JMA and JAXA

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1:JMA, 2:JAXA

JMA

Current Status

- MTSAT-2 (Himawari-7)
  - Imaging operation at 145 since 1 July 2010
    - Operation is extremely stable
  - http://mscweb.kishou.go.jp/index.htm
- MTSAT-1R (Himawari-6)
  - Imaging operation standby at 140E, direct broadcast
  - 5-min rapid scan observation around Japan for aviation users during daytime from Jun. to Sep.
  - High Ice Water Content (HIWC) study on the jet-engine power-loss by ice in Darwin
    - 10-min rapid scan observation around Australia from Jan. to Mar. 2014

Himawari -8 and -9 satellites

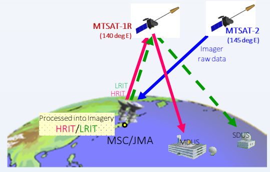
- Launch in summer 2014 and 2016, and start operation in 2015 and 2022
- AHI (Advanced Himawari Imager)
  - Enhance channel number, spatial resolution and measurement frequency
- → Improve current products and create new products
  - Cloud products. AMV, CSR, aerosol, volcanic ash, global instability index,,,
- To support research and development, JMA website provides http://mscweb.kishou.go.jp/himawari89
  - Estimated Spectral Response Functions (SRFs)
  - Simulated radiances generated from a radiative transfer model and NWP
- Data dissemination
  - Distribute test data in early 2015, and operational data in summer 2015
  - Full dataset can be accessed via the Internet
  - Under discussion that reduced dataset could be accessed via a CTS (Commercial Telecommunication Satellite) → announce in spring 2014

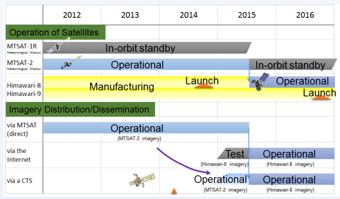
MTSAT-2/Imager Channel Set

Band	Central Wavelength [μm]	Spatial Resolution
1	0.55 - 0.80	1Km
2	3.5 - 4.0	4Km
3	6.5 - 7.0	4Km
4	10.3 - 11.3	4Km
5	11.5 - 12.5	4Km

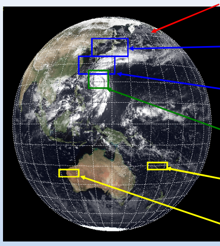
Himawari-8,9/AHI Channel Set

Band	Central Wavelength [μm]	Spatial Resolution
1	0.43 - 0.48	1Km
2	0.50 - 0.52	1Km
3	0.63 - 0.66	0.5Km
4	0.85 - 0.87	1Km
5	1.60 - 1.62	2Km
6	2.25 - 2.27	2Km
7	3.74 - 3.96	2Km
8	6.06 - 6.43	2Km
9	6.89 - 7.01	2Km
10	7.26 - 7.43	2Km
11	8.44 - 8.76	2Km
12	9.54 - 9.72	2Km
13	10.3 - 10.6	2Km
14	11.1- 11.3	2Km
15	12.2 - 12.5	2Km
16	13.2 - 13.4	2Km





2012
2013
2014
2015
2016
Operation of Satellites
MTSAT-1R
In-orbit standby
MTSAT-2
Operational
In-orbit standby
Himawari-8
Himawari-9
Manufacturing
Launch
Operational
Launch
Imagery Distribution/Dissemination
via MTSAT (direct)
Operational
via the Internet
Test
Operational
via a CTS
Operational
Operational



Full disk
Interval : 10 minutes (6 times per hour), 23 swath

Region 1 JAPAN (North-East)
Interval : 2.5 minutes (4 times in 10minutes)
EW x NS: 2000 x 1000 km, 2 swath

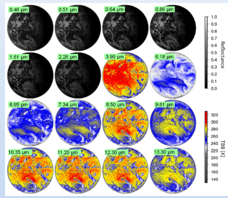
Region 2 JAPAN (South-West)
Interval : 2.5 minutes (4 times in 10minutes)
EW x NS: 2000 x 1000 km, 2 swath

Region 3 Typhoon
Interval : 2.5 minutes (4 times in 10minutes)
EW x NS: 1000 x 1000 km, 2 swath

Region 4 Land mark
Interval : 0.5 minutes (20 times in 10minutes)
EW x NS: 1000 x 500 km, 1 swath

Region 5 Land mark
Interval : 0.5 minutes (20 times in 10minutes)
EW x NS: 1000 x 500 km, 1 swath

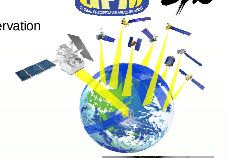
Simulated images of all 16 ch of AHI



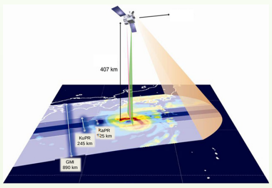
JAXA

DPR on GPM (Global Precipitation Mission) Feb 2014~

- GPM: international mission for high accurate/frequent global precipitation observation
  - Core observatory: developed under NASA and JAXA equal partnership
  - Constellation satellites: TRMM, Megha-Tropiques, DMSP, GCOM-W, MetOp, NOAA, Suomi-NPP, JPSS
- DPR (Dual-frequency Precipitation Radar)
  - KuPR (13.6 GHz) and KaPR (35.5 GHz)
  - Highly sensitive precipitation measurement
  - Calibration for constellation radiometers
- Data release
  - Launch+ 3 month: L1 limited release
  - L+4 month: L2 limited release
  - L+6 month: L1 & L2 public release



Satellite	GPM core		TRMM
Radar	KuPR	KaPR	PR
Observation frequency	13.597 & 13.603 GHz	35.547 & 35.553 GHz	13.796 & 13.802 GHz
Swath width	245 km	125 km	215 km
Horizontal resolution	5 km	5 km	4.3 km
Range resolution	250 m	250/500 m	250 m
Minimum Ze and rain rate	18 dBZ 0.3 mm/h	12 dBZ 0.5 mm/h	18 dBZ 0.7 mm/h
Launch date (JST)	28 Feb. 2014		28 Nov. 1997
Orbit (inclination)	Non-sun-synchronous (65 deg)		Non-sun synchronous (35 deg)
Altitude	407 km		350 km



http://www.eorc.jaxa.jp/GPM/index_e.htm

GCOM-W/AMSR2 May 2012~

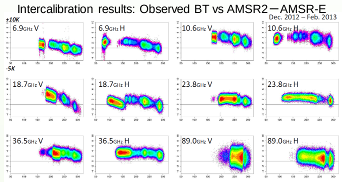
- Progress
  - 2012.05.18 GCOM-W1 (SHIZUKU) launched
  - 2012.07.03 AMSR2 observation starts in A-Train orbit
  - 2012.07.04 Release AMSR2 observation images
  - 2013.01.25 Public release of L1 products
  - 2013.05.17 Public release of L2 products
  - https://gcom-w1.jaxa.jp/auth.html

AMSR2 Channel Set

Center Freq. [GHz]	Polarization	Beam width [deg] (Ground res. [km])	Reference: Ground res of AMSR-E	NEdT [K]	Sampling interval [km]
6.925/7.3	V and H	1.8 (35 x 62)	43 x 75 km	<0.34/0.43	10
10.65		1.2 (24 x 42)	29 x 51 km	<0.70	
18.7		0.65 (14 x 22)	16 x 27 km	<0.70	
23.8		0.75 (15 x 26)	18 x 32 km	<0.60	
36.5		0.35 (7 x 12)	8 x 14 km	<0.70	
89.0		0.15 (3 x 5)	4 x 6 km	<1.20/1.40	5

- AMSR2 (Advanced Microwave Scanning Radiometer 2)
  - Deployable main reflector system with 2.0 m diameter
    - 20% finer resolution than AMSR-E with 1.6 m reflector
  - Frequency ch set is identical to that of AMSR-E except additional 7.3 GHz channel to mitigate RFI of 6.9 GHz ch
  - Calibration system improved
    - Improved thermal design, intensive sunlight shielding

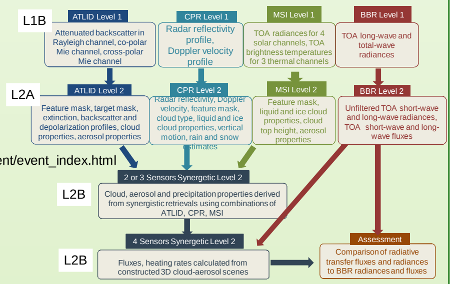
Intercalibration results: Observed BT vs AMSR2－AMSR-E



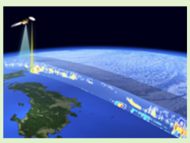
- Level1R (synthesized BT) data
  - Small footprints of high frequency ch are weighted-summed to a large footprint of low frequency ch (6, 10, 18/23, 36GHz) based on antenna patterns
  - Used to create all Level 2 products except precipitation, SST and SSW
  - http://suzaku.eorc.jaxa.jp/GCOM_W/materials/w_productinfo_j.html
- Intercalibration between AMSR2 and TMI/AMSR-E
  - Aqua/AMSR-E slow rotation mode data are used in addition to TRMM/TMI
  - Brightness temperature (BT) differences between AMSR2 and TMI/AMSR-E seems to be BT-dependent.
  - Intercalibration coefficients (slope and intercept) are derived and the investigation is underway.
  - http://suzaku.eorc.jaxa.jp/GCOM_W/materials/product/140312_AMSR2_XcalResults_1-1.pdf

CPR on EarthCARE (2016)

- EarthCARE : ESA Earth Explorer Core Mission
  - Objective : evaluate the radiative interaction and radiative forcing of cloud and aerosol, and reduce the uncertainties in global warming prediction by measuring 3 dimensional global structure of clouds and aerosols
  - Joint mission by ESA and JAXA
  - Launch in 2016, 3 years lifetime, 400 km altitude, sun-synchronous orbit at local time of 14:00
  - 4 instruments: CPR, Atmospheric Lidar (ATLID), Multi Spectral Imager (MSI) and Broad Band Radiometer (BBR)
- CPR (Cloud Profiling Radar)
  - The world's first satellite-borne Doppler cloud radar
    - W-band (94GHz) radar to observe 3-dimentinal distribution and physical characteristics of cloud and drizzle.
      - Approximately 6 times higher sensitivity than CloudSat/CPR
    - In-cloud vertical motion by Doppler measurement function has the potential to contribute to the understanding of cloud and precipitation process.
- Data release schedule
  - L1B L+6 month;
  - L2A & L2B (CPR+ATLID) L+9 month
  - L2B (others): L+18 month
- Data dissemination timing
  - L1B: nominal 3.1 hours (worst 18 hours)
  - L2A (CPR): 5.4 hours (23 hours)
  - L2A (ATLID,MSI): 4.4 hours (23 hours)
  - L2B: 6.1 hours (26 hours)
- EarthCARE workshop 2014
  - 17-19 Sep. 2014, Tokyo
  - http://www.eorc.jaxa.jp/EARTHCARE/event/event_index.html



L1B
ATLID Level 1
Attenuated backscatter in Rayleigh channel, co-polar Mie channel, cross-polar Mie channel
CPR Level 1
Radar reflectivity profile, Doppler velocity profile
MSI Level 1
TOA radiances for 4 solar channels, TOA brightness temperatures for 3 thermal channels
BBR Level 1
TOA long-wave and total-wave radiances
L2A
ATLID Level 2
Feature mask, target mask, extinction, backscatter and depolarization profiles, cloud properties, aerosol properties
CPR Level 2
MSI Level 2
Feature mask, liquid and ice cloud properties, cloud top height, aerosol properties
BBR Level 2
Unfiltered TOA short-wave and long-wave radiances, TOA short-wave and long-wave fluxes
L2B
2 or 3 Sensors Synergetic Level 2
Cloud, aerosol and precipitation properties derived from synergistic retrievals using combinations of ATLID, CPR, MSI
L2B
4 Sensors Synergetic Level 2
Fluxes, heating rates calculated from constructed 3D cloud-aerosol scenes
Assessment
Comparison of radiative transfer fluxes and radiances to BBR radiances and fluxes

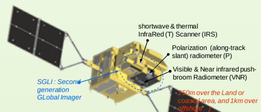


SGLI on GCOM-C1 (2016)

- GCOM-C targets
  - Long-term observations of the climate system (the radiation budget and carbon cycle)
- SGLI (Second Generation Global Imager)
  - 250-m resolution and 1150-km (1400-km) swath for the land and coast observations
  - Near-UV (380nm) and polarization observation for the land aerosol estimation
  - Two angle & two channel observations for the biomass and land cover classification
  - (Multiple calibration functions: solar diffuser, LED, Moon, and vical)
- L1, 2, and 3 products will be released to the public one year after the launch
- Data dissemination
  - Svalbard downlink station
    - Global observation data downlink including all the 250-m & 1-km observation mode (Raw data: about 6GB/path)
  - Japanese near-real time station
    - Near-real time data distribution to specific users
    - A backup of the Svalbard station
  - Direct downlink capability to other local stations
    - Required to make agreement individually with JAXA
  - General policy has been changed:
    - GCOM data can be used freely for both science and commercial purpose

GCOM-C SGLI characteristics (Current baseline)

Orbit	Sun-synchronous (descending local time: 10:30), Altitude: 798km, Inclination: 98.6deg
Launch Date	JFY 2016 (TBD)
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 POL
Along track tilt	Nadir for VN, SW and TIR, & +/-45 deg for P
On-board calibration	VN: Solar diffuser, Internal lamp (LED, halogen), Lunar by pitch maneuvers (~once/month), and dark current by masked pixels and nighttime obs. SW: Solar diffuser, Internal lamp, Lunar, and dark current by deep space window TIR: Black body and dark current by deep space window All: Electric calibration



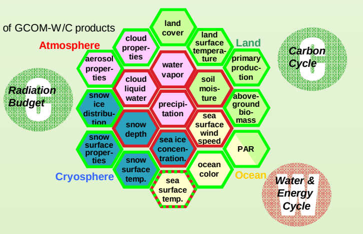
Characteristics of SGLI spectral bands

CH	λ	Δλ	L_{std}	L_{max}	SNR@L_{std}	IFOV	Tilt
	nm		W/m²/sr/μm K: Kelvin		- K: NEΔT	m	deg
VN1	380	10	60	210	250	250/1000	0
VN2	412	10	75	250	400	250/1000	0
VN3	443	10	64	400	300	250/1000	0
VN4	490	10	53	120	400	250/1000	0
VN5	530	20	41	350	250	250/1000	0
VN6	565	20	33	90	400	250/1000	0
VN7	673.5	20	23	62	400	250/1000	0
VN8	673.5	20	25	210	250	250/1000	0
VN9	763	12	40	350	1200*	250/1000*	0
VN10	868.5	20	8	30	400	250/1000	0
VN11	868.5	20	30	300	200	250/1000	0
POL1	673.5	20	25	250	250	1000	±45
POL2	868.5	20	30	300	250	1000	±45
SW1	1050	20	57	248	500	1000	0
SW2	1380	20	8	103	150	1000	0
SW3	1630	200	3	50	57	250/1000	0
SW4	2210	50	1.9	20	211	1000	0
TIR1	10800	0.7	300K	340K	0.2K	250/500/1000	0
TIR2	12000	0.7	300K	340K	0.2K	250/500/1000	0

Multi-angle obs. for 674nm and 869nm

250m-mode possibility

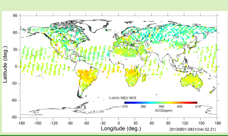
Overview of GCOM-W/C products



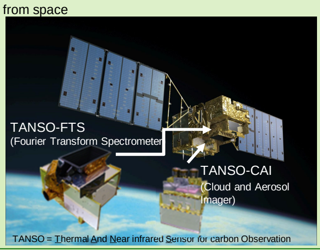
Atmosphere
Land
Radiation Budget
Carbon Cycle
Cryosphere
Ocean
Water & Energy Cycle
aerosol properties
cloud properties
land cover
land surface temperature
water vapor
primary production
cloud liquid water
soil moisture
above-ground bio-mass
snow ice distribution
snow depth
precipitation
sea surface wind speed
PAR
snow surface properties
sea ice concentration
ocean color
snow surface temp.
sea surface temp.

GOSAT (Green house gases Observing SATellite) Jan 2009~

- Monitor global distribution of greenhouse gases (CO_2 & CH_4) from space
  - Errors of SWIR CO2 against aircraft are Average: -1.56 ppm over land (-1.52 ppm over ocean), Std: 2.36 ppm (2.02 ppm)
- Demonstrate the value of satellite-based concentration data to estimate global CO2 fluxes
  - Improve regional CO2 flux



CO2 column-averaged volume mixing ratios in Aug. 2013
http://www.gosat.nies.go.jp/index_e.html



GOSAT Characteristics

Launch	Jan 23, 2009 (by H2A-15 rocket)	
Orbit	Sun synchronous orbit 3 days revisit Local time 13:00 +/- 15min (12:47 Mar 17)	
Mission Life	5 years	
Mission Instruments	Thermal And Near infrared Spectrometer for carbon Observation (TANSO)	
	Fourier Transform Spectrometer (FTS)	Cloud and Aerosol Imager (CAI)
Swath	790km (Nominal: 5 points cross track)	750-1000km
Resolution	10.5km	0.5-1.5km
Spectral Coverage	B1: 0.75-0.78 um B2: 1.56-1.72 um B3: 1.92-2.08 um B4: 5.5-14.3 um B1-3 polarization bands	B1: 0.38 um B2: 0.67 um B3: 0.87 um B4: 1.62 um
Spectral Resolution	0.2 cm^{-1}	20nm

GOSAT2 (2017)

- Improve FTS and CAI with small design modification
  - Reduce the noise by optimizing spectral coverage and improving analog electronics
  - Add CO, fluorescence and aerosol measurement capability
    - Add 2.3 μm band and shift the spectral coverage of O2A
    - Imaging spectrometer, multi-angle measurement
  - New function: intelligent pointing and sampling
    - Onboard camera implements self pointing control to direct clear sky footprint
- Preliminary specification of FTS
  - Band1: 12900-13350 cm^{-1} (O2A,chlorophyll, fluorescence), 5900-6350 cm^{-1} (CO_2,CH_4), 4800-5200 cm^{-1} (CO_2), 4200-4300 cm^{-1} (CO), 650-1400 cm^{-1} (CO_2,CH_4,O_3)
  - Spectral resolution: 0.2 cm^{-1}
  - IFOV: 10.5 km with imaging capability
  - SNR target: 400 for Band1, 300 for Bands 2, 3, and 4
  - Coverage: cross track (±35deg), along track (±40deg←20deg)