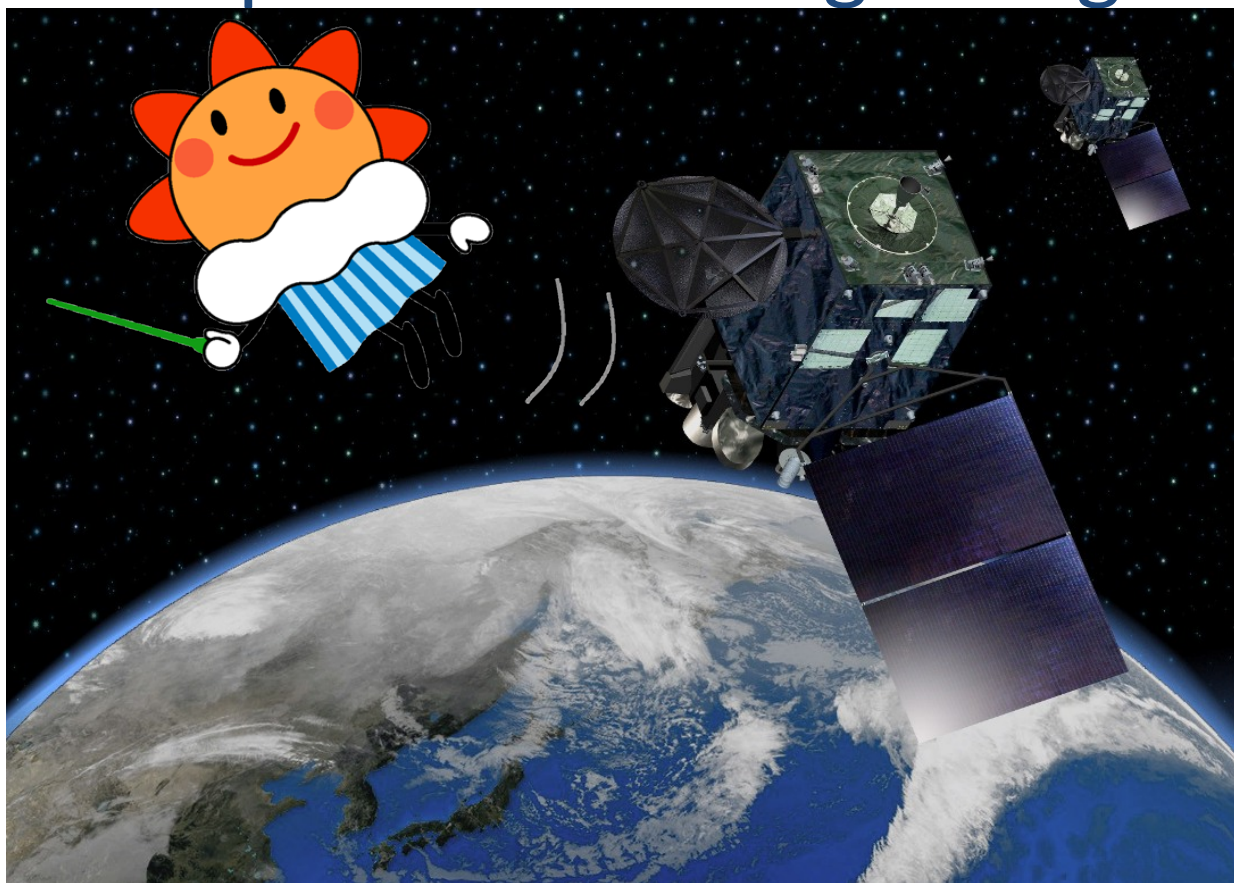




Status of Current and Future Satellite Programs of Japan Meteorological Agency



Contents

1. History and Current Status

- History and Mission
- Image acquisition and Dissemination
- Products

2. Future Plan

- Schedule
- Mission of Himawari-8/9
- Development of Products
- Data Dissemination

1. History and Current Status

History of Japanese Geostationary Meteorological Satellites "Himawari"

GMS (Geostationary Meteorological Satellite)

GMS
(Himawari)



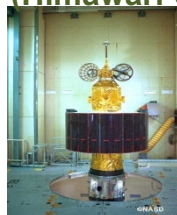
Jul 1977

GMS-2
(Himawari-2)



Aug 1981

GMS-3
(Himawari-3)



Aug 1984

GMS-4
(Himawari-4)



Sep 1989

GMS-5
(Himawari-5)



Mar 1995

**A Ranging Station
for GMS was
operated by
Australian Bureau
of Meteorology**

(GOES-9)

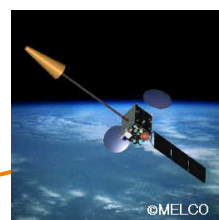
Back-up operation of
GMS-5 with GOES-9
by
NOAA/NESDIS
from May 22, 2003
to June 28, 2005

MTSAT (Multi-functional Transport SATellite)

MTSAT-1R **MTSAT-2**
(Himawari-6) (Himawari-7)



Feb 2005

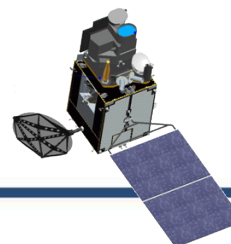
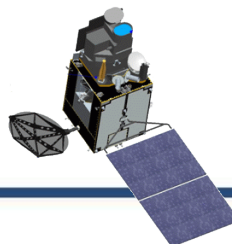


Feb 2006

Himawari Himawari-8 Himawari-9

2014

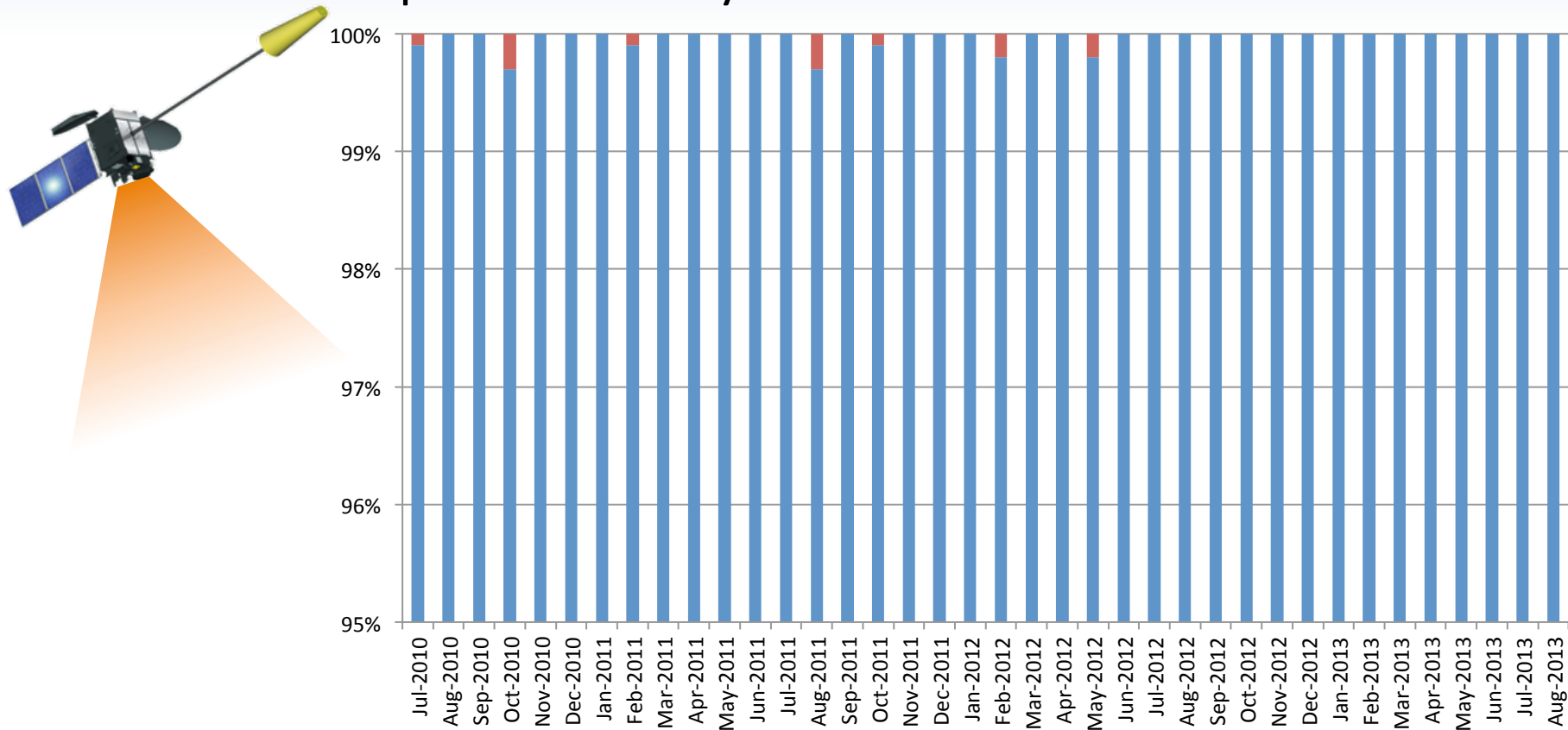
2016



Satellite	Observation period
GMS	1977 – 1981
GMS-2	1981 – 1984
GMS-3	1984 – 1989
GMS-4	1989 – 1995
GMS-5	1995 – 2003
GOES-9	2003 – 2005
MTSAT-1R	2005 – 2010
MTSAT-2	2010 –
Himawari-8	Launch in 2014
Himawari-9	Launch in 2016

Operation of the Current Satellite, MTSAT-2

- Operation of **MTSAT-2** is extremely **stable** after **MTSAT-2** started its operation in July 2010.



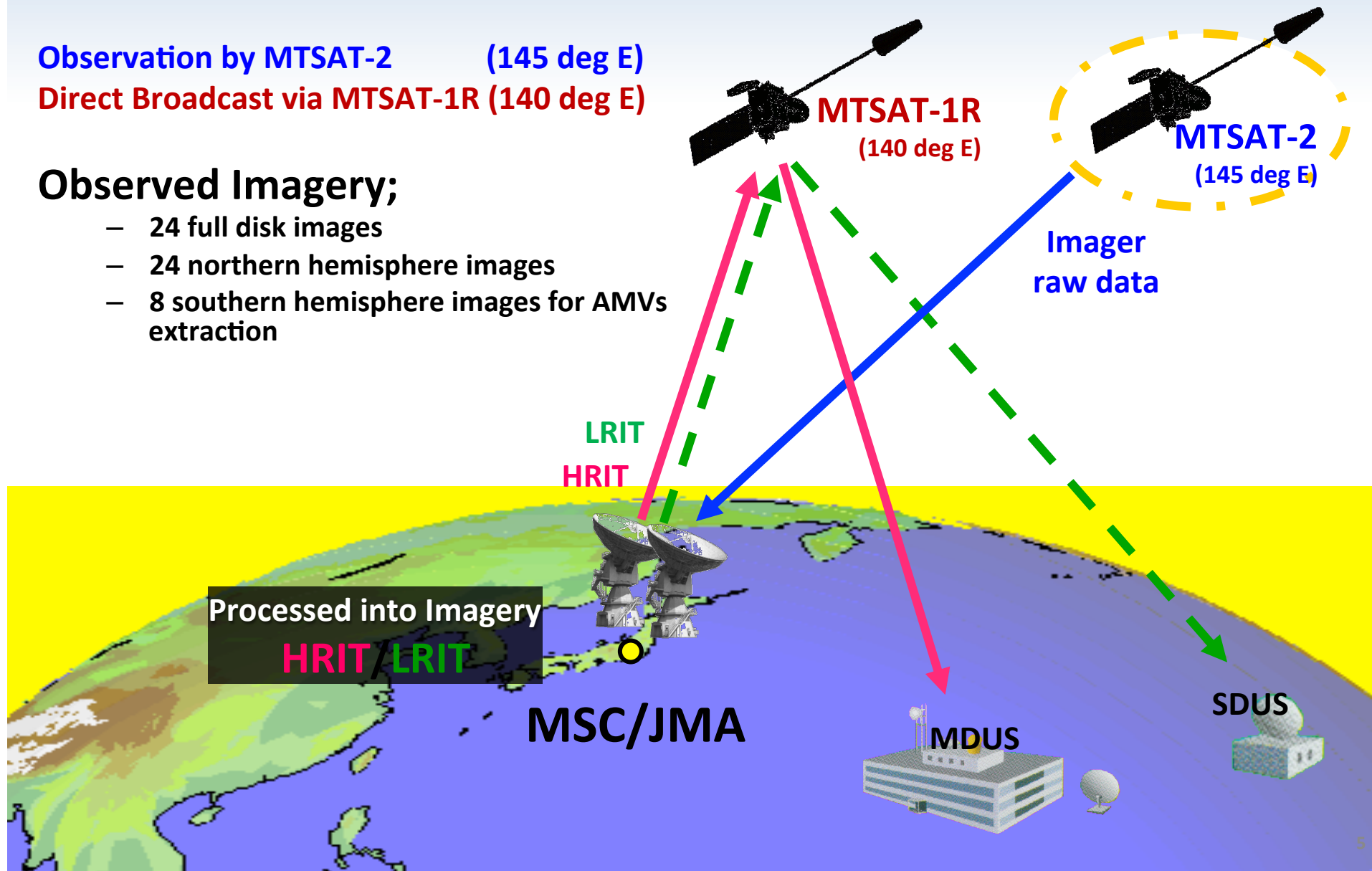
HRIT availability from July 2010 to August 2013

Observation/Direct Broadcast Configurations by MTSAT-1R/2

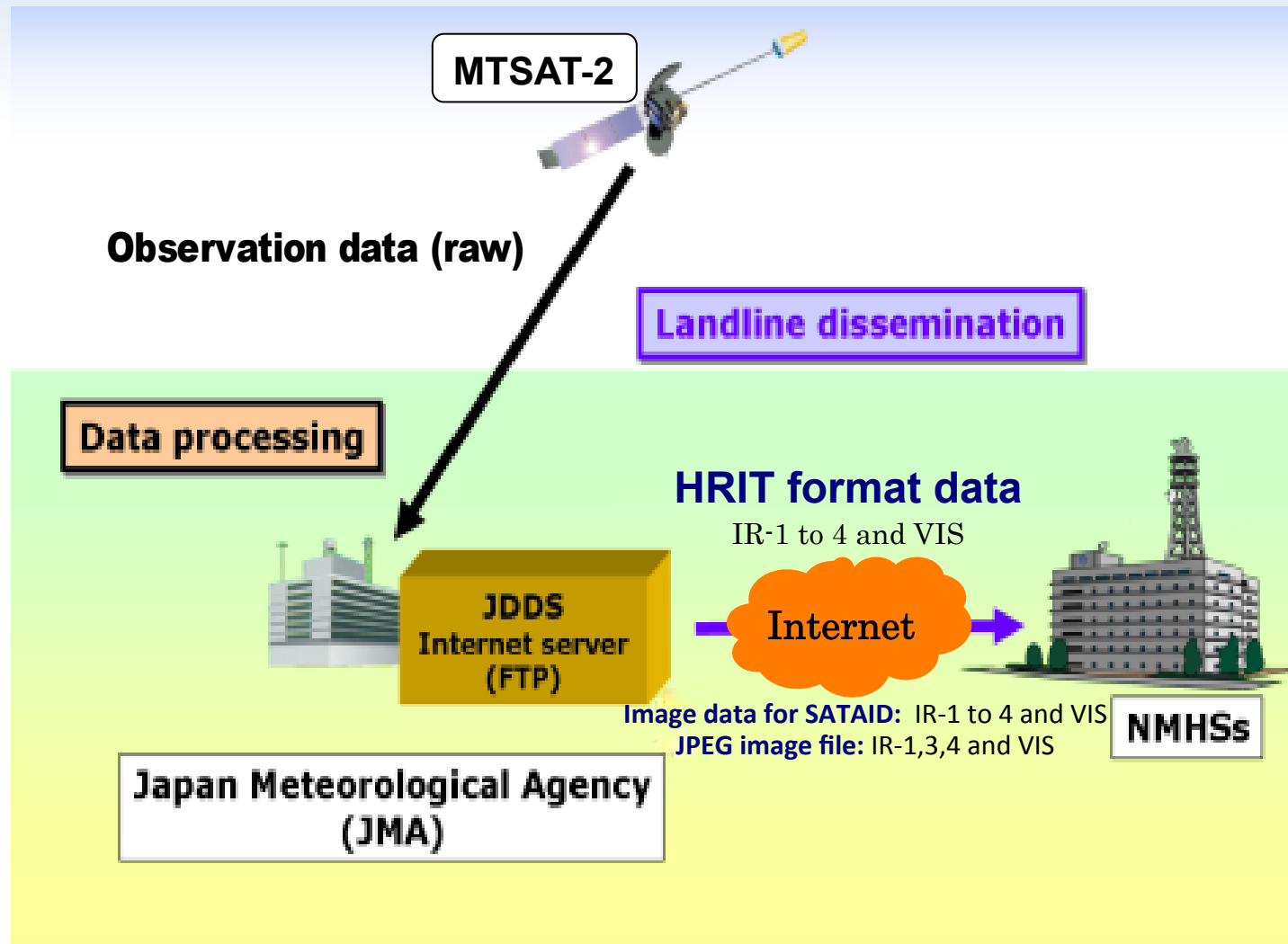
Observation by MTSAT-2 (145 deg E)
Direct Broadcast via MTSAT-1R (140 deg E)

Observed Imagery;

- 24 full disk images
- 24 northern hemisphere images
- 8 southern hemisphere images for AMVs extraction



Landline dissemination service via Internet (JDDS: JMA Data Dissemination System)



Real-time JPEG Imagery Service on JMA/MSWeb

Meteorological Satellite Center (MSC) of JMA

Home | MTSAT Data | Products | Operations | Supports

Current position: Home > Real-Time Image > For Individual Sectors

Back

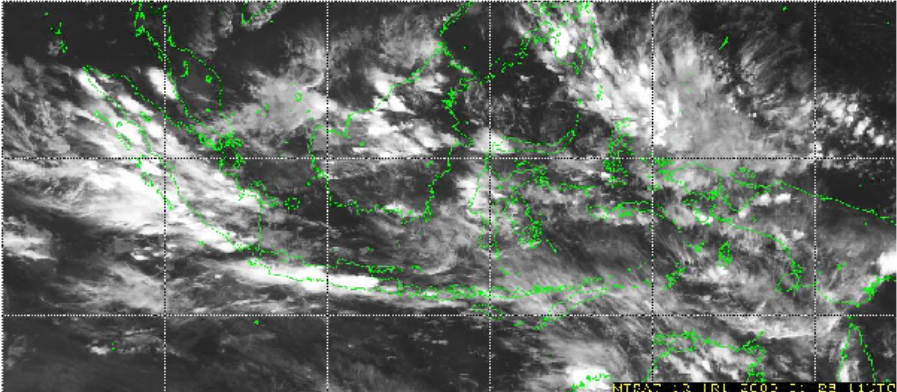
Real-Time Image

MTSAT Real-Time Image

Image and Animation

Select Area: **Southeast Asia 3** Channel: Infrared Time: Latest Next Prev

Animation: Last 3 Hours Play Stop sea3/ir1_00.jpg



(Click the image to enlarge.)

Back

[The Legal Notice of this website]

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- **Providing imagery on MSCweb**
easy access to MTSAT imagery
especially for NMHSs with
limited Internet bandwidth
(data size: 64~128kbytes)

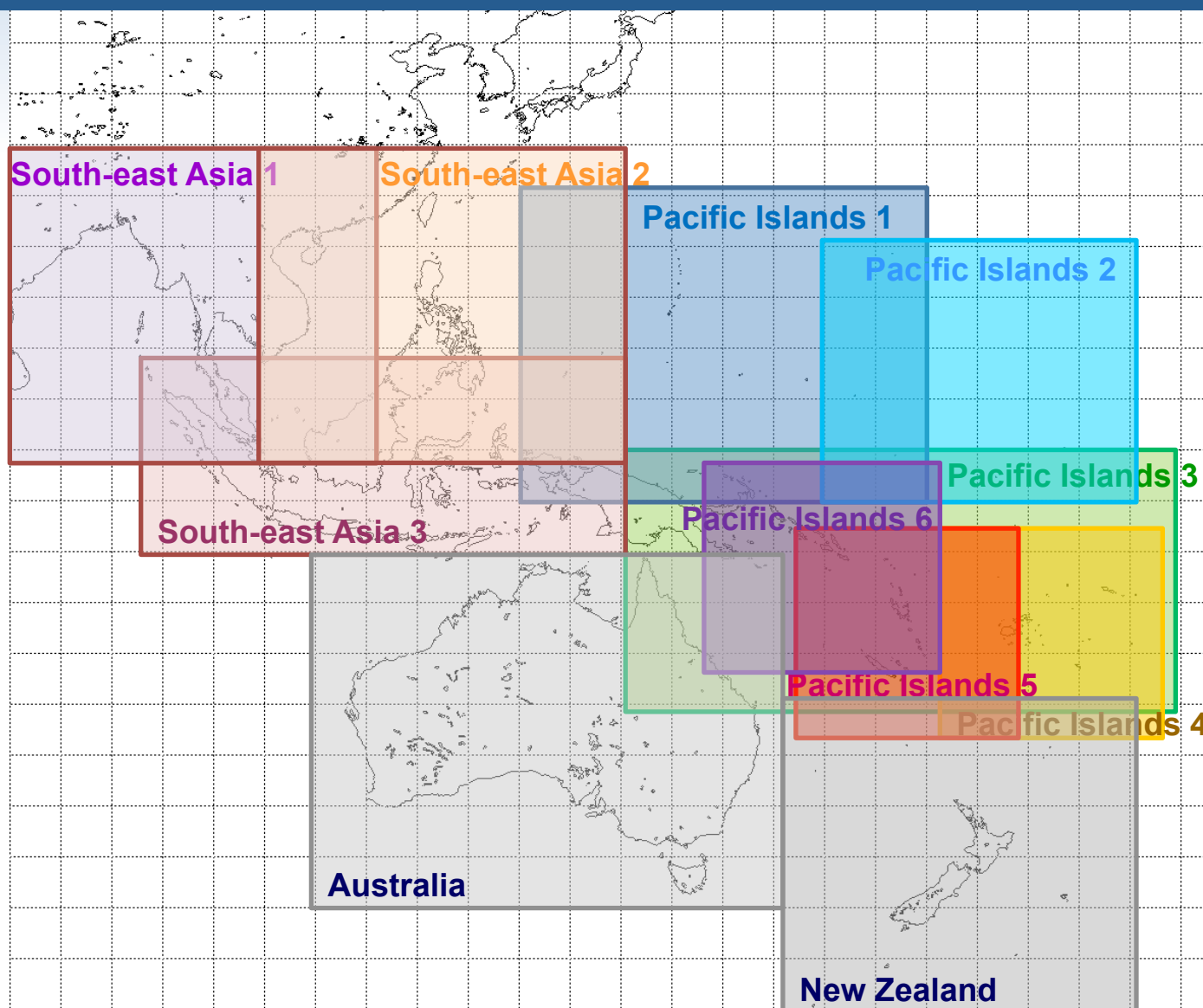
- **Processed into sectored images
in JPEG format** for;

- Australia
 - Central Asia
 - New Zealand
 - Pacific Islands
 - Southeast Asia
- and more....

**on real-time basis with
animation in the last 24
hours**

http://mscweb.kishou.go.jp/sat_dat/img/reg/sat_img.htm

Real-time JPEG Imagery Service through JMA/MSC Website for Asia-Oceania Region



Access statistics

(Apr 2012-Mar 2013)

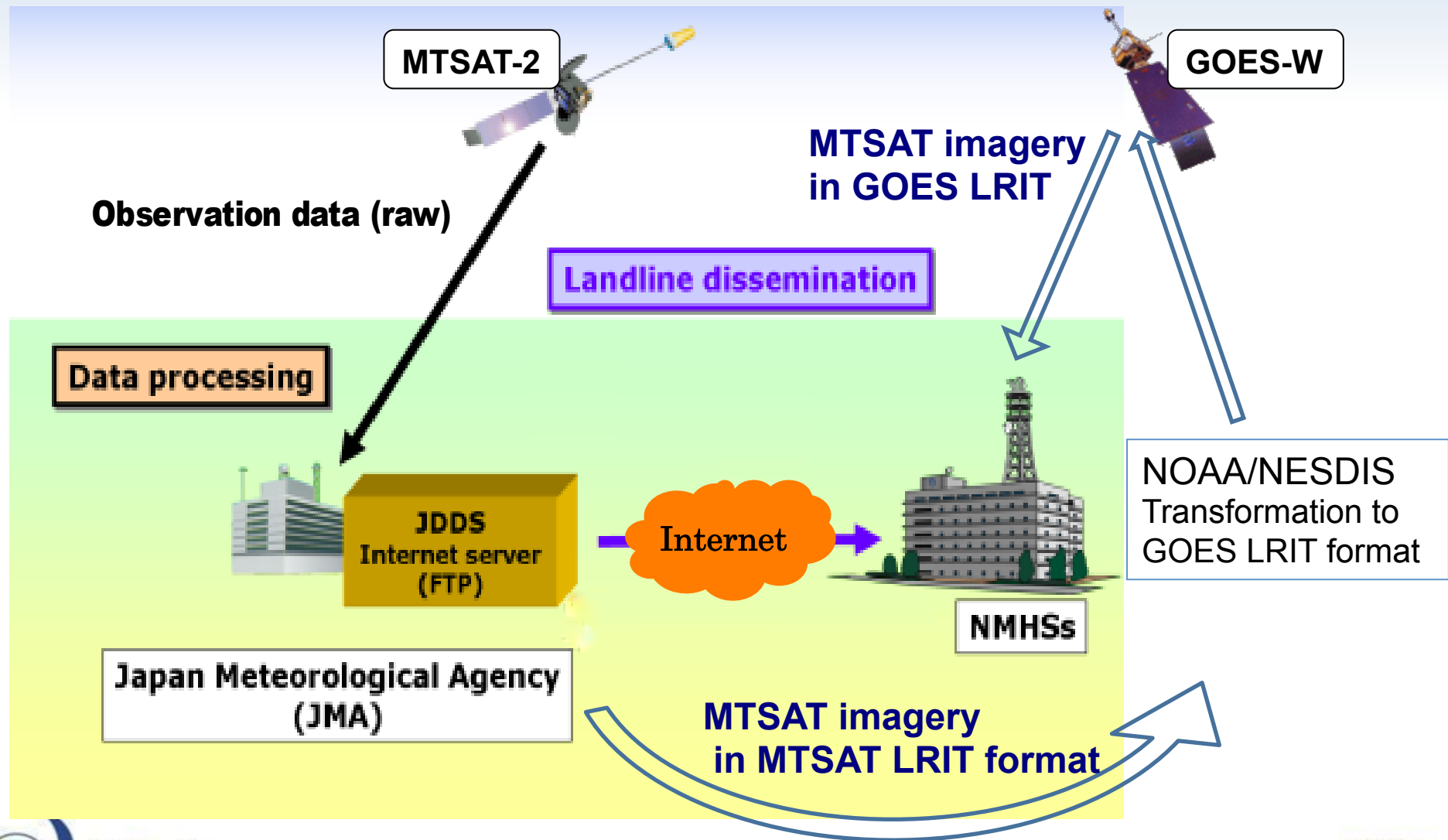
1 USA	63GB
2 Japan	56GB
3 Thailand	50GB
4 Indonesia	49GB
5 Unknown	18GB
6 China	14GB
7 New Zealand	12GB
8 <u>Fiji</u>	<u>9GB</u>
9 Australia	8GB
10 Viet Nam	5GB
11 <u>Tonga</u>	<u>5GB</u>
12 Philippines	4GB
13 Germany	4GB
14 <u>Solomon Islands</u>	<u>4GB</u>
15 Malaysia	4GB
16 <u>Singapore</u>	<u>3GB</u>
...	
22 <u>Kiribati</u>	<u>0.8GB</u>
24 <u>Niue</u>	<u>0.5GB</u>
25 <u>Tuvalu</u>	<u>0.4GB</u>

LDC and SIDS

SIDS

JMA will consider providing other sectorized JPEG Imagery on request !!

MTSAT imagery dissemination via GOES-W LRIT (Collaboration with NOAA/NESDIS for Pacific islands)



Satellite-related Activities

WMO Activities

- DCPC of WIS
- GSICS
- SCOPE-CM
- DCS

Training Activities

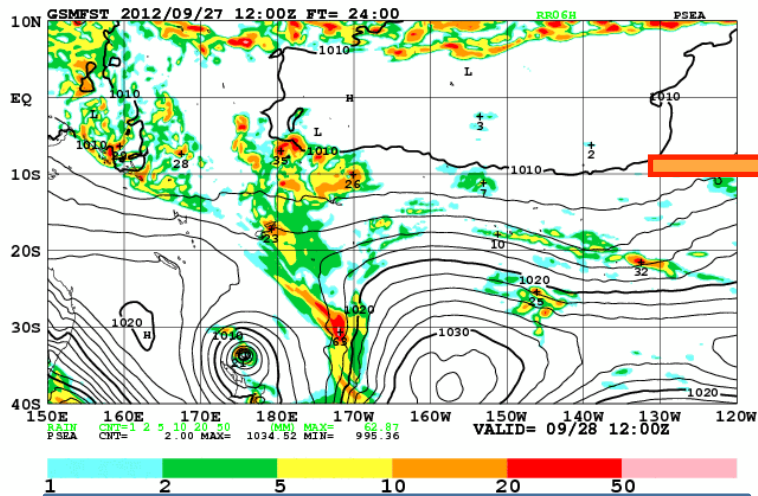
- JICA Group Training Course in Reinforcement of Meteorological Services
- Virtual Resource Library (VRL) on MSC website

(<http://mscweb.kishou.go.jp/VRL/index.htm>)

JMA SWFDP Webpage

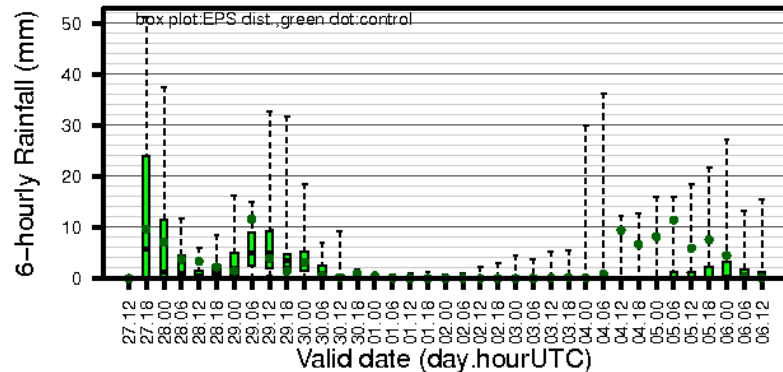
Forecast charts of GSM/JMA

Precipitation since last 6 hours [mm], PSEA



Ensemble Forecast products

JMA ensemble forecast starting from 12UTC 2012/9/27
at model SEA grid(0m,lat=21.06S,lon=174.94W) corresponding to Nuku'alofa



Utilizing of the Backup Satellite, MTSAT-1R

Special Observations

Rapid Scan Observation

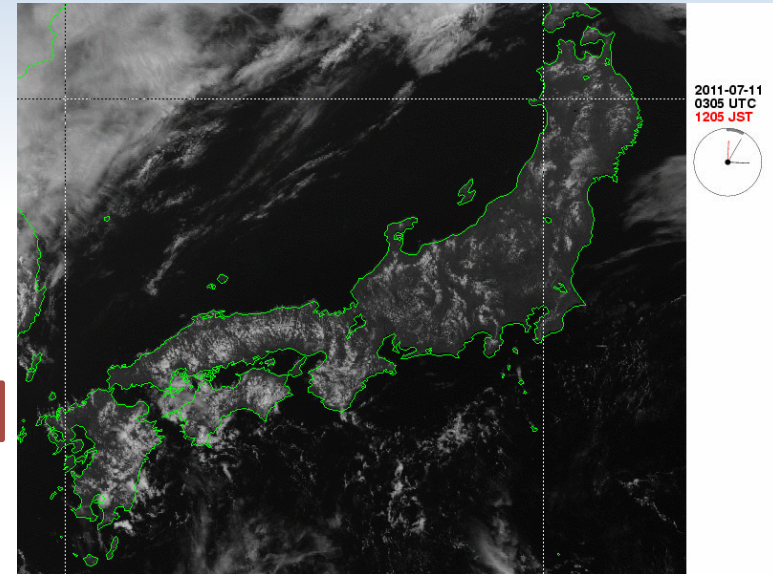
Period: June – September
00 UTC – 09 UTC (daytime)

Interval: 5 minutes

Area: around Japan



Aviation user



High Ice Water Content (HIWC) Study in Darwin, Australia

- HIWC Study: Study on phenomena of jet-engine power-loss by ice crystals.
- JMA will support the HIWC Study field campaign by conducting **MTSAT-1R rapid scan observation**.

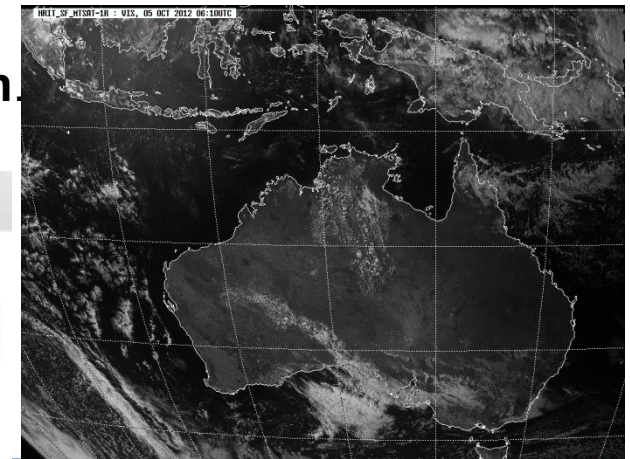
Period: January – March 2014

Interval: 10 minutes

Area: around Australia



NASA



CGMS: Coordination Group for Meteorological Satellites

- **CGMS-41** was successfully held in Tsukuba, Japan from 8 to 12 July 2013, hosted by **JMA** and JAXA.

Objectives

- **Exchange of technical information** among satellite operators and WMO
e.g. future plans, algorithms, products
- **Harmonizing of satellite mission parameters**
e.g. orbits, data formats

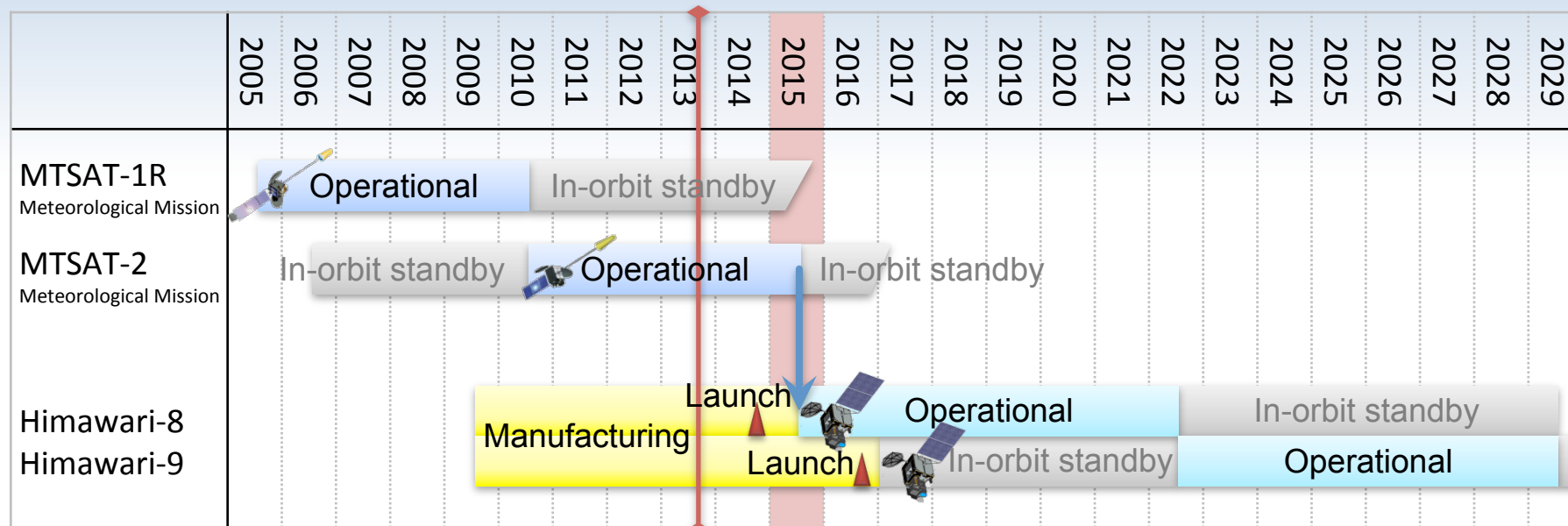
(See <http://www.cgms-info.org/>)

- **CGMS** members agreed to promote the preparedness of users for new generation of satellites such as **Himawari-8**.



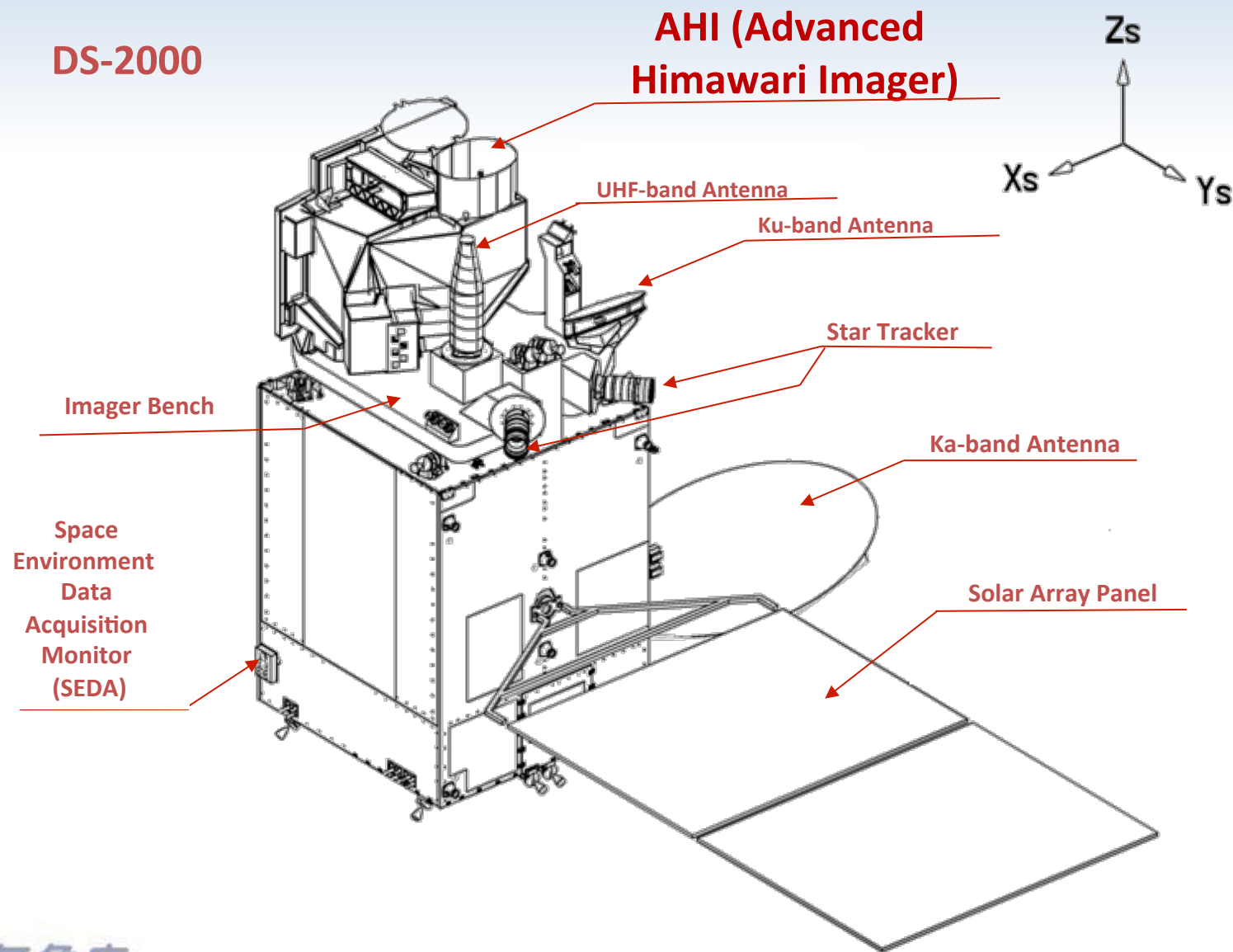
2. Future Plan

Transition of Operational Satellites



- JMA plans to launch **Himawari-8** in **2014** and begin its operation in **2015**.
- The launch of **Himawari-9** for in-orbit standby is scheduled in **2016**.
- **Himawari-8/9** will be in operation around **140 degrees East** covering the East Asia and Western Pacific regions for 15 years.

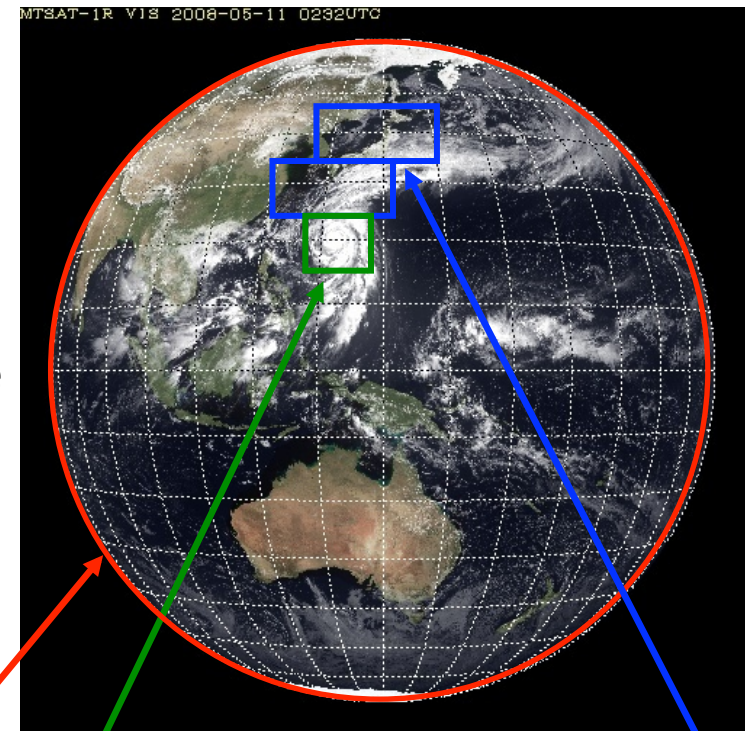
Appearance of Himawari-8/9



Himawari-8/9: Specification of Observation

Channels of the Advanced Himawari Imager (AHI)

Channel	Central Wavelength [μm]	Spatial Resolution	
1	0.43 – 0.48	1 km	RGB Composited True Color Image
2	0.50 – 0.52	1 km	
3	0.63 – 0.66	0.5 km	
4	0.85 – 0.87	1 km	Water Vapor
5	1.60 – 1.62	2 km	
6	2.25 – 2.27	2 km	
7	3.74 – 3.96	2 km	
8	6.06 – 6.43	2 km	SO ₂
9	6.89 – 7.01	2 km	
10	7.26 – 7.43	2 km	O ₃
11	8.44 – 8.76	2 km	
12	9.54 – 9.72	2 km	Atmospheric Windows CO ₂
13	10.3 – 10.6	2 km	
14	11.1 – 11.3	2 km	
15	12.2 – 12.5	2 km	
16	13.2 – 13.4	2 km	



Full disk
Interval: **10 minutes** (6 times per hour)

Region: Japan
Interval: **2.5 minutes** (4 times in 10 minutes)
Dimension: EW x NS: 2000 x 1000 km x 2

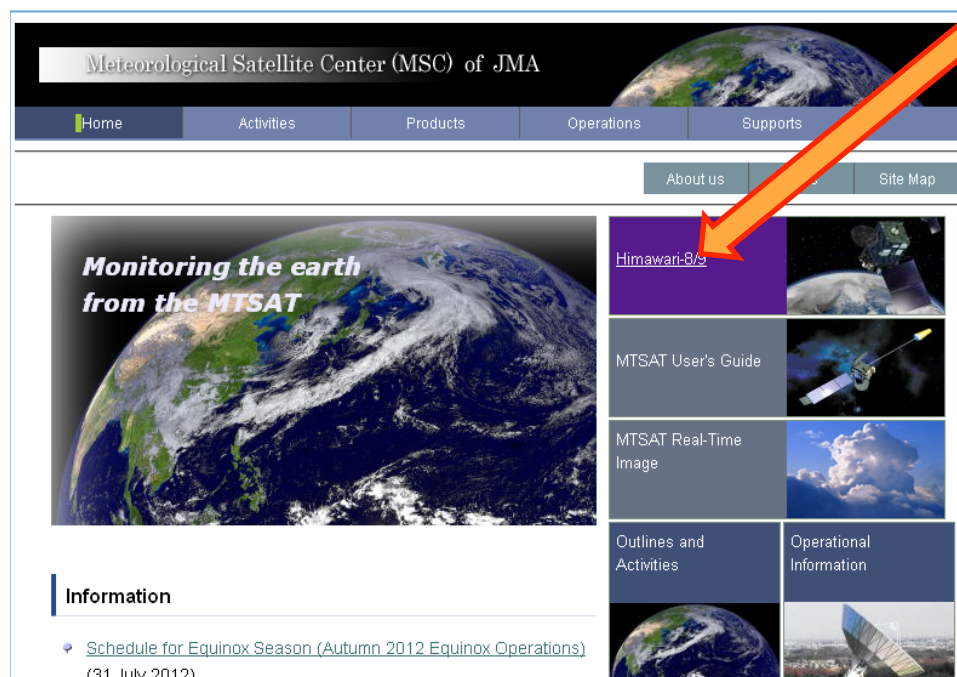
Region: Typhoon
Interval: **2.5 minutes** (4 times in 10 minutes)
Dimension: EW x NS: 1000 x 1000 km

Number of Channels: 5 ➡ 16

Interval: 30/60 min. ➡ 10min.

MSC Web Page for Himawari-8/9 Information

MSC website top page
<http://mscweb.kishou.go.jp/>



Meteorological Satellite Center (MSC) of JMA

Home

Activities

Products

Operations

Supports

Current position: Home > Himawari-8/9

Himawari-8/9

Introduction

Spacecraft

Imager (AHI)

The Japan Meteorological Agency (JMA) has operated the GMS and MTSAT series of satellites at around 140 degrees east to cover the East Asia and Western Pacific regions since 1977, and makes related contributions to the WMO's World Weather Watch (WWW) Programme. As a follow-on to the MTSAT series, the Agency plans to operate next-generation satellites called Himawari-8 and Himawari-9 (*himawari* means "sunflower" in Japanese).

Overview of satellite observations

The functions and specifications are notably improved from those of the on-board imager of MTSAT, and enable better nowcasting, improved numerical weather prediction accuracy and enhanced environmental monitoring.

Enhancement of the observation function of Himawari-8/9 as compared to that of MTSAT-1R/2

Higher spatial resolutions <table> <tr> <td>MTSAT-1R/2</td> <td>Himawari-8/9</td> </tr> <tr> <td>VIS 1km</td> <td>VIS 0.5 - 1km</td> </tr> <tr> <td>IR 4km</td> <td>IR 2km</td> </tr> </table>	MTSAT-1R/2	Himawari-8/9	VIS 1km	VIS 0.5 - 1km	IR 4km	IR 2km	More frequent observations <table> <tr> <td>Full disk observation with 10-minute intervals</td> <td>Small-sector observation</td> </tr> <tr> <td>30 min.</td> <td>10 min. 10 min. 10 min.</td> </tr> <tr> <td></td> <td>Every 2.5 minute around Japan</td> </tr> </table>	Full disk observation with 10-minute intervals	Small-sector observation	30 min.	10 min. 10 min. 10 min.		Every 2.5 minute around Japan	More spectral bands <table> <tr> <td>MTSAT-1R/2</td> <td>Himawari-8/9</td> </tr> <tr> <td>VIS 1 band (black/white image)</td> <td>3 bands (color image)</td> </tr> <tr> <td>NIR N/A</td> <td>3 bands</td> </tr> <tr> <td>IR 4 bands</td> <td>10 bands</td> </tr> <tr> <td>5 bands</td> <td>16 bands</td> </tr> </table>	MTSAT-1R/2	Himawari-8/9	VIS 1 band (black/white image)	3 bands (color image)	NIR N/A	3 bands	IR 4 bands	10 bands	5 bands	16 bands
MTSAT-1R/2	Himawari-8/9																							
VIS 1km	VIS 0.5 - 1km																							
IR 4km	IR 2km																							
Full disk observation with 10-minute intervals	Small-sector observation																							
30 min.	10 min. 10 min. 10 min.																							
	Every 2.5 minute around Japan																							
MTSAT-1R/2	Himawari-8/9																							
VIS 1 band (black/white image)	3 bands (color image)																							
NIR N/A	3 bands																							
IR 4 bands	10 bands																							
5 bands	16 bands																							

Details of AHI

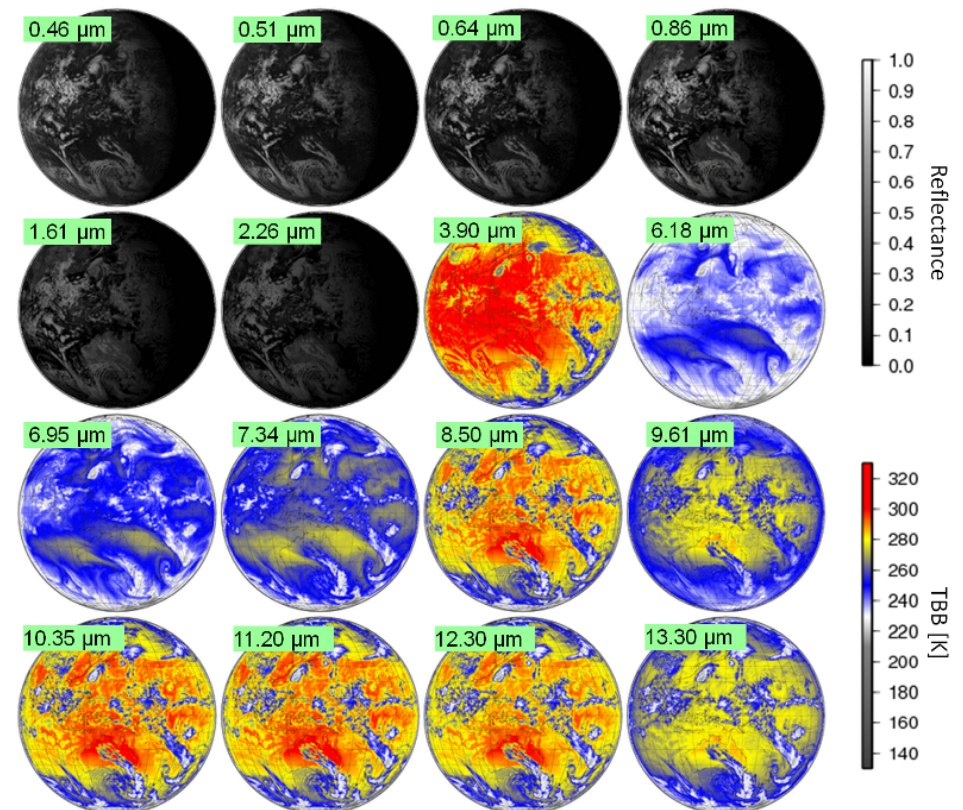
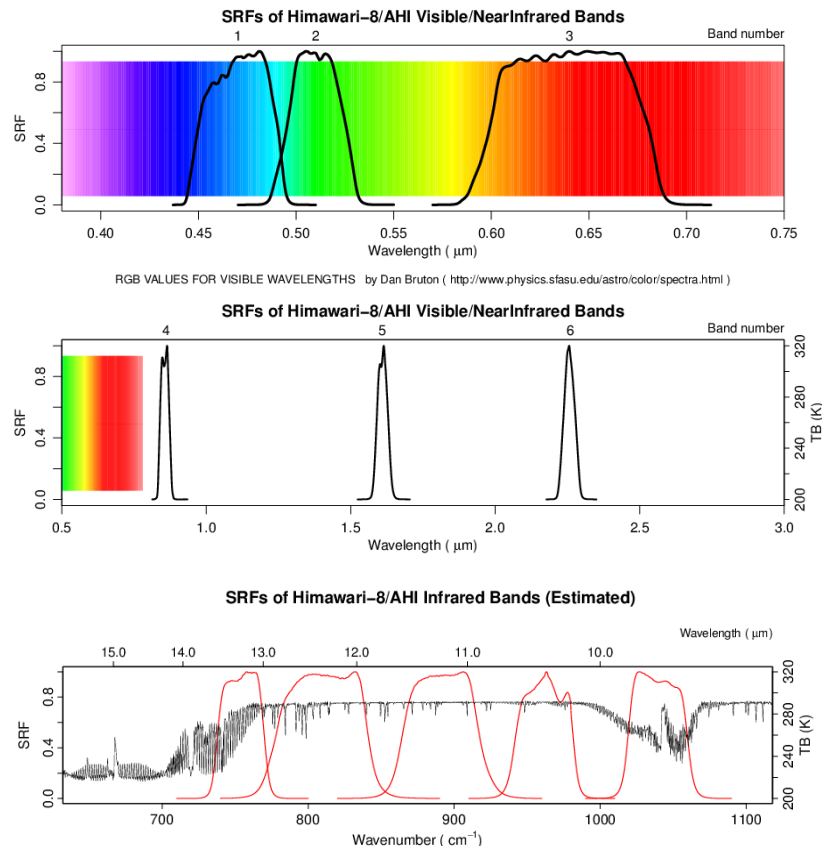
Himawari-8/9: Technical Information

To support research and development of products based on **Himawari-8/9**,

- Estimated Spectral Response Functions (SRFs) of **AHI** are **available** on JMA website.

<http://mscweb.kishou.go.jp/himawari89/>

- **Simulation data** generated using a radiative transfer model are also **available** on JMA website.



Development of products of Himawari-8/9 AHI

Higher resolution

Horizontal:

1km -> 0.5km for a VIS channel

4km -> 2 km for IR channels

Temporal:

1 hr -> 10 min for a full disk scan

2.5min for limited areas

Increased observation channels

VIS: 1 -> 3 bands

IR : 4 -> 13 bands

Examples of expected new/enhanced products

- Atmospheric Motion Vectors (AMVs)
- Volcanic Ash (VA) / Aerosol
- Global Instability Index

Severe weather
monitoring/ nowcasting

Climate change
monitoring

Volcano eruption
Ash area detection

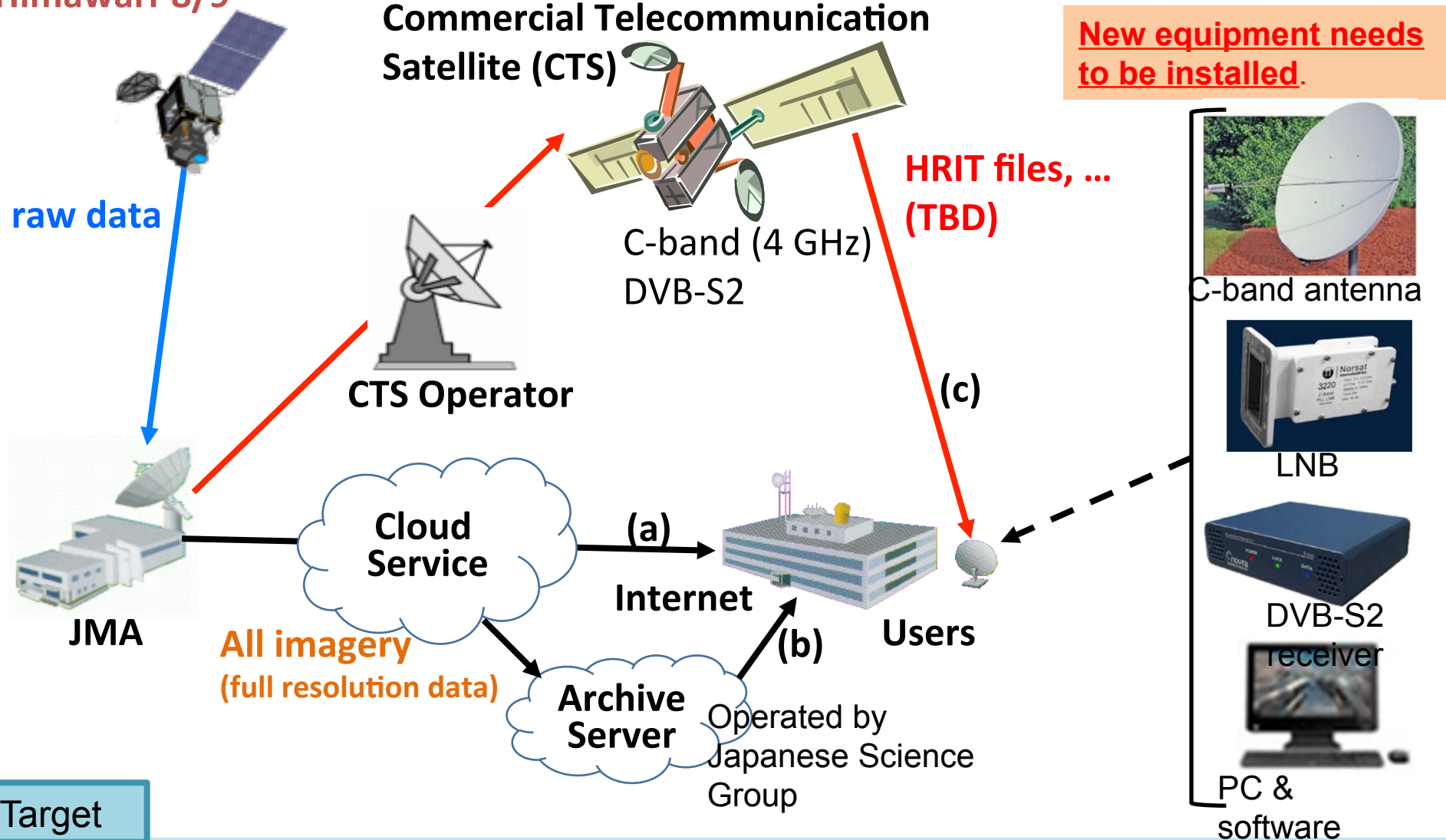
Numerical prediction

Yellow sand/ dust storm

Solar energy monitoring

Himawari-8/9: Data Distribution/Dissemination

Himawari-8/9

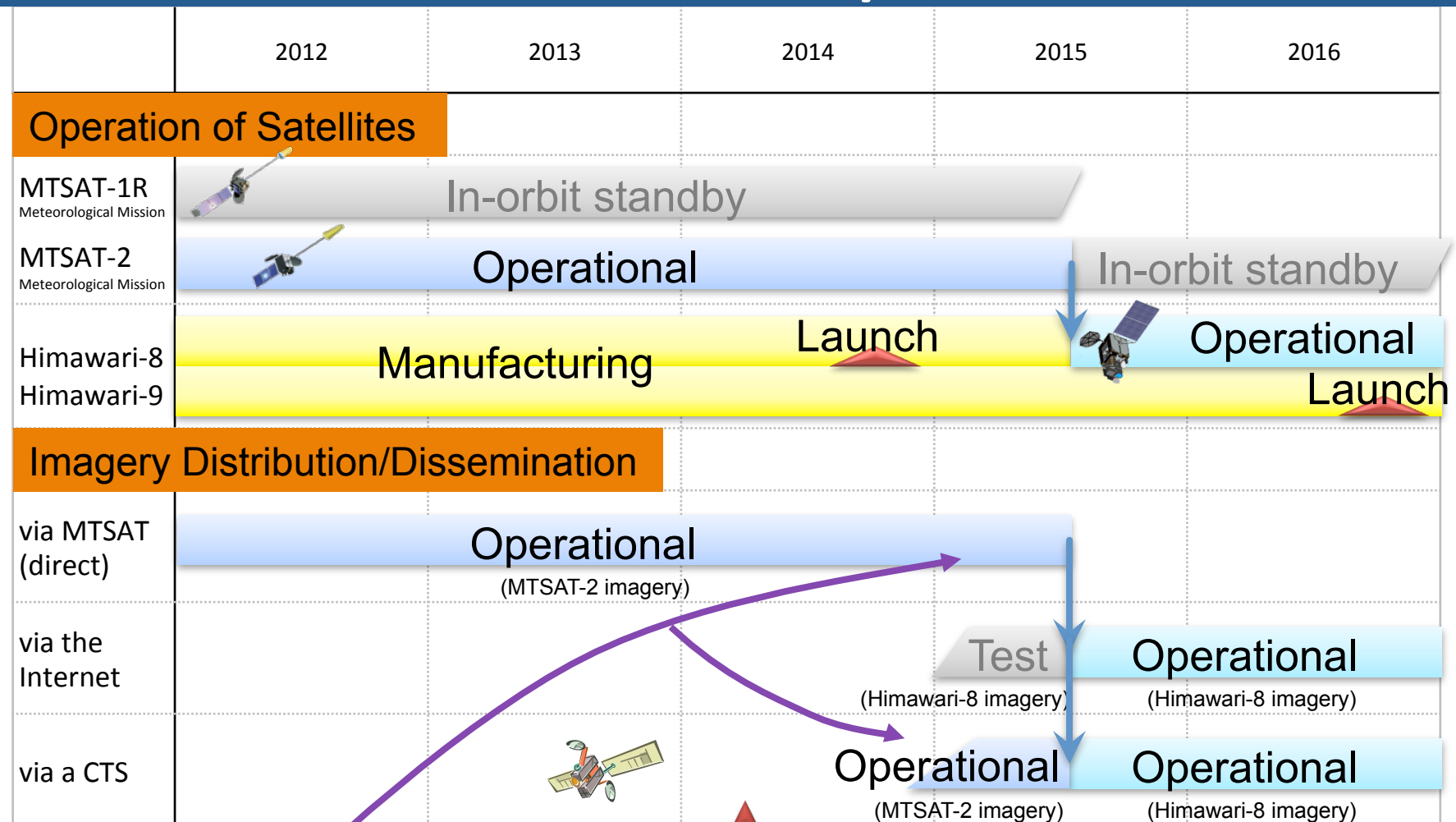


New equipment needs to be installed.

Target

- (a) Cloud Service:** National Meteorological and Hydrological Services
- (b) Archive Server:** Researchers
- (c) CTS:** Everyone in the East Asia and Western Pacific regions

Schedule of Distribution/Dissemination

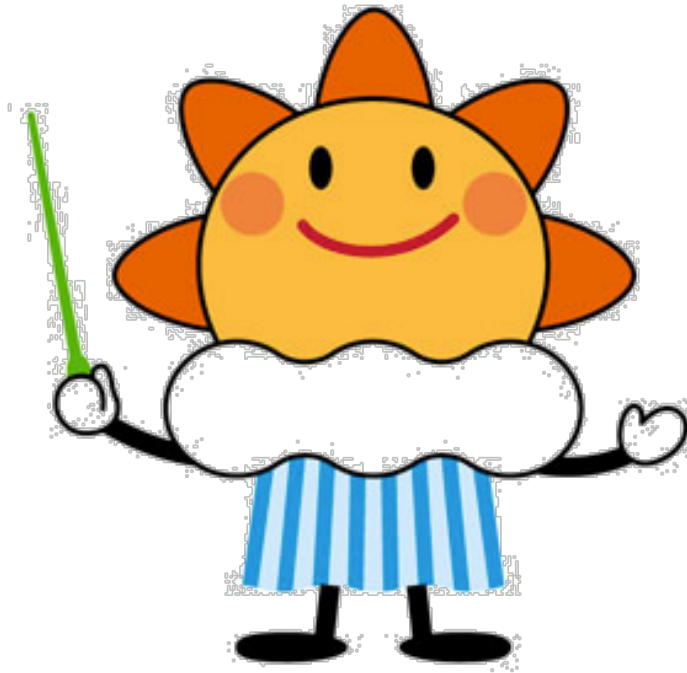


JMA will announce the details of CTS (to be fixed in April 2014) and its receiving equipment in the spring of 2014.

- **Parallel dissemination** is planned for users' smooth transitions to the receipt of imagery via a CTS.



Thank You.



Appendix

Imagery via the Internet

	Name	Interval	Channel & Resolution	Size
Full disc observation	TBD	10 min	All (16) channels #3: 0.5 km #1, 2, 4: 1 km #5-16: 2 km	329 GB (1 day) #3: 930 MB (10 min) #1, 2, 4: 230 MB (10 min) #5-16: 60MB (10 min)
	PNG	10 min	Composite (#1-3) 1 km	49 GB (1 day) 350 MB (10 min)
	HRIT (same as MTSAT)	10 min	5 channels Vis: 1 km IR: 4 km	41 GB (1 day) Vis: 230 MB, IR: 15 MB (10 min)
	LRIT (same as MTSAT)	10 min	3 channels 5 km	432 MB (1 day) each: 1 MB (10 min)
Regional observation (Typhoon)	TBD & netCDF	2.5 min	All (16) channels #3: 0.5 km #1, 2, 4: 1 km #5-16: 2 km	12 GB (1 day) #3: 8 MB (2.5 min) #1, 2, 4: 2 MB (2.5 min) #5-16: 0.5 MB (2.5 min)
Cut-out (several regions)	PNG JPEG	10 min	TBD	Not so large

Imagery via a CTS

	Name	Interval	Channel & Resolution	Size
Full disc observation	TBD	10 min	All (16) channels #3: 0.5 km #1, 2, 4: 1 km #5-16: 2 km	329 GB (1 day) #3: 930 MB (10 min) #1, 2, 4: 230 MB (10 min) #5-16: 60MB (10 min)
	PNG	10 min	Composite (#1-3) 1 km	49 GB (1 day) 350 MB (10 min)
	HRIT (same as MTSAT)	10 min (TBD)	5 channels Vis: 1 km IR: 4 km	41 GB (1 day) Vis: 230 MB, IR: 15 MB (10 min)
	LRIT (same as MTSAT)	10 min (TBD)	3 channels 5 km	432 MB (1 day) each: 1 MB (10 min)
Regional observation (Typhoon)	TBD & netCDF	2.5 min	All (16) channels #3: 0.5 km #1, 2, 4: 1 km #5-16: 2 km	12 GB (1 day) #3: 8 MB (2.5 min) #1, 2, 4: 2 MB (2.5 min) #5-16: 0.5 MB (2.5 min)
Cut-out (several regions)	PNG JPEG	10 min	TBD	Not so large

Equipment to receive imagery via a CTS

Tentative

Needed equipment



C-band antenna



LNB



DVB-S2



PC & software

	Required/recommended specifications	Estimated cost (US\$)
C-band antenna	Dish type with a diameter of 1.2 – 2.4 m	1,500 – 9,000
Low-noise block (LNB)	Standard-performance type	600 or less
DVB-S2* receiver	Standard-performance type such as Novra S300, Comtech EF DATA CMR-5975 or Advantech S4020	1,500 – 3,000
Software for DVB acquisition and processing	KenCast Fazzt standard software	900 or less

* DVB-S2: Digital Video Broadcasting – Satellite – Second Generation (a digital video broadcast standard)

Notes

- HRIT imagery can be displayed on a PC using a set of software modules for data processing and visualization.
- Construction of dish antenna foundations and wiring work for antenna-PC connection are required for installation of the above equipment.
- The diameter of a dish antenna depends on its geographical location and the footprint of the commercial telecommunication satellite to be used by JMA.