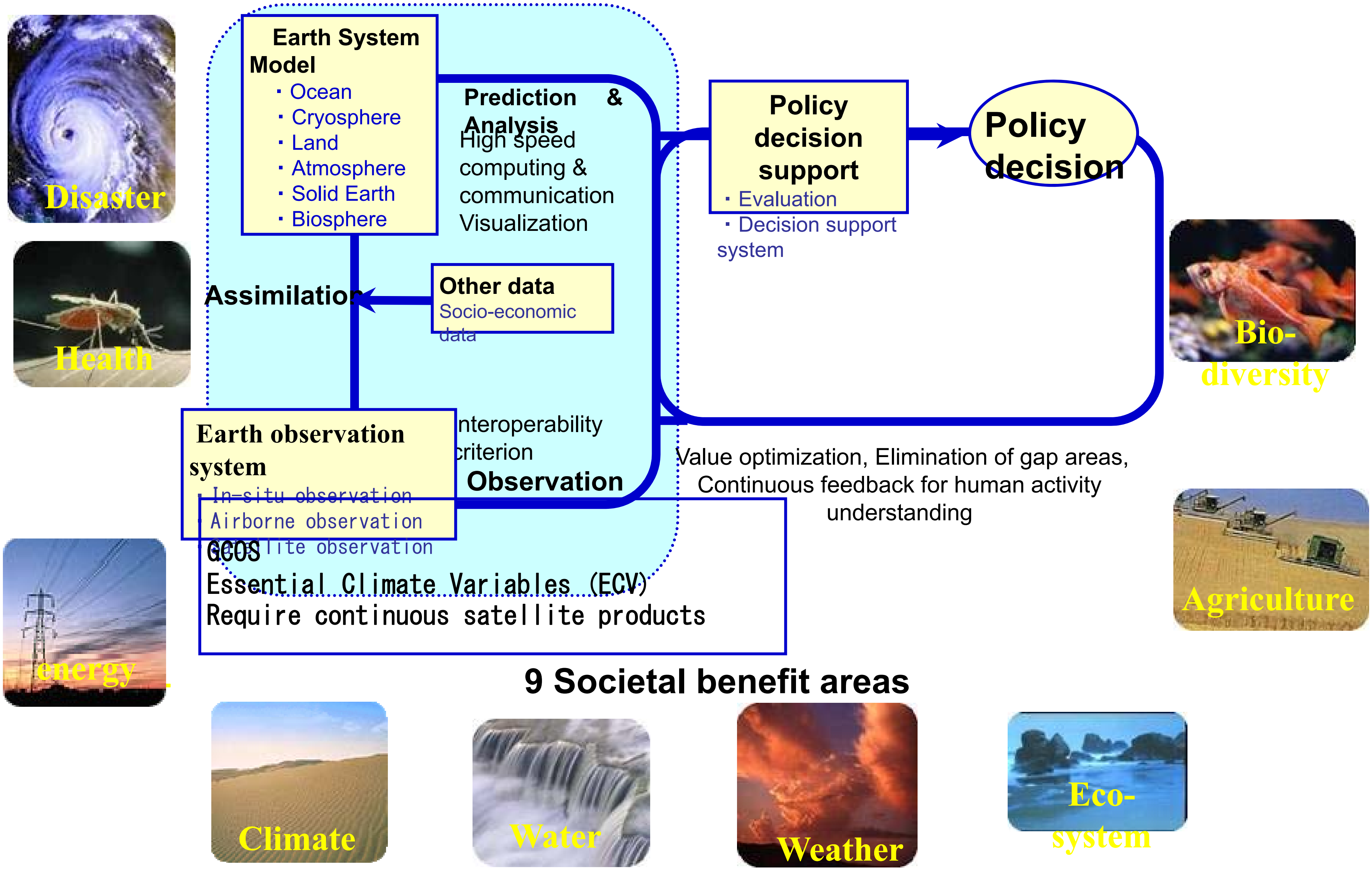
  "Stable and continuous social infrastructure"

  Contribution to GEOSS

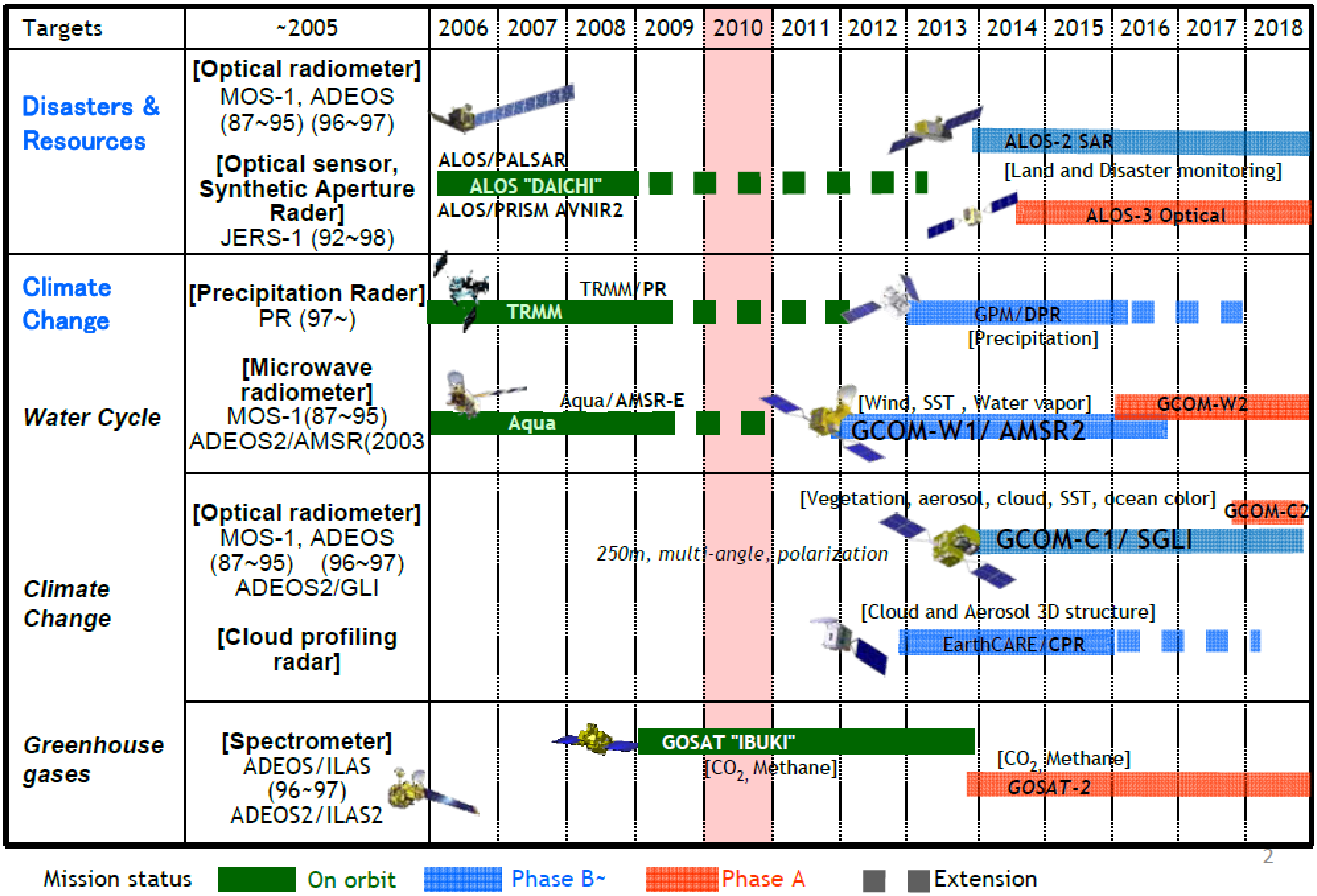
Council for Science and Technology Policy (CSTP)

- 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

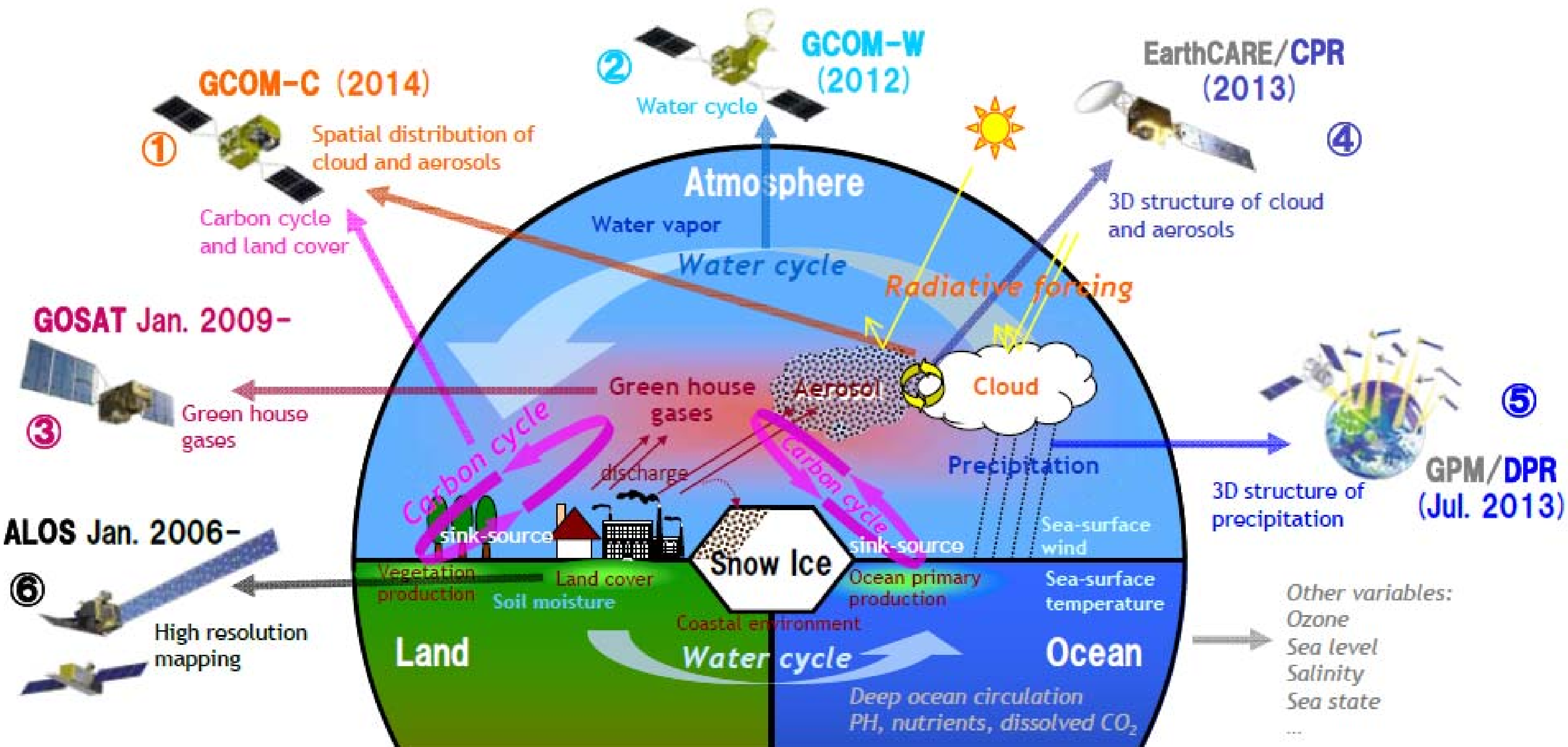
GEOSS 10 year implementation plan



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

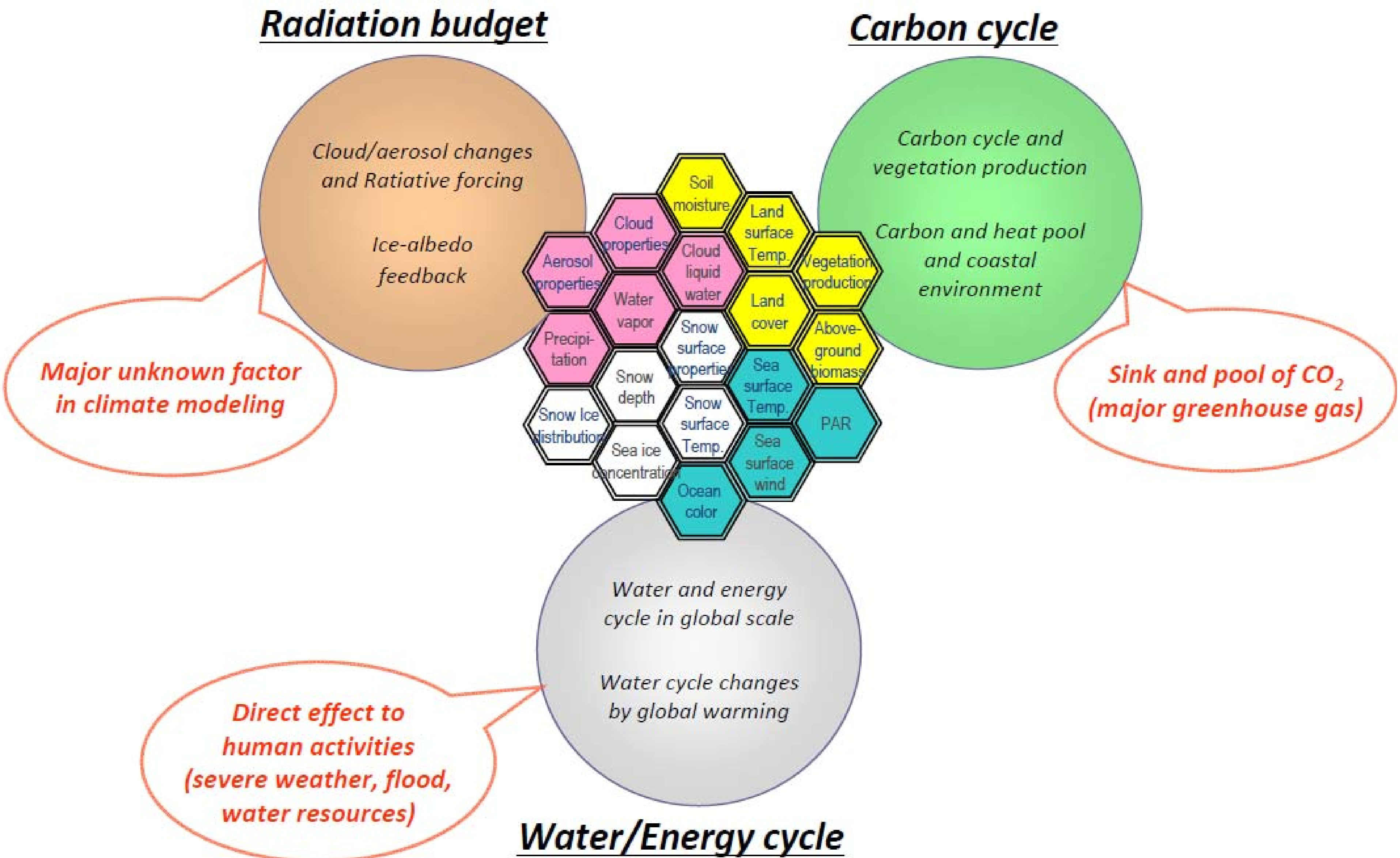
GCOM Mission

- **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**

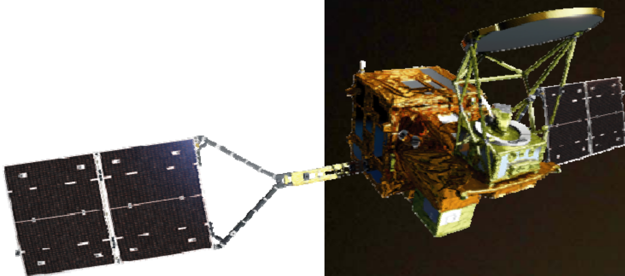
GCOM satellites

- **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 2020), GCOM-W3 (in 2026)**
  - **GCOM-C2 (in 2022), GCOM-C3 (in 2028)**

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.
- AMSR-E finally stopped on Dec. 2015.

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

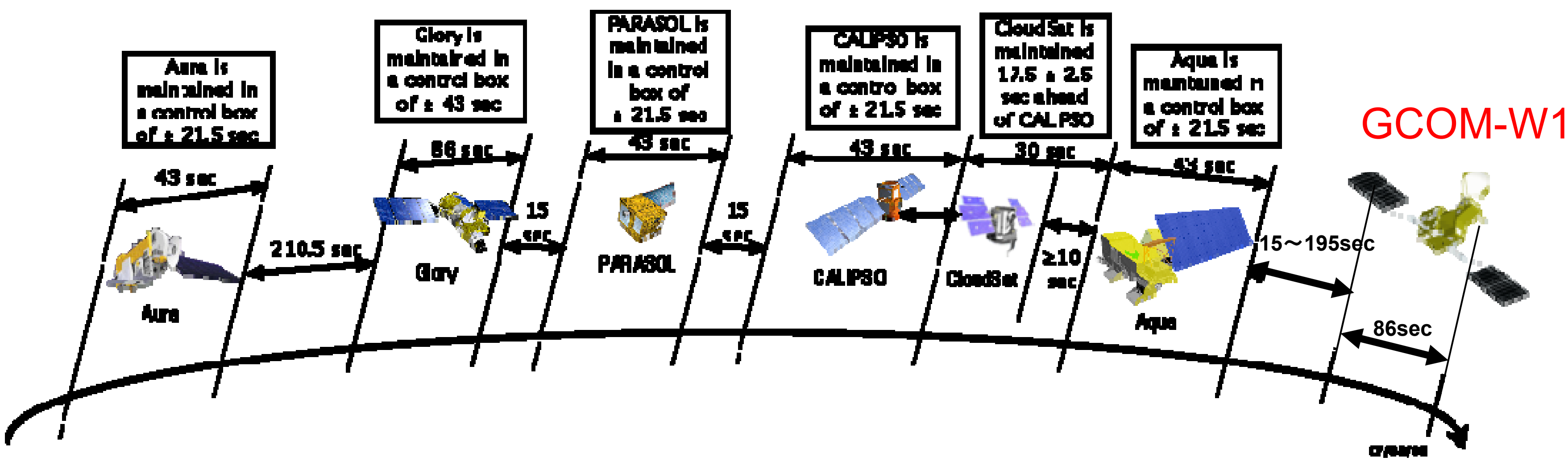


GCOM-W1

- 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

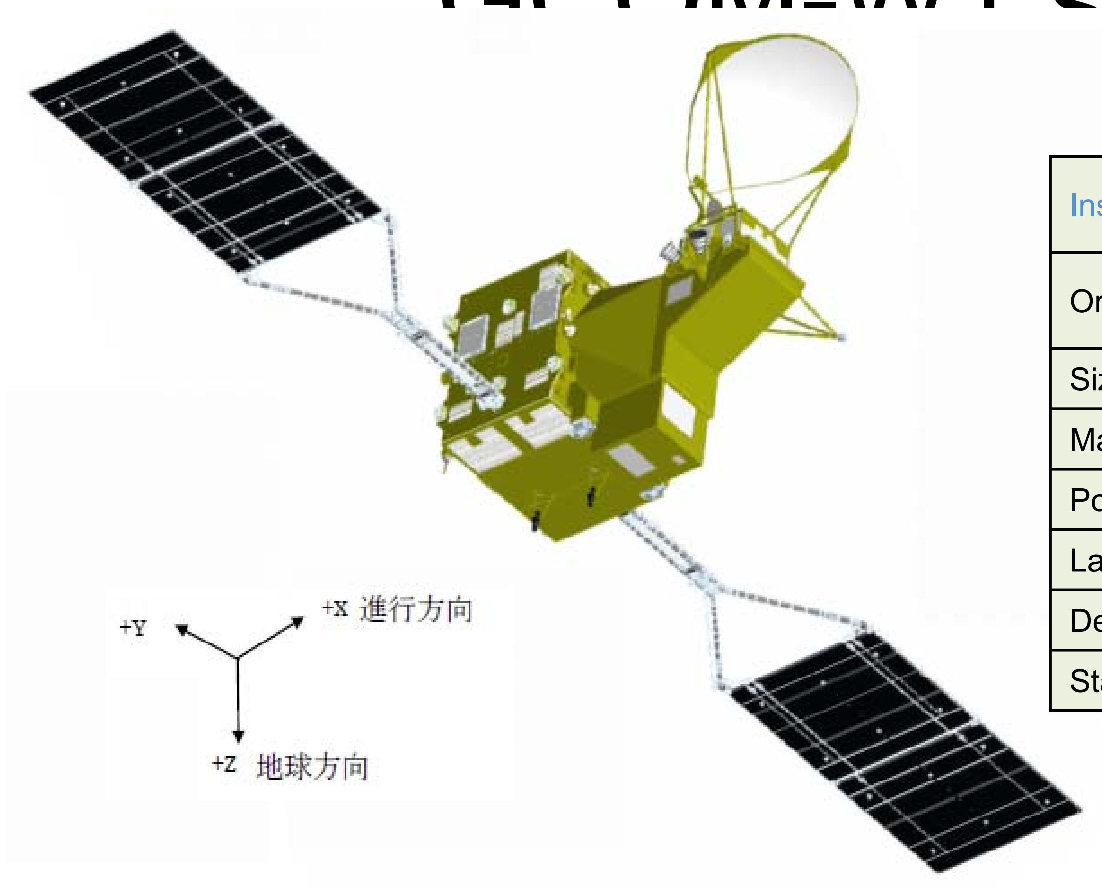
- After invitation to A-Train constellation from NASA, JAXA and A-Train members studied the possibility of participation of GCOM-W1 to A-Train.
- Participation of GCOM-W1 to A-Train was approved by A-Train members last October. The position of GCOM-W1 is ahead of Aqua.
- Benefits of joining the A-train 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).

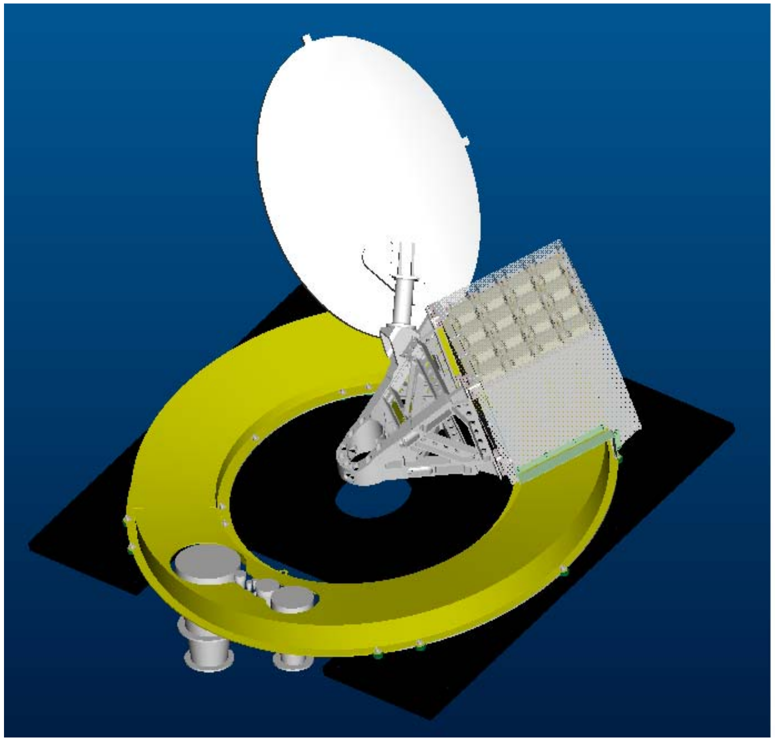
Basic requirements for AMSR 2

- 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

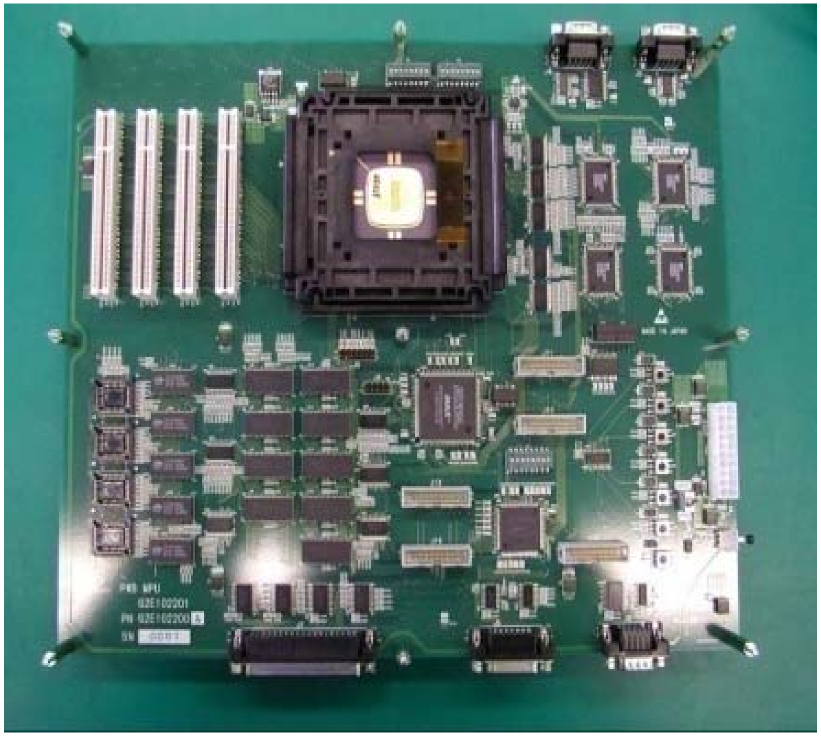
Improvement of hot load

- 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

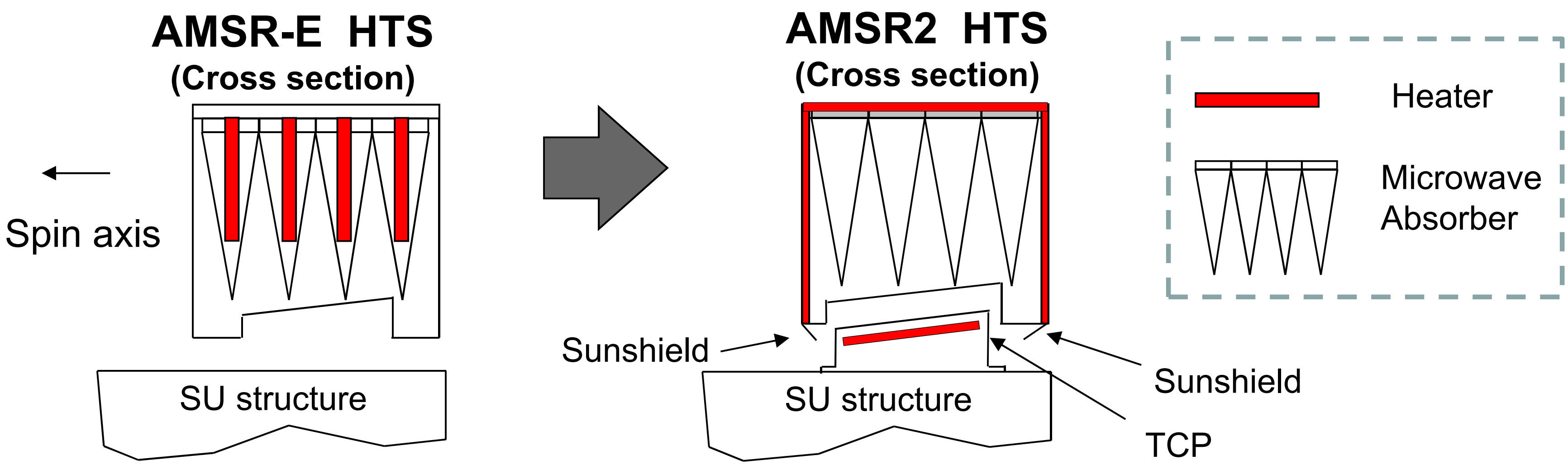


MPU testing board

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

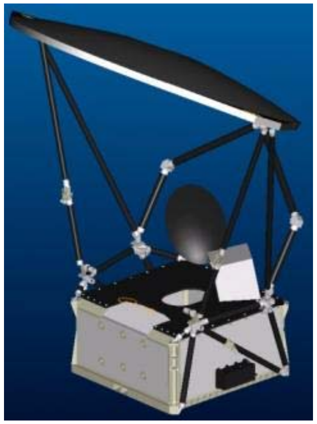


- **Maximum temperature difference inside HTS : less than 2K**
- **Estimated brightness temperature accuracy :**
  - **0.2 K (Variable bias during orbit, season, design life)**
  - **0.1 K (Random due to quantization)**

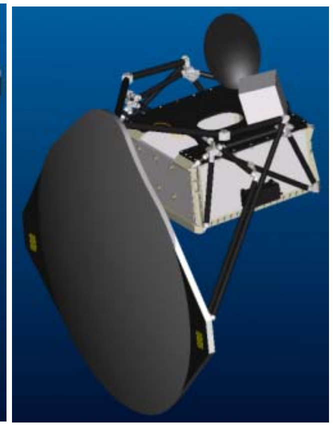
Temperature Resolution

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.

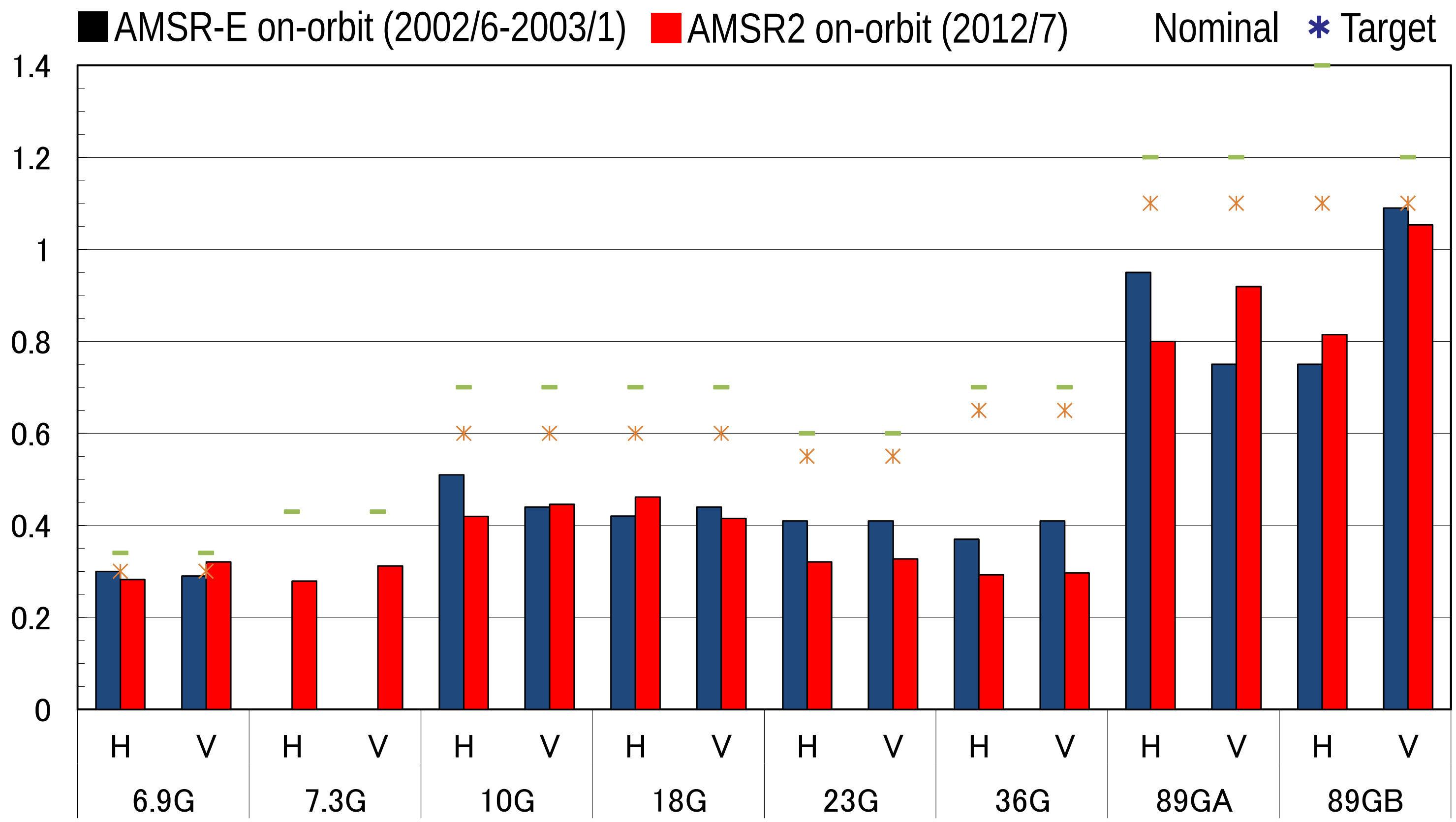
GCOM-W1/AMSR2 characteristics	
Orbit	Sun Synchronous with 699.6km altitude (over the equator)
Launch	JFY2011
Design-Life	5-years
Local time	13:30 LTAN
Swath width	1450km
Antenna	2.0m offset parabola
Incidence angle	Nominal 55 degree

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

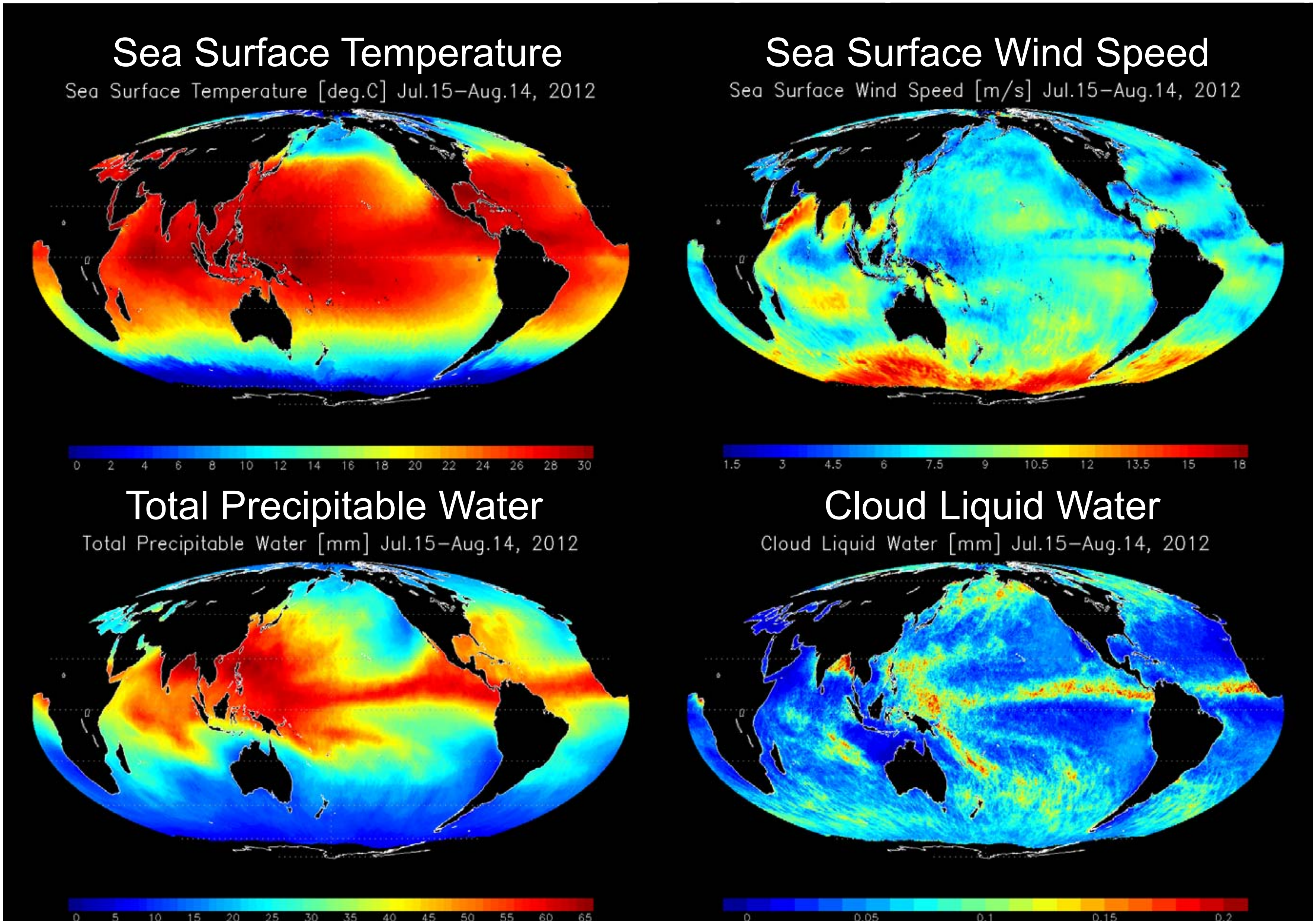
On-Orbit Radiometer Sensitivity

All channels meet the requirements of radiometer sensitivity.

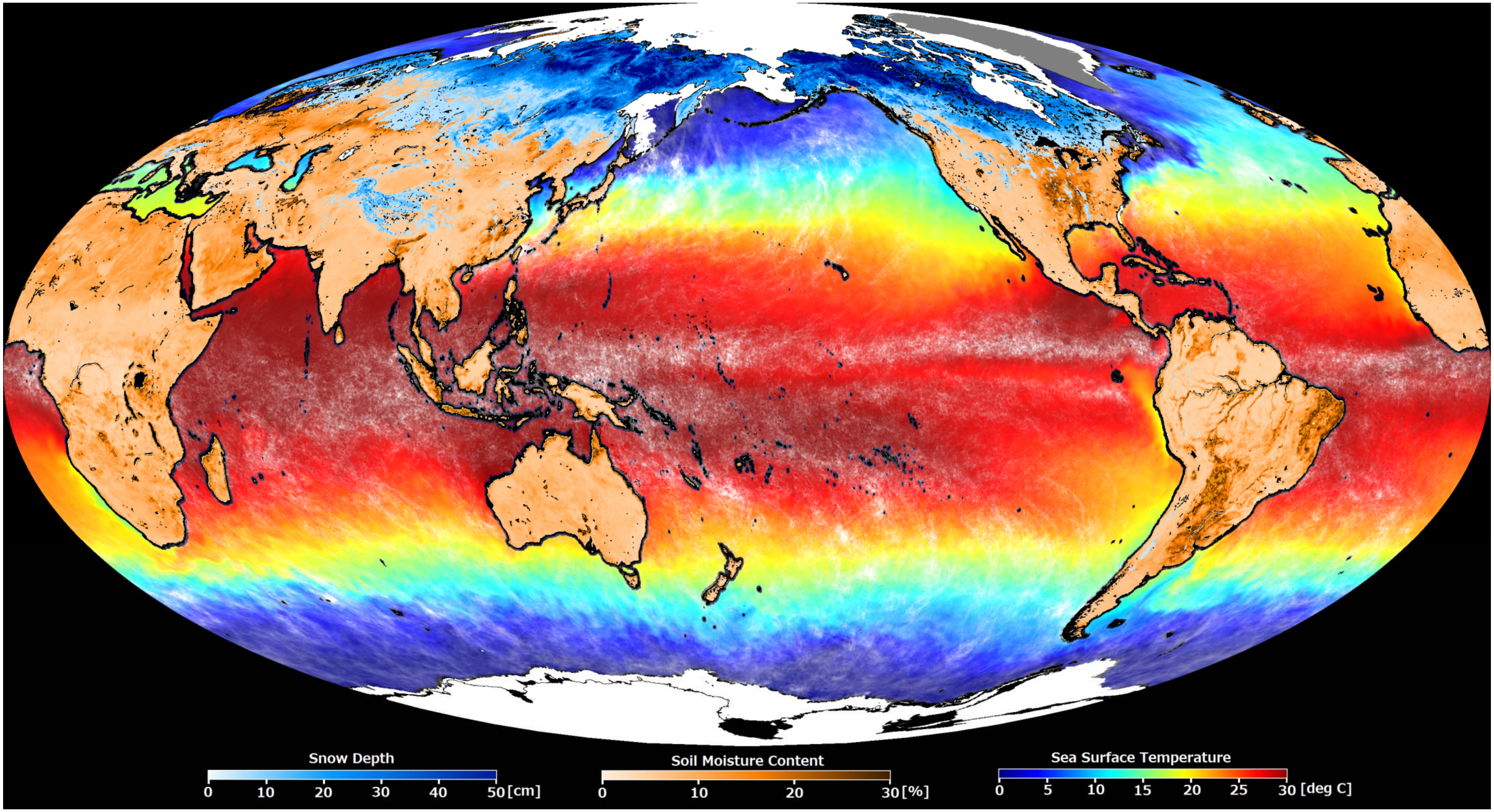


Radiometer sensitivities were computed as follows.

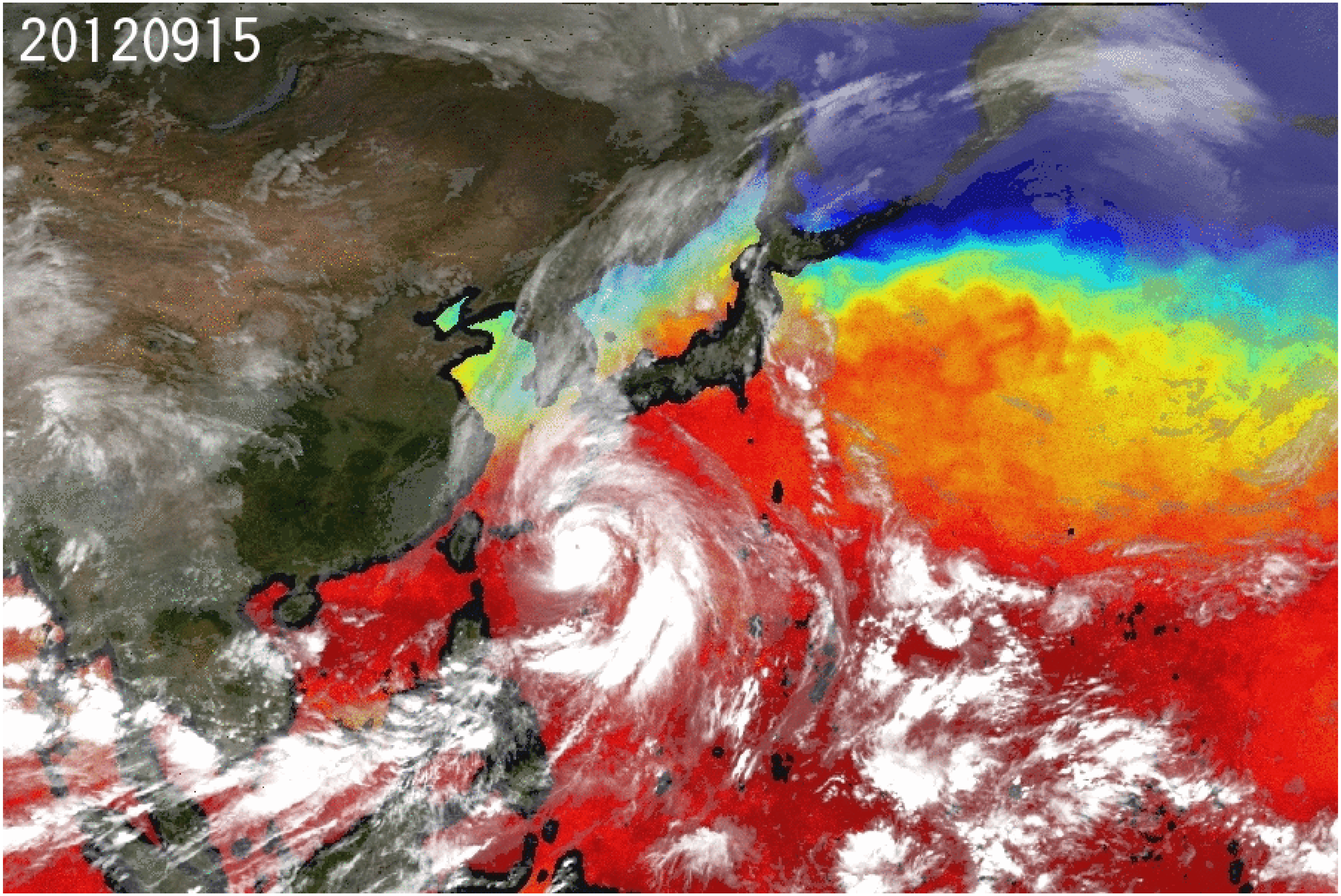
- Use center 2-points among 16-points (4-points among 32-points for 89GHz) and consecutive 10-scans (in total, 2*10=20 samples for lower frequencies, 4*10=40 samples for 89GHz) to compute standard deviation of radiometer counts, and then convert to temperature scale.
- Compute radiometer sensitivities 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.



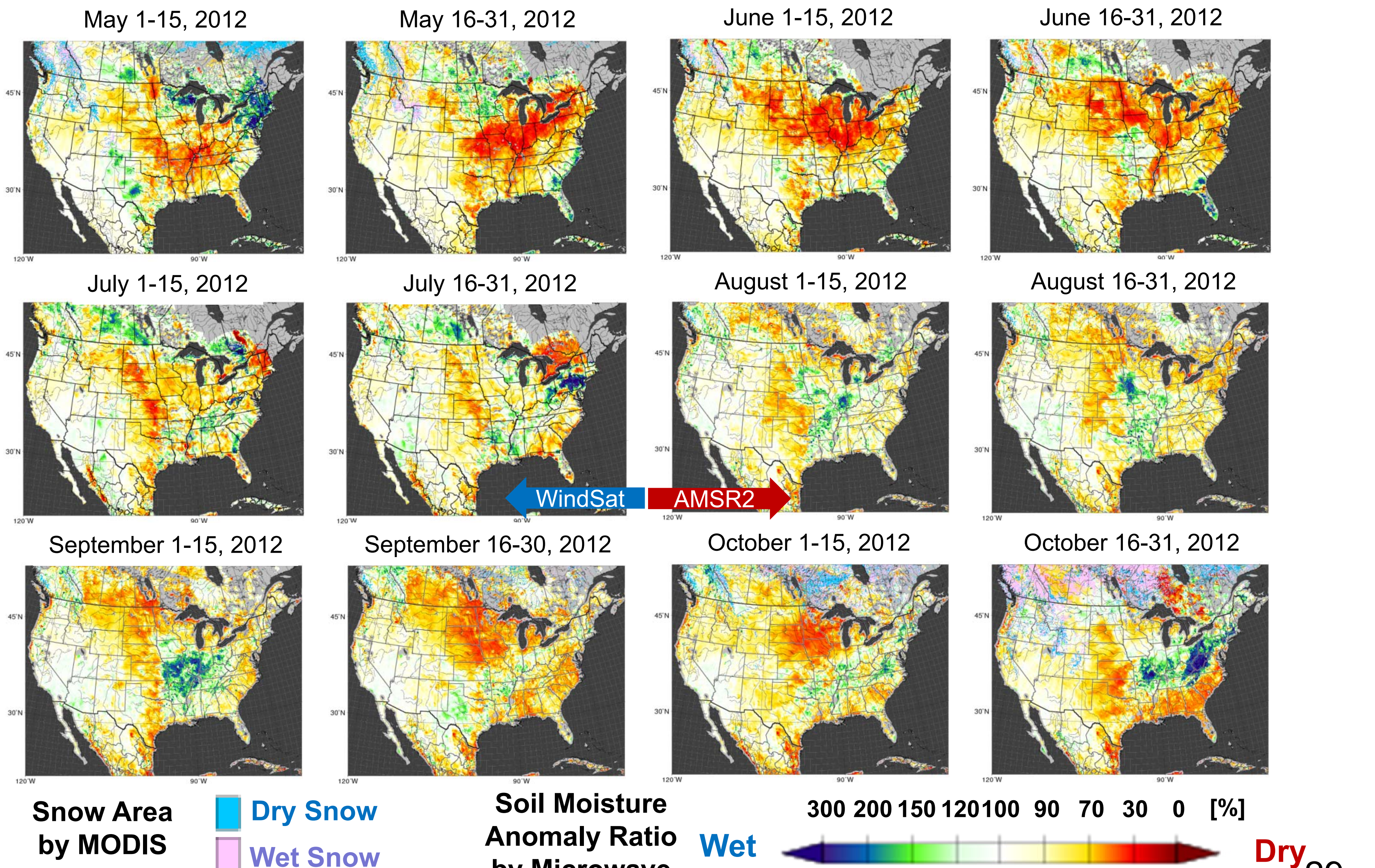
Monthly average (July 15 – August 14, 2012)


Snow Depth
0 10 20 30 40 50 [cm]
Soil Moisture Content
0 10 20 30 [%]
Sea Surface Temperature
0 5 10 15 20 25 30 [deg C]

Depression of SST by Typhoon passage



Soil Moisture Anomaly over North America

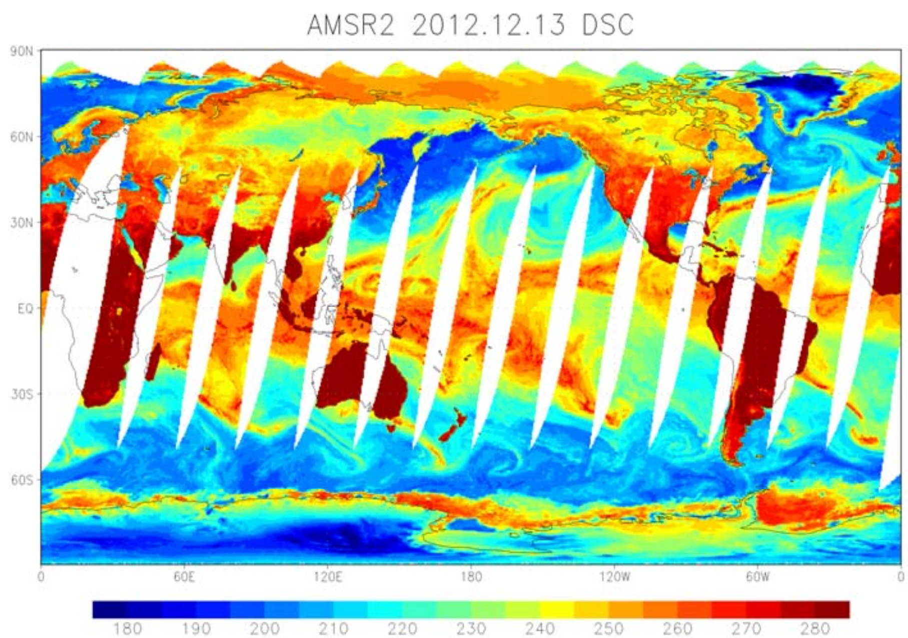


Cross Calibration with AMSR-E

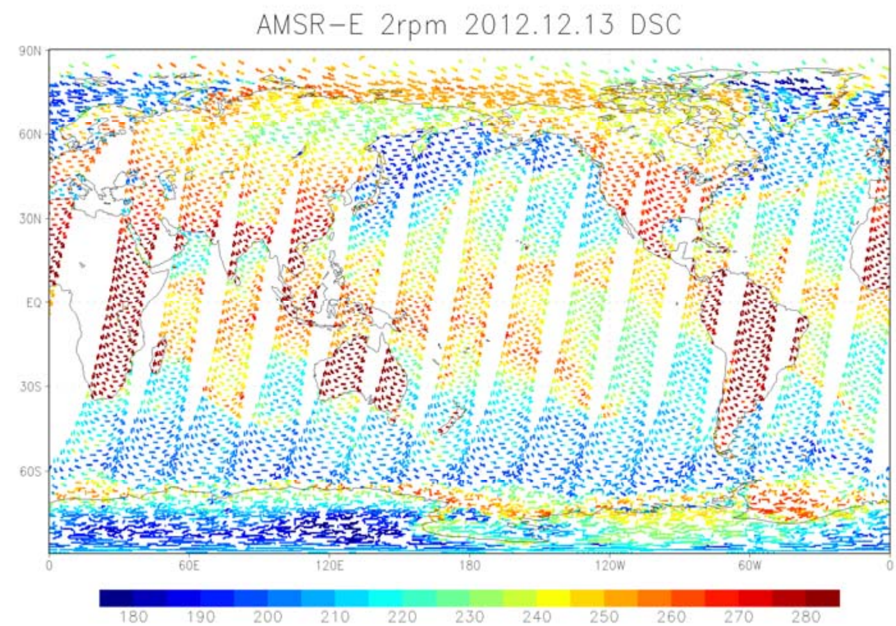
- AMSR-E is now rotating at 2rpm.
- AMSR-E and AMSR2 will remain in A-train at least 1 year.
- Cross calibration will be conducted during this 1 year period.
- New calibration parameters of AMSR-E will be determined.
- The whole AMSR-E products will be reprocessed using this new parameters.

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.



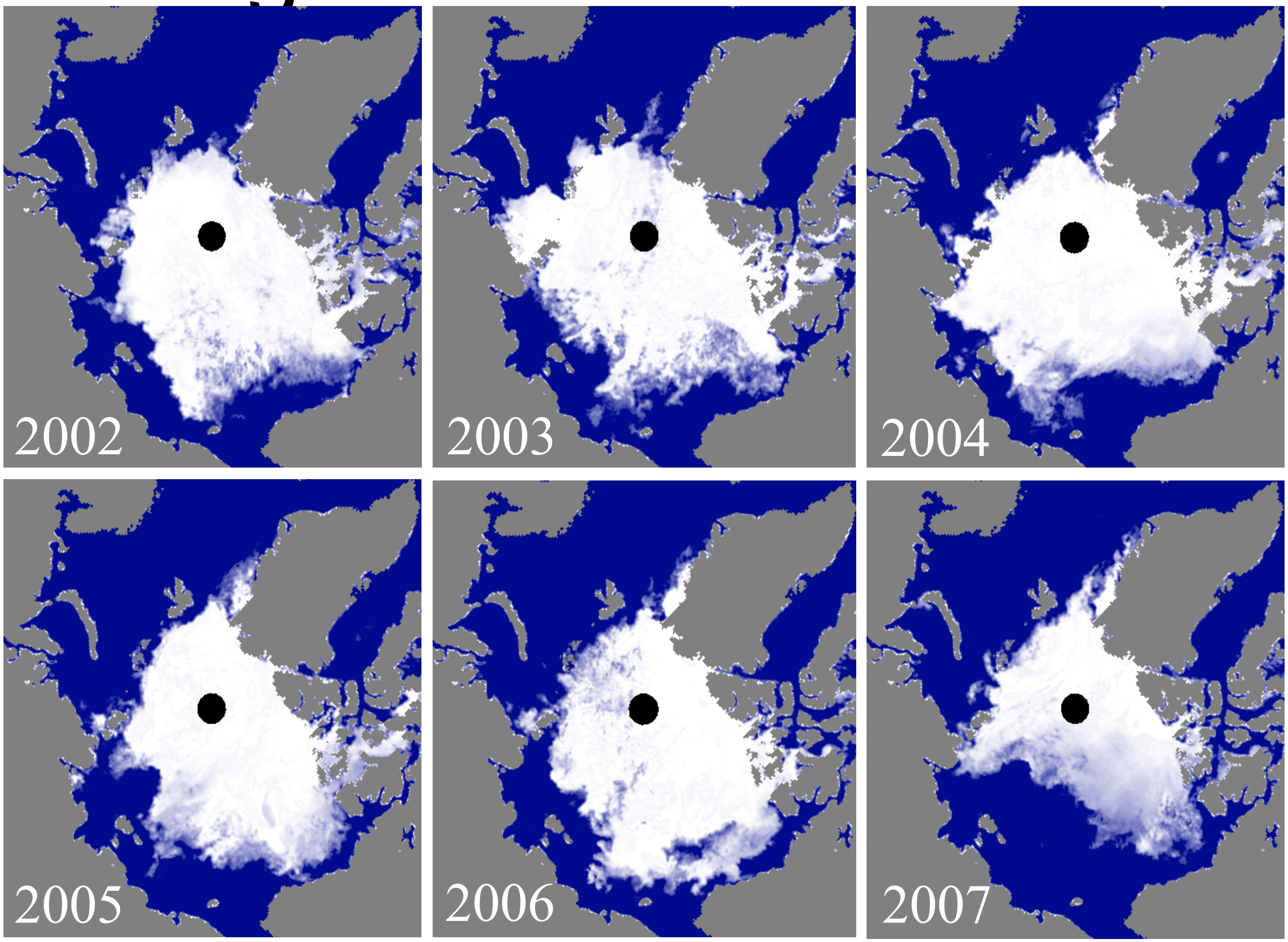
AMSR2 23V Descending



AMSR-E 2rpm 23V Descending

products	IFOV	std. accr.	dynamic range
brightness temp.	5-50km	±1.5K	2.7-340K
total prec. water	15km	$\pm 3.5 kg/m^3$	$0\text{-}70 kg/m^3$
cloud liq. water	15km	$\pm 0.05 kg/m^2$	$0\text{-}1.0 kg/m^2$
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

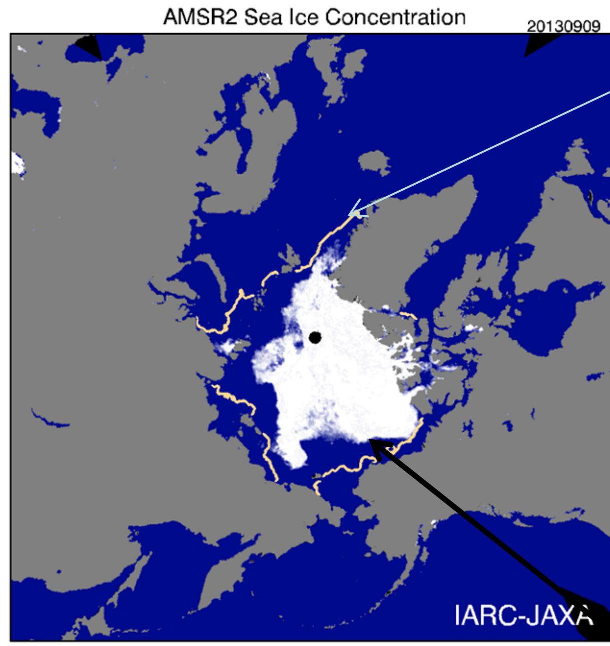


AMSR-E sea ice extent over northern polar region on August 20 of recent 6 years (2002-2007). Images were obtained from the Arctic Sea-Ice Monitor site maintained by the International Arctic Research Center (http://www.ijis.iarc.uaf.edu/en/index.htm).

Arctic Sea Ice by AMSR2

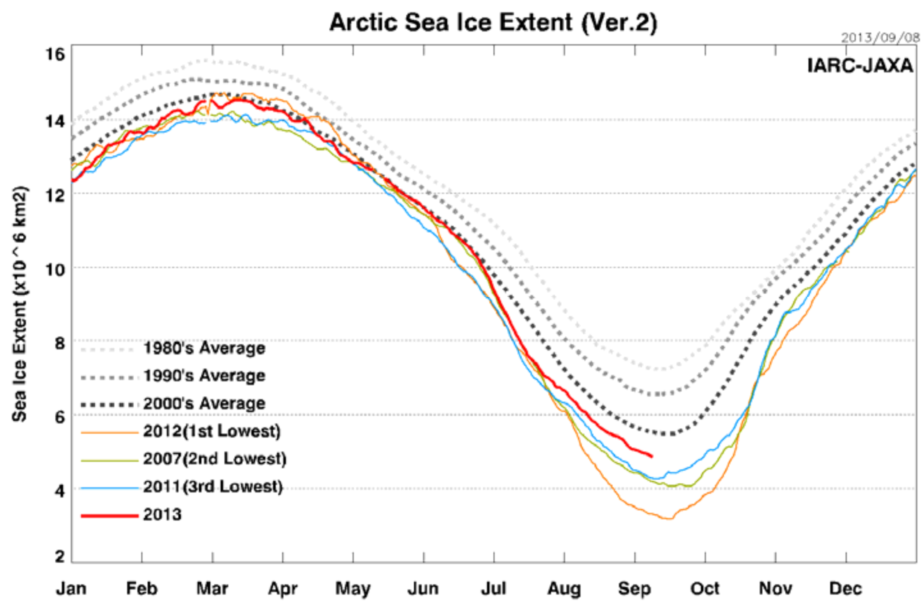
September 16, 2012

September 9, 2013

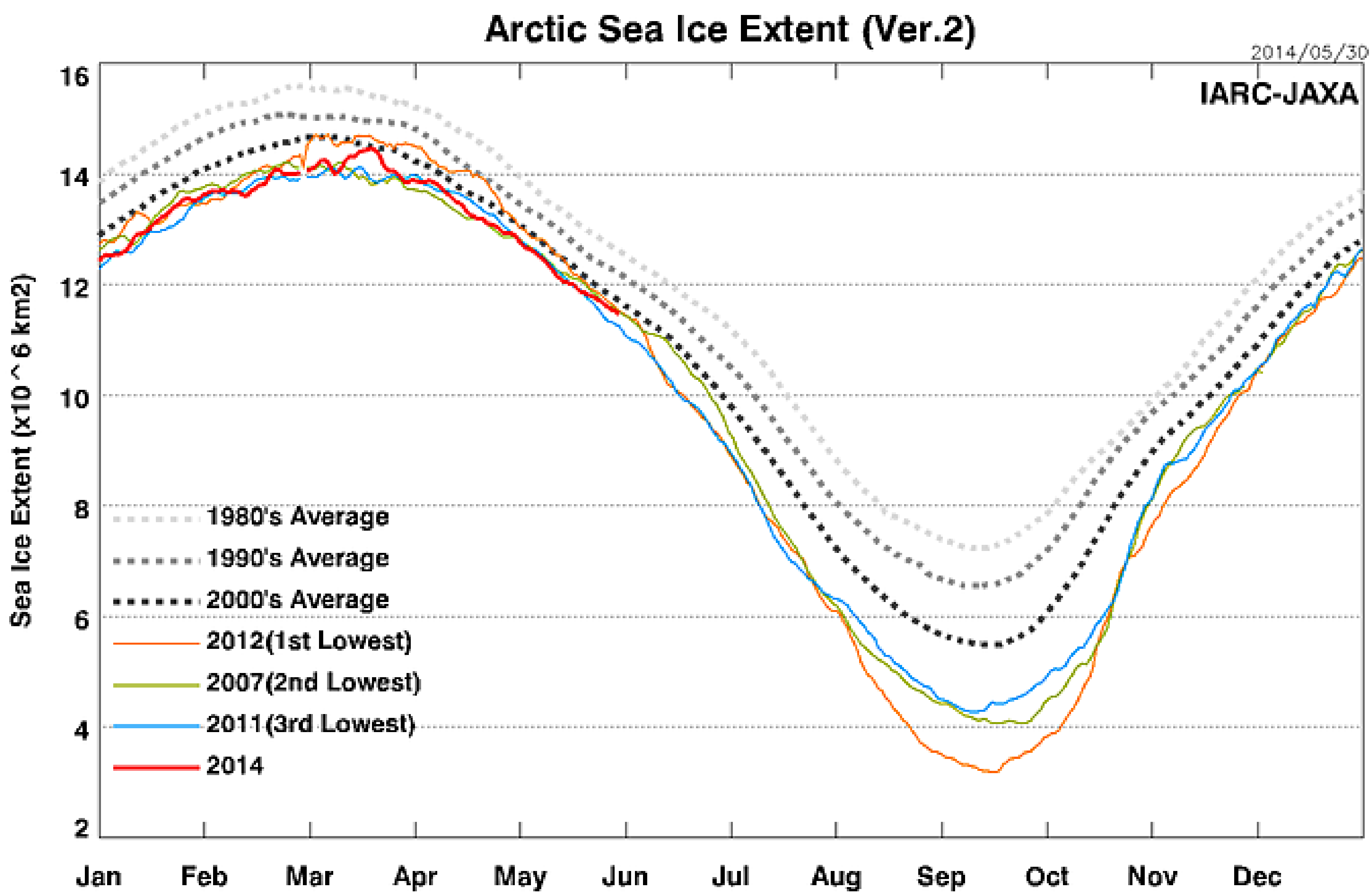


September average in 1980s

The smallest sea ice extent by satellite was recorded in 2012.



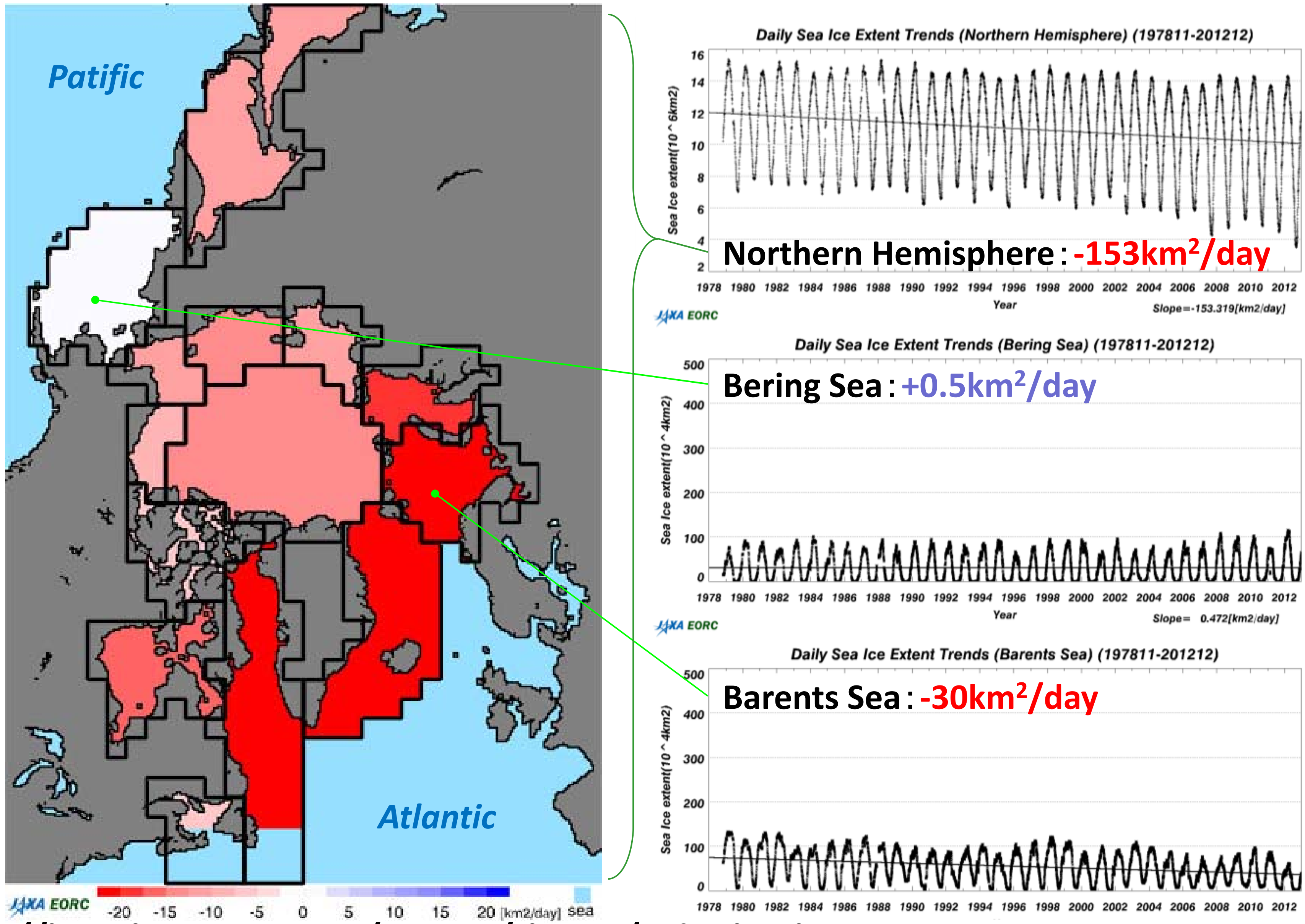
As of September 9, decrease of sea ice extent is less significant.



Arctic Sea Ice Extent (Ver.2)
2014/05/30
IARC-JAXA
Sea Ice Extent (x10 ^ 6 km2)
16
14
12
10
8
6
4
2
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1980's Average
1990's Average
2000's Average
2012(1st Lowest)
2007(2nd Lowest)
2011(3rd Lowest)
2014

Long-Term Dataset of Arctic Sea Ice

Combining histrical dataset and AMSR-E/AMSR2



http://kuroshio.eorc.jaxa.jp/JASMES/climate/index.html

AMSR2 Product Validation

Obs. Sites: 54SONDE

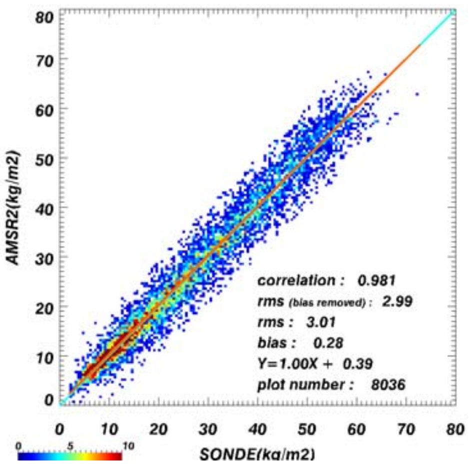


Photo: Japan Meteorological Agency

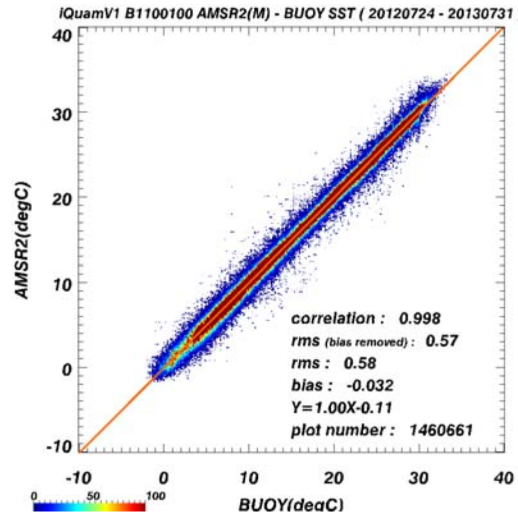


Photo: JAMSTEC

Sea Surface Temperature

Obs. sites: 11GPS

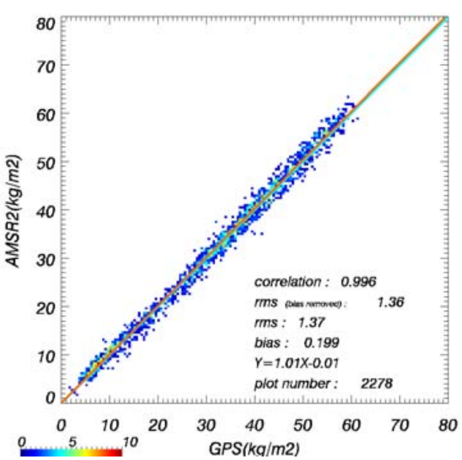


Photo: Geospatial Information Authority of Japan

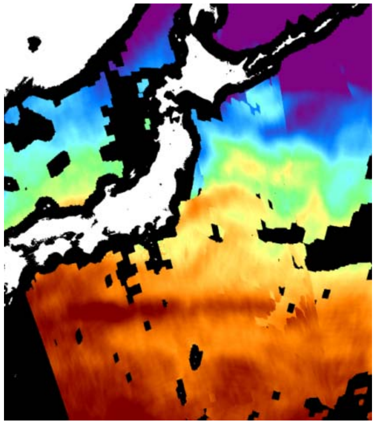
Total Precipitable Water

- Utilization of existing global observation network such as radiosondes, ocean buoys, and GPS measurements.

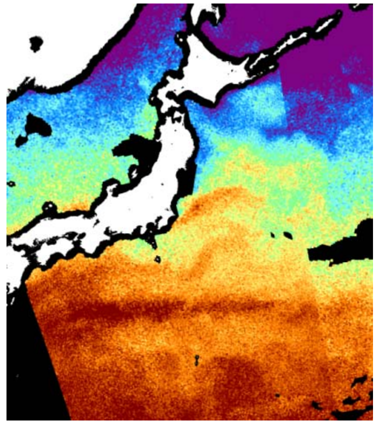
AMSR2 Research Products

- All weather sea surface wind speed (C-band)
- 10GHz sea surface temperature
- Land surface temperature
- High resolution sea ice concentration (89GHz)
- Sea ice moving vector
- Thin sea ice detection
- Vegetation water contents
- Soil moisture & vegetation water contents based on assimilation

Development of Research Products

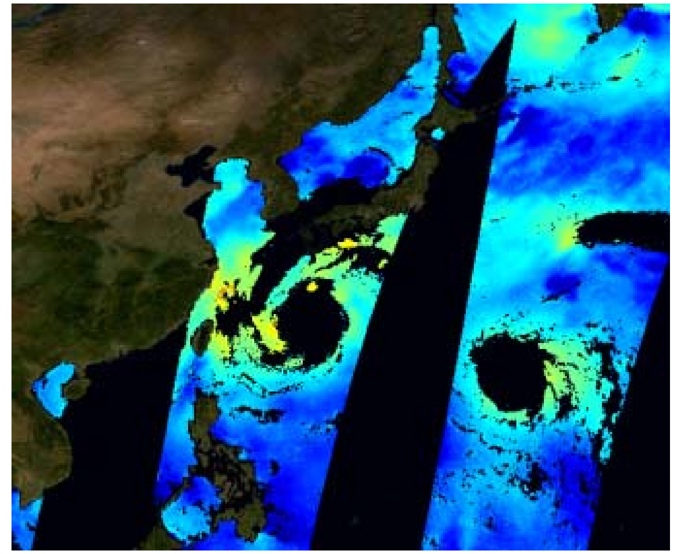


6GHz-SST
(Standard)

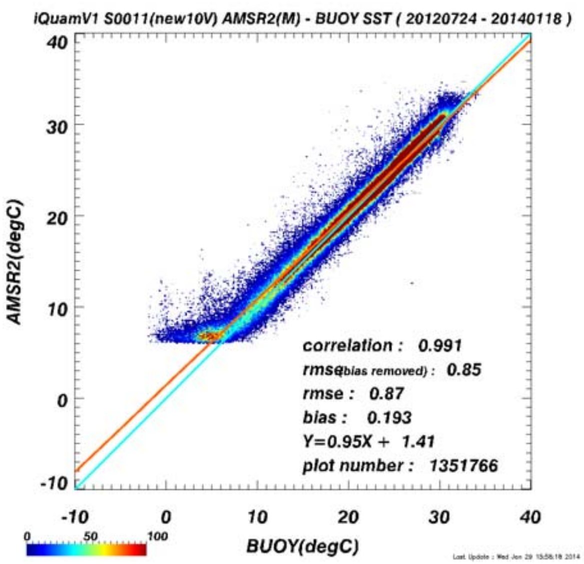


10GHz-SST
(Research candidate)

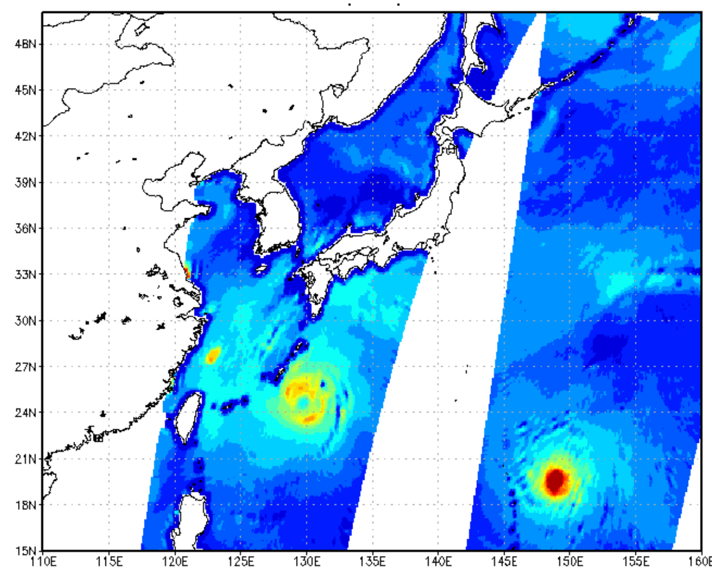
Sea surface wind speed (Standard)



All-weather sea surface wind speed
(Research candidate)

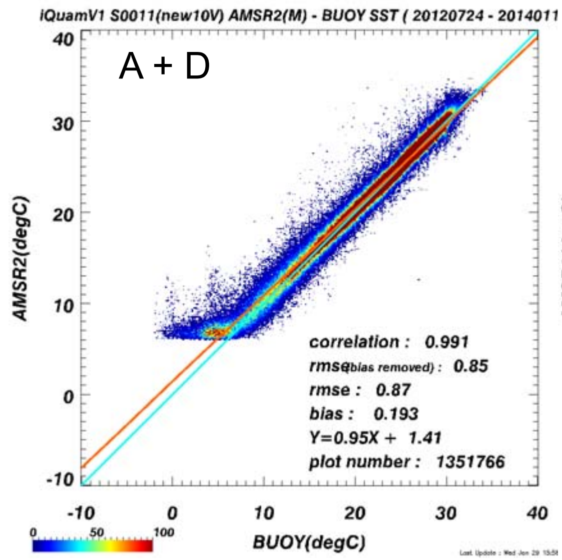


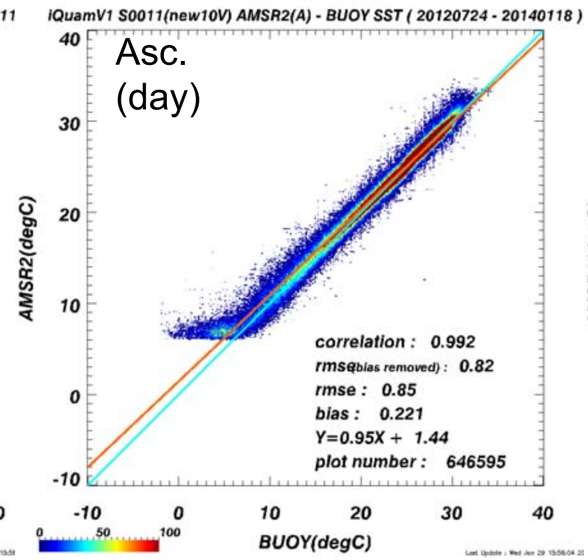
Validation of 10GHz-SST against buoy

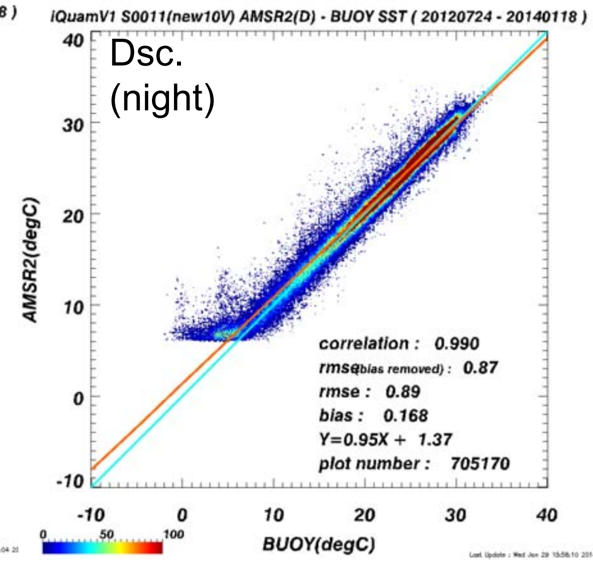


Validation of AMSR2 10G-SST

Period: Jul. 24, 2012 – Jan. 18, 2014)



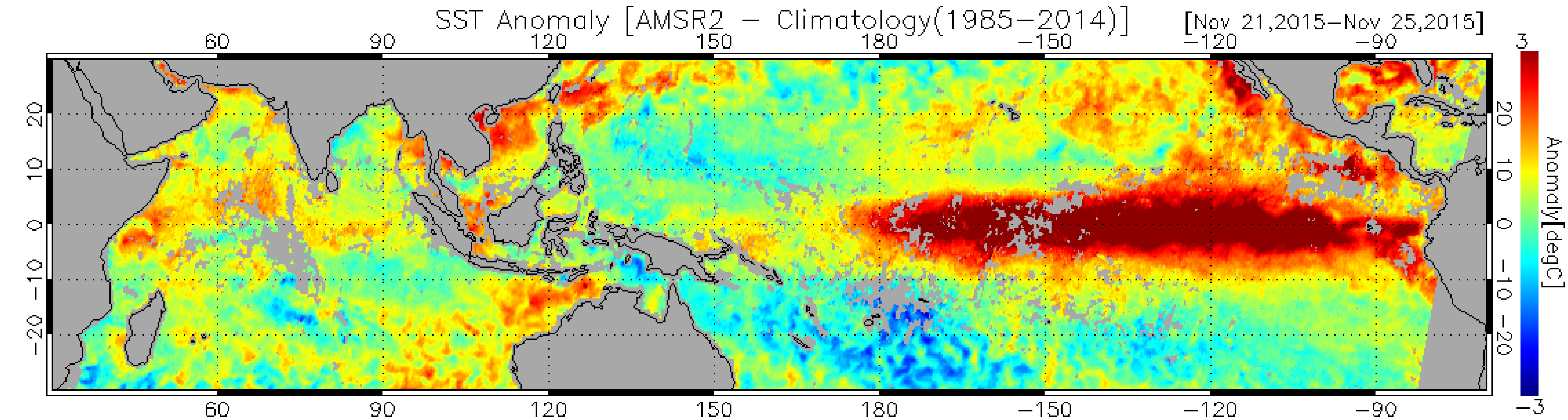


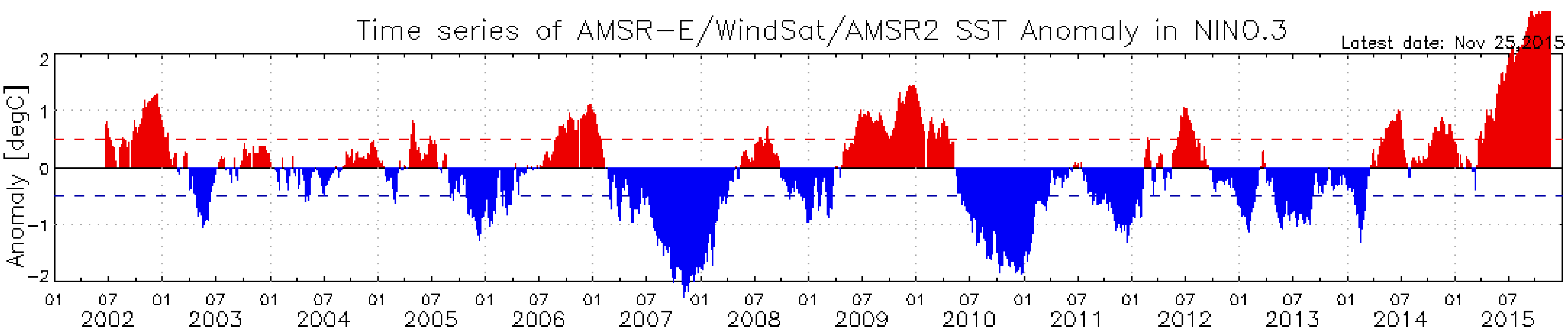


	AMSR2 10-GHzSST(degC)		
	Asc. + Dsc.	Asc. (day)	Dsc. (night)
Bias	**0.193**	**0.221**	**0.168**
RMSE	**0.87**	**0.85**	**0.89**
Correlation	**0.991**	**0.992**	**0.990**

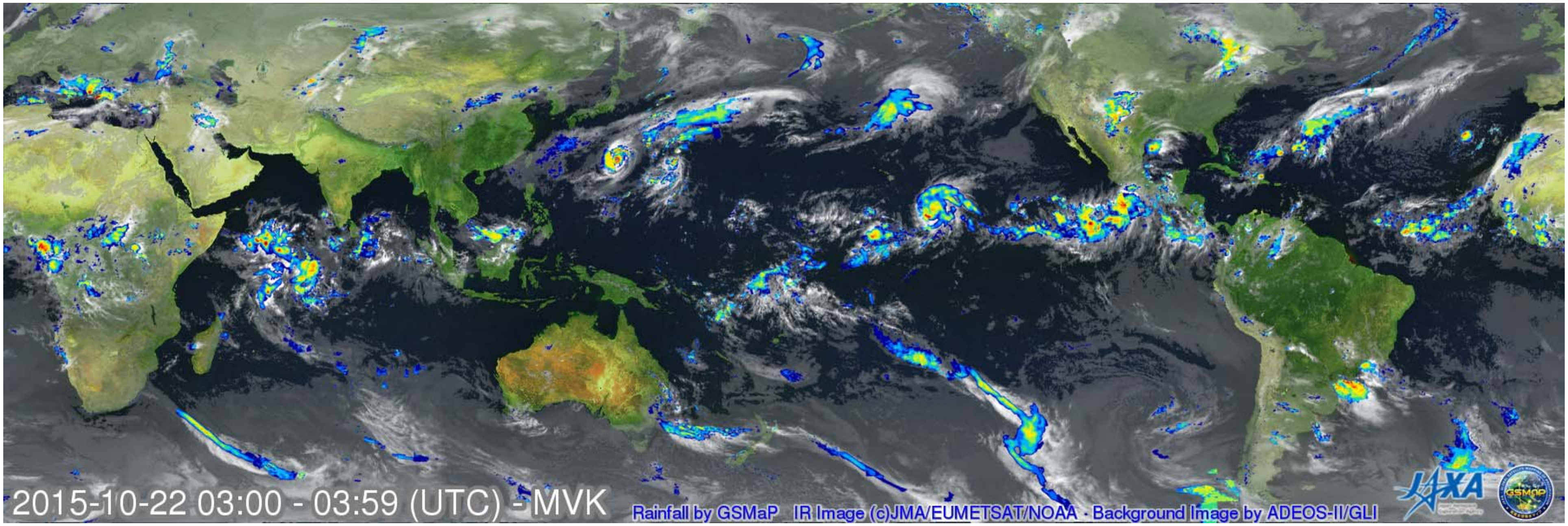
(NOTE) SST under 10 degC is not excluded in comparison with buoys.

El-Nino Watch





GsMaP


2015-10-22 03:00 - 03:59 (UTC) - MVK
Rainfall by GSMaP IR Image (c)JMA/EUMETSAT/NOAA Background Image by ADEOS-II/GLI
JAXA
GSMaP

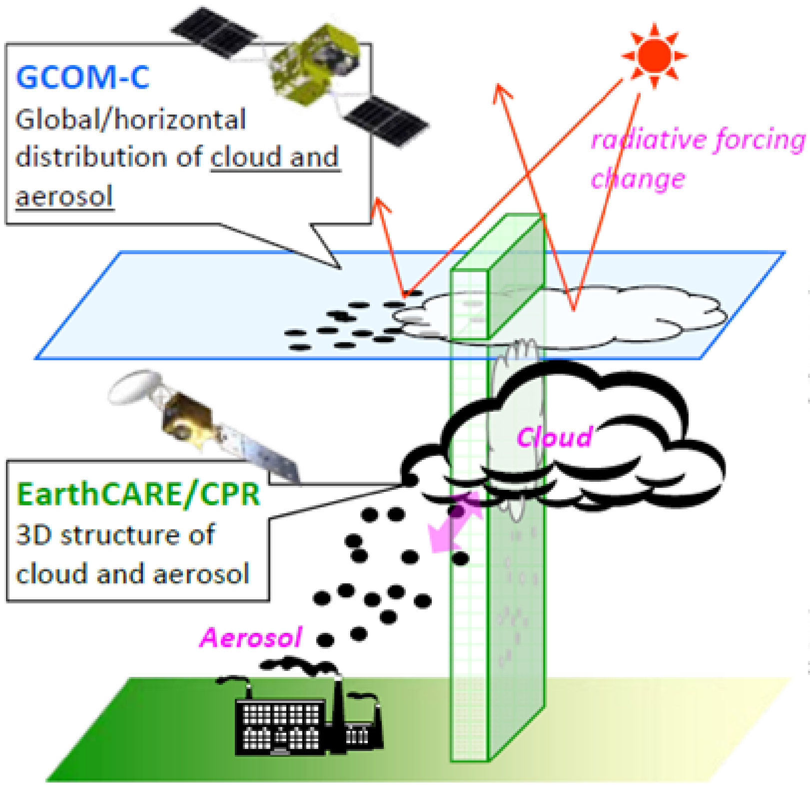
AMSR2 Status

- Extremely stable.
- Contributed to the ECMWF NWP model improvement(Kazumori).
- New version L1B was released in 2015.
- AMSR-E reprocessing is planned.
- AMSR2 research products were defined.
- L1B version up is planned in 2016.
- AMSR2 rotation torque is little higher but stable

GCOM-C Science Targets

Radiation budget of the atmosphere-surface system

Today's the most significant factor: atmospheric CO_2



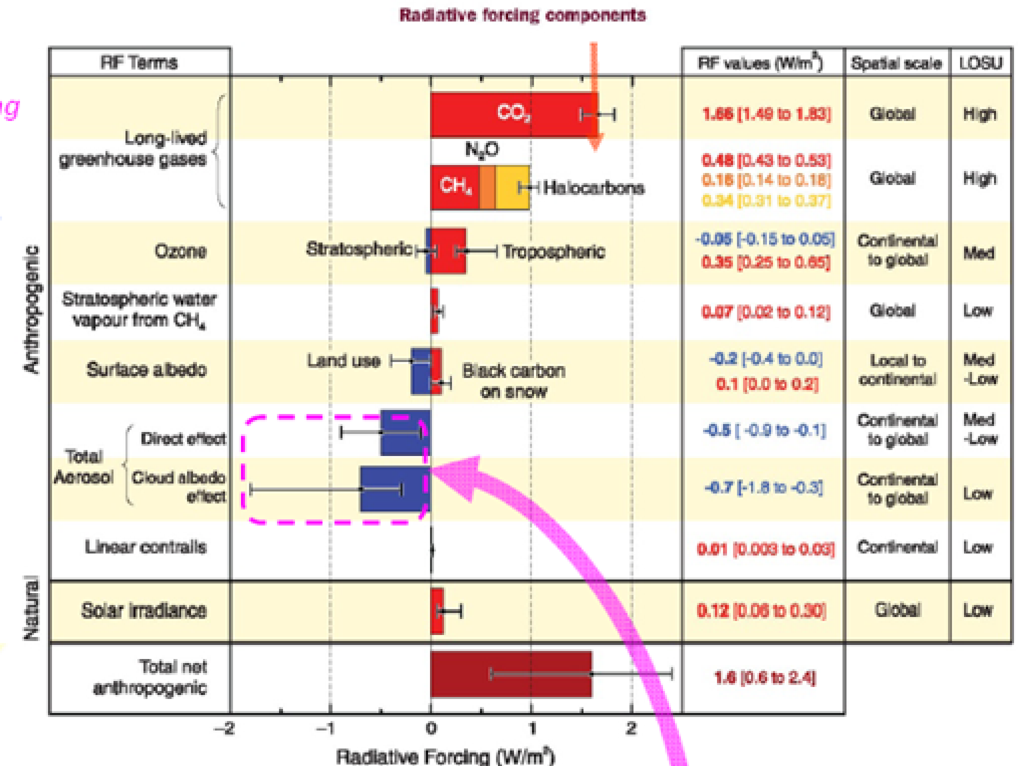


Figure 2.4. Global average radiative forcing (RF) in 2005 (best estimates and 5 to 95% uncertainty ranges) with respect to 1750 for CO_2, CH_4, N_2O and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific 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
cloud and aerosol by GCOM-C & EarthCARE

Improvement

Evaluation of model outputs and process parameterization

Climate models
present and future cloud and aerosol roles in the global warming scenarios

Today's the most significant uncertainty 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(spec)	S/N(PFT
VN1	380	250	10	60	210	250	613
VN2	412	250	10	75	250	400	703
VN3	443	250	10	64	400	300	474
VN4	490	250	10	53	120	400	815
VN5	530	250	20	41	350	250	410
VN6	565	250	20	33	90	400	936
VN7	673.5	250	20	23	62	400	1010
VN8	673.5	250	20	25	210	250	473
VN9	763	1000	12	40	350	1200	1580
VN10	868.5	250	20	8	30	400	460
VN11	868.5	250	20	30	300	200	451

Polarization channels (3 directions)

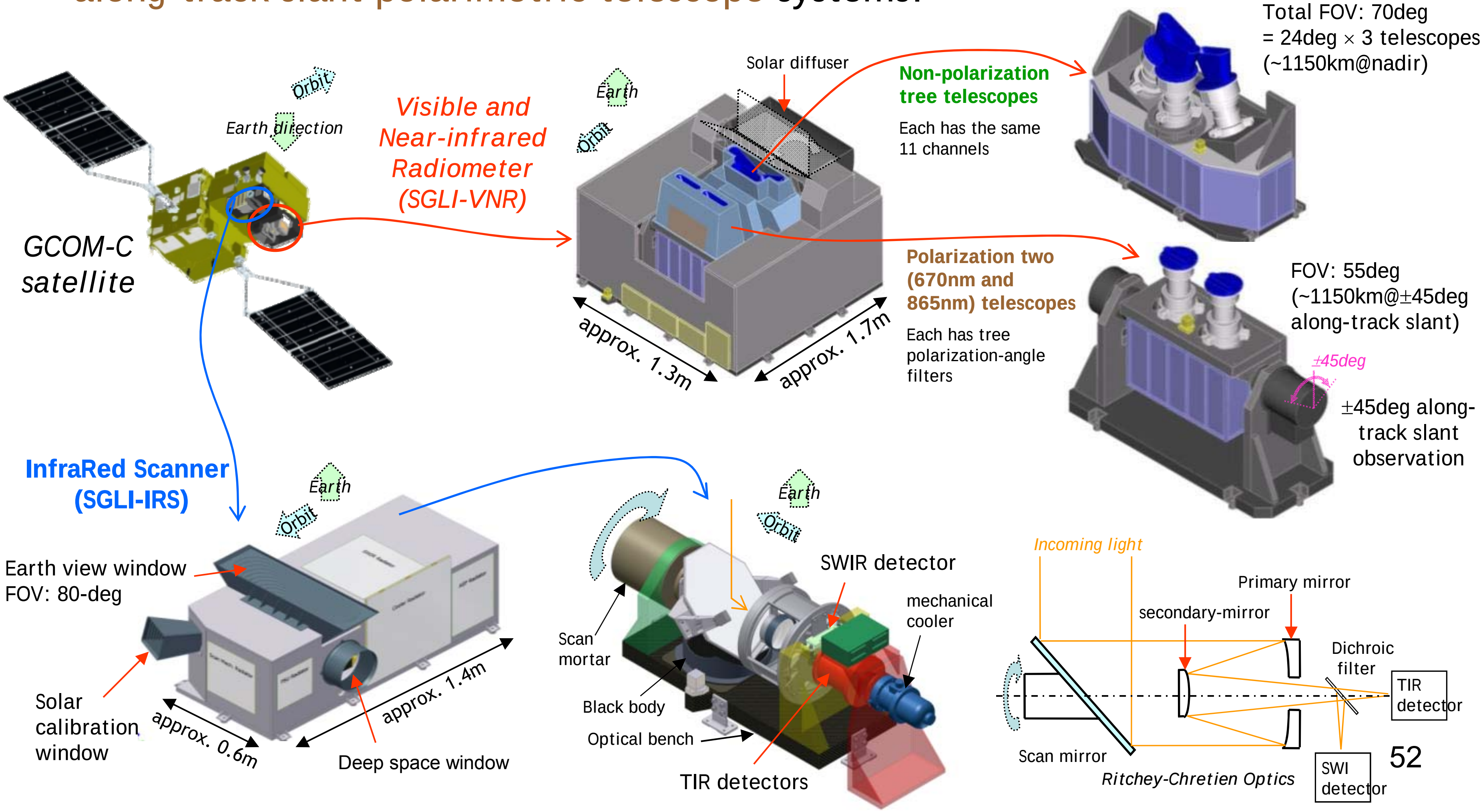
polarization (3 directions)							
Ch.	central wavelength [nm]	IFOV [m]	$\Delta\lambda$ [nm]	$L\lambda$ [W/m^2/str/µm]	L_{max}. [W/m^2/str/µm]	S/N(spec)	S/N(PFT)
673-P1	673.5	1000	20	25	250	250	712
673-P2	673.5	1000	20	25	250	250	727
673-P3	673.5	1000	20	25	250	250	586
868-P1	868.5	1000	20	30	300	250	719
868-P2	868.5	1000	20	30	300	250	693
868-P3	868.5	1000	20	30	300	250	580

Ch.	central wavelength[μm]	IFOV[m]	Δλ[μm]	L_{λ}[W/m^2/str/μm] or Tstd[K]	L_{max}[W/m^2/str/μm] or T_{max}[K]	S/N or NEdT @300[K](spec)	S/N or NEdT@300[K](PFT)
SW1	1.05	1000	0.02	57	248	500	941.8
SW2	1.38	1000	0.02	8	103	150	328.8
SW3	1.63	250	0.2	3	50	57	100
SW4	2.21	1000	0.05	1.9	20	211	367.7
T1	10.8	500	0.7	300	340	0.2	0.039
T2	12.0	500	0.7	300	340	0.2	0.069
T1		250				0.2	0.073
T2		250				0.2	0.109

2. GCOM-C products and SGLI design

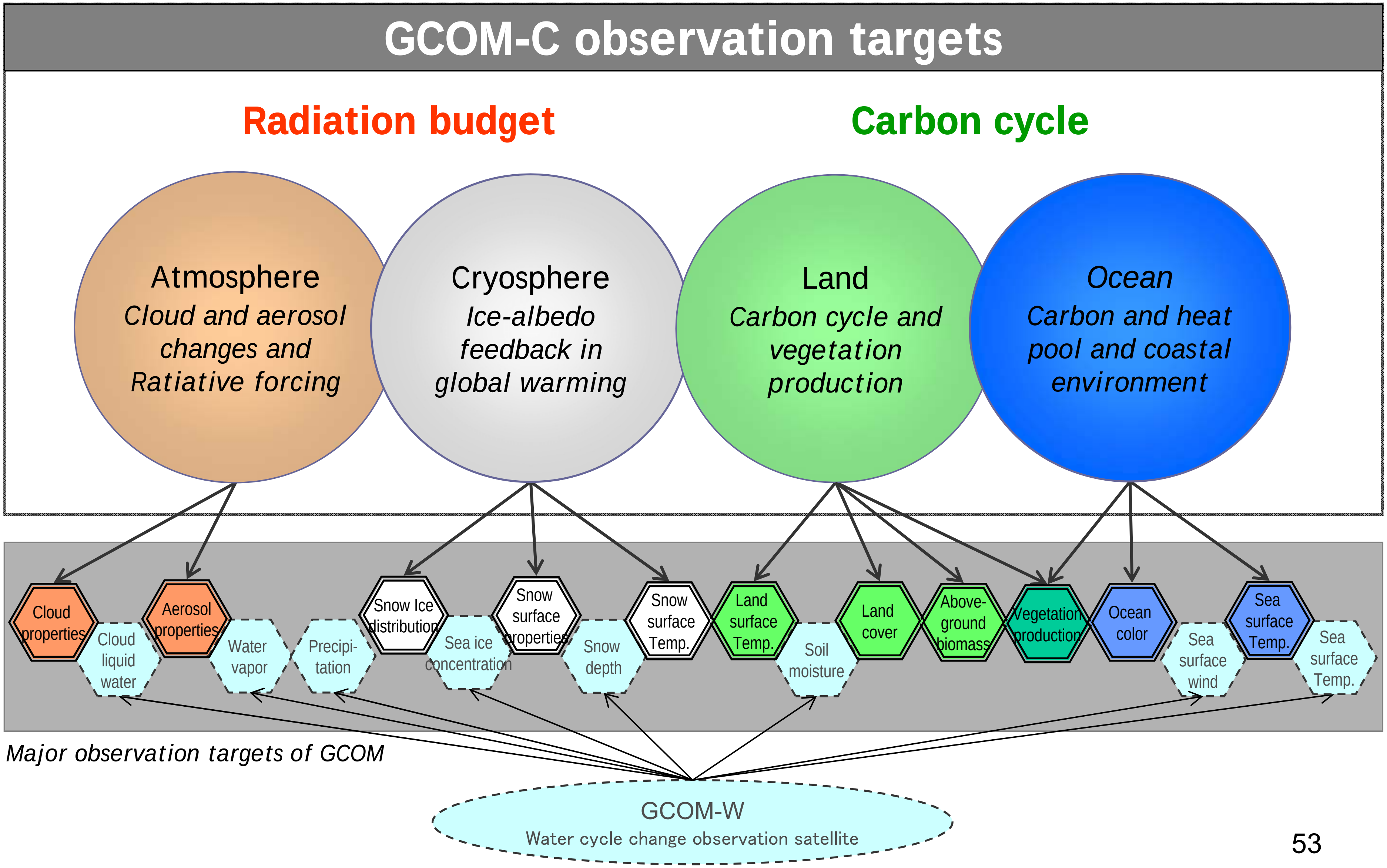
- 2.8 SGLI design (VNR and IRS)

- 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



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)

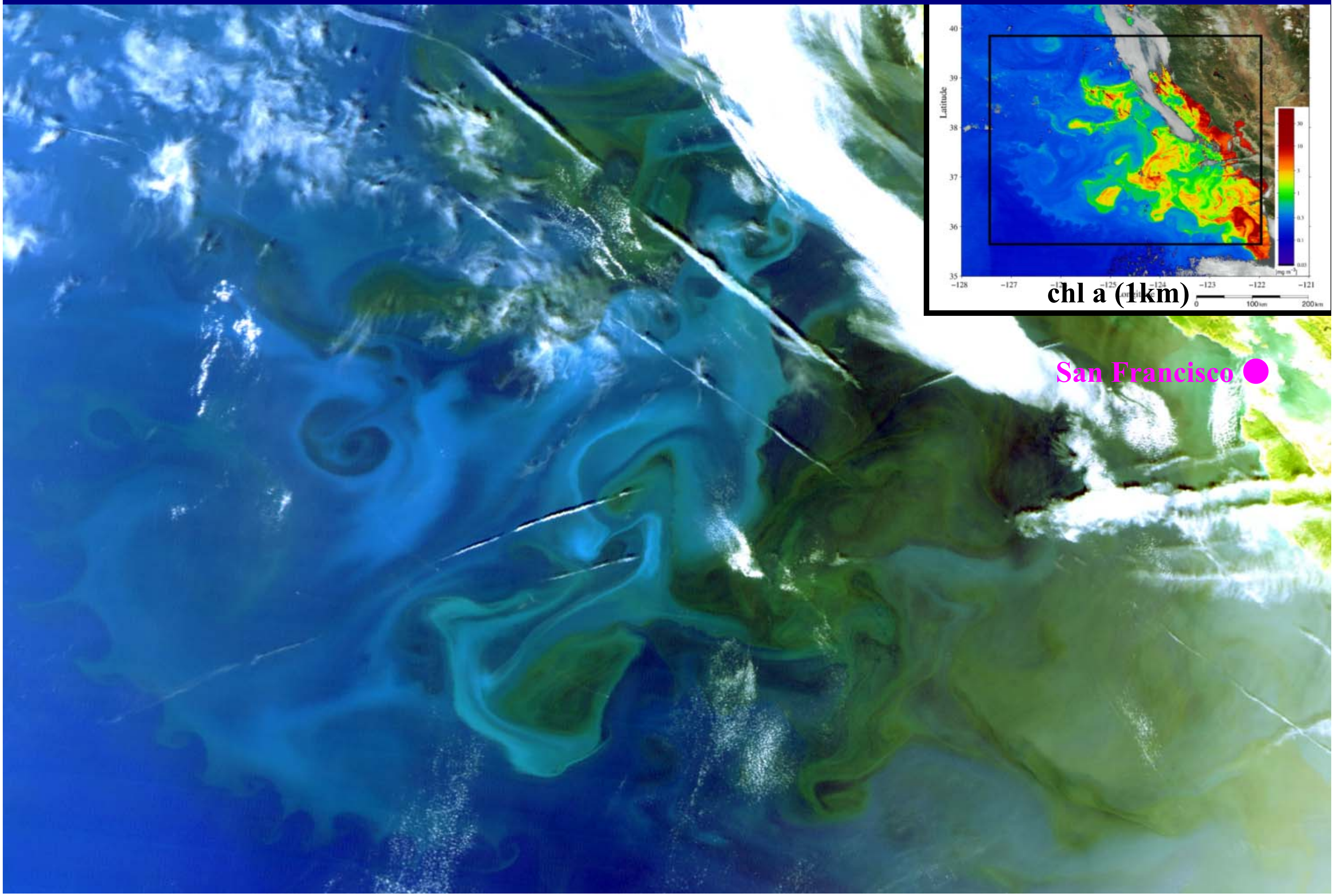
products	GSD	accuracy
snow & ice cover	250m/1km	7%
sea ice dist. in Okhotsk sea	250m	5%
snow/ice surface temp.	500m/1km	2K
snow particle size	250m/1km	50%

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

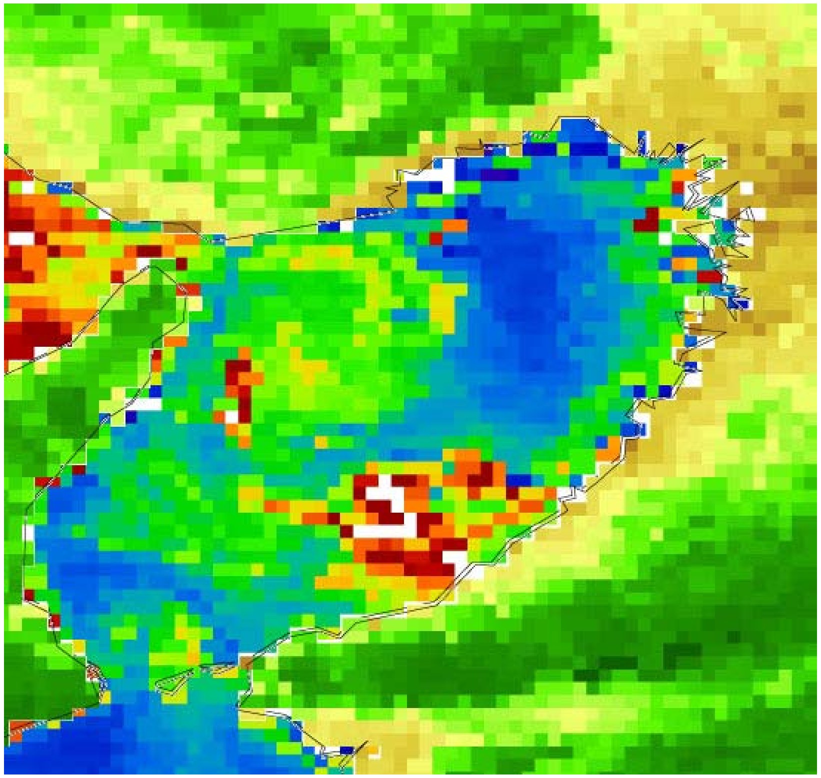
GLI 250m RGB:22/21/20, 2003.5.26



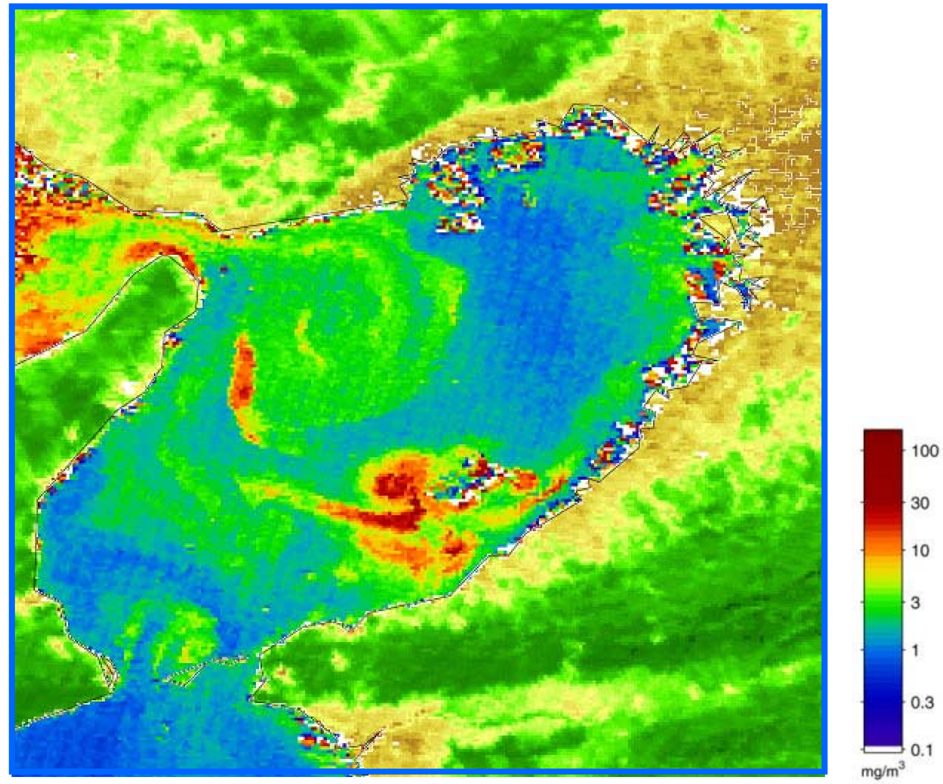
3. Examples of expected GCOM-C product

- 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)

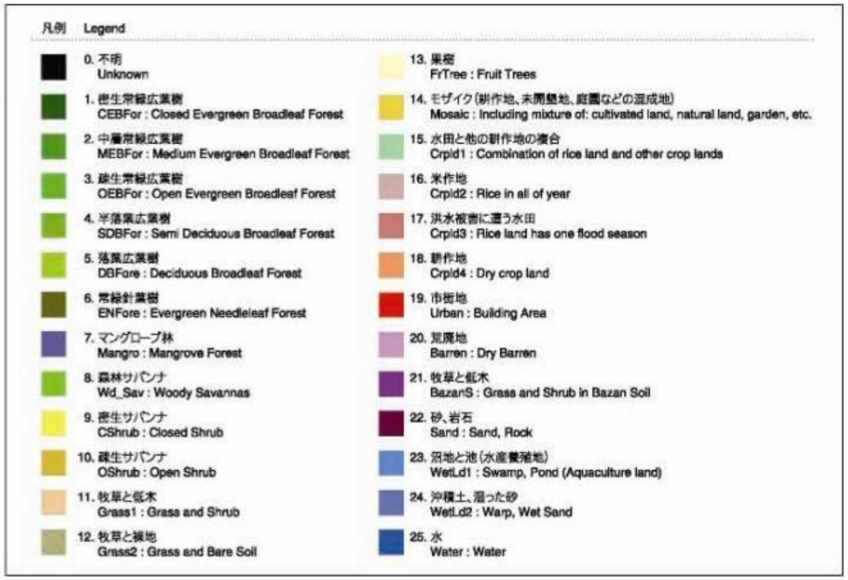
SGLI 250m resolution will enable to detect more fine structure in the coastal area such as river outflow, regional blooms, and small current.

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

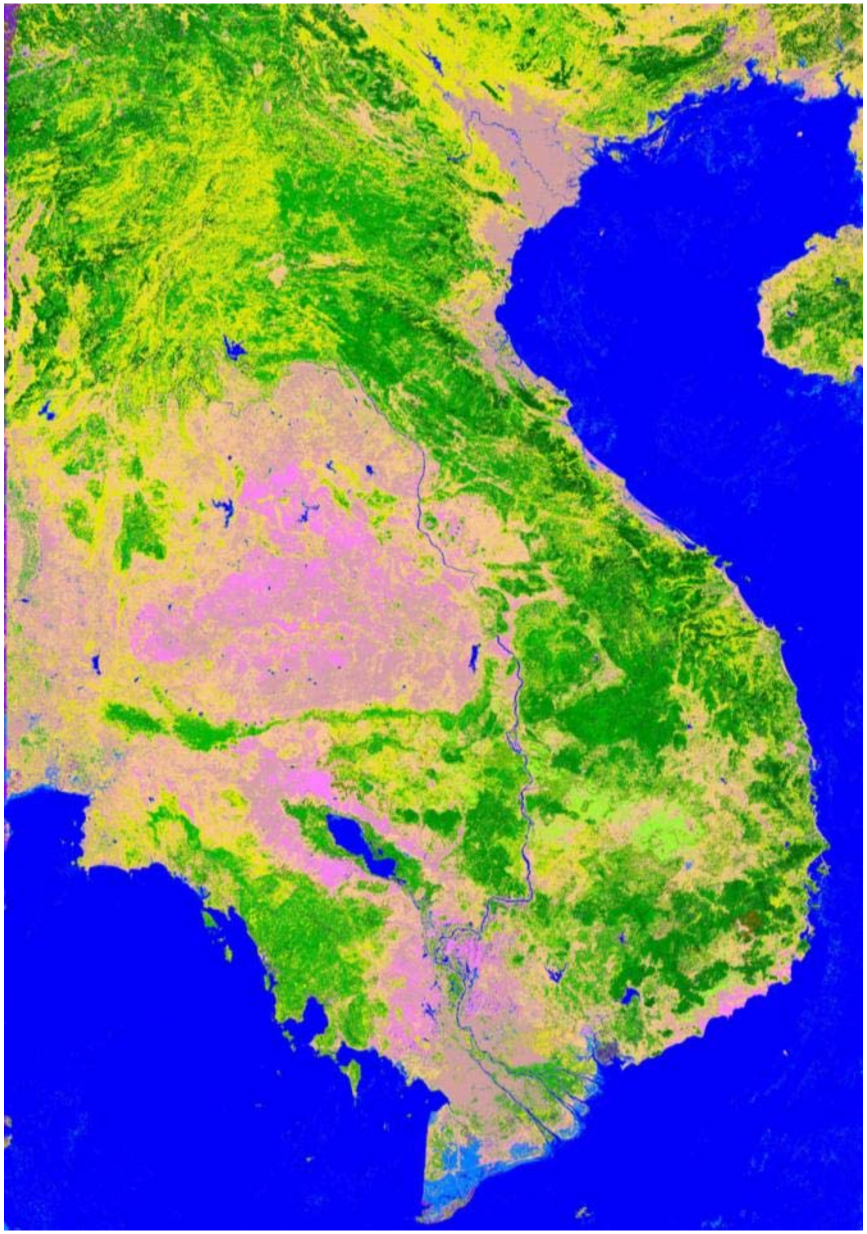
3. Examples of expected GCOM-C product

- 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.

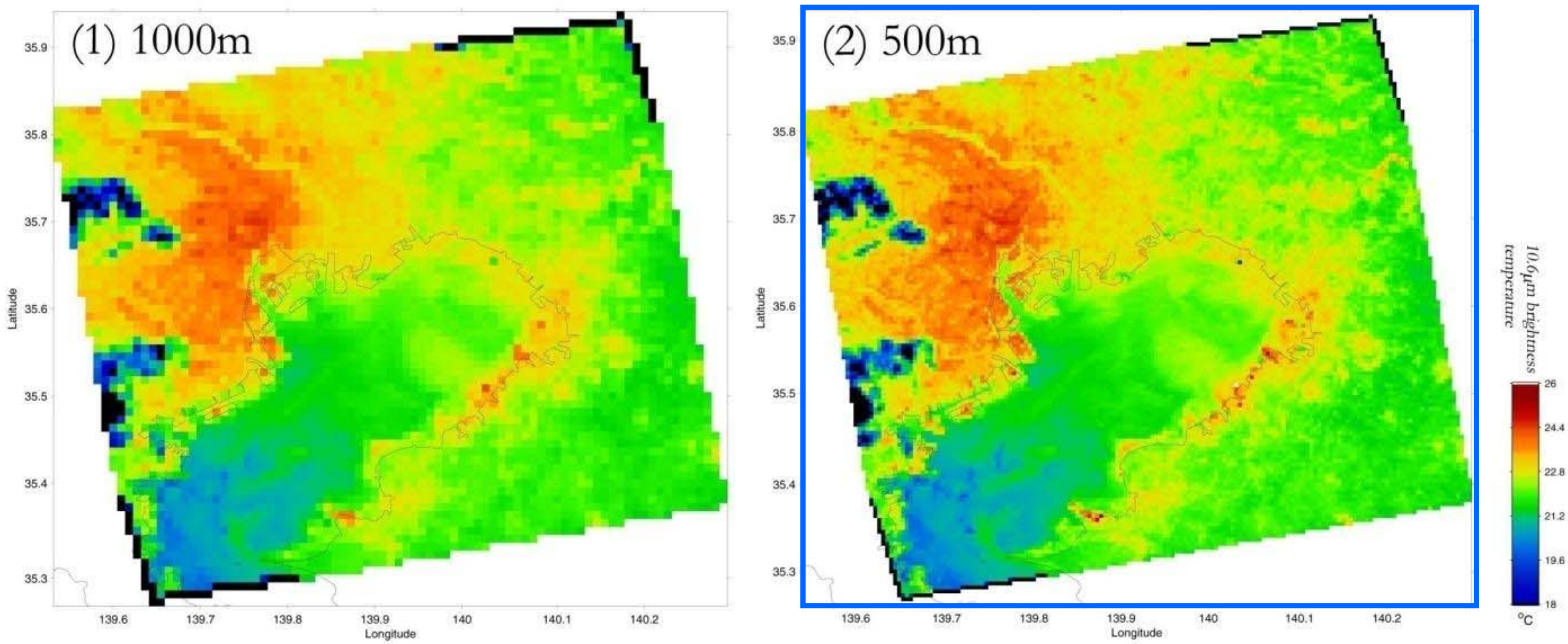


Classification to 25 class (IGBP: International Geosphere-Biosphere Program) using GLI 39 scenes (2003/04~2003/10)
(provided by Dr. Nguyen Dinh Duong, VAST(Vietnamese Academy of Science and Technology)



3. Examples of expected GCOM-C product

- 3.5 Thermal infrared 500m land and coastal observation

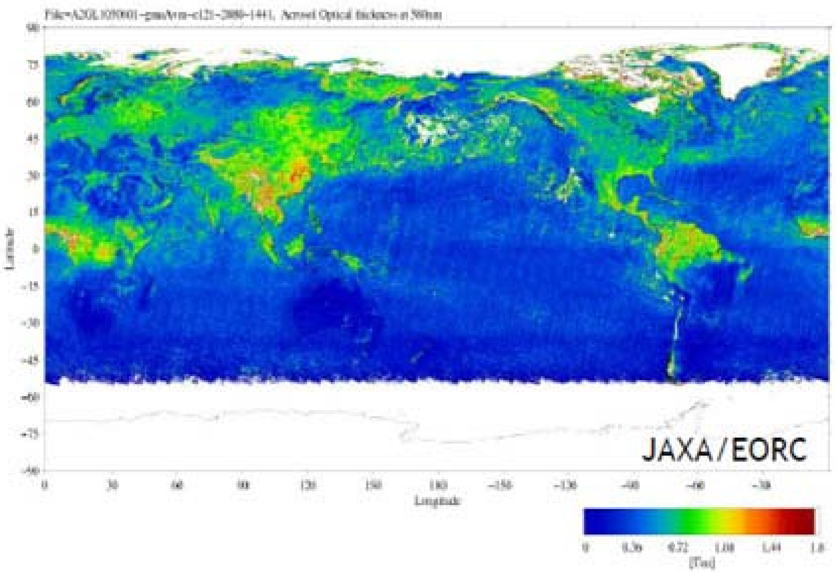


- The 500m and 1000m spatial resolution thermal infrared images are simulated using ASTER data (original resolution is 90m) (Tokyo Bay in the night on August 4, 2003).
- *SGLI 500m-resolution thermal infrared channels will enable detection of fine structures such as land and coastal surface temperature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

Examples of expected GCOM-C product

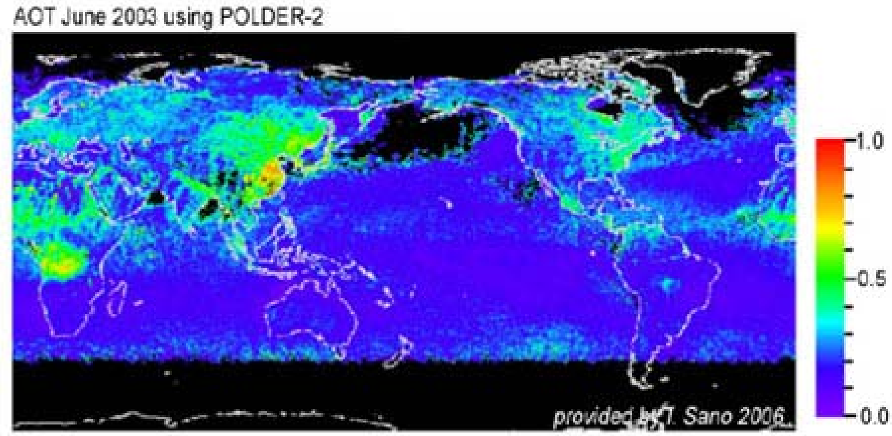
- 6. Land aerosol by Near-UV and polarization

- ***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***

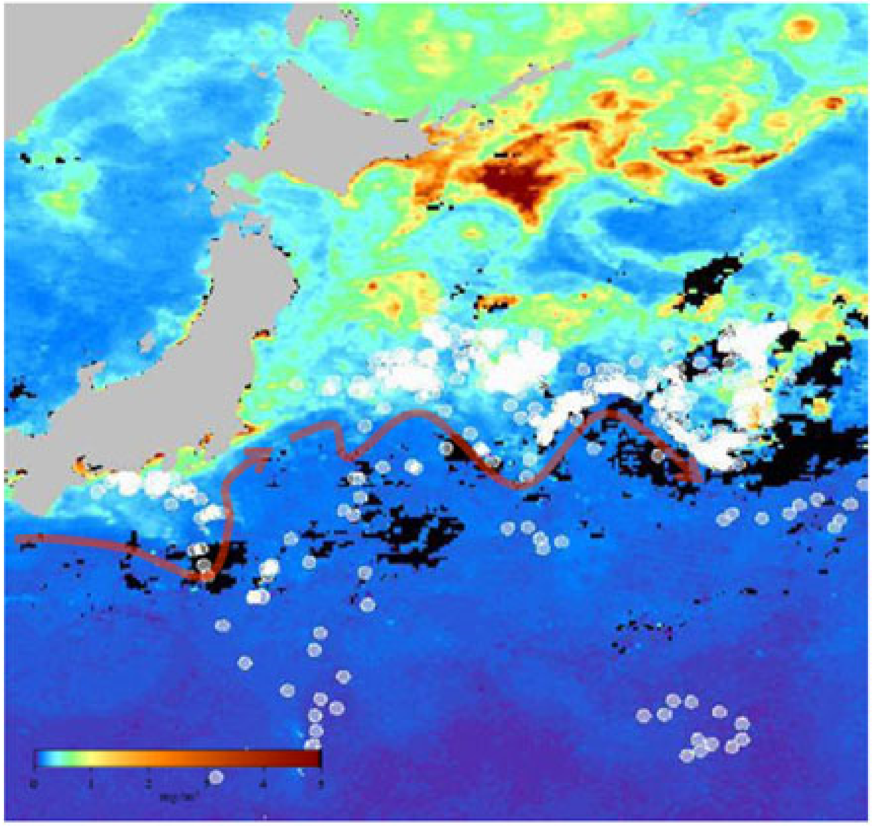


Global aerosol optical thickness in June 2003 using POLDER-2 polarization reflectance

- 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.

GCOM-C/SGLI observes sea surface temperature, chlorophyll-a concentration and solar radiation (PAR) (indicate ocean current structure and marine ecosystem activity)

Monitoring

- Marine resources distribution
- Ocean primary production sustaining marine resources
- Marine environment change relevant to climate

Ocean ecosystem model

Fishery inquiry (left figure)

Prediction of future marine resources

Marine-resource management for continuous use (contribution to the policy design)

Cooperation with a operational organization and a numerical model research institution

Recent status of GCOM-C1

- GCOM-C1 finished CDR.
- Component PQR is on-going.

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., 2016.
- PIs of Second W1 RA were selected.
- Pis of Second C1 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 ISRO.

New Scatterometer on GCOM-W2

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

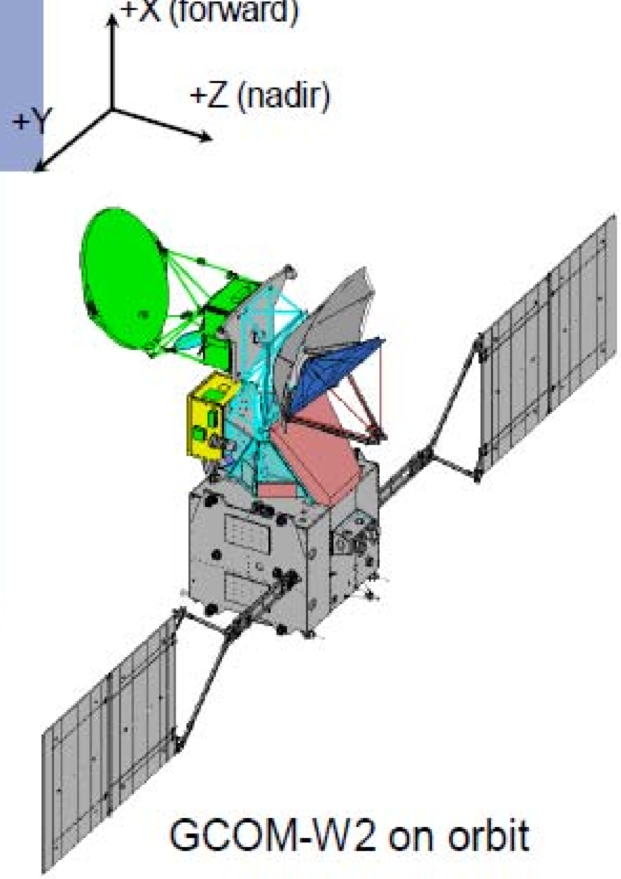
AMSR3 on GCOM-W2

- 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 status

- GPM & ALOS2 were launched.
- GCOM-C1 will be launched on fiscal 2016.
- GOSAT-2 will be launched on 2017.
- EarthCare will be launched on 2018.
- No program beyond 2018.
- Study of GCOM-W2 program will start on 2016.

GCOM-W2 Overview

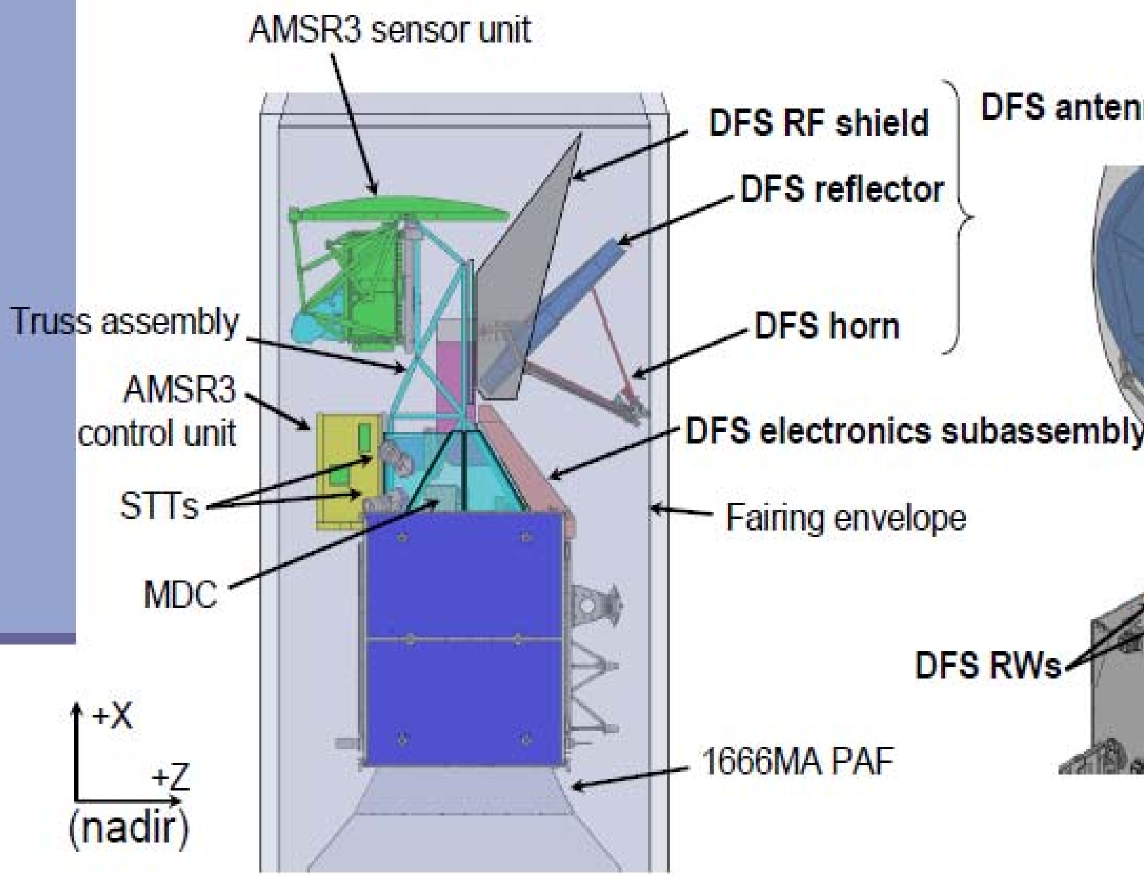


GCOM-W2 on orbit

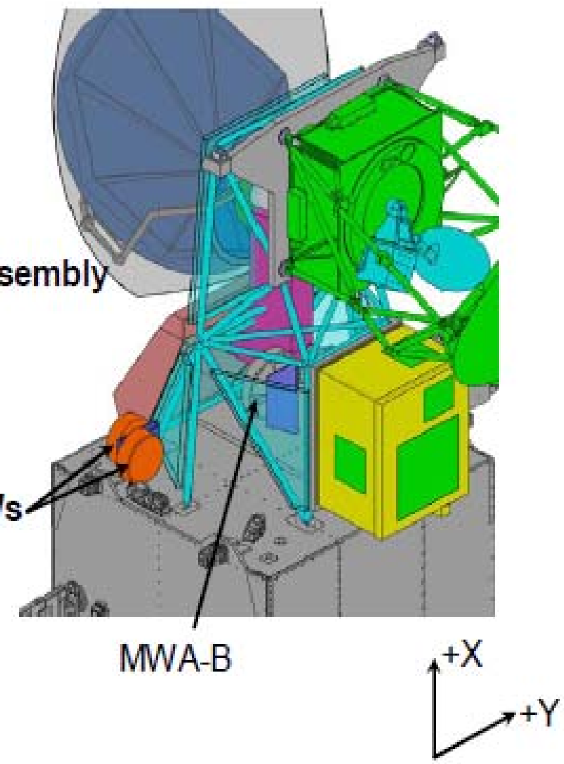
GCOM-W2 Overview

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.