

Introduction to Himawari-8

Training on meteorological satellite data usage

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Japan Meteorological Agency (JMA)

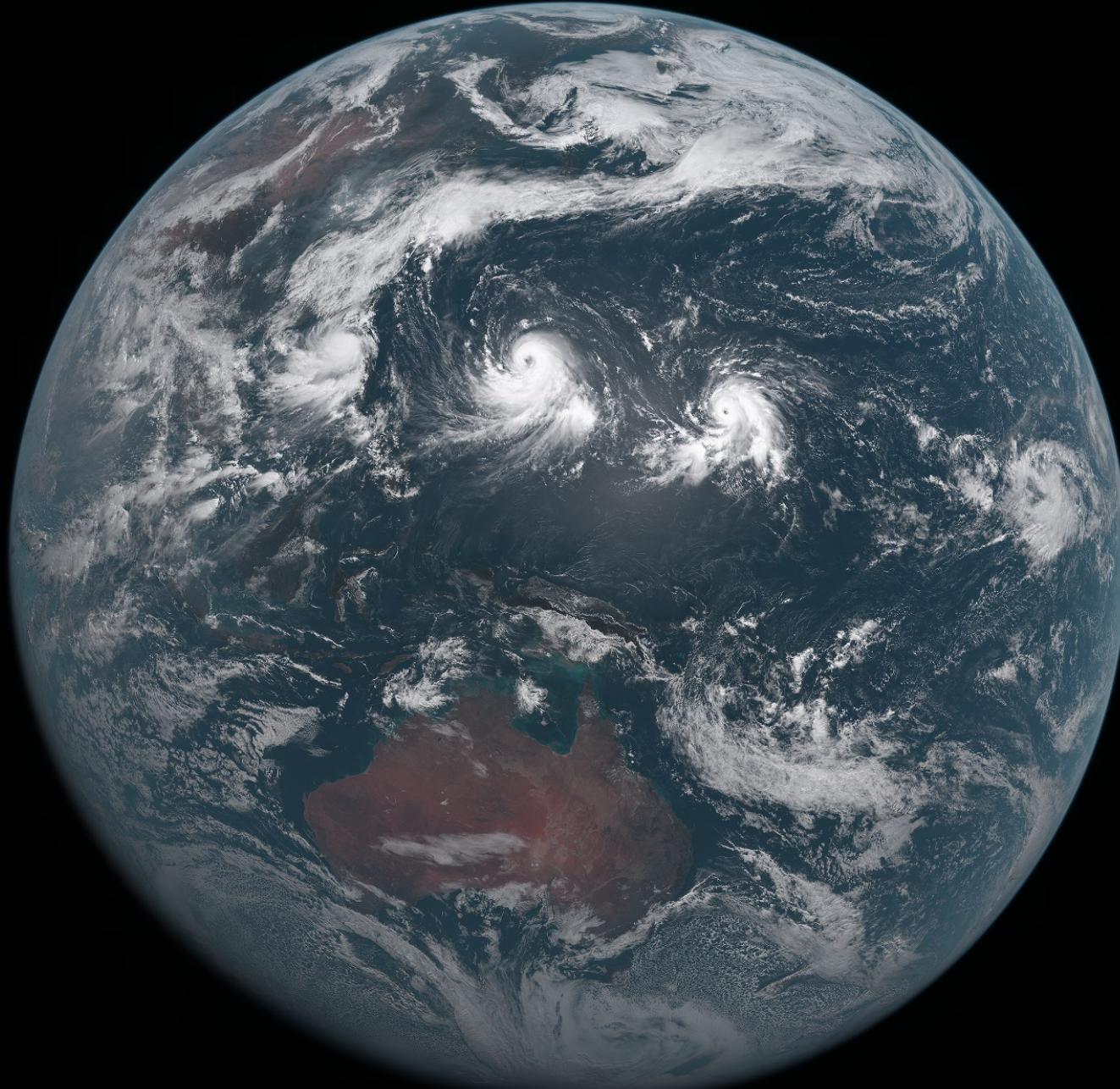
The Sixth Asia/Oceania Meteorological Satellite Users' Conference
Tokyo, Japan
9 – 13 November 2015

Successful Launch of Himawari-8

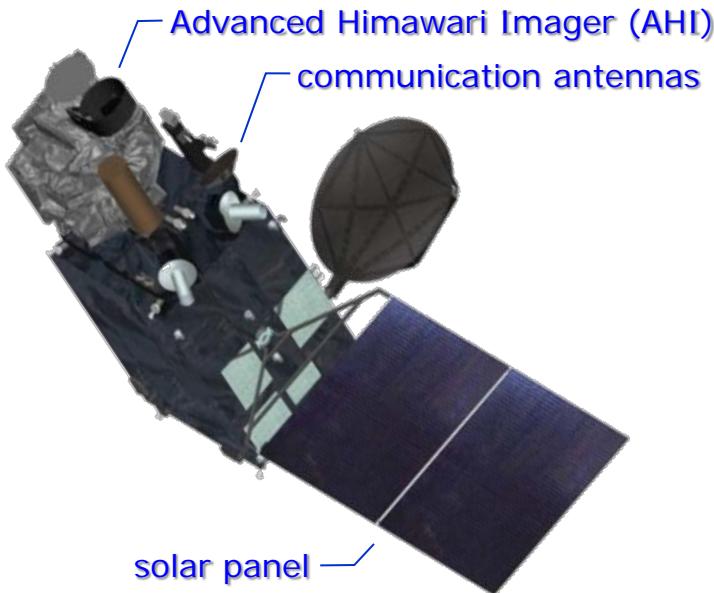


Himawari-8 was successfully launched using H-IIA Launch Vehicle # 25 on 7 October 2014 from the Tanegashima Space Center in Kagoshima, Japan

Himawari-8 began operation at 02:00 UTC on 7th July 2015.

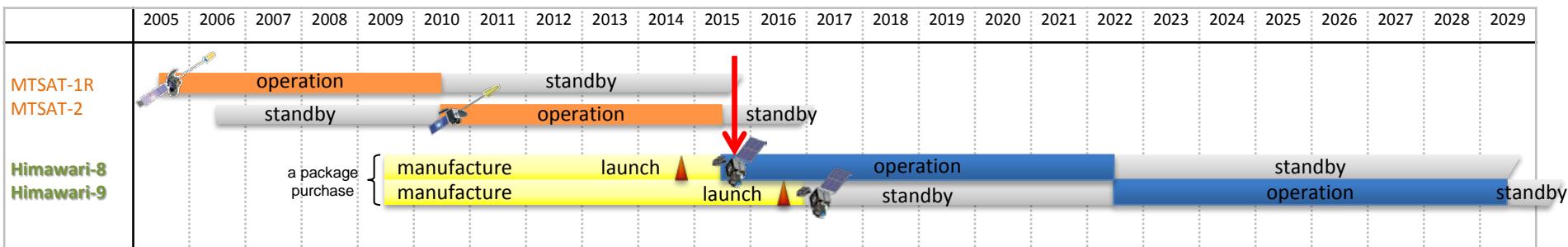


Outline of Himawari-8



Geostationary position	Around 140.7° E
Attitude control	3-axis attitude-controlled geostationary satellite
Communication	1) Raw observation data transmission Ka-band, 18.1 - 18.4 GHz (downlink) 2) DCS International channel 402.0 - 402.1 MHz (uplink) Domestic channel 402.1 - 402.4 MHz (uplink) Transmission to ground segments Ka-band, 18.1 - 18.4 GHz (downlink) 3) Telemetry and command Ku-band, 12.2 - 12.75 GHz (downlink) 13.75 - 14.5 GHz (uplink)

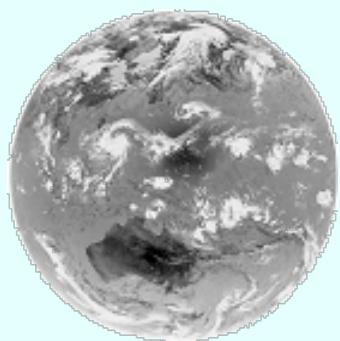
Himawari-8 began operation on 7 July 2015, replacing the previous MTSAT-2 operational satellite



Improved Resolutions

Spectral

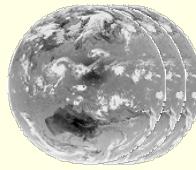
VIS 1 band



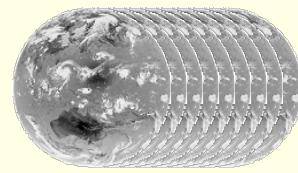
VIS 3 bands



NIR 3 bands



IR 10 bands



5 bands

MTSAT-1R/2

Himawari-8/9

Spatial

At sub-satellite point

VIS 1 km

IR 4 km

MTSAT-1R/2

VIS 0.5/1 km

IR 2 km

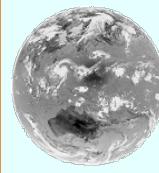
Himawari-8/9

Temporal

Observation Frequency

60min.

(full-disk
obs.)



MTSAT-1R/2

10min.
10min.
10min.
10min.
10min.
10min.



Himawari-8/9

Spectral Bands



Himawari-8/9 Imager (AHI)

Band		Spatial Resolution	Central Wavelength	Physical Properties
1	Visible	1 km	0.47 µm	vegetation, aerosol
2			0.51 µm	vegetation, aerosol
3		0.5 km	0.64 µm	Vegetation, low cloud, fog
4	Near Infrared	1 km	0.86 µm	vegetation, aerosol
5		2 km	1.6 µm	cloud phase
6			2.3 µm	particle size
7	Infrared	2 km	3.9 µm	low cloud, fog, forest fire
8			6.2 µm	mid- and upper-level moisture
9			6.9 µm	mid-level moisture
10			7.3 µm	mid- and lower-level moisture
11			8.6 µm	cloud phase, SO ₂
12			9.6 µm	Ozone content
13			10.4 µm	cloud imagery, information of cloud top
14			11.2 µm	cloud imagery, sea surface temperature
15			12.4 µm	cloud imagery, sea surface temperature
16			13.3 µm	cloud top height



3 Visible Bands

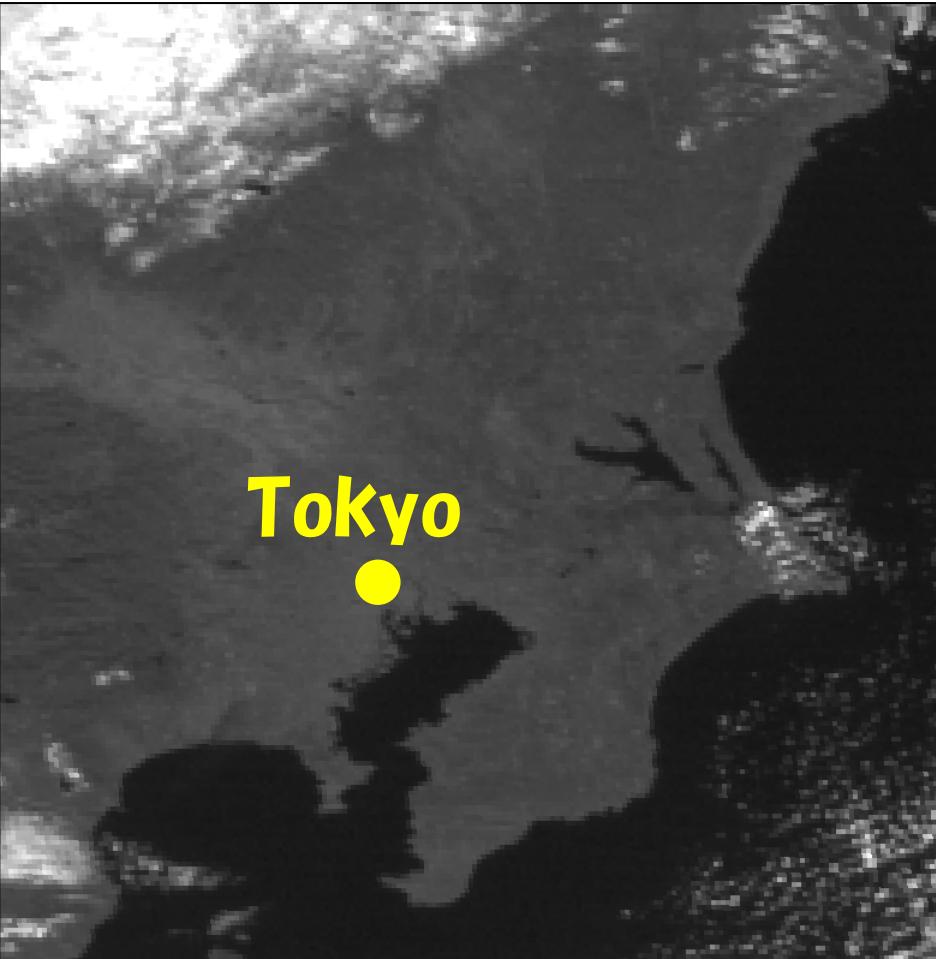
Addition of NIR Bands

Increase of WV Bands

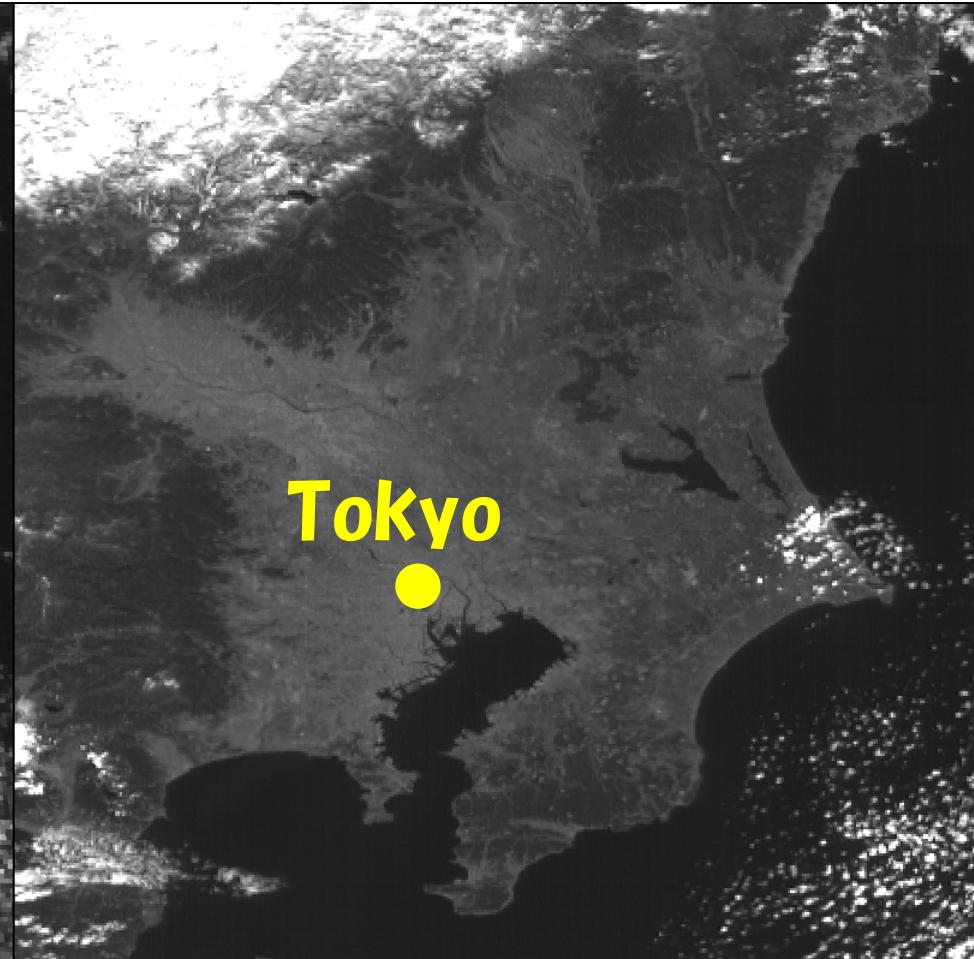
Increase of TIR Bands

Spatial Resolution

MTSAT-2 (VIS)
1km



Himawari-8 (B03)
0.5 km



03:00 UTC on 29 January 2015

Observation Frequency

MTSAT-2 (VIS)
Hourly in Monochrome

Himawari-8 (Band01-03)
Every 10 minutes in Full-Color

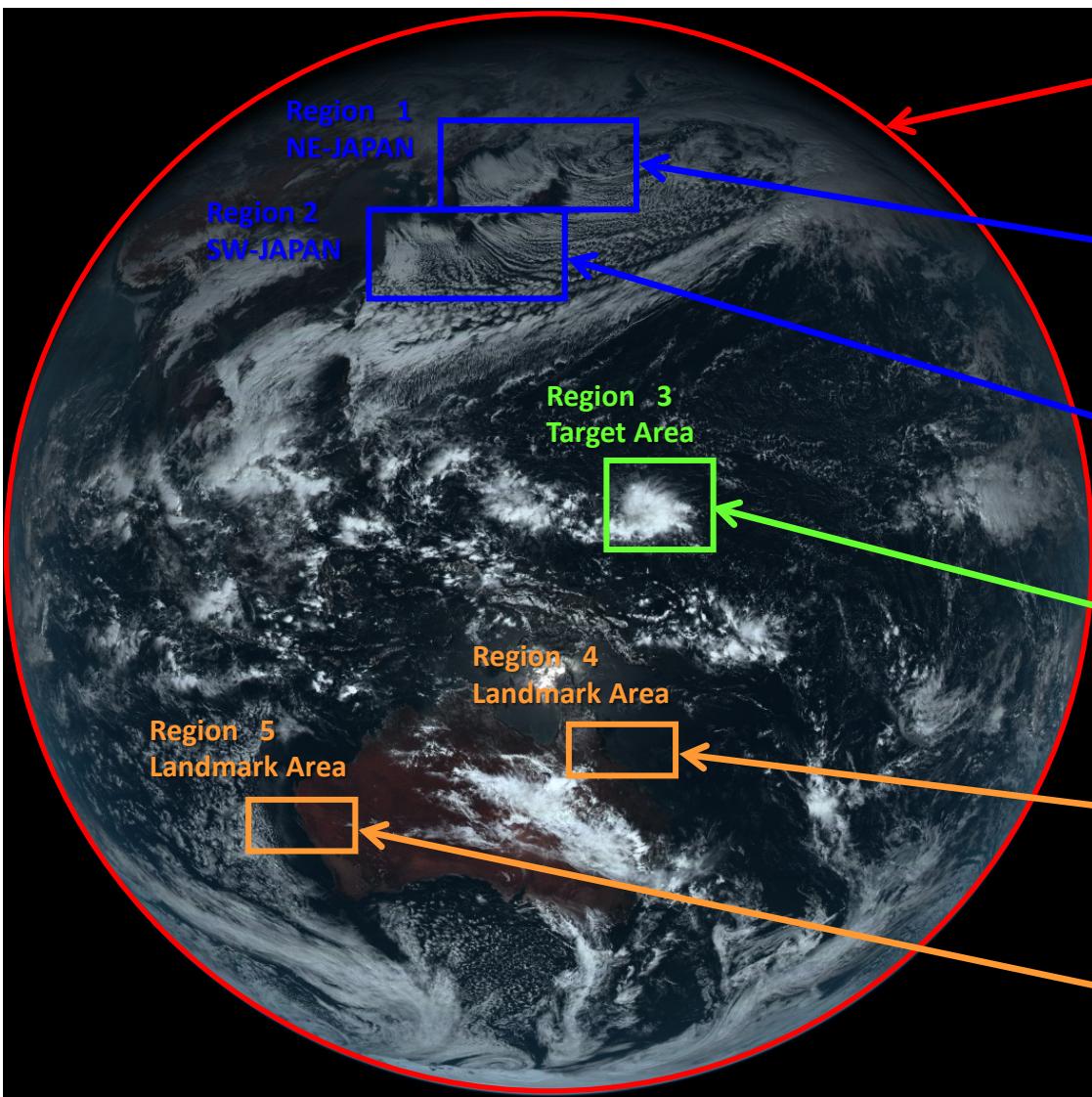


MTSAT-2 VIS 02. APR. 2015 16:00UTC

16 UTC on 2nd to 13 UTC on 3rd, April 2015

Himawari-8 02. APR. 2015 16:00UTC

AHI Observation Modes



Full disk

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

Region 1 JAPAN (North-East)

Interval : **2.5 minutes** (4 times in 10 min)

Dimension : EW x NS: 2000 x 1000 km

Region 2 JAPAN (South-West)

Interval : **2.5 minutes** (4 times in 10 min)

Dimension : EW x NS: 2000 x 1000 km

Region 3 Target Area

Interval : **2.5 minutes** (4 times in 10 min)

Dimension : EW x NS: 1000 x 1000 km

Region 4 Landmark Area

Interval : **0.5 minutes** (20 times in 10 min)

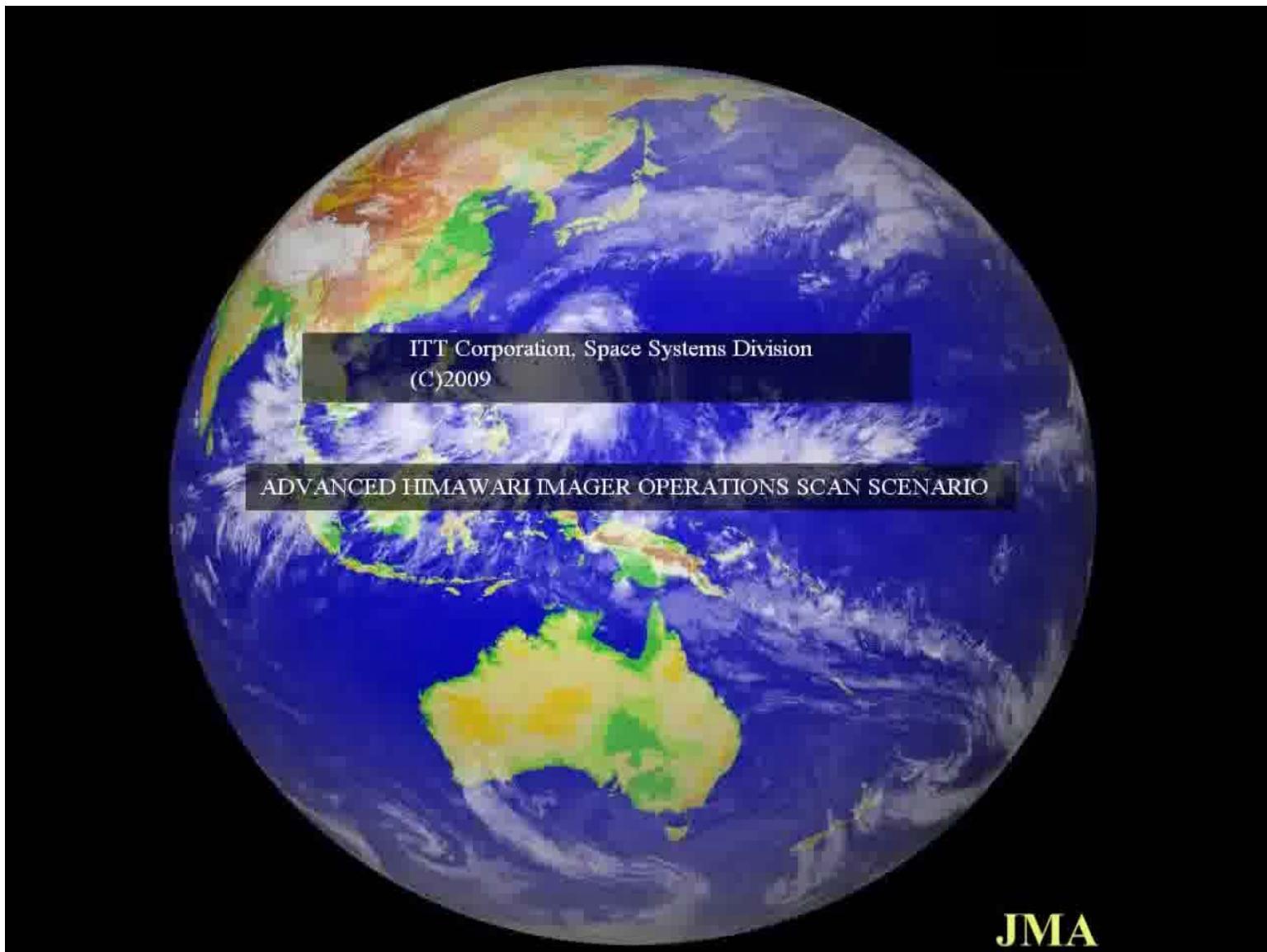
Dimension : EW x NS: 1000 x 500 km

Region 5 Landmark Area

Interval : **0.5 minutes** (20 times in 10 min)

Dimension : EW x NS: 1000 x 500 km

AHI Scan Scenario



Revolution of Advanced Himawari Imager

Upgrade of

- Number of bands
- Spatial resolutions
- Temporal resolutions

MTSAT -> **Himawari-8/9**

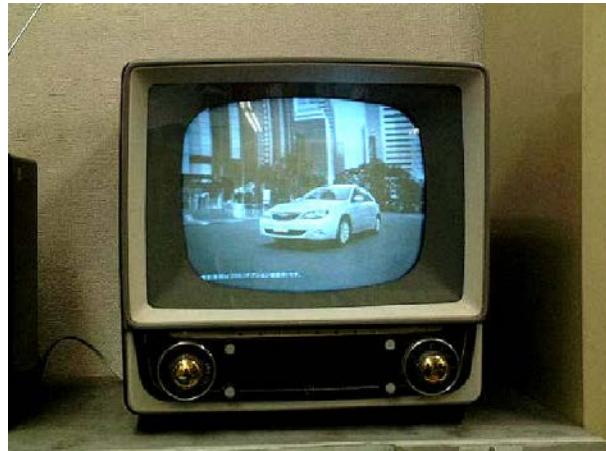
5 -> **16**

VIS: 1 km -> **0.5 or 1.0 km**

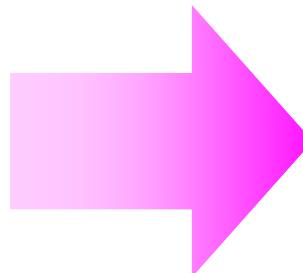
IR: 4.0 km -> **2.0 km**

30/60 min -> **10 min**

(Total data size: **50 times!!**)



B/W TV



HD TV

Himawari-8: Observation Area and Interval

Visible band

in 10 minutes time frame

RGB Composited True Color

Japan & Vicinity Obs.

Targeted Area obs.

Full Disk Obs.

Visible band

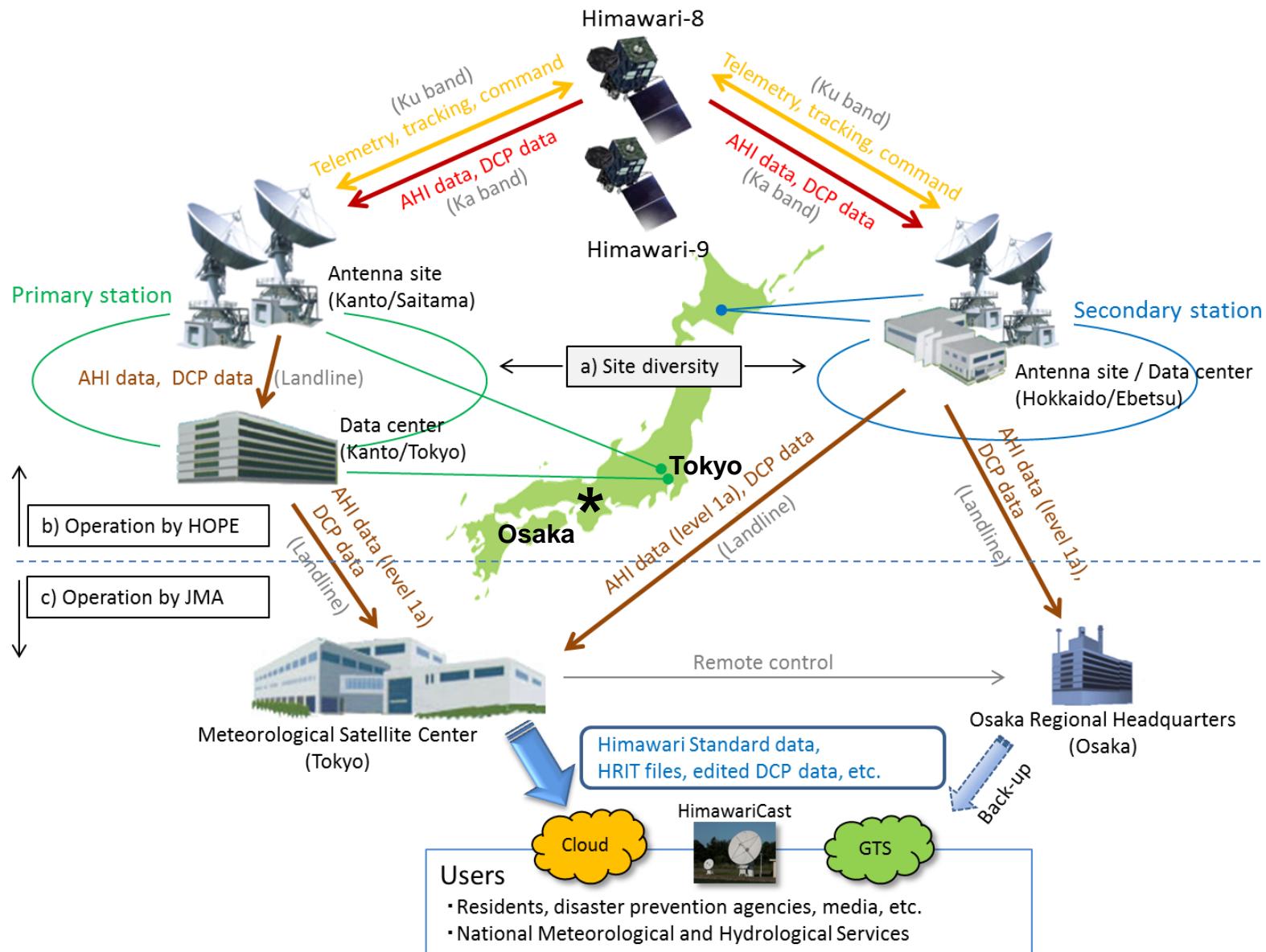
July 9-10, 2015

Himawari-8 B03 2015.07.08 20:00UTC

Himawari-8/9

Ground Segments

Himawari-8/9 Ground Segment and Operations



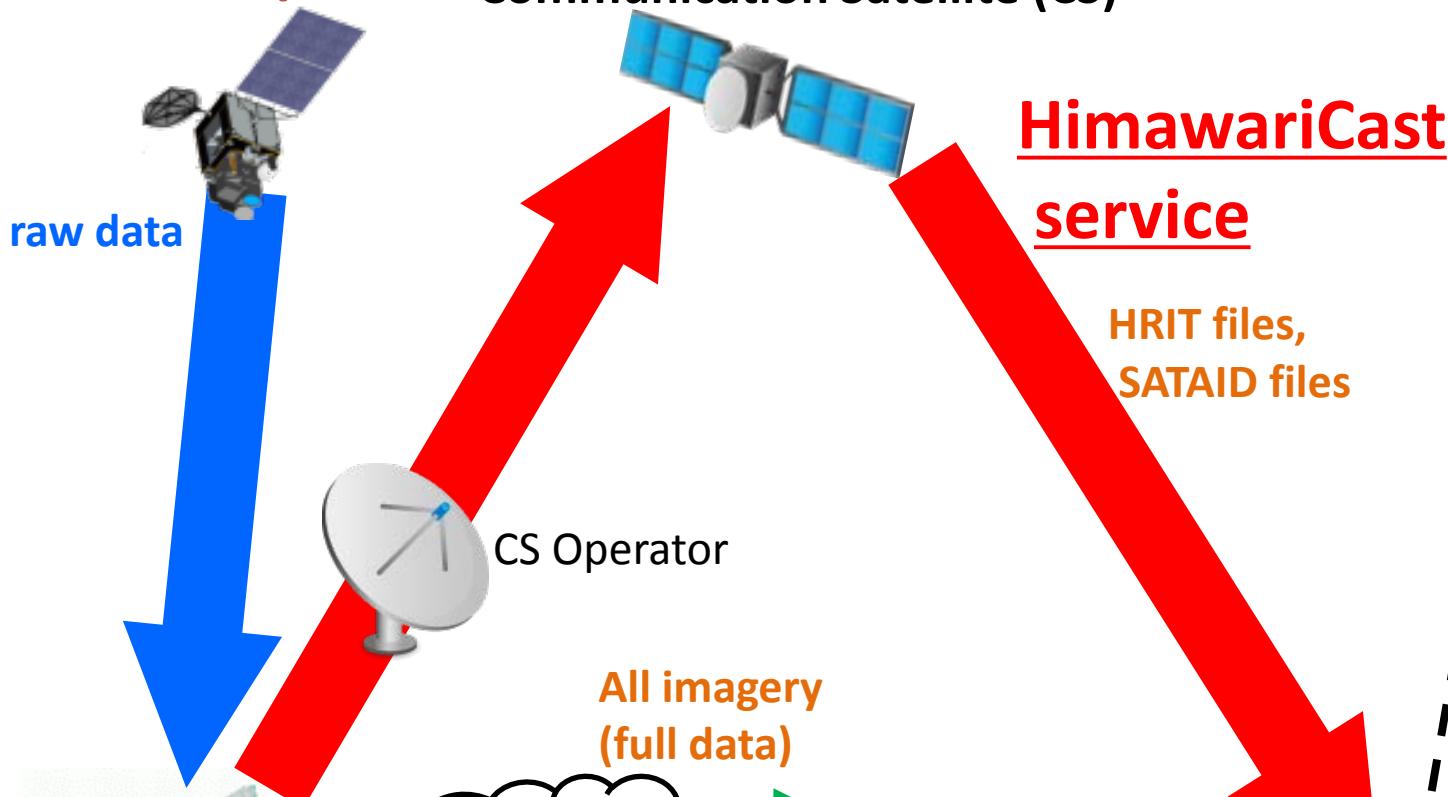
Two Ways of Data Dissemination/Distribution

HimawariCast/HimawariCloud

Himawari-8/9

Communication Satellite (CS)

HimawariCast
service



JMA

HimawariCloud
service

NMHSs

Users



C-band antenna



LNB



DVB-S2 receiver



PC & software

Data distribution/dissemination methods

Two Ways of Himawari-8/9 Imagery Dissemination/Distribution

HimawariCast via Communication Satellite

- Service for Everyone
- No Pass Code for Receiving
- JMA's Baseline for Imagery Dissemination
- 14 bands (1 VIS and 13 IR) every 10 minutes for Full Disk
- Spatial Resolution is same as that of MTSAT HRIT compatible

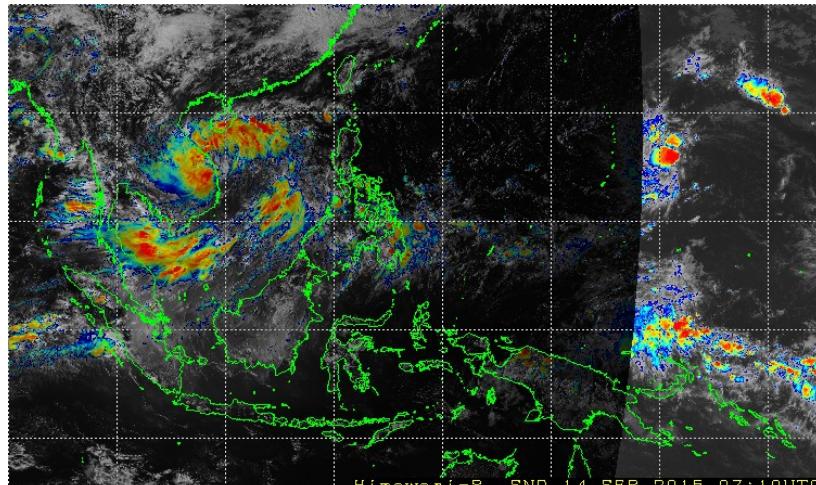
HimawariCloud via Internet Cloud

- Service for NMHSs with high-speed Internet access
- All 16 bands (3 VIS and 13 IR)
- Full Specification (temporal and spatial) of Imagery

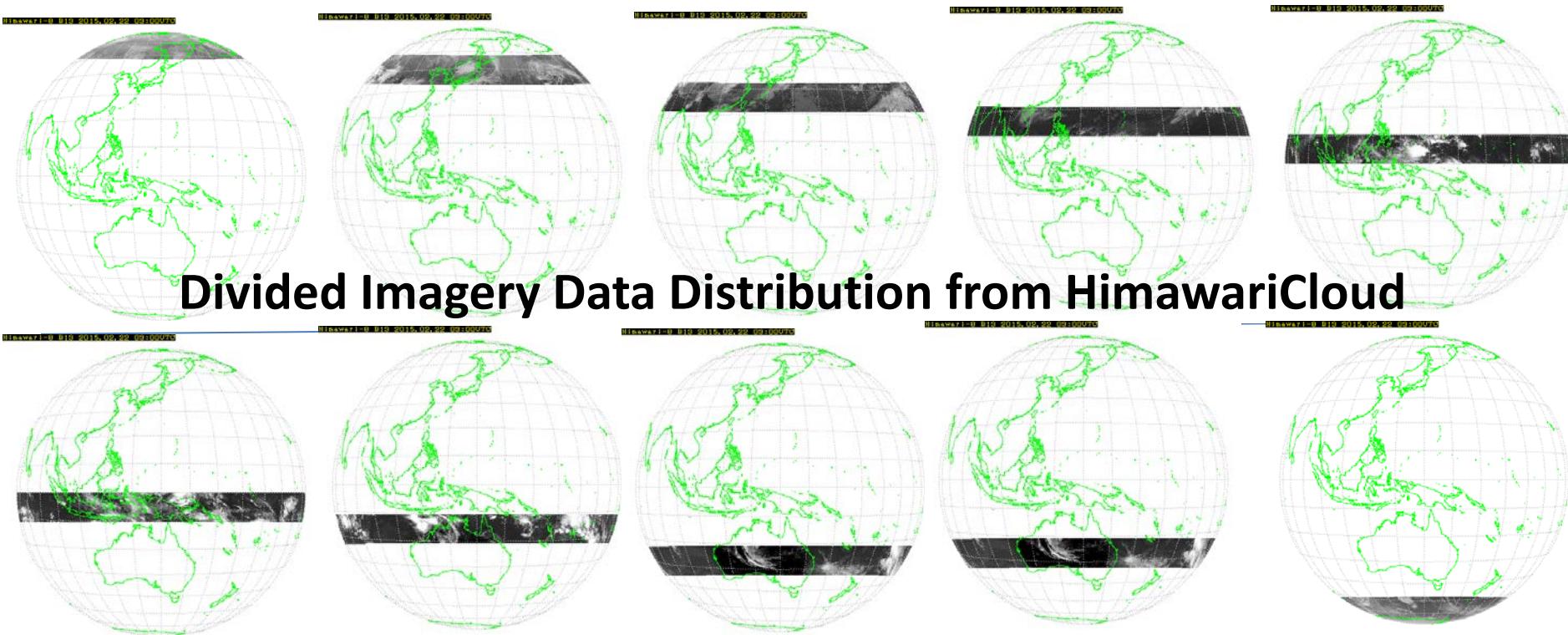
HimawariCast/HimawariCloud: Data spec.

Service	Users	Format	Interval	Band	Resolution	Delivery
HimawariCloud (for advanced usage)	NMHS	HSD (Himawari Standard Data)	10 min	16	VIS: 0.5-1 km IR: 2 km	<u>High-speed Internet</u> (NTT Communication)
HimawariCast (for baseline usage)	All	HRIT files (MTSAT Compatible)	10 min	14	VIS: 1 km IR: 4 km	Communication Satellite (JCSAT-2A/2B)
Web-based Quick-Look	All	JPEG	10 min	4+	several km	

http://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php?area=se1



Integrated Usage of HimawariCloud and HimawariCast



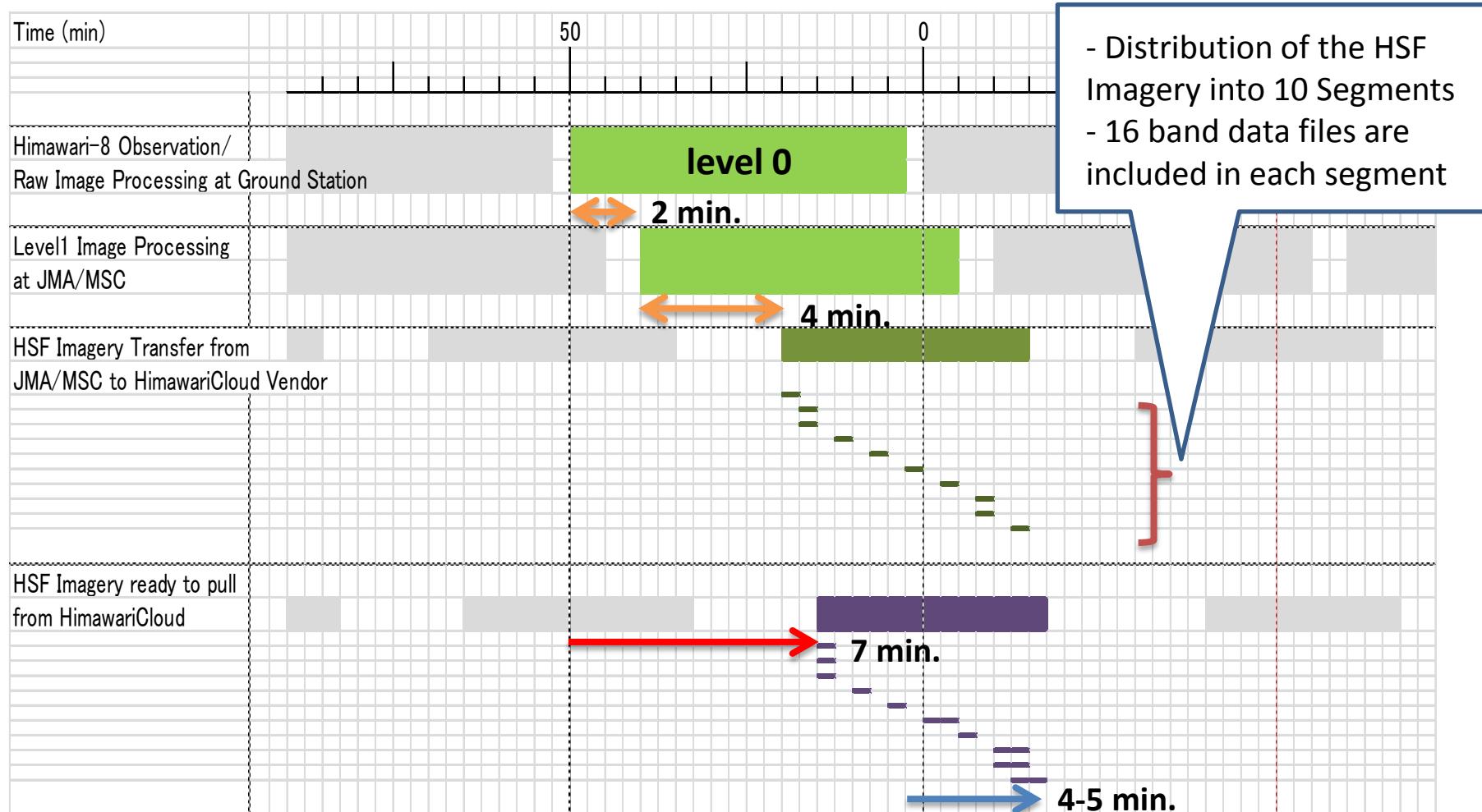
- Full Disk Imagery from HimawariCast
- The Specific Imagery in detail from HimawariCloud

Table. Segment number and approximate coverage in latitude

Segment #	North Edge (lat.)	South Edge (lat.)
1	--	47 deg.N
2	47 deg.N	32 deg.N
3	32 deg.N	21 deg.N
4	21 deg.N	10 deg.N
5	10 deg.N	Equator
6	Equator	10 deg.S
7	10 deg.S	21 deg.S
8	21 deg.S	32 deg.S
9	32 deg.S	47 deg.S
10	47 deg.S	---

Timeline of HimawariCloud HSF Imagery data Distribution

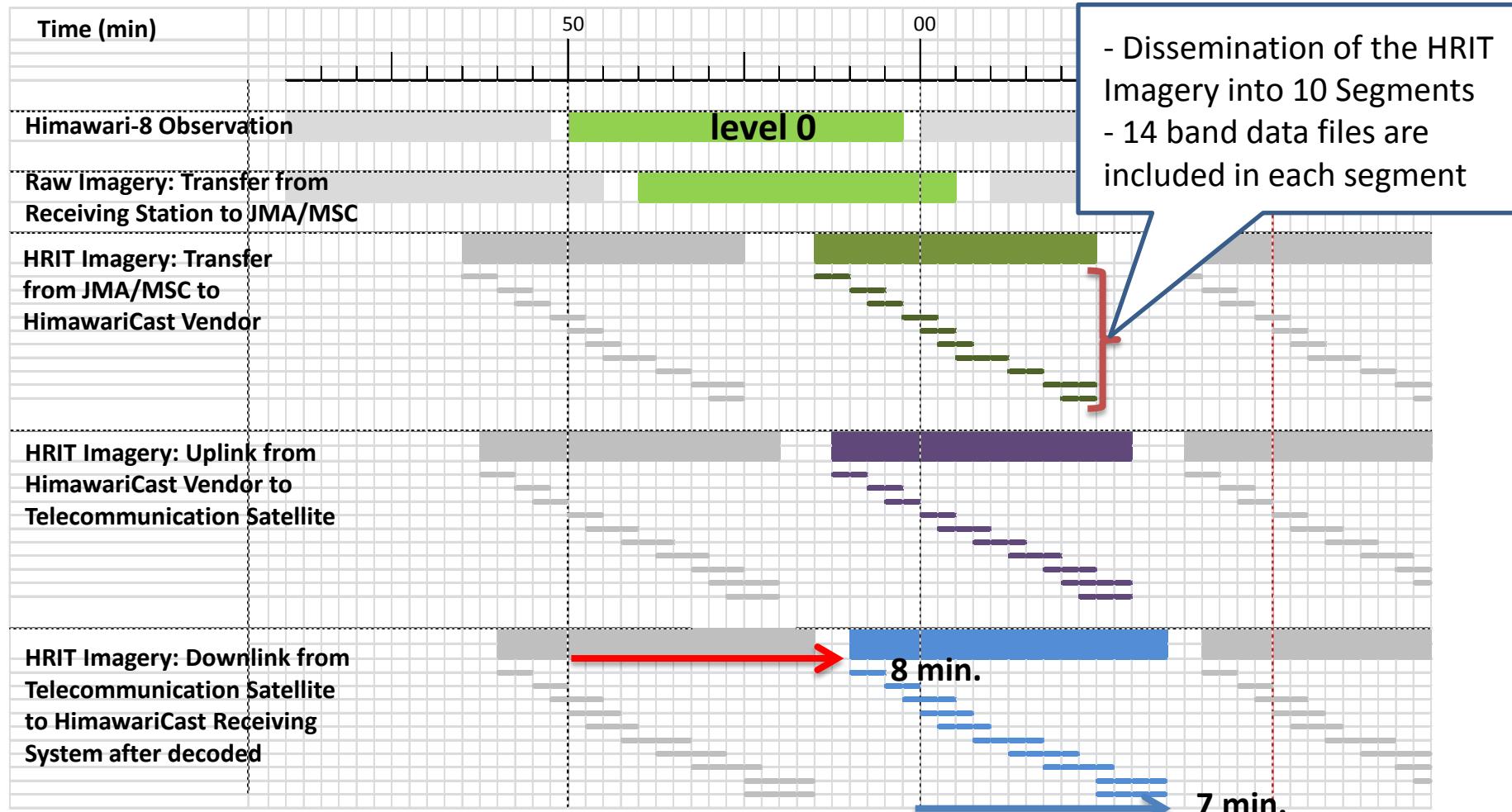
time is rounded in minutes based on the past record at "peak time" (local noon after spring equinox)



The first Segment Imagery Data will be ready to pull **within 7 min. after observation start time (the last Segment within 4-5 min. after observation end time)**

Timeline of HimawariCast HRIT Imagery data Dissemination

time is rounded in minutes based on the past record at "peak time" (local noon before spring equinox)



The first segment data is to be disseminated **within 8 min. after observation start time** (the last segment data within 7 min. after observation end time)

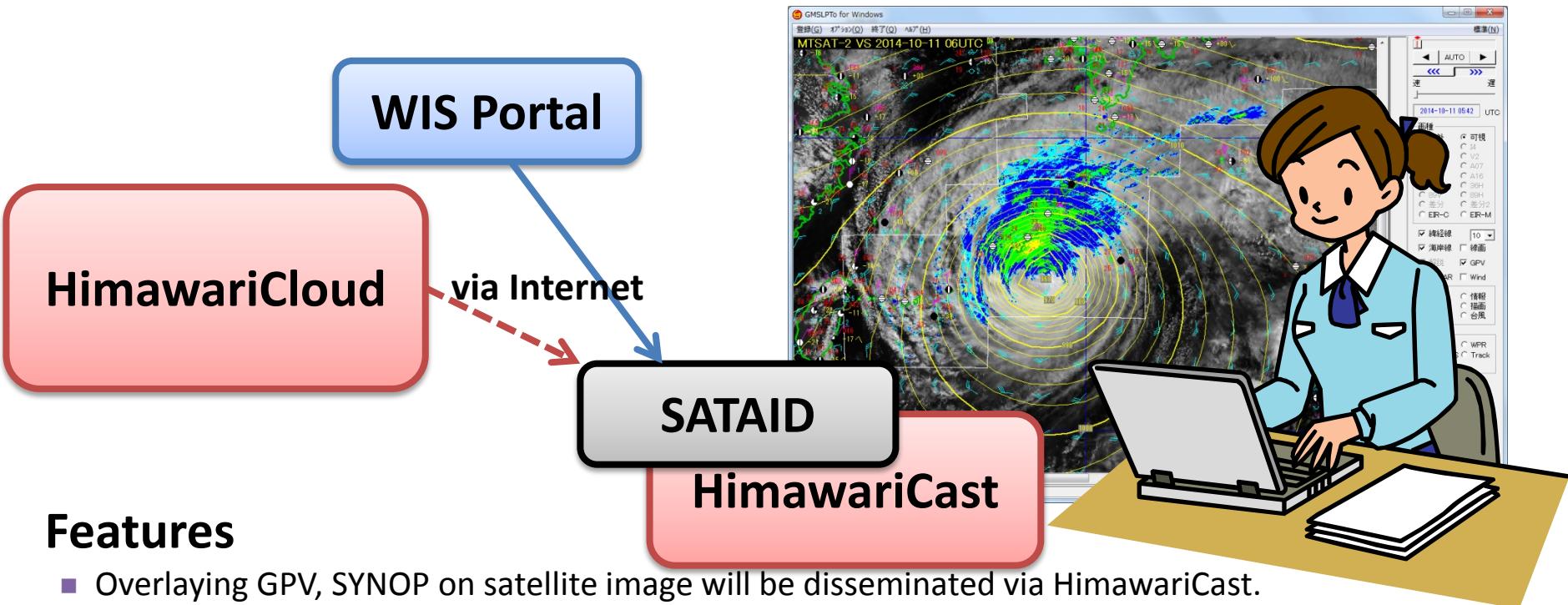
Archived Servers Operated by Japanese Science Group

The following Himawari Historical Data Servers are operated by Japanese Science Group on a voluntary basis for Non-Profit R&D Users

- **Chiba University Data Server**
CEReS (Center for Environmental Remote Sensing)
- **ICT Himawari-8 Real-time Web**
<http://himawari8.nict.go.jp/>
- **JAXA Himawari Monitor**
<http://www.eorc.jaxa.jp/ptree/index.html>
- **University of Tokyo**
DIAS (Data Integration and Analysis System)
(in preparation for operation)

HimawariCast with SATAID

HimawariCast provides
an Integrated Environment for Satellite Cloud Imagery Analysis
with overlaying weather radar, GPV, SYNOP on SATAID system



Features

- Overlaying GPV, SYNOP on satellite image will be disseminated via HimawariCast.
- Satellite image in SATAID format can be downloaded from WIS Portal server, or you can convert from HRIT image data.
- SATAID System will be available from MSC Website with “Source Code”
- Image data format converter between HRIT and SATAID/NetCDF will be provided from MSC Website
- Handling Tools for reading Image Data in NetCDF format will also be provided from MSC Website for the further use in GIS applications.

HimawariCloud/HimawariCast Users

HimawariCloud: 20 Countries
HimawariCast: 18 Countries
registered (as of September 2015)

HIMAWARI-8 Image Navigation & Calibration Status

Himawari-8 Image Navigation

Estimated from “Coast Line” Analysis

Image Navigation

for band 13 (10.4 μ m)

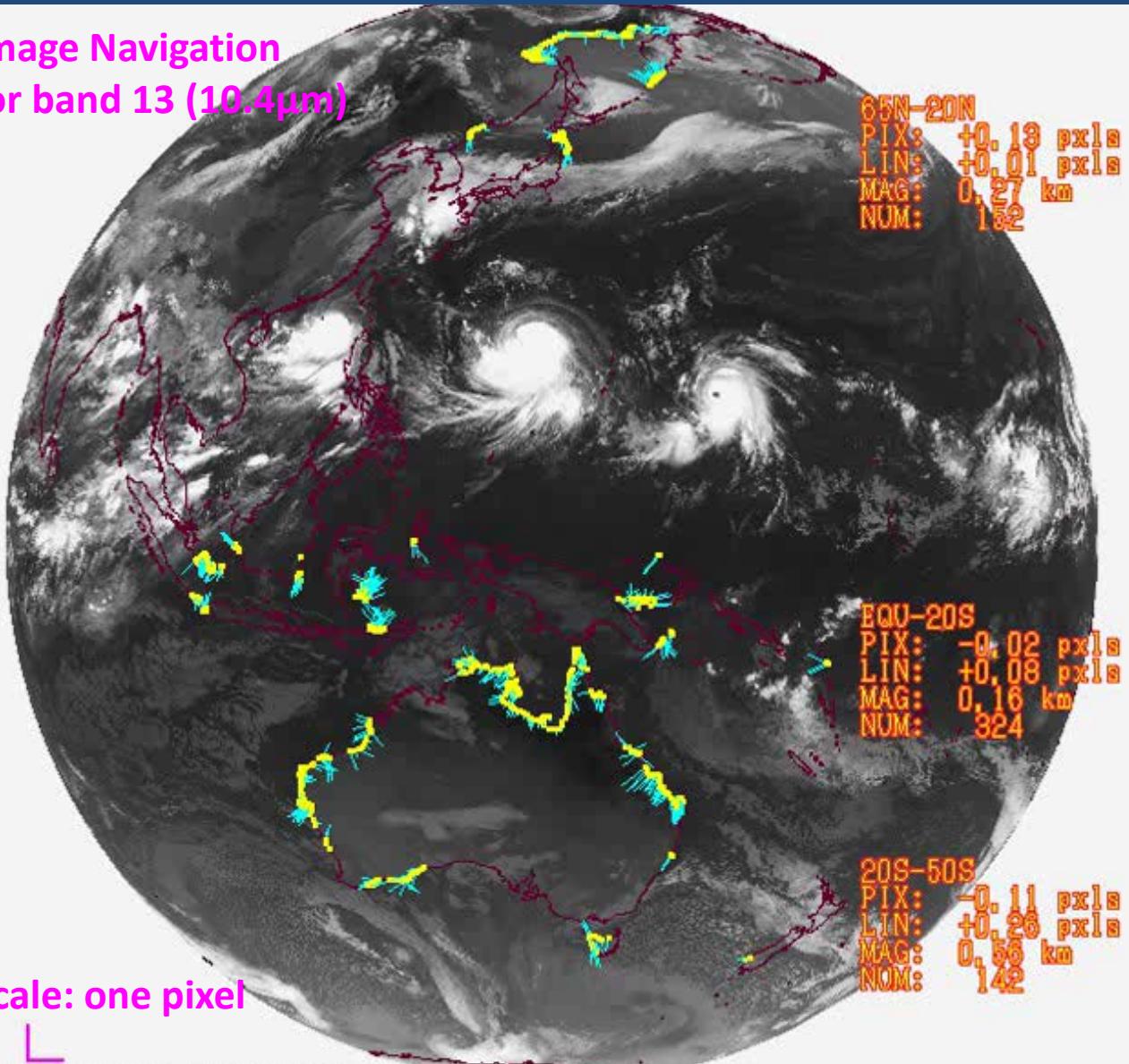


Image navigation accuracy is mostly less than 0.3 pixels

Scale: one pixel



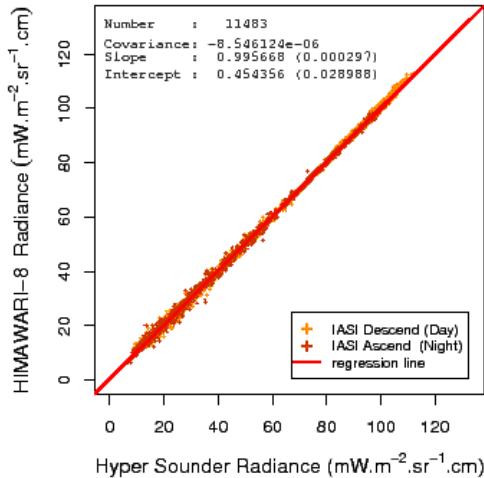
MEAN OF VECTOR MAGNITUDES (pixels): 0.16 (=0.3 km)

MEAN VECTOR (pixels): PIX -0.00, LIN +0.10, MAG 0.10 (=0.2 km), # OF SAMPLES: 618

Validation of IR Bands Calibration based on GSICS inter-calibration

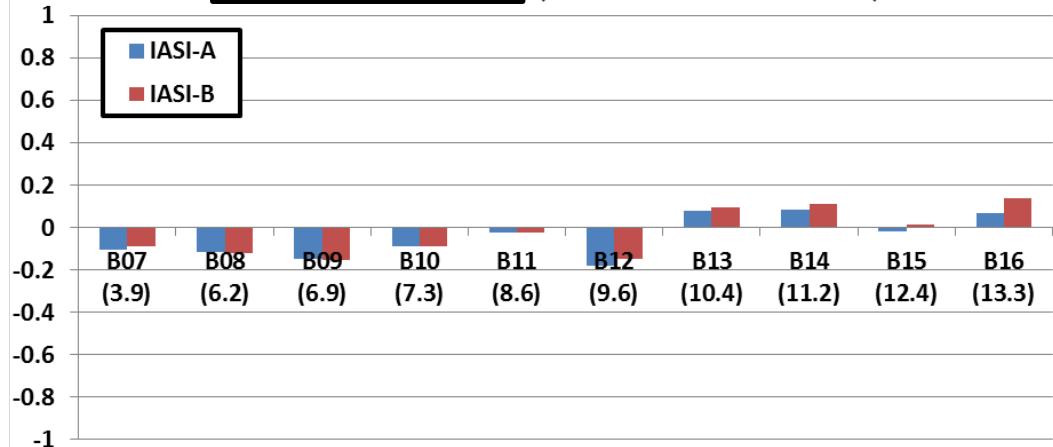
Radiance

HIMAWARI-8 BAND13 vs. METOP-A/IASI
27 Jul 2015 (Period: 13 Jul 2015 to 10 Aug 2015)



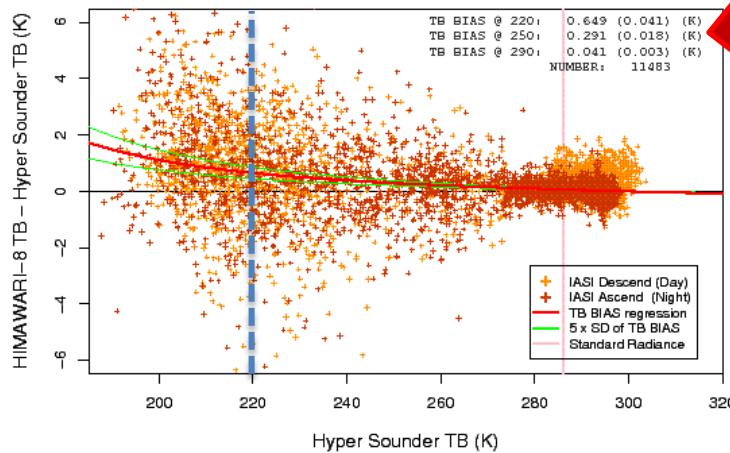
Tb Bias

(at standard radiance)



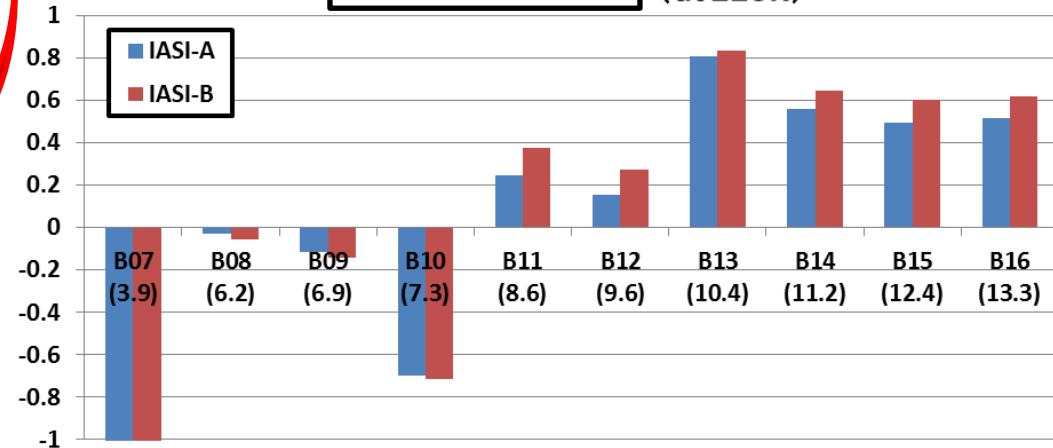
Brightness Temp. (Tb)

HIMAWARI-8 BAND13 vs. METOP-A/IASI
27 Jul 2015 (Period: 13 Jul 2015 to 10 Aug 2015)



Tb Bias

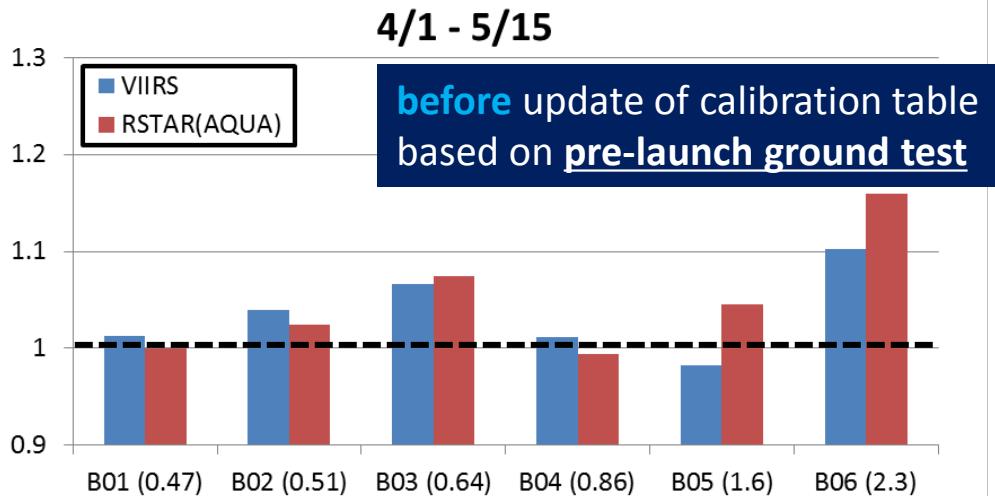
(at 220K)



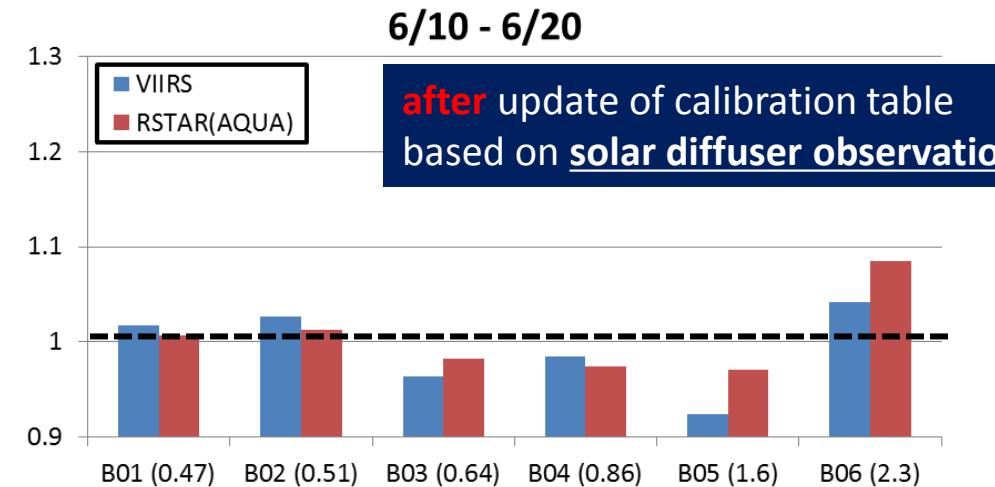
* Standard Radiance was calculated under clear sky condition over the ocean in nighttime by RTTOV 11.2 with US standard atmosphere (1976)

Validation of VIS/NIR Bands Calibration for Himawari-8 Imagery

- Two ways of validation results are well agreed
- Ratio to observed AHI reflectivity are around 1.0 for all VIS/IR bands
- However, it differs in property between B01-04 and B05-06

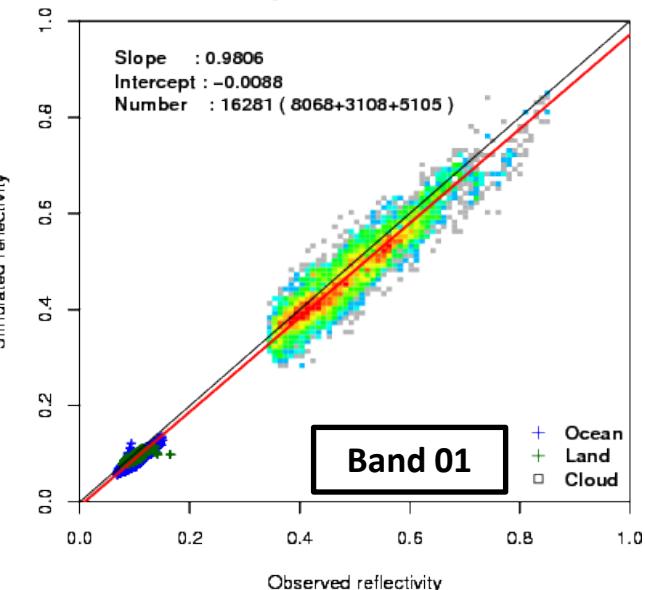


Updating calibration coefficients on 8 June, 2015

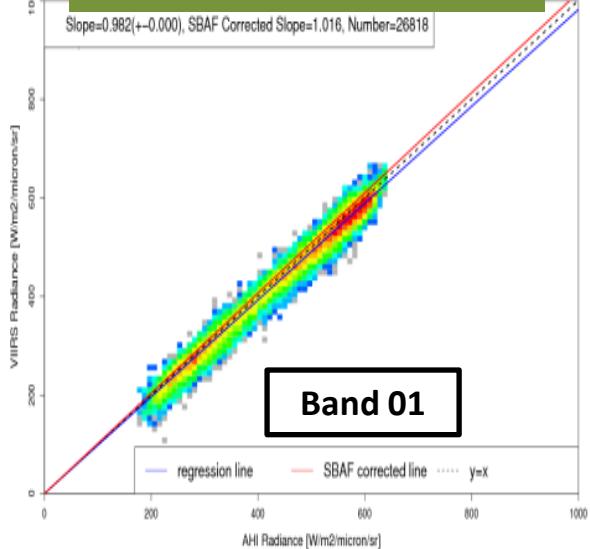


Radiative Transfer Simulation with RSTAR

29 May 2015 to 21 Jun 2015



Ray-matching with VIIRS



Himawari Operation Status and Imagery Calibration/Navigation Monitoring from MSC Web

Himawari-8 Operation Status

Meteorological Satellite Center (MSC) of JMA

Home Activities Products Operations Supports

About us Aims Japanese

Monitoring the earth from space

Himawari-8 Real-Time Image

Himawari-8 User's Guide

Himawari-8 Operational Information MTSAT Operational Information

Virtual Laboratory (VL)

Products and Library

VLab

Navigation Monitoring Calibration Monitoring

RARS Monitoring Outlines and Activities

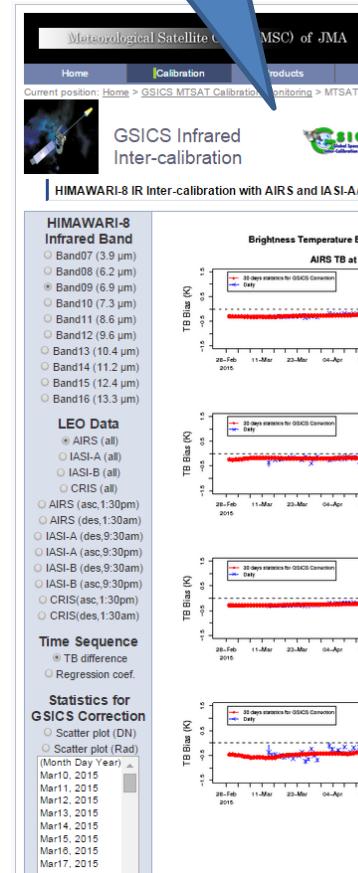
ATTENTION

- This website renewed with Himawari-8 operation starting on 7 July, 2015.

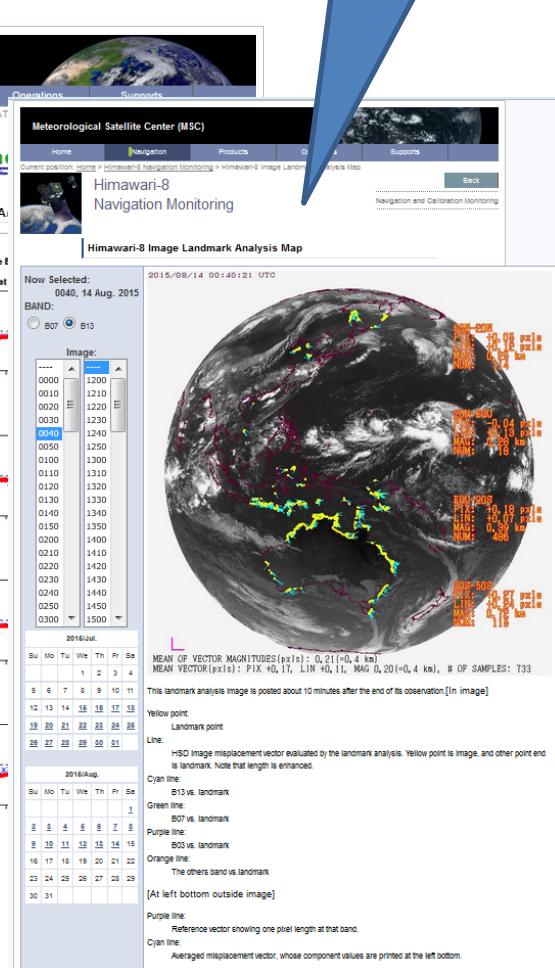
Information

- The Sixth Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-6) Venue decided (8 June 2015)
- Himawari-8 is scheduled to start operation at 02 UTC on 7 July 2015 (27 May 2015)
- Collection of images captured by Himawari-8 (1 May 2015)
- The Sixth Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-6) First Announcement (12 March 2015)
- Test dissemination of Himawari-8 imagery via the HimawariCast service (12 March 2015)
- Detailed information on utilization of HimawariCloud service (11 March 2015)

Imagery Calibration



Imagery Navigation



<http://www.jma-net.go.jp/msc/en/index.html>

Himawari-8/9 Users Support Information

<http://www.jma-net.go.jp/msc/en/support/>

Contents:

- Overview of satellite observation
- Overview of data dissemination
- Imager (AHI) specifications
- Operational status
- [Sample data](#)
- [Sample source code](#) to read
Himawari-8 data and convert into
other formats

The screenshot shows the "Sample Data (Names/formats)" page of the JMA MSC website. The top navigation bar includes links for Home, Activities, Products, Operations, and Supports. A banner image of Earth from space is visible. Below the navigation, a breadcrumb trail shows the current position: Home > Himawari-8/9 > Sample Data. The main content area features a sub-header "Sample Data (Names/formats)" with a small icon of a satellite. Below this are several tabs: Imager (AHI), Sample Data (highlighted in green), AHI Proxy Data (For researchers), HimawariCast, and HimawariCloud (For NMHSs). Under the "Names/formats" tab, there are sub-links for Himawari Standard Data, HRIT/LRIT Data, NetCDF Data, Color Image Data, JPEG Image Data, and SATAID Data.

Names and formats

This page provides sample data created from AHI Observation data and [AHI Proxy data](#). Table 1 shows names and formats of Himawari-8 and -9 data processed by JMA. AHI Observation data set is acquired in Himawari-8 in-orbit-test period, not in its operational. The bzip2-compressed AHI Proxy data file is smaller than the AHI Observation data file.

Table 1. Names/formats of Himawari-8 and -9 observation data processed by JMA

Name (format)	Observation area	Method				
				For NMHSs		
		via JMBSC	via HimawariCast	via HimawariCloud	via JDDS	via WIS Portal
Himawari Standard Data (Himawari Standard Format)	Full disk	o	-	o	-	-
	Japan area	o	-	o	-	-
	Target area	o	-	o	-	-
HRIT Data (HRIT File Format)	Full disk	o	o	-	o	-
	LRIT Data (LRIT File Format)	Full disk	-	o	-	-

Feel free to contact:

Satellite Program Division, Japan Meteorological Agency
metsat@met.kishou.go.jp

Enhancement in HIMAWARI-8 Level-2 Products

Development of L2 Products from Himawari-8/9 AHI

Increased Observation Spectral Bands

VIS: 1 --> 3

NIR/IR : 4 --> 13

with Higher Resolution

Spatial:

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



Development of Baseline Products, focusing on

- Atmospheric Motion Vectors (AMVs)
- Cloud Properties (incl. Rapidly Developed Convective Clouds)
- Aerosol (incl. Asian Dust) / Volcanic Ash



Numerical Prediction

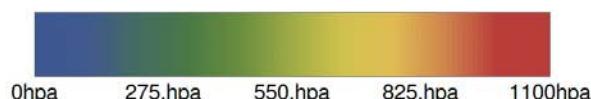
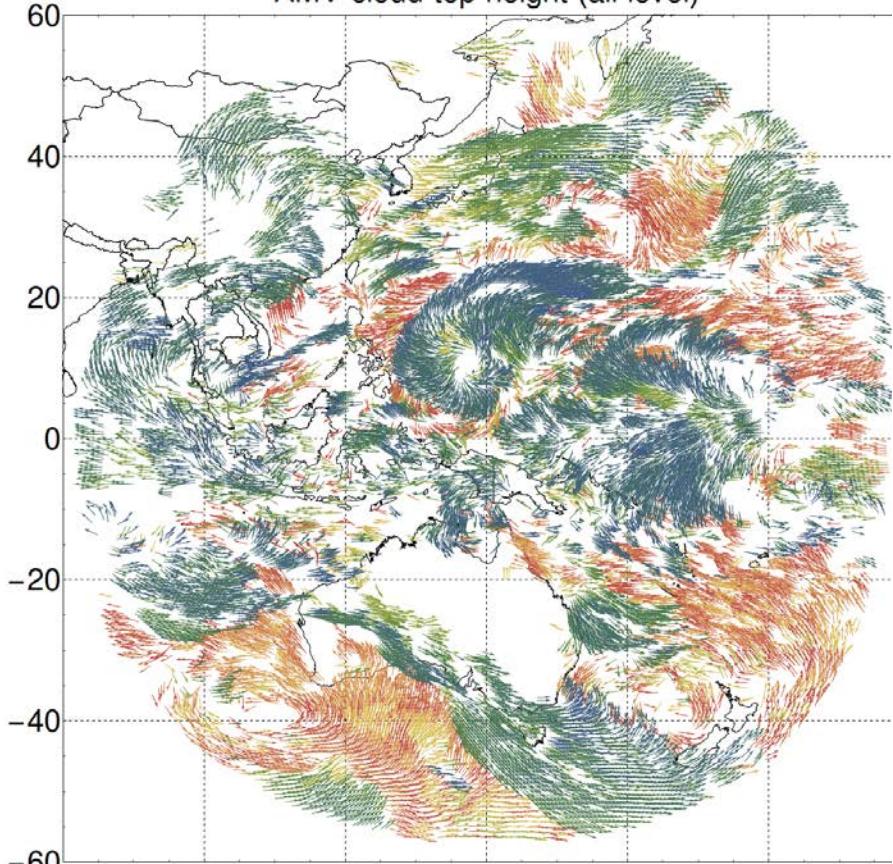
Severe Weather Monitoring

Environmental Monitoring

Himawari-8 Derived AMVs

201504010100 B13

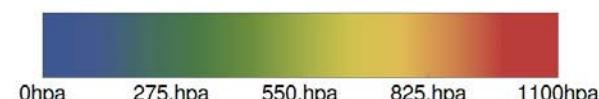
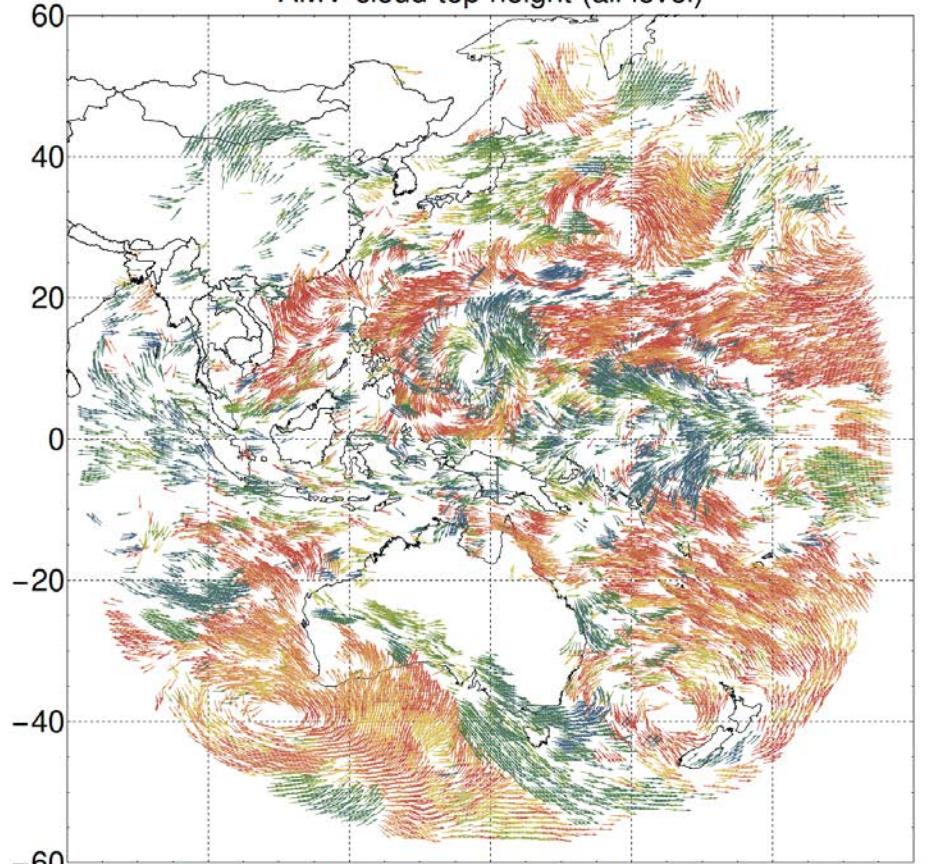
AMV cloud top height (all level)



Infrared AMV

201504010100 B03

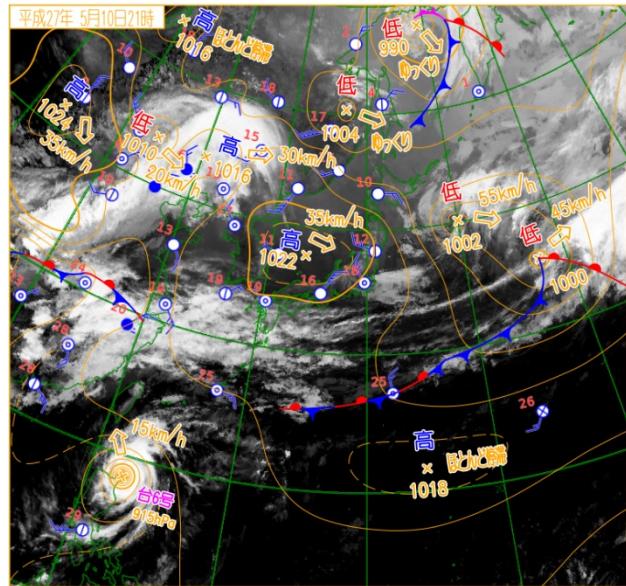
AMV cloud top height (all level)



Visible AMV

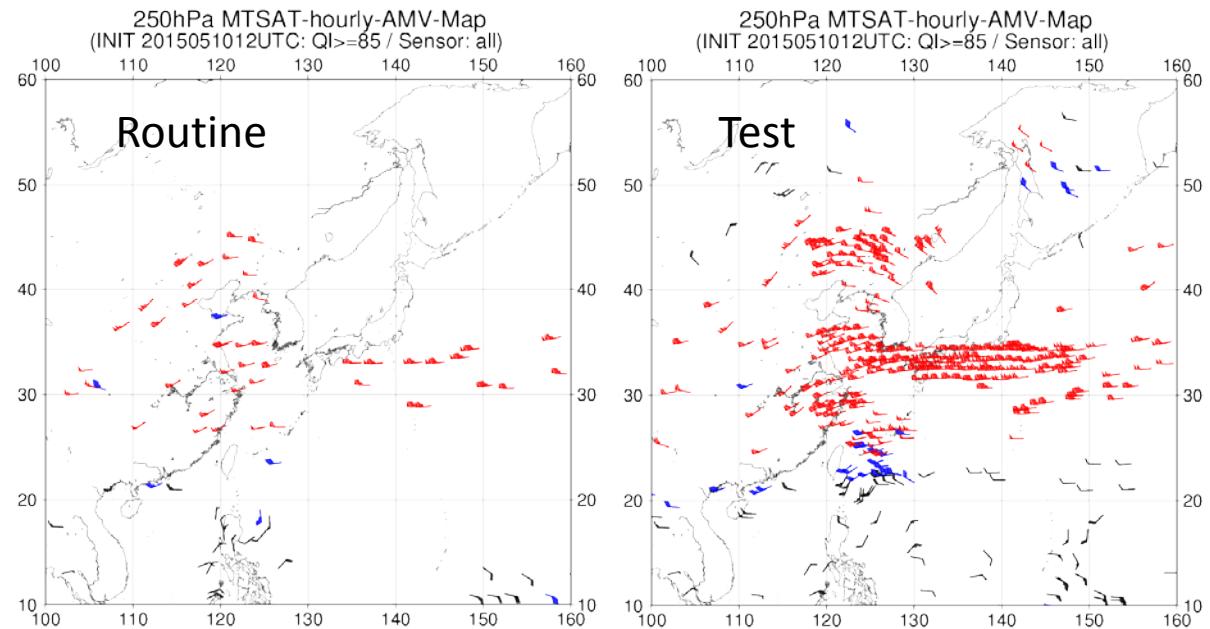
Case Study on Impact of Himawari-8 AMVs using JMA's global NWP system

A sample of the assimilated data distribution (12 UTC, 10 May 2015)



Weather chart with MTSAT-2 infrared satellite image

Red:	$\geq 50\text{kt}$
Blue:	$\geq 30\text{kt}$
Black:	$< 30\text{kt}$



MTSAT-2 AMVs on 250 hPa in vicinity of Japan, which were assimilated into the routine system

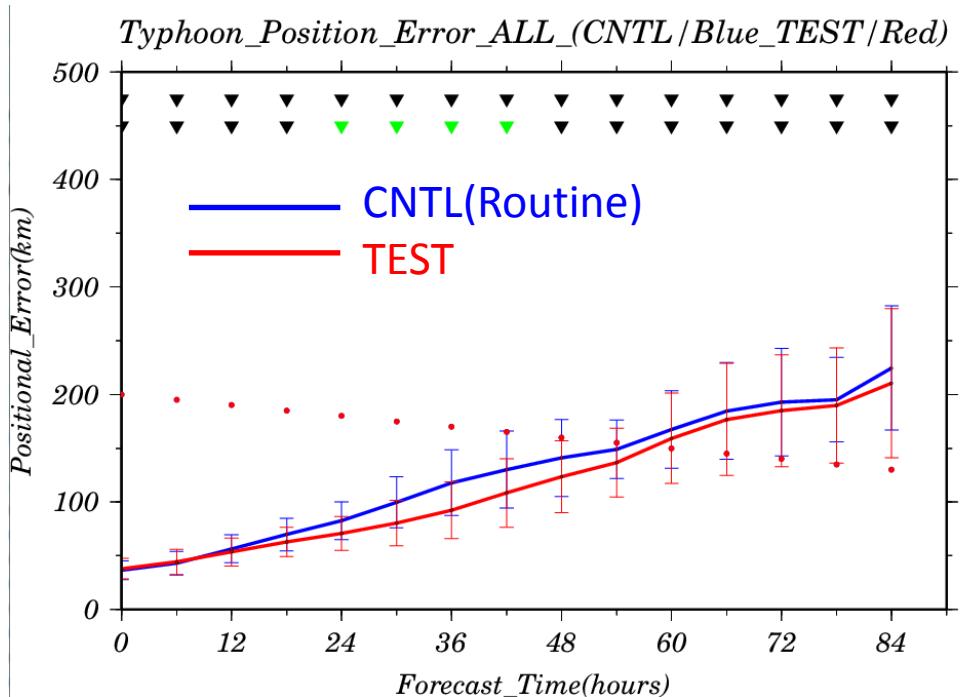
Himawari-8 AMVs on 250 hPa in vicinity of Japan, which were assimilated into the test system

Himawari-8 AMVs were derived from three sequential satellite images with 10-minute time interval by a new retrieval method based on maximum likelihood estimation.

MTSAT-2 AMVs were derived from three sequential satellite images with 15- or 30-minute time interval. (Himawari-8 and MTSAT-2 AMVs used for this study were produced by Meteorological Satellite Center of JMA.)

Typhoon track forecasts using Himawari-8 AMVs

Impact of Himawari-8 AMVs compared to routine



Typhoon track forecast errors averaged for NOUL (T1506)

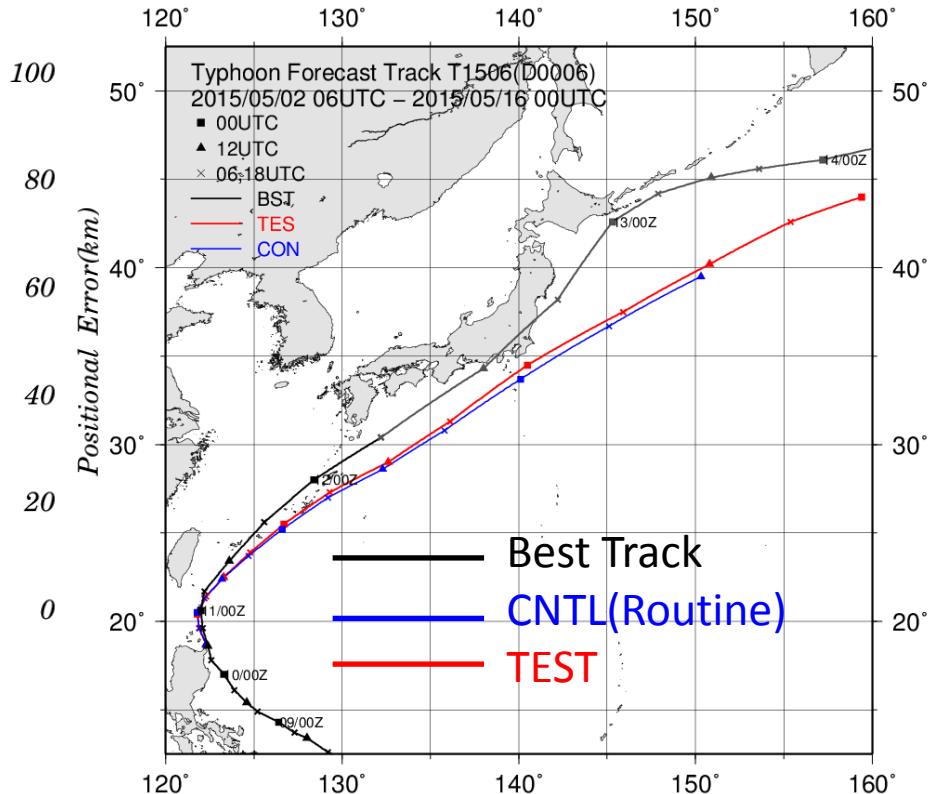
CNTL(Routine): Result by assimilating MTSAT-2 AMVs

TEST: Result by assimilating Himawari-8 AMVs

Period:

Assimilation : From 1 to 24 May 2015

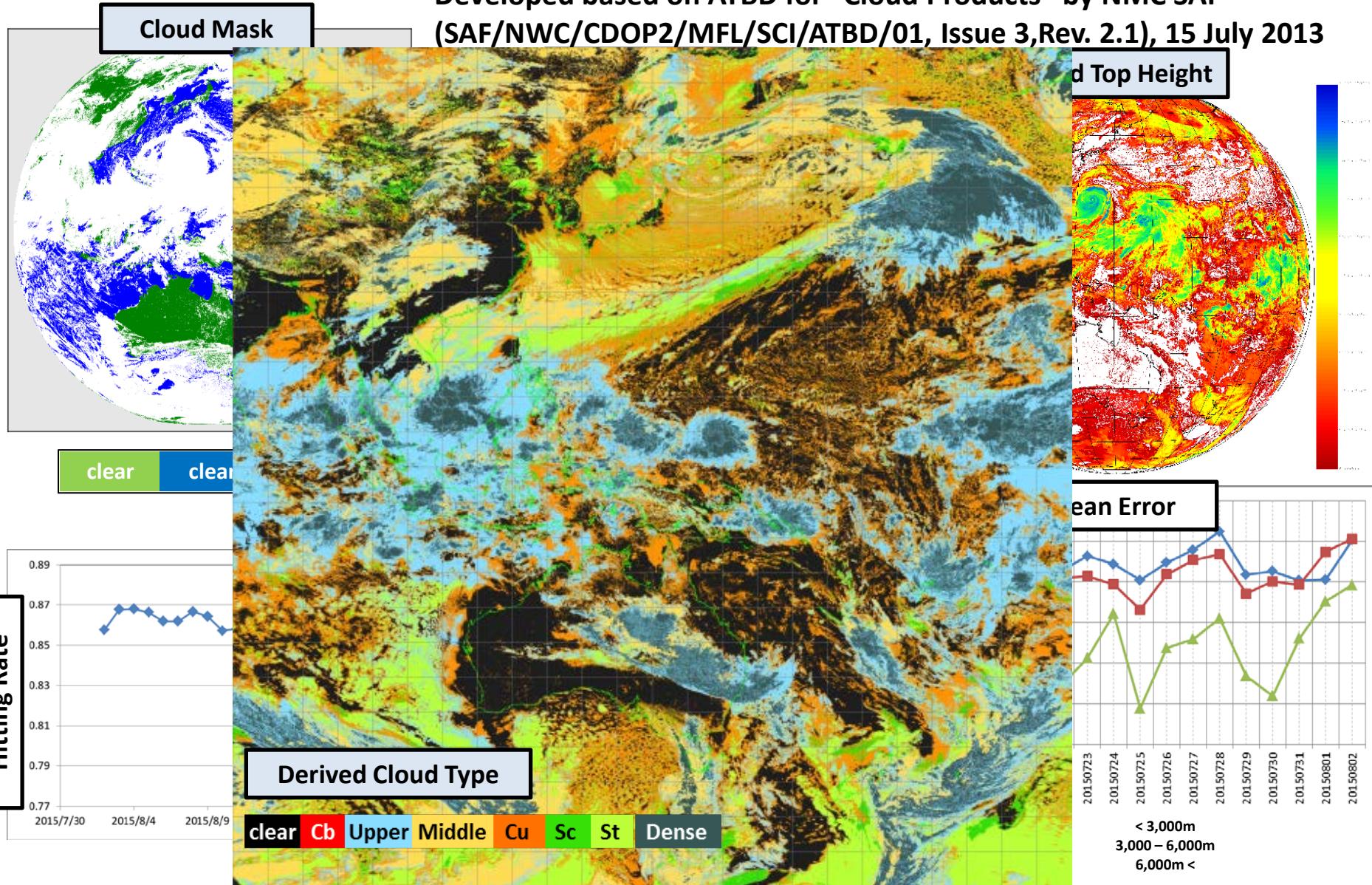
Forecast : From 2 to 12 May 2015



Typhoon track forecast of NOUL (T1506) initialized at 12 UTC on 10 May 2015.
Black is the best track. **CNTL(Routine)** and **TEST** are same to the left panel.

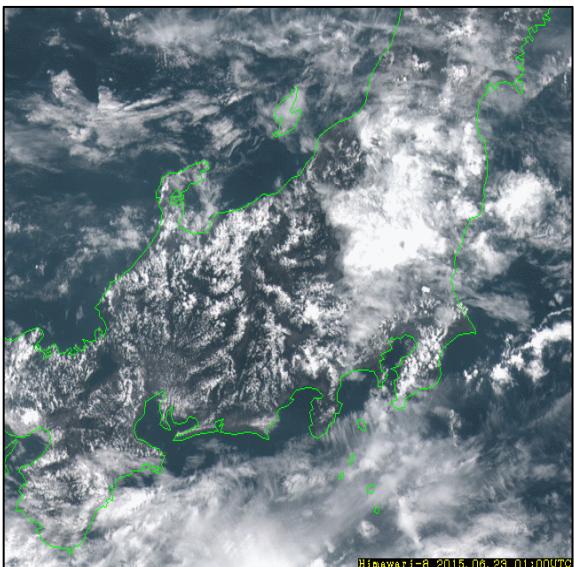
Himawari-8 Derived Cloud Properties “High Resolution Cloud Parameters”

Developed based on ATBD for “Cloud Products” by NMC SAF
(SAF/NWC/CDOP2/MFL/SCI/ATBD/01, Issue 3, Rev. 2.1), 15 July 2013

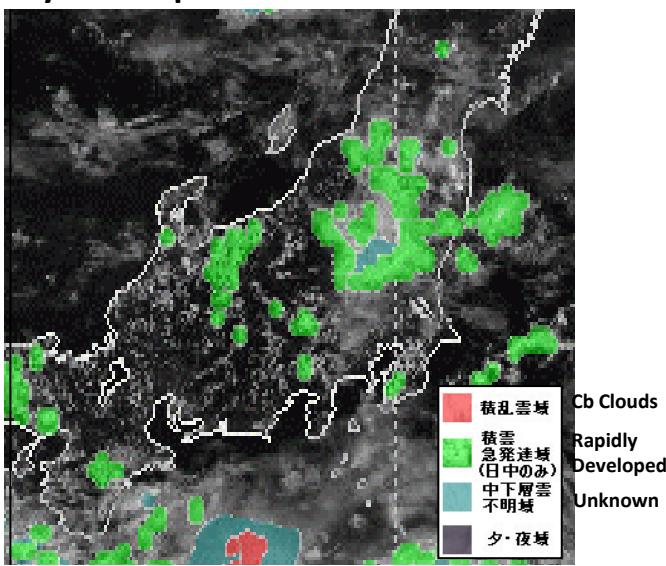


Detection of Rapidly Developed Convective Clouds

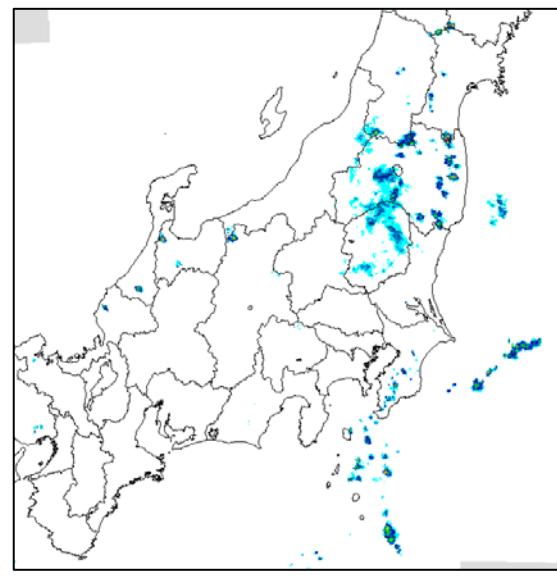
Himawari-8 Imagery



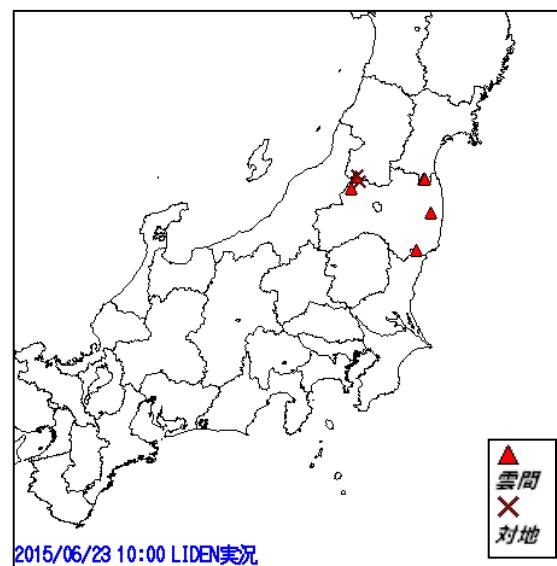
Information on Potential Area for
Rapidly Developed Convective Cloud Area



JMA's Weather Radar System



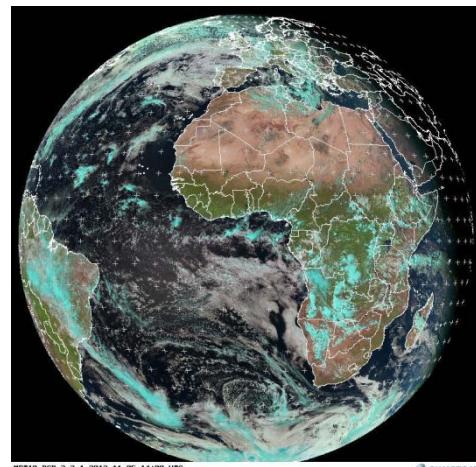
JMA's Lightning Detection System (LIDEN)



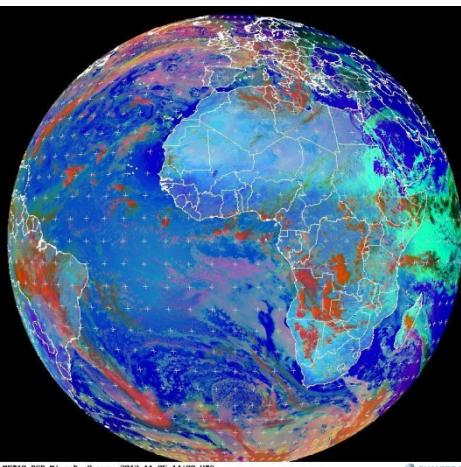
Multi-band Imagery Data Utilization

- Starting with “Qualitative (Subjective)” analysis by multi-band RGB composited imagery developed by EUMETSAT from the METEOSAT MSG onboard SEVIRI of 12 bands.
- Based on the knowledge and understanding from RGB imagery, “Quantitative” level 2 products will be produced through an “empirical” statistics, or “physical” retrieving with other ancillary data such as NWP model.

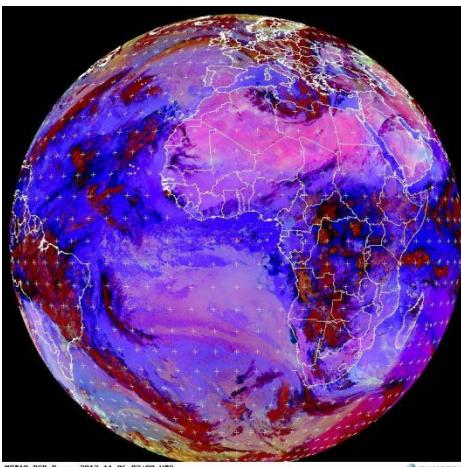
EUMETSAT MSG/SEVIRI RGBs



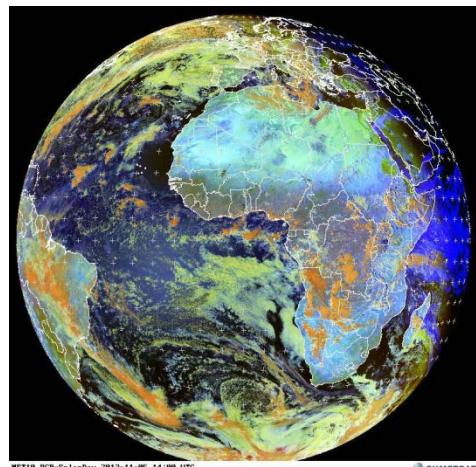
Day Natural Colors



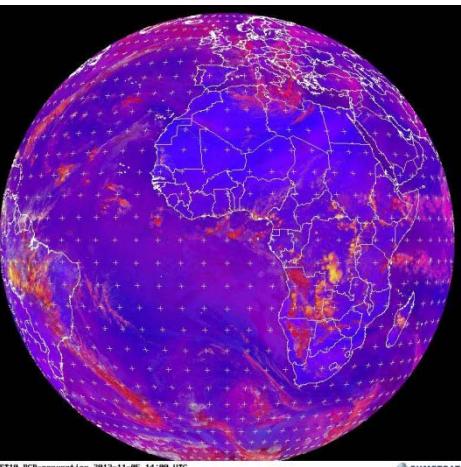
Day Microphysics



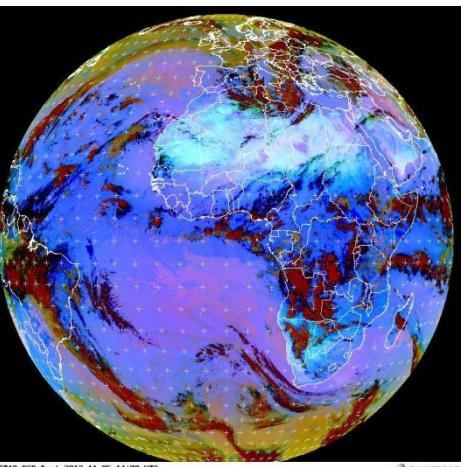
Night Microphysics



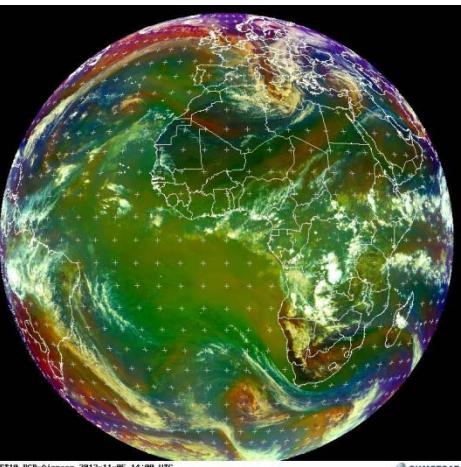
Day Solar



Convective Storms



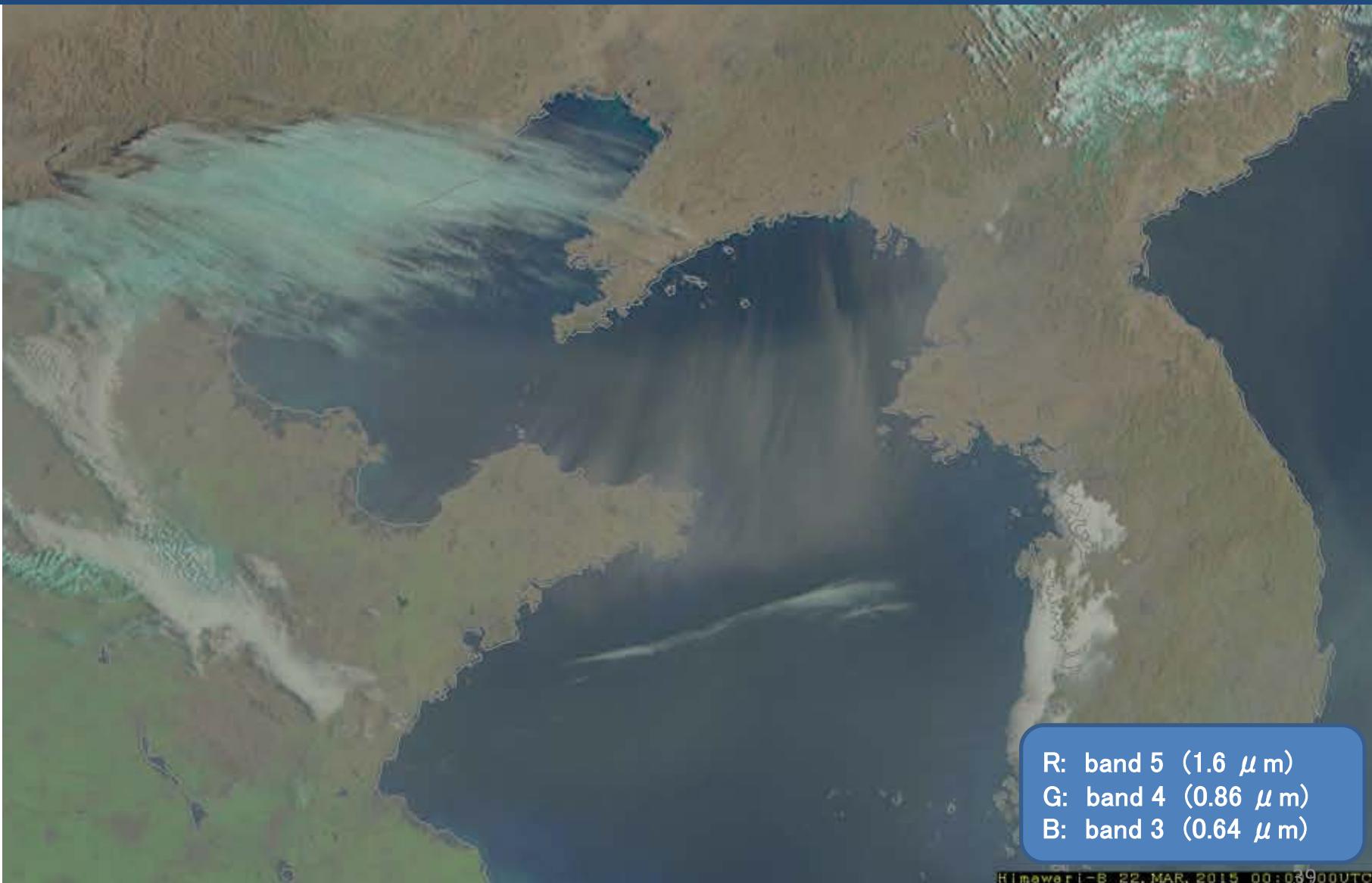
Dust



Airmass

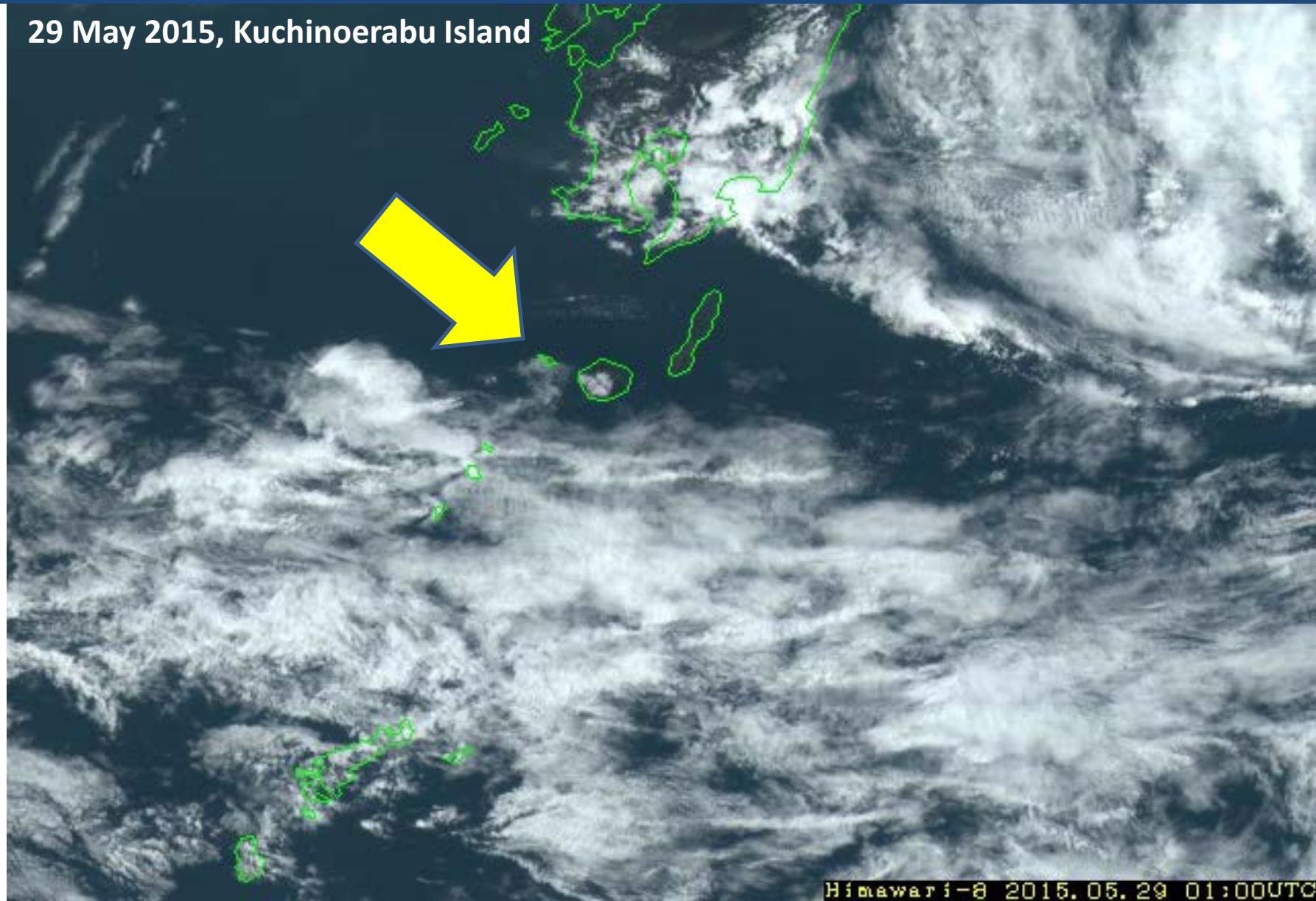
<http://oiswww.eumetsat.org/IPPS/html/MSG/RGB/>

Utilization of RGB Imagery: Visible and Near Infrared Detection of Aerosol (Asian Dust)



Utilization of RGB Imagery: Visible True Color Detection of Volcanic Ash and Gas from Volcano Eruption

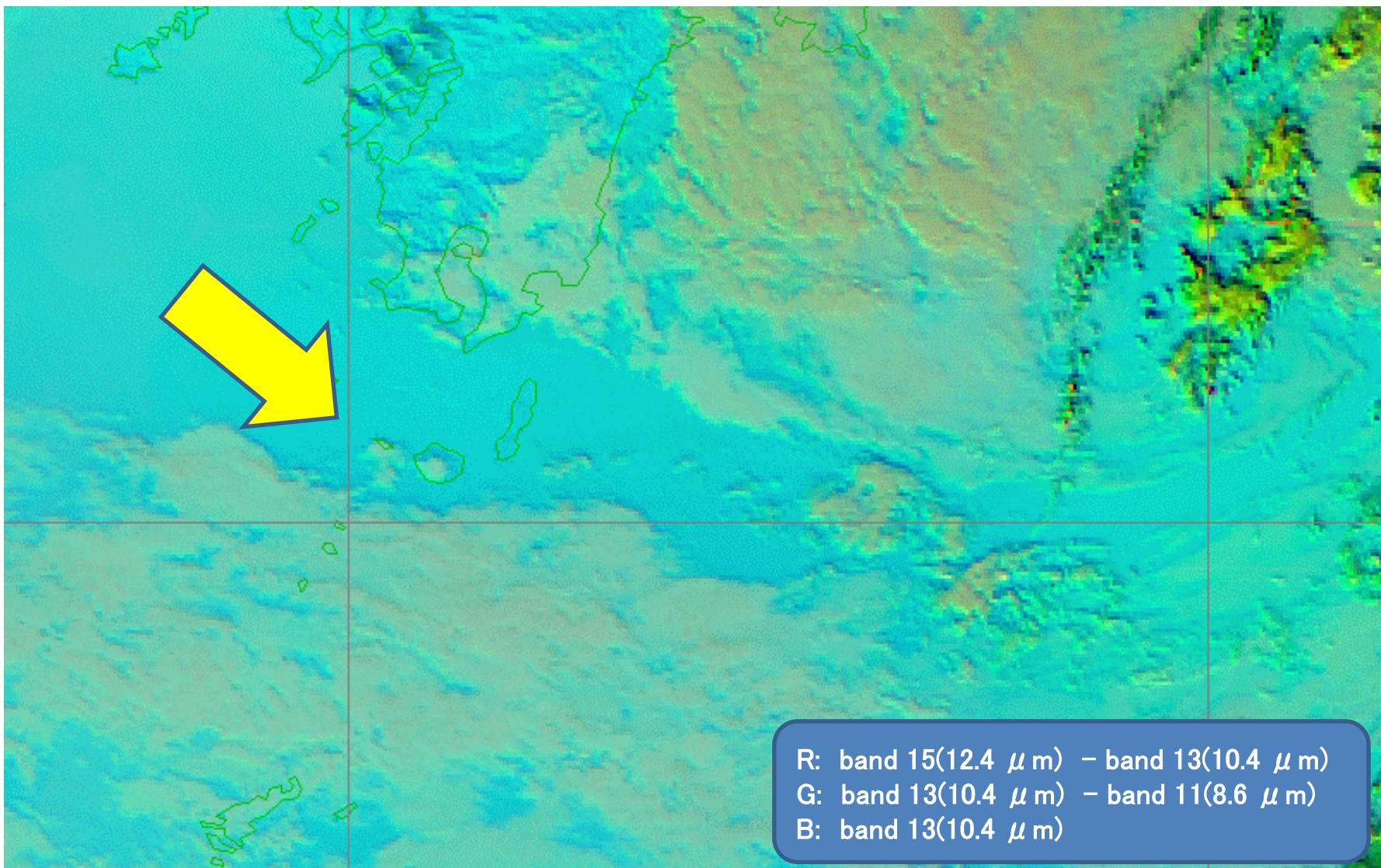
29 May 2015, Kuchinoerabu Island



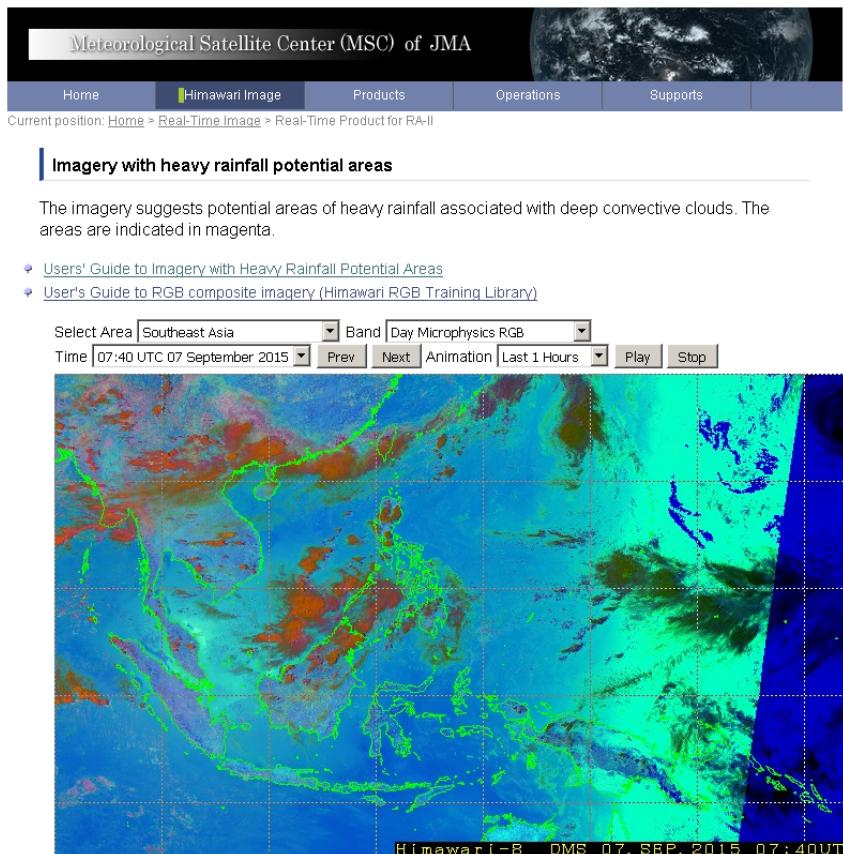
Utilization of RGB Imagery: SO₂ Band (8.6 μm)

Detection of Volcanic Ash and Gas from Volcano Eruption

29 May 2015, Kuchinoerabu Island



JMA real-time RGB Website for supporting SWFDP in RA II and SWFDDP in RA V



Day Microphysics RGB

JMA provides the Web site and the User's Guide documentation.

- RGB composite imagery based on the WMO standard recipe are produced from Himawari-8 imagery.
e.g. Day Microphysics, Night Microphysics.
- Products are provided for supporting SWFDP in RA II/RA V region.
- IR(10.8um), IR(3.9um), WV(6.8um), VIS(0.68um), and **Sandwich Imagery** are also provided.

Future plan

- Development of new RGB imagery or “localization” for typical weather phenomena in Asia/Oceania regions.

RGB Imagery are available from:

http://www.data.jma.go.jp/mscweb/data/himawari/sat_hrp.php?area=r2s
http://www.data.jma.go.jp/mscweb/data/himawari/sat_hrp.php?area=r5s

Thank you !!



Eruption of Mt. Shiveluch in Kamchatka
March 25, 2015

Footage from Himawari-8 Test Observation (Band-3 (0.64 μ m), 2.5 min.)

Himawari-8 B03 25. MAR. 2015 22:02:30 UTC