Status of GCOM and expectation for microwave scatterometer

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Ocean Vector Winds Science Team Meeting 2008
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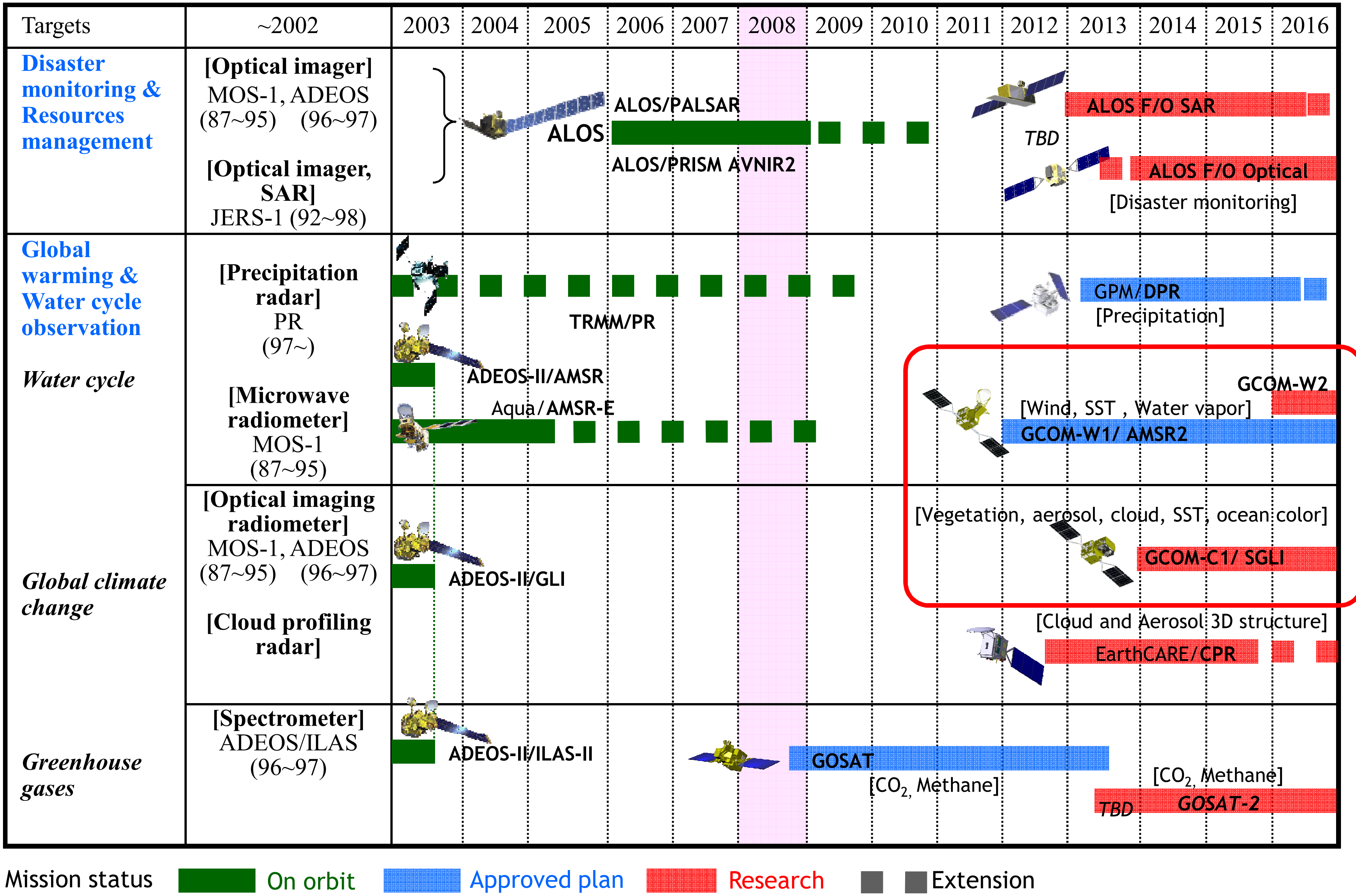
JAXA Earth observation satellites



Status of Aqua/AMSR-E

- Mission status
  - Modification of ADEOS-II/AMSR to Aqua.
  - Continuous observation over 6-years onboard NASA's EOS Aqua satellite.
  - Aqua will be maintained at least until 2011 according to the NASA senior review.
- Instrument characteristics
  - JAXA's passive microwave radiometer with high-spatial resolution and C-band capability.

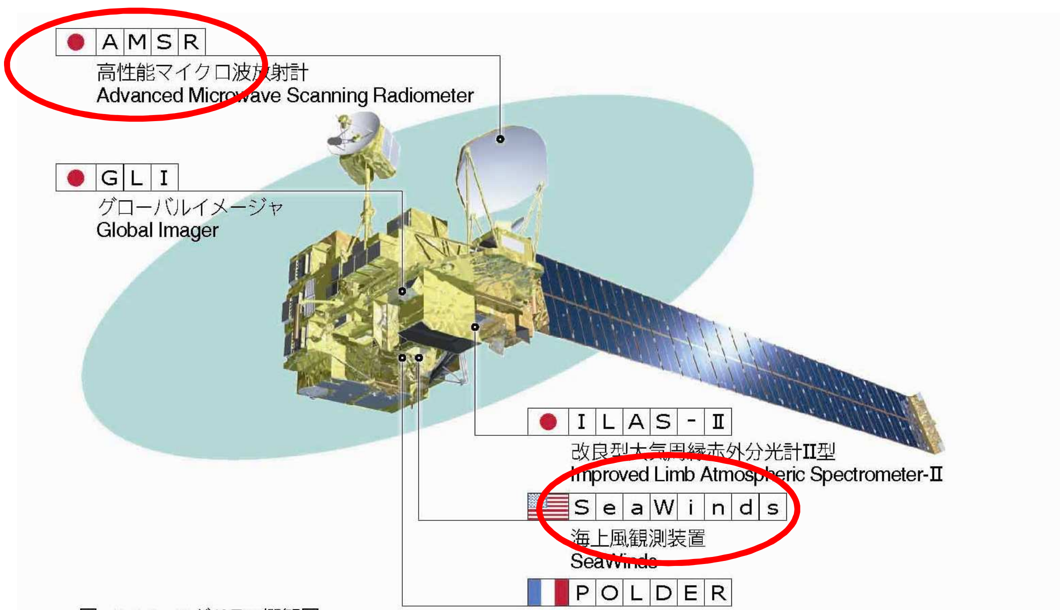


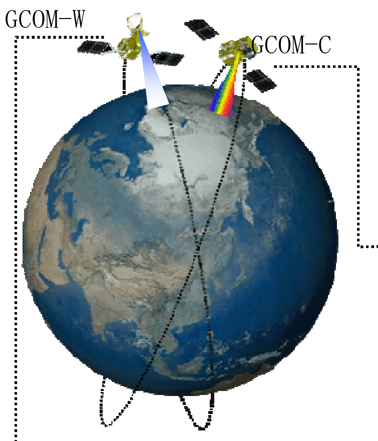
図 9.1.1 みどりIIの概観図
Fig. 9.1.1 Midori-II over view

Pre-launch AMSR-E in Tsukuba Space Center

Global Change Observation Mission

Main responsibility of JAXA

Satellite observation



Frequent and long-term (>10yer) global observation system required for earth environment change monitoring and prediction

GCOM observation

Radiation budget
- Surface forcing
- Snow ice
- Cloud aerosol
- Temperature

Carbon cycle
- Land cover
- Primary production
- Coastal environment

Water cycle
- Water vapor, cloud, precipitation
- Soil moisture
- Sea ice, snow
- SST, wind

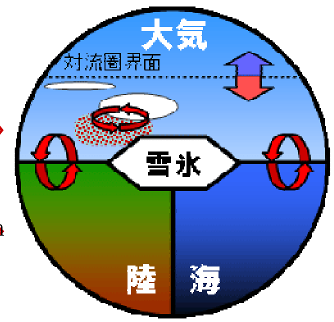
Input

Comparison

Cooperation with the climate model research institutions

Model prediction

Climate system model



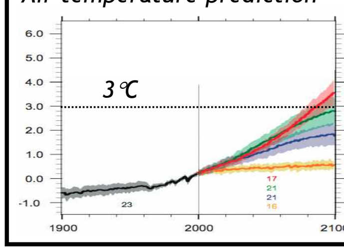
Improve accuracy

- Improvement of parameterization about radiation budget and carbon cycle, etc. in climate prediction model.
- Verification and improvement of prediction of the earth environment change including the water cycle by comparison with the satellite observation.

Prediction results

- Surface temperature
- Sea level
- Snow and sea ice area
- Environmental change
- Rain distribution
- Extreme weather frequency
- Land cover

Air temperature prediction



Data application

Knowledge

Scenario

Operational use

Data distribution to the operational organization which performs fishery information service, sea route information, weather forecast management, etc.

monitoring and understanding of the earth environment change

Continuous monitoring of the earth environment change and improvement of the mechanism understanding

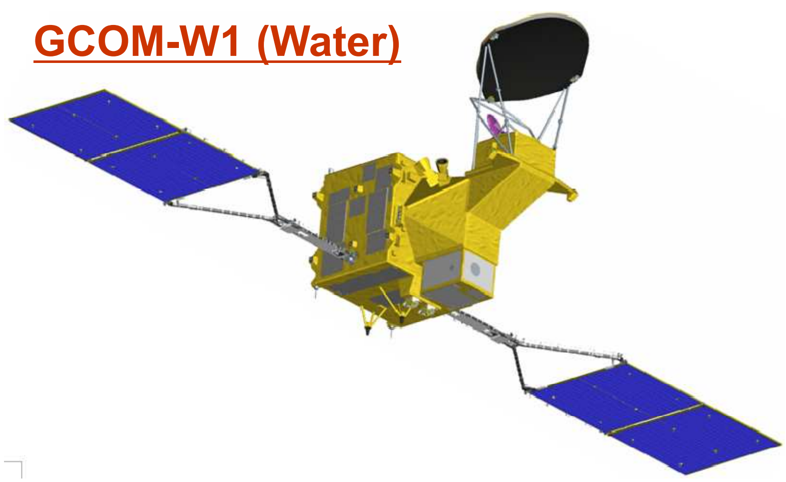
Policy design

improvement of prediction accuracy of the environmental change (degree, area and impact), and contribution to the design of policy for taking measures against adaptation.

GCOM 1st generation

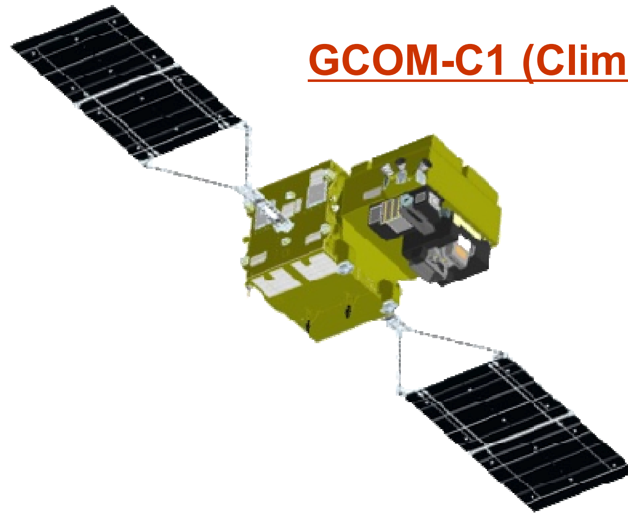
- 2 medium-sized satellite: GCOM-W and -C.
- 3 consecutive generations with 1 year overlaps for assuring long-term inter-calibrated data records.

GCOM-W1 (Water)



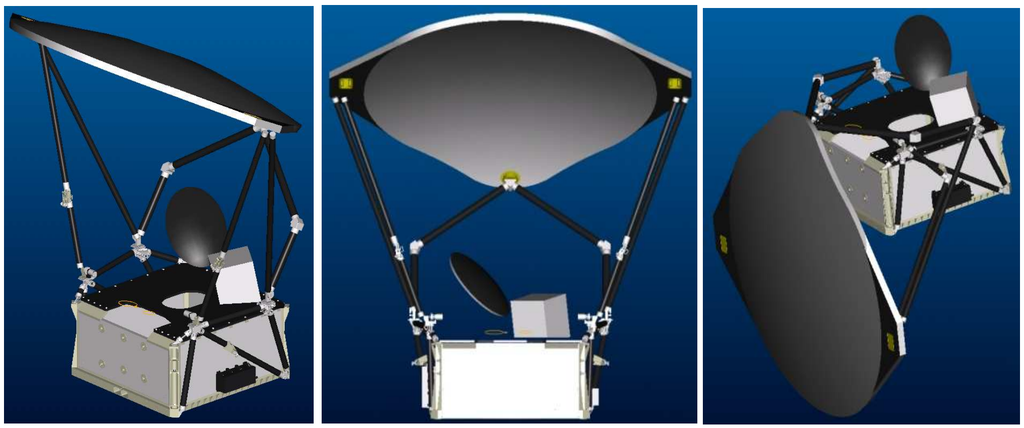
Instrument	Advanced Microwave Scanning Radiometer-2
Orbit	Sun Synchronous orbit Altitude: 700km, Inclination: 98.2 deg.
Size	5.1m (X) * 17.6m (Y) * 5.0m (Z) (on-orbit)
Mass	1940kg
Power	4050W @ EOL
Launch	JFY2011
Design Life	5-years
Status	Phase-C

GCOM-C1 (Climate)



Instrument	Second-generation Global Imager
Orbit	Sun Synchronous orbit Altitude: 798km, Inclination: 98.6 deg.
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z)
Mass	1950kg
Power	4250W @ EOL
Launch	JFY2013 (TBD)
Design Life	5-years
Status	Phase-A

AMSR2 instrument



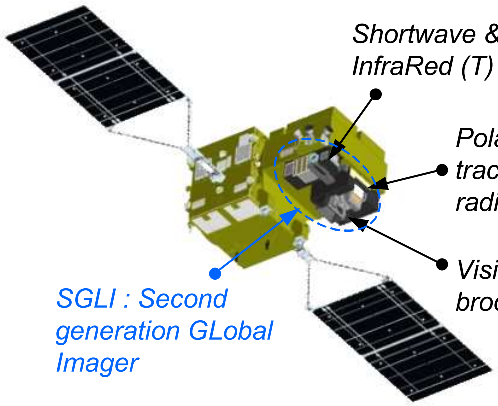
Deployed　　　　Stowed

- 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
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

SGLI instrument



- *The SGLI features are finer spatial resolution (250m (VNI) and 500m (T)) and polarization/along-track slant view channels (P), which will improve land, coastal, and aerosol observations.*

GCOM-C SGLI characteristics (baseline of GCOM-C1 BBM design)	
Orbit (TBD)	Sun-synchronous (descending local time: 10:30) Altitude: 798km, Inclination: 98.6deg
Launch Date	Jan. 2013 (HII-A)
Mission Life	5 years (3 satellites; total 13 years)
Scan	Push-broom electric scan (VNR: VN & P) Wisk-broom mechanical scan (IRS: SW & T)
Scan width	1150km cross track (VNR: VN & P) 1400km cross track (IRS: SW & T)
Digitalization	12bit
Polarization	3 polarization angles for P
Along track direction	Nadir for VN, SW and T, +45 deg and -45 deg for P
On-board calibration	VN: Solar diffuser, Internal lamp (PD), Lunar by pitch maneuvers, and dark current by masked pixels and nighttime obs. SW: Solar diffuser, Internal lamp, Lunar, and dark current by deep space window T: Black body and dark current by deep space window All: Electric calibration

Multi-angle obs. for 670nm and 865nm

SGLI channels

CH	λ	$\Delta\lambda$	L_{std}	L_{max}	SNR at Lstd	IFOV
	VN, P, SW: nm T: μm		VN, P: $W/m^2/sr/\mu m$ 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(TBD)	1000
T1	10.8	0.7	300	340	0.2	500
T2	12.0	0.7	300	340	0.2	500

GCOM program status

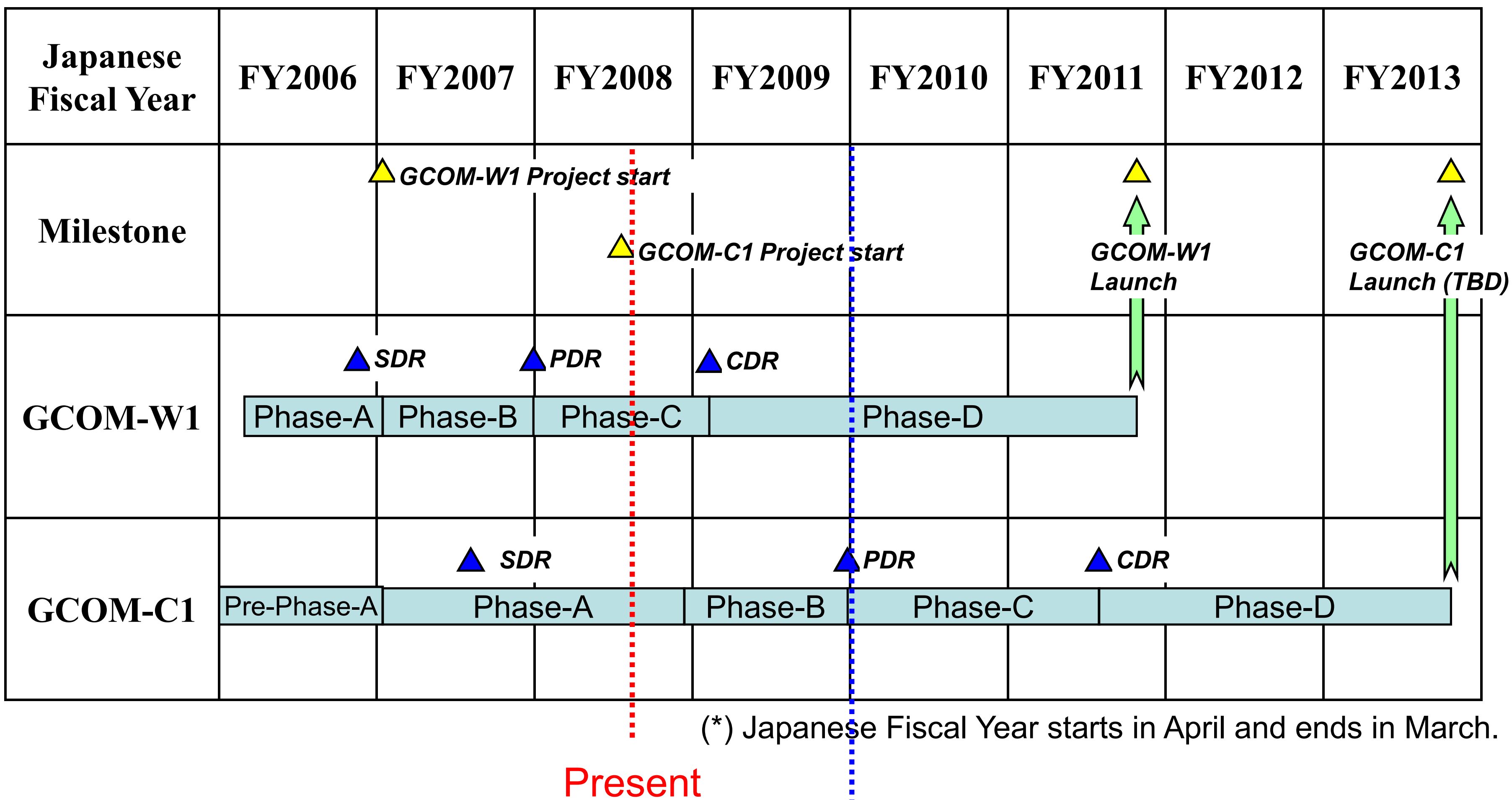
- GCOM-W1
  - System PDR was over in March.
  - Engineering model tests are performed:
    - System Structure Model Test (in July. - Nov. 2008)
    - System Thermal Model Test (in Feb. 2009)
    - System Electrical Mosel Test (in Sep.2008 – Jan. 2009)
  - AMSR2 CDR (Part 1) was finished in July.
  - AMSR2 CDR (Part 2) will be held about Data Processing Unit in January, 2009 .

GCOM-W1 STM

GCOM program status (cont'd)

- GCOM-C1
  - SDR (System Definition Review) of GCOM-C1 was over in December last year.
  - The proto-type test of SGLI was over in September.
  - The GCOM-C1 project started in October. GCOM-C1 is developed together with GCOM-W1 by the GCOM Project Team.
  - JAXA is requiring the GCOM-C1 Phase B/C budget in JFY 2009.
- Ground system of GCOM-W1
  - The SDR of the GCOM-W1 ground system was held in March.
  - The RFP of GCOM-W1 ground system had been submitted to the industry and the contractors was selected in October. The preliminary design has started.

GCOM program status (cont'd)



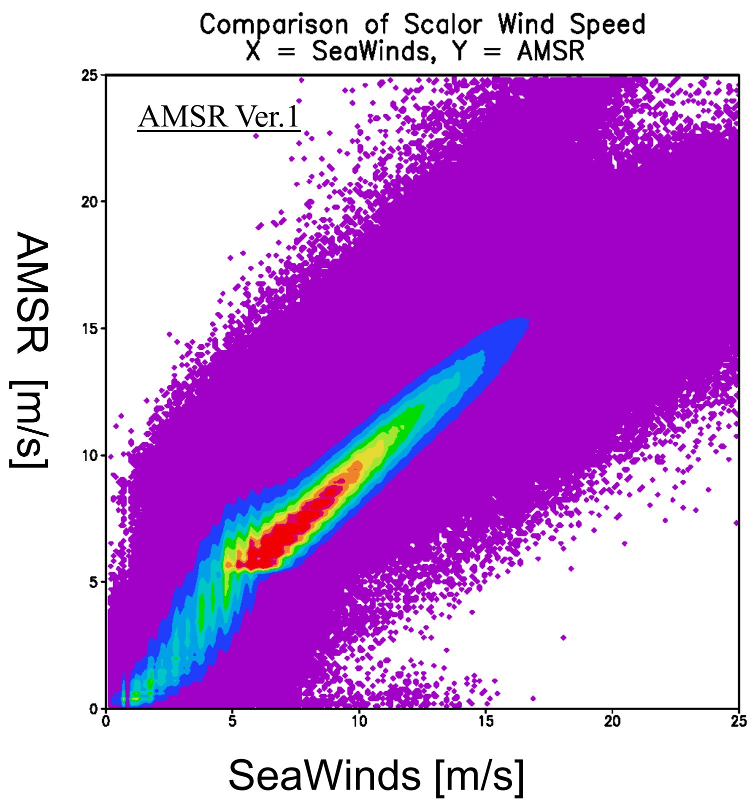
GCOM-W2: Phase-A needs to be started for FY2015 launch

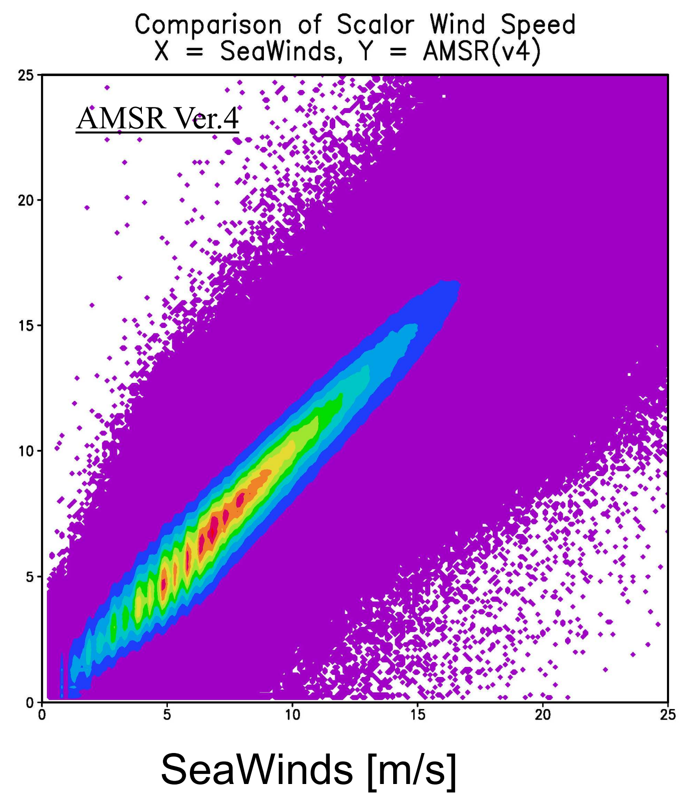
Discussion on GCOM-W2

- Ongoing science discussions
  - Sensor combination
    - Microwave scatterometer
  - Enhancement of AMSR2 instrument
    - Possible requirements include:
      - High-frequency channels up to 200GHz for snow detection
      - Enhancement of spatial resolution (larger antenna aperture)
      - Temperature/Vapor sounding capability
- Continuity of scatterometer
  - Long-term continuity of scatterometer from ERS-1/AMI in 1991.
  - Afternoon scatterometer on GCOM-W2 will increase time resolution and data coverage together with METOP observations.
  - Scatterometer is valuable in operational use.

Potential Synergy

- Synergism of SeaWinds and AMSR (N.Ebuchi and T.Liu).
- Sensor-level synergy
  - SeaWinds : Rain flagging and correction.
  - AMSR : Improving Tb model as a function of wind vector.
  - Cross validation, Active/Passive synergy

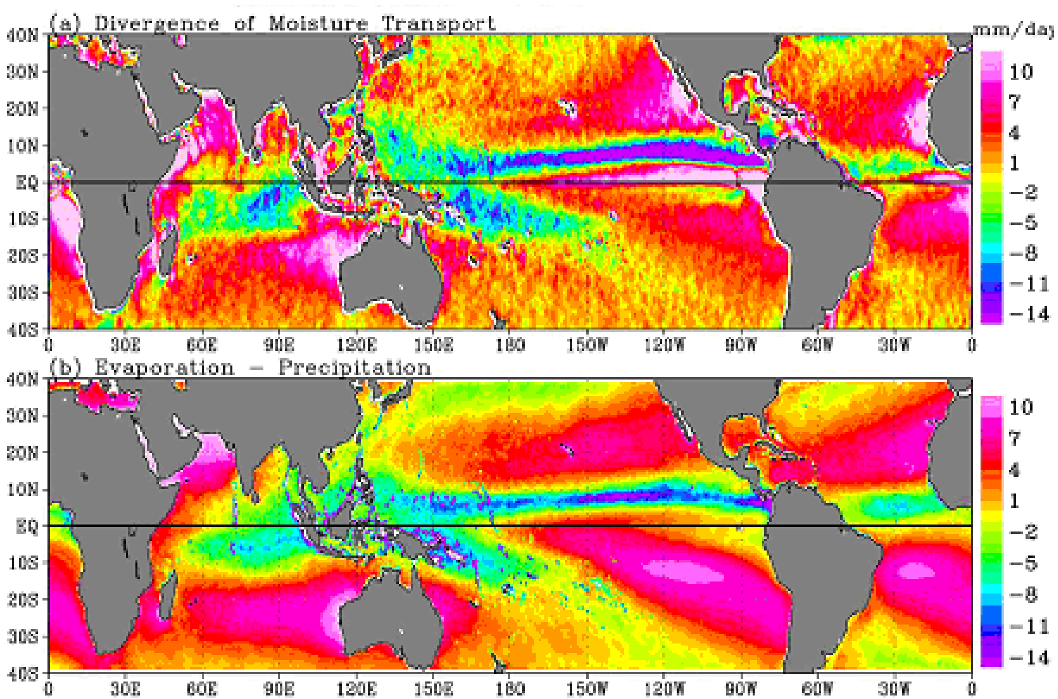




Provided by Professor Naoto Ebuchi of Hokkaido University.

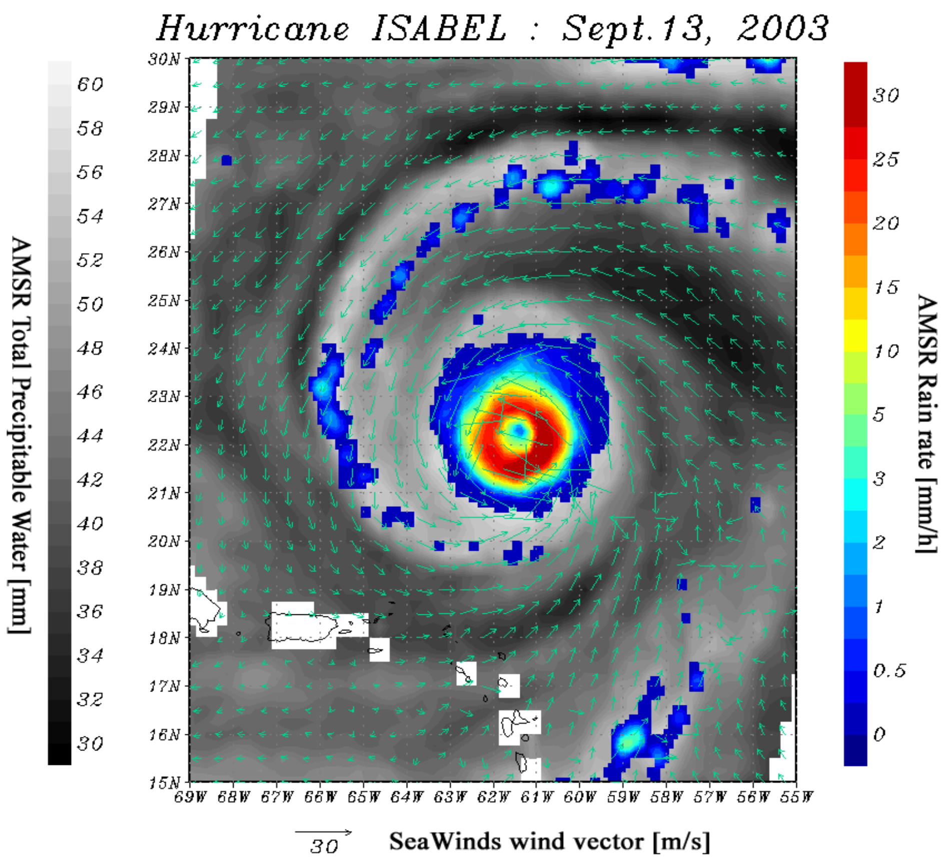
Potential Synergy (cont’d)

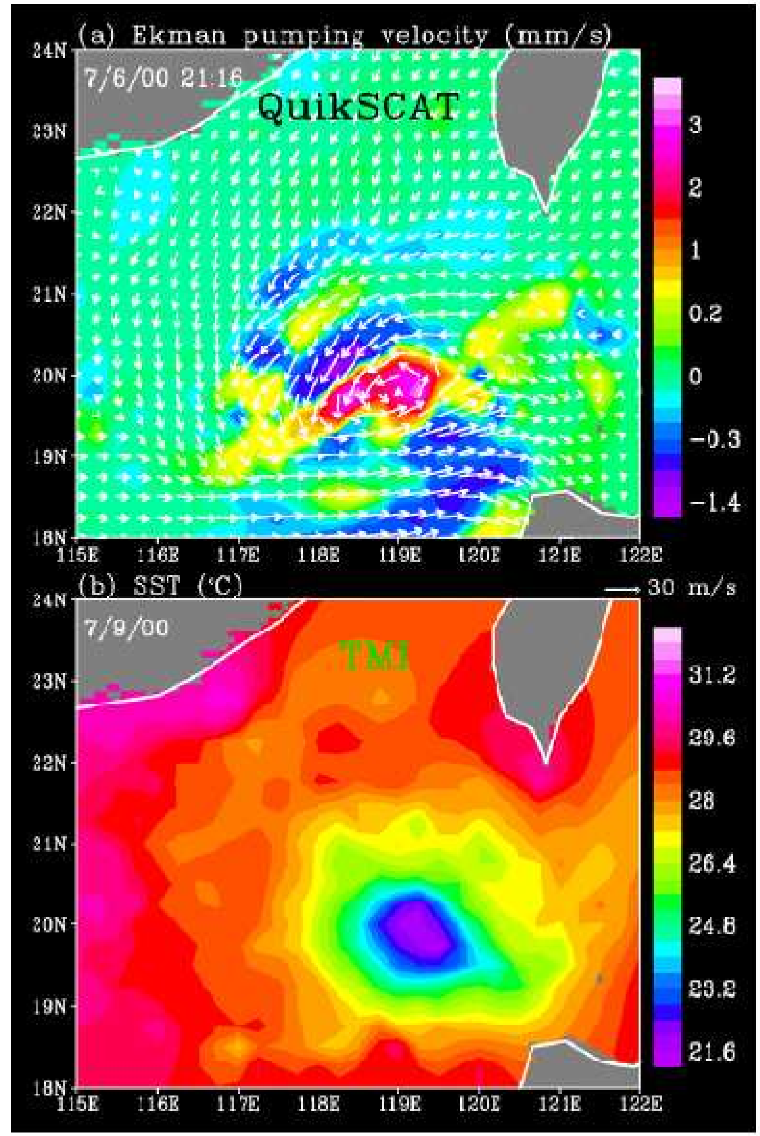
- Science-level synergy
  - Ocean surface heat flux : needs simultaneous observation.
  - Simultaneous measurements of water vapor, SST, precipitation, and sea surface winds are effective for investigating various time-space scale phenomenon (MJO, typhoon, monsoon, ENSO, water-energy cycle, ocean circulation in surface mixed layer).
  - Cryospheric and land studies.



Annual mean (a) divergence of moisture transport integrated over the depth of the atmosphere, and (b) evaporation-precipitation. Evaporation and precipitation were estimated independently from TRMM data. Moisture transport was estimated from a combination of TRMM and QuikSCAT data. From Xie and Liu (2005).

Potential Synergy (cont'd)

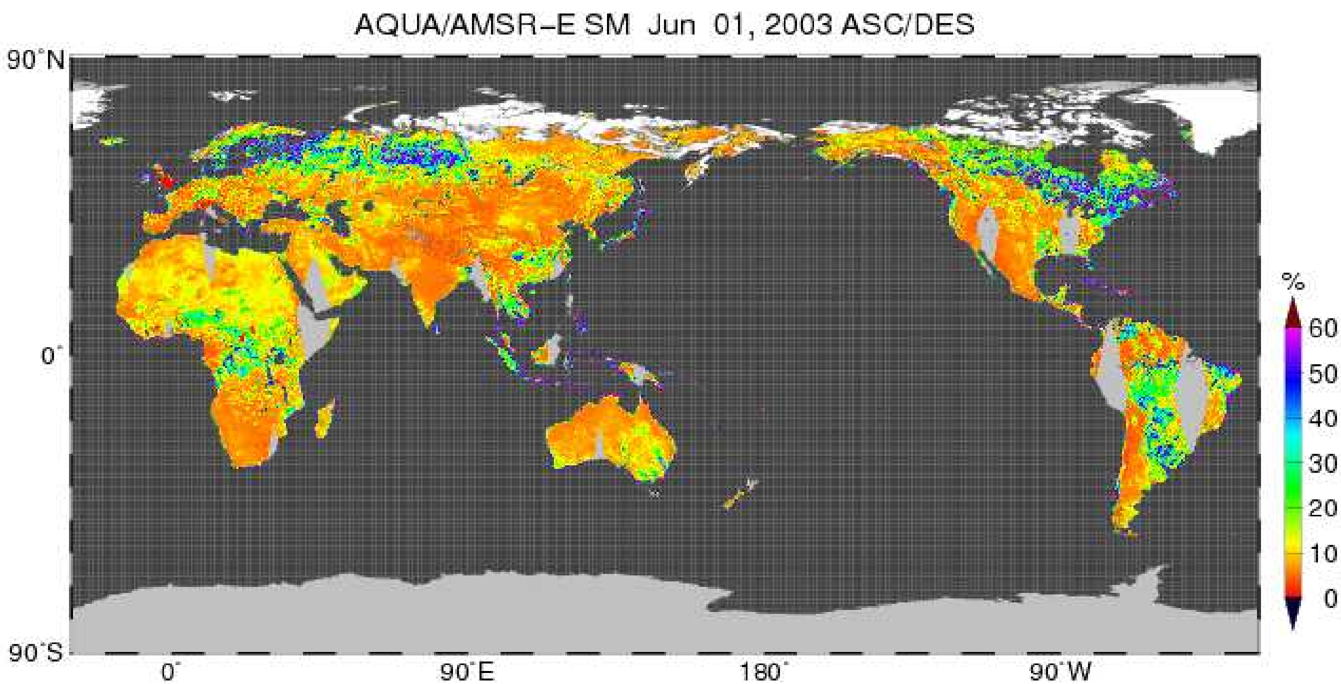




N.Ebuchi and T.Liu (2005)

Potential Synergy (cont'd)

- Future enhancements
  - GCOM-W2 will be a unique opportunity of scatterometer and radiometer combination after Seasat and ADEOS-II, even with the current capabilities of SeaWinds and AMSR.
  - By the future enhancements including SeaWinds follow-on's C-band capability, all-weather type ocean observations using active/passive microwave system will be obtained.
  - C-band active/passive applications are also expected in land and cryosphere.



Summary

- Overview of the GCOM program and status of the GCOM-W1 and -C1 were presented.
- Discussion of GCOM-W2 science and sensor system is ongoing. GCOM science community in Japan has strong interest in having the microwave scatterometer on GCOM-W2.
- Active/passive combination on GCOM-W2 will become a very unique opportunity. Synergism of microwave scatterometer and radiometer is gaining importance and producing scientific results in air-sea interaction and water cycle studies.
- Continuity of microwave scatterometer is important both for climate research and operational applications. GCOM science will increase its significance with scatterometer.