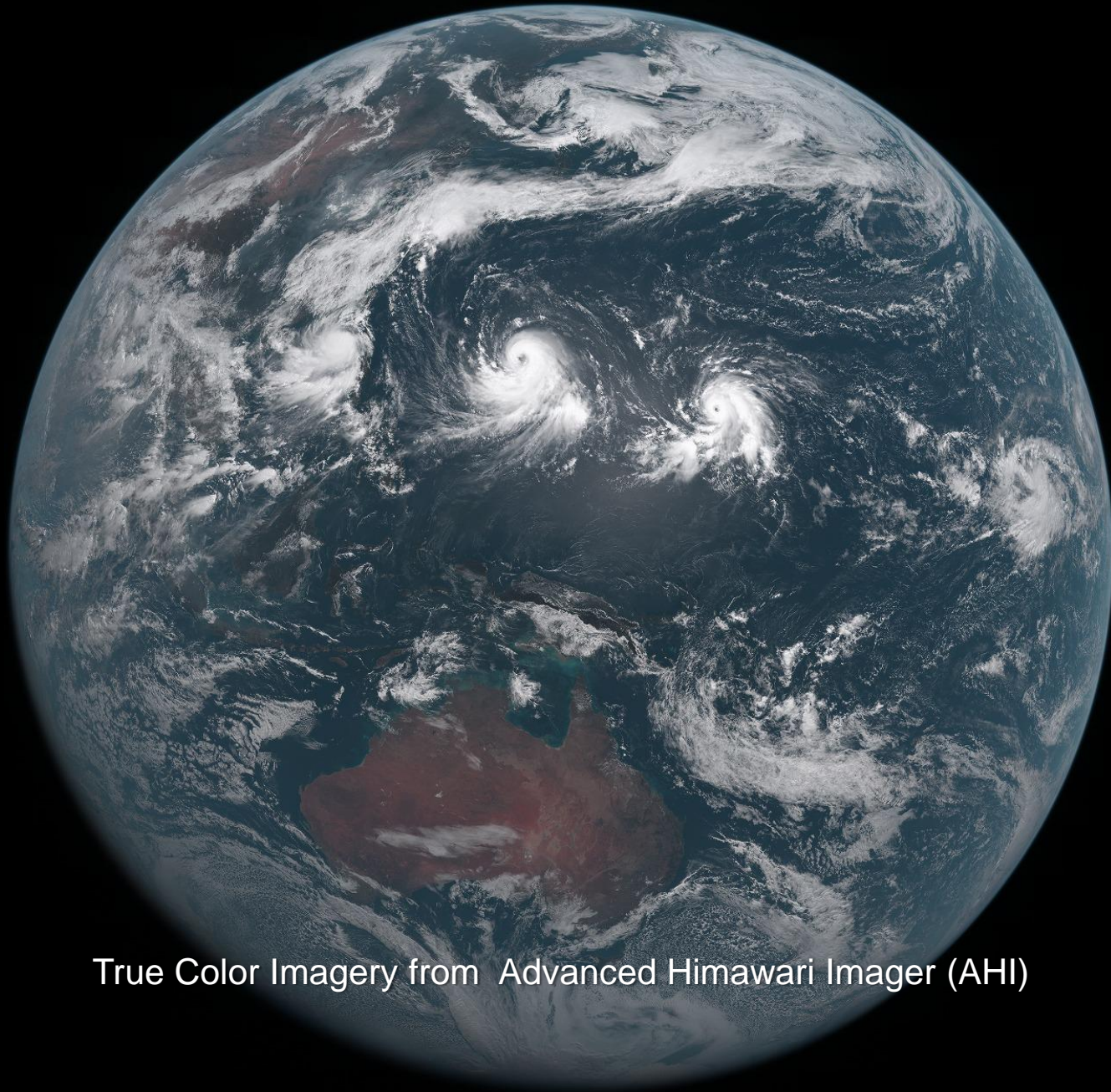


# Overview of Himawari-8/9

Toshiyuki SAKURAI  
Meteorological Satellite Center (MSC)  
Japan Meteorological Agency (JMA)

**EUMeTrain Event Week on MTG-I Satellite 2016**  
**Session2 - Himawari-8 and Data Applications**  
**8 November 2016**

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



True Color Imagery from Advanced Himawari Imager (AHI)

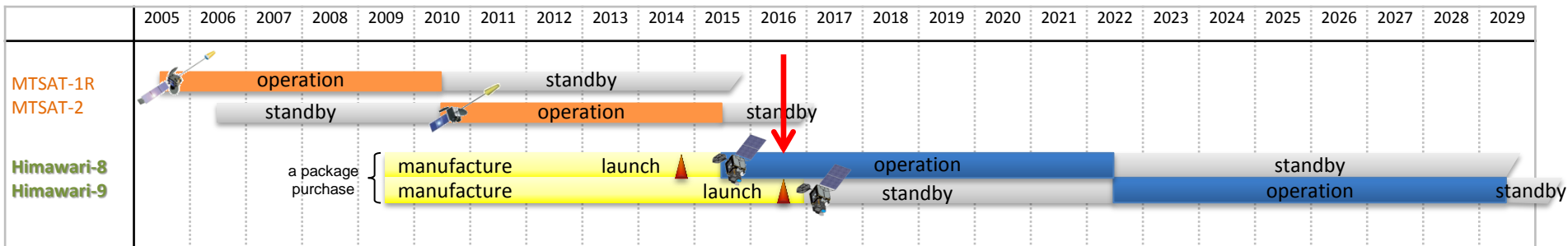
# Himawari-8/9



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

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

Himawari-9 was successfully launched using H-IIA Launch Vehicle No.31 on 2 November 2016 from the Tanegashima in Japan!

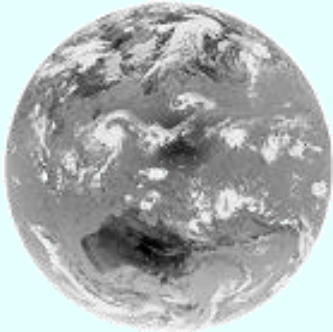




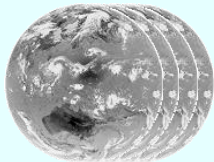
# Improved Resolutions

## Spectral

VIS 1 band



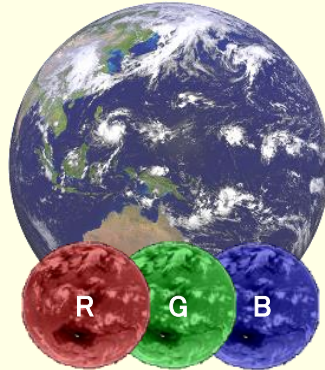
IR 4 bands



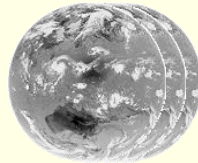
5 bands

**MTSAT-1R/2**

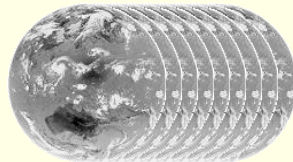
VIS 3 bands



NIR 3 bands



IR 10 bands



16 bands

**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

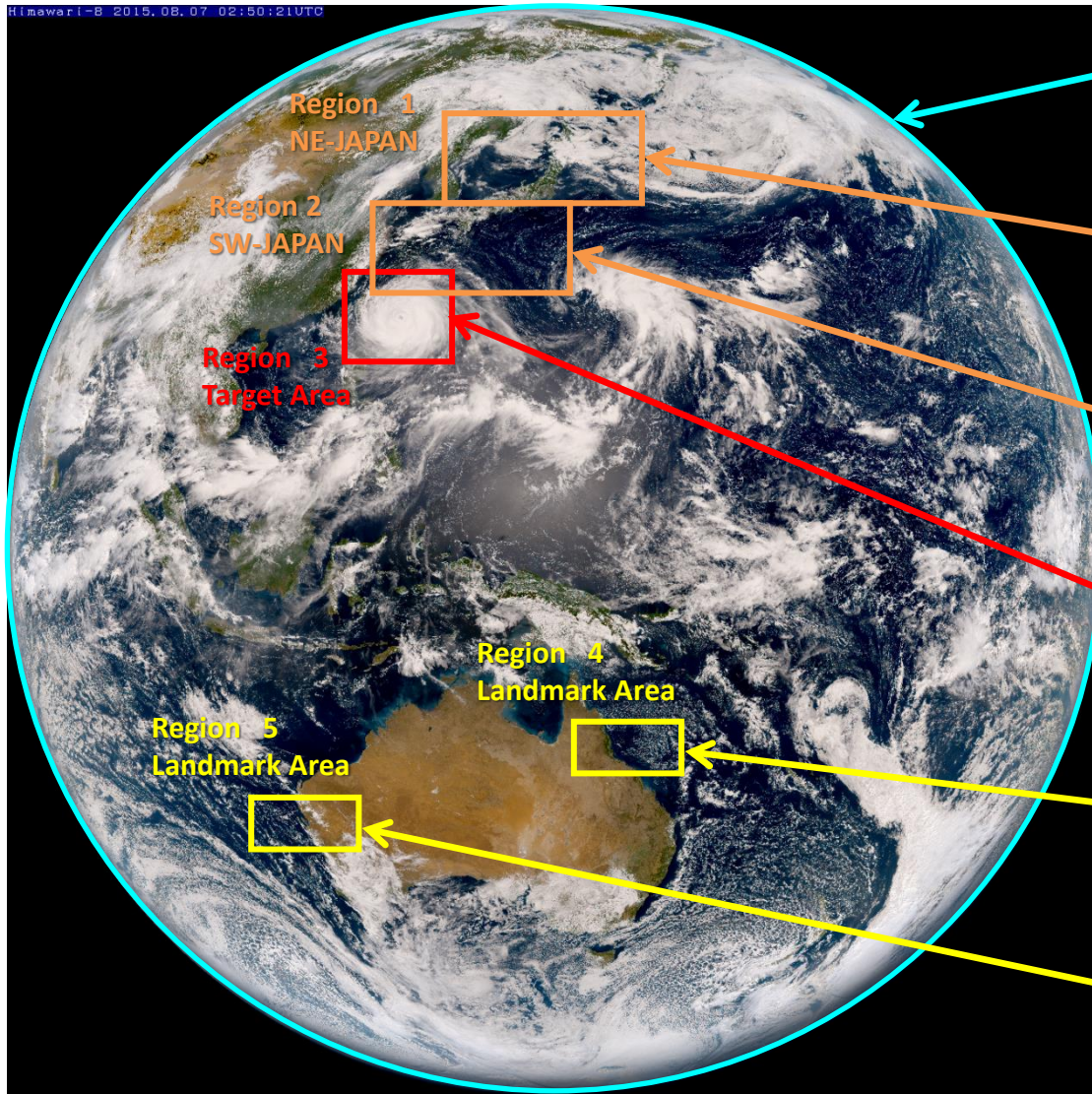
60min.  
[full-disk  
obs.]

**MTSAT-1R/2**

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

**Himawari-8/9**

# 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

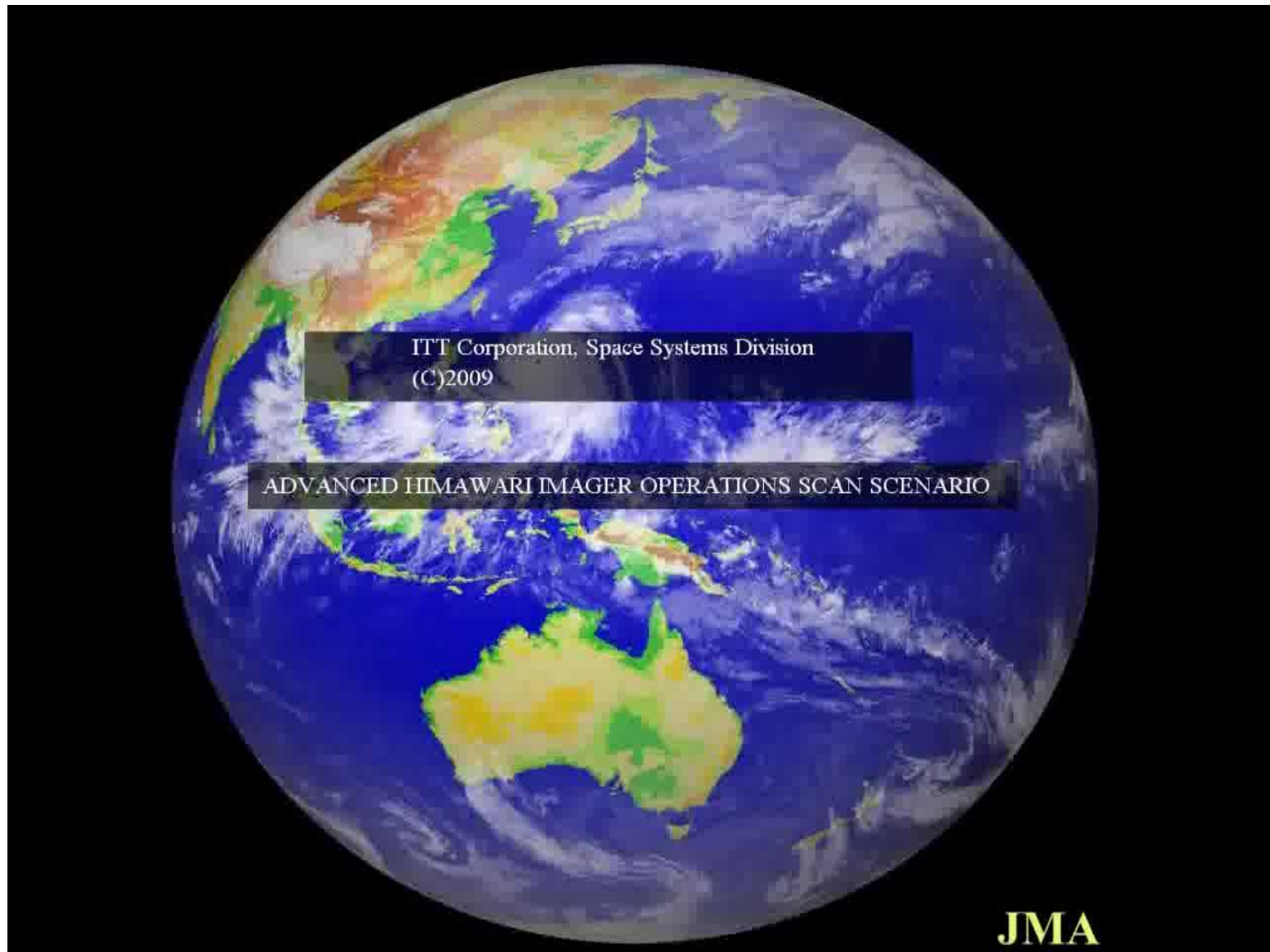
## Region 5 Landmark Area

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

Dimension : EW x NS: 1000 x 500 km

# AHI Scan Scenario

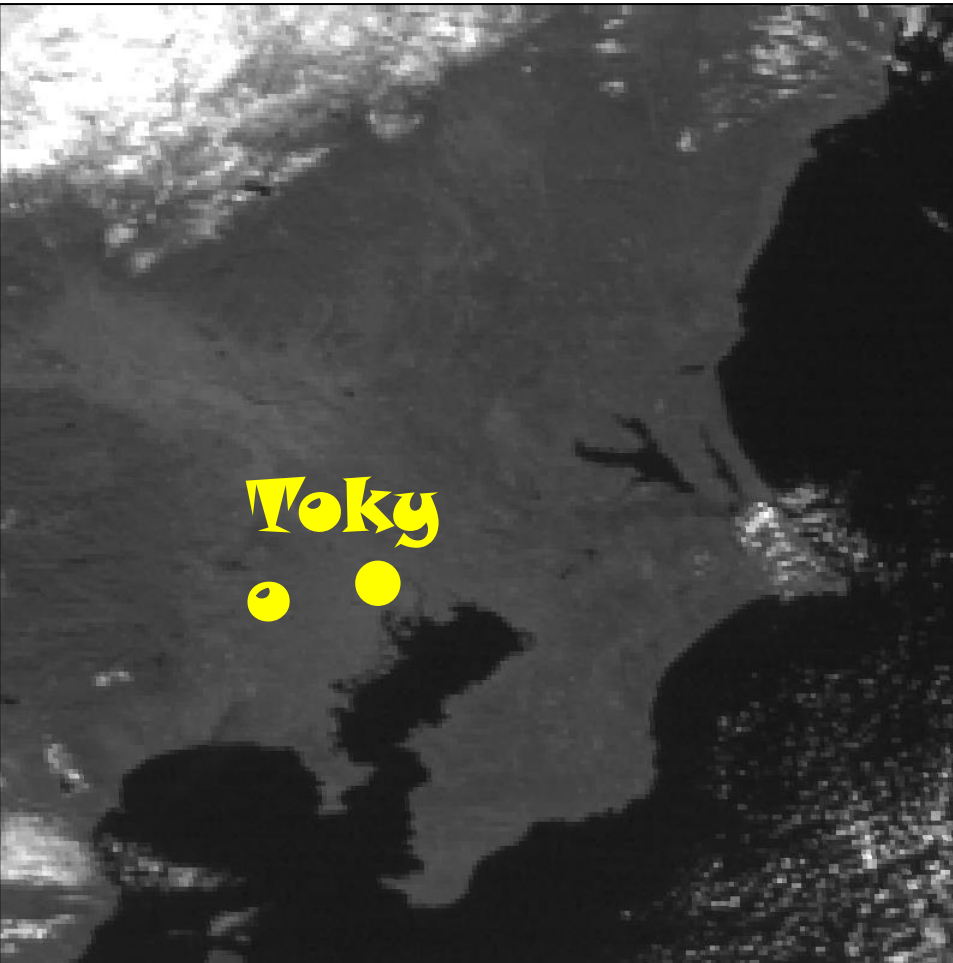
(MOVIE)



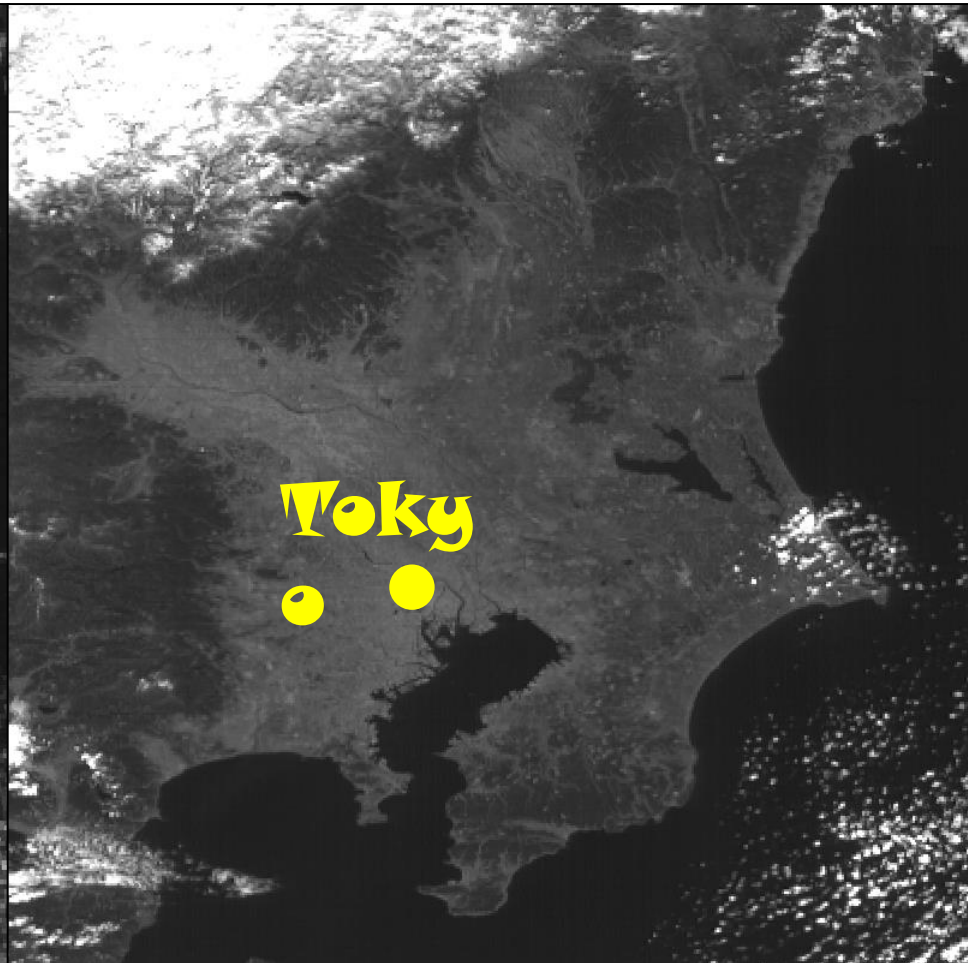


# Spatial Resolution

**MTSAT-2 (VIS)**  
**1km**



**Himawari-8 (B03)**  
**0.5 km**



03:00 UTC on 29 January 2015

# Observation Frequency

(MOVIE)

**MTSAT-2 (VIS)**  
**Hourly in Monochrome**

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



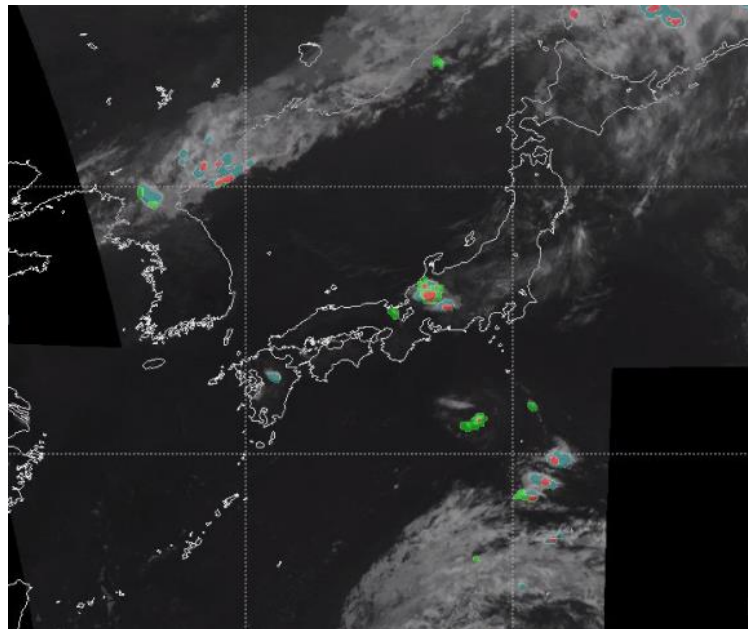
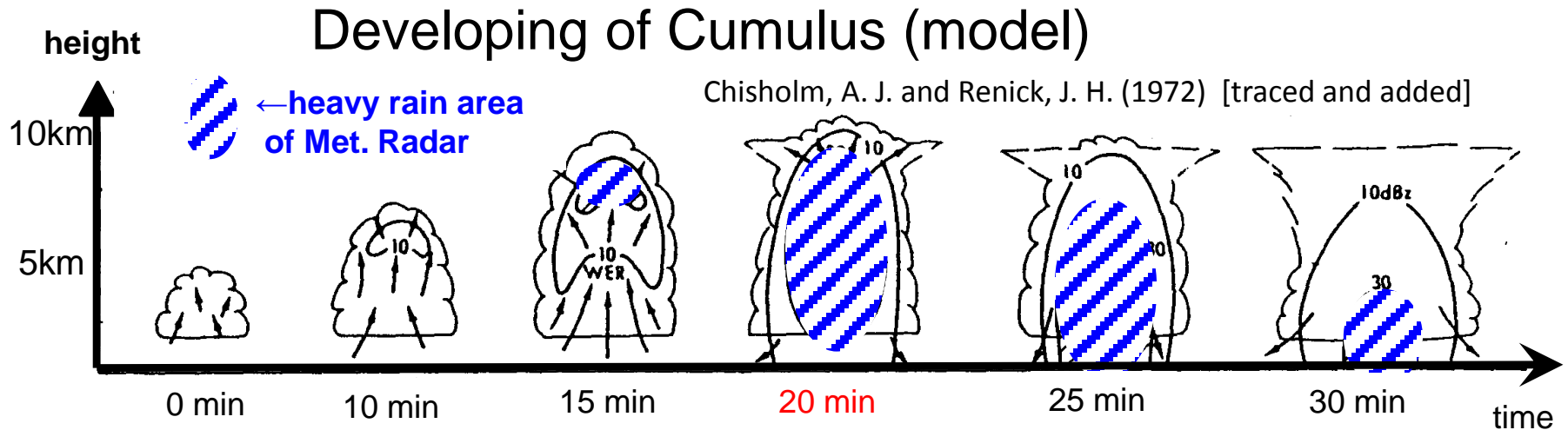
MTSAT-2 VIS 02.APR.2015 16:00UTC

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

16 UTC on 2<sup>nd</sup> to 13 UTC on 3<sup>rd</sup>, April 2015



# Rapidly Developing Cumulus Area Detection



Convective  
Cloud  
Information  
2015-08-04  
104500 UTC  
194500 JST



- **Cloud top is higher**  
Brightness temperature is getting low.
- **Roughness of cloud top increases**  
Contrast between light and dark is getting clear.
- **Cloud microphysical parameters change**  
Ice particles are produced near cloud top

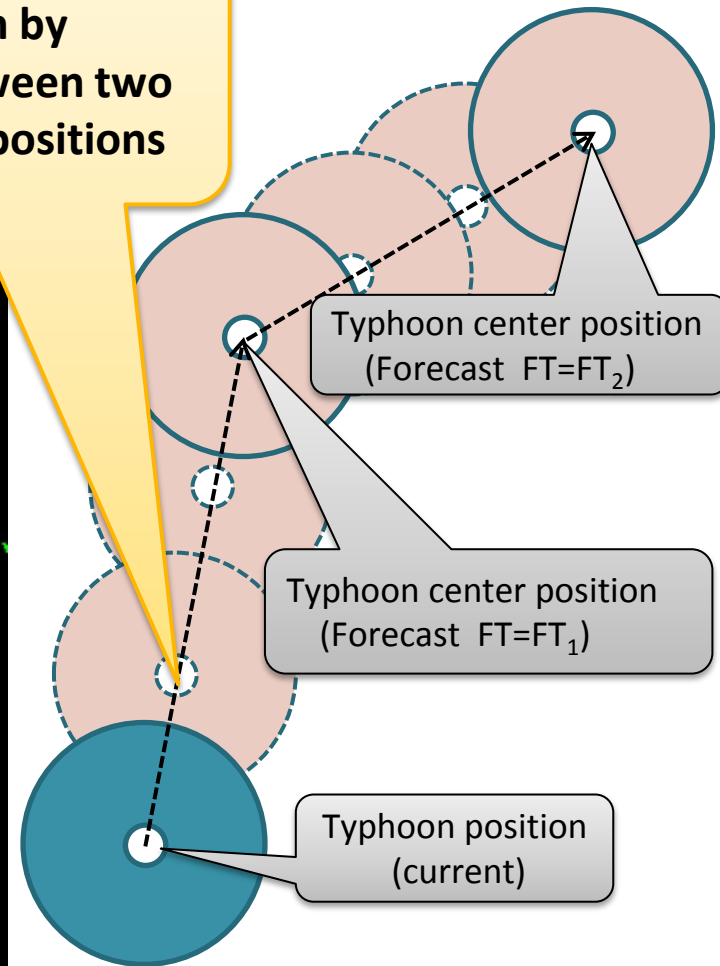
Cumulonimbus  
Rapidly Developing Cumulus  
Mid/Low cloud unknown

# Target Area Observation (Typhoon)

(MOVIE)

Himawari-8  
B03 (0.64  $\mu\text{m}$ )  
Every 2.5 min.

Estimated position by  
interpolation between two  
forecast(current) positions



# Comparison of Observation Frequency (MOVIE)

## Target Area Observation (Volcano)

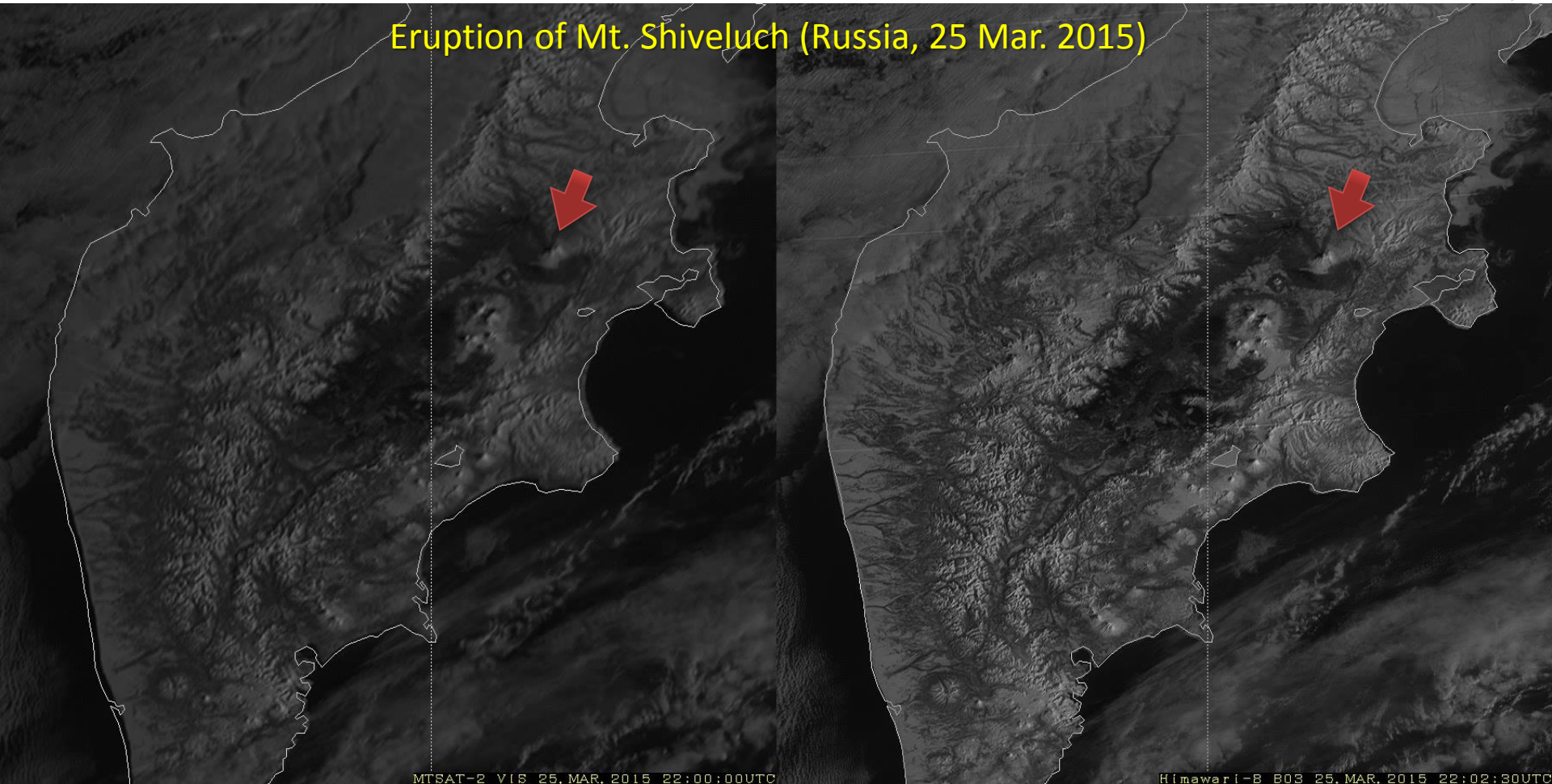


**MTSAT-2 VIS (0.68  $\mu\text{m}$ )  
Every 30 min.**



**Himawari-8 B03 (0.64  $\mu\text{m}$ )  
Every 2.5 min.**

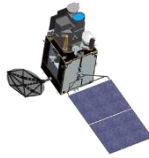
Eruption of Mt. Shiveluch (Russia, 25 Mar. 2015)





# Spectral Bands

## Himawari-8/9 Imager (AHI; Advanced Himawari Imager)



cf.  
MTSAT-2  
Bands



VIS  
0.68  $\mu\text{m}$

IR4  
3.7  $\mu\text{m}$

IR3  
6.8  $\mu\text{m}$

IR1  
10.8  $\mu\text{m}$

IR2  
12.0  $\mu\text{m}$

| Band |                     | Spatial Resolution | Central Wavelength | Physical Properties                     |
|------|---------------------|--------------------|--------------------|---|
| 1    | Visible (VIS)       | 1 km               | 0.47 $\mu\text{m}$ | aerosol                                 |
| 2    |                     |                    | 0.51 $\mu\text{m}$ | aerosol                                 |
| 3    |                     | 0.5 km             | 0.64 $\mu\text{m}$ | low cloud, fog                          |
| 4    | Near Infrared (NIR) | 1 km               | 0.86 $\mu\text{m}$ | vegetation, aerosol                     |
| 5    |                     | 2 km               | 1.6 $\mu\text{m}$  | cloud phase/particle size               |
| 6    |                     |                    | 2.3 $\mu\text{m}$  | cloud particle size                     |
| 7    | Infrared (IR)       | 2 km               | 3.9 $\mu\text{m}$  | low cloud, fog, forest fire             |
| 8    |                     |                    | 6.2 $\mu\text{m}$  | upper-level moisture                    |
| 9    |                     |                    | 6.9 $\mu\text{m}$  | mid- to upper-level moisture            |
| 10   |                     |                    | 7.3 $\mu\text{m}$  | mid-level moisture                      |
| 11   |                     |                    | 8.6 $\mu\text{m}$  | cloud phase, SO <sub>2</sub>            |
| 12   |                     |                    | 9.6 $\mu\text{m}$  | ozone content                           |
| 13   |                     |                    | 10.4 $\mu\text{m}$ | cloud imagery, information of cloud top |
| 14   |                     |                    | 11.2 $\mu\text{m}$ | cloud imagery, sea surface temperature  |
| 15   |                     |                    | 12.4 $\mu\text{m}$ | cloud imagery, sea surface temperature  |
| 16   |                     |                    | 13.3 $\mu\text{m}$ | cloud top height                        |

**3 Visible Bands**

**Addition of NIR Bands**

**Increase of WV Bands**

**Increase of TIR Bands**

# Comparison of imagers

<https://www.wmo-sat.info/oscar/>

## Himawari-8 AHI

| Central Wavelength (μm) | Spatial Res. (km) |
|-------------------------|-------------------|
| 0.47063                 | 1                 |
| 0.51000                 |                   |
| 0.63914                 | 0.5               |
| 0.85670                 | 1                 |
| -                       | 2                 |
| -                       |                   |
| 1.6101                  |                   |
| 2.2568                  |                   |
| 3.8853                  |                   |
| 6.2429                  |                   |
| 6.9410                  |                   |
| 7.3467                  |                   |
| 8.5926                  |                   |
| 9.6372                  |                   |
| 10.4073                 |                   |
| 11.2395                 |                   |
| 12.3806                 |                   |
| 13.2807                 |                   |

## GOES-R ABI

| Central Wavelength (μm) | Spatial Res. (km) |
|-------------------------|-------------------|
| 0.47                    | 1                 |
| -                       | -                 |
| 0.64                    | 0.5               |
| 0.86                    | 1                 |
| -                       | -                 |
| 1.38                    | 2                 |
| 1.61                    | 1                 |
| 2.26                    | 2                 |
| 3.90                    |                   |
| 6.15                    |                   |
| 7.00                    |                   |
| 7.40                    |                   |
| 8.50                    |                   |
| 9.70                    |                   |
| 10.3                    |                   |
| 11.2                    |                   |
| 12.3                    |                   |
| 13.3                    |                   |

## MSG SEVIRI

| Central Wavelength (μm)      | Spatial Res. (km)   |
|------------------------------|---|
| N/A(broad bandwidth channel) | 1.6 km IFOV, 1 km sampling for broad VIS channel / 4.8 km IFOV, 3 km sampling for narrow channels |
| 0.635                        |   |
| 0.81                         |   |
| -                            |   |
| -                            |   |
| 1.64                         |   |
| -                            |   |
| 3.92                         |   |
| 6.25                         |   |
| -                            |   |
| 7.35                         |   |
| 8.70                         |   |
| 9.66                         |   |
| 10.8                         |   |
| -                            |   |
| 12.0                         |   |
| 13.4                         |   |

## MTG FCI

\*Resolution depends on imaging mode

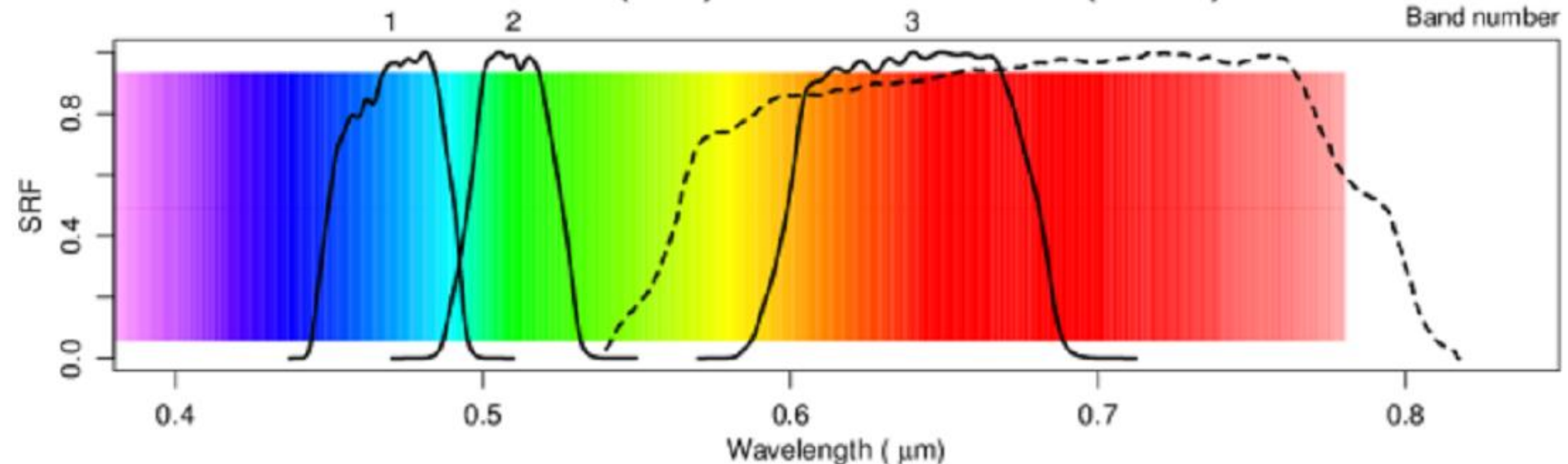
| Central Wavelength (μm) | Spatial Res. (km) |
|-------------------------|-------------------|
| 0.444                   | 1                 |
| 0.510                   |                   |
| 0.640                   | 1/0.5*            |
| 0.865                   | 1                 |
| 0.914                   |                   |
| 1.380                   |                   |
| 1.610                   |                   |
| 2.250                   | 1/0.5*            |
| 3.80                    | 2/1*              |
| 6.30                    | 2                 |
| -                       |                   |
| 7.35                    |                   |
| 8.70                    |                   |
| 9.66                    |                   |
| 10.50                   | 2/1*              |
| -                       | -                 |
| 12.30                   | 2                 |
| 13.30                   |                   |

# Visible bands

|               |                   |              |              |
|---------------|-------------------|--------------|--------------|
| <u>Band 1</u> | <u>0.47micron</u> | <u>Blue</u>  | <u>1 km</u>  |
| <u>Band 2</u> | <u>0.51micron</u> | <u>Green</u> | <u>1 km</u>  |
| <u>Band 3</u> | <u>0.64micron</u> | <u>Red</u>   | <u>0.5km</u> |

For True Color Image.

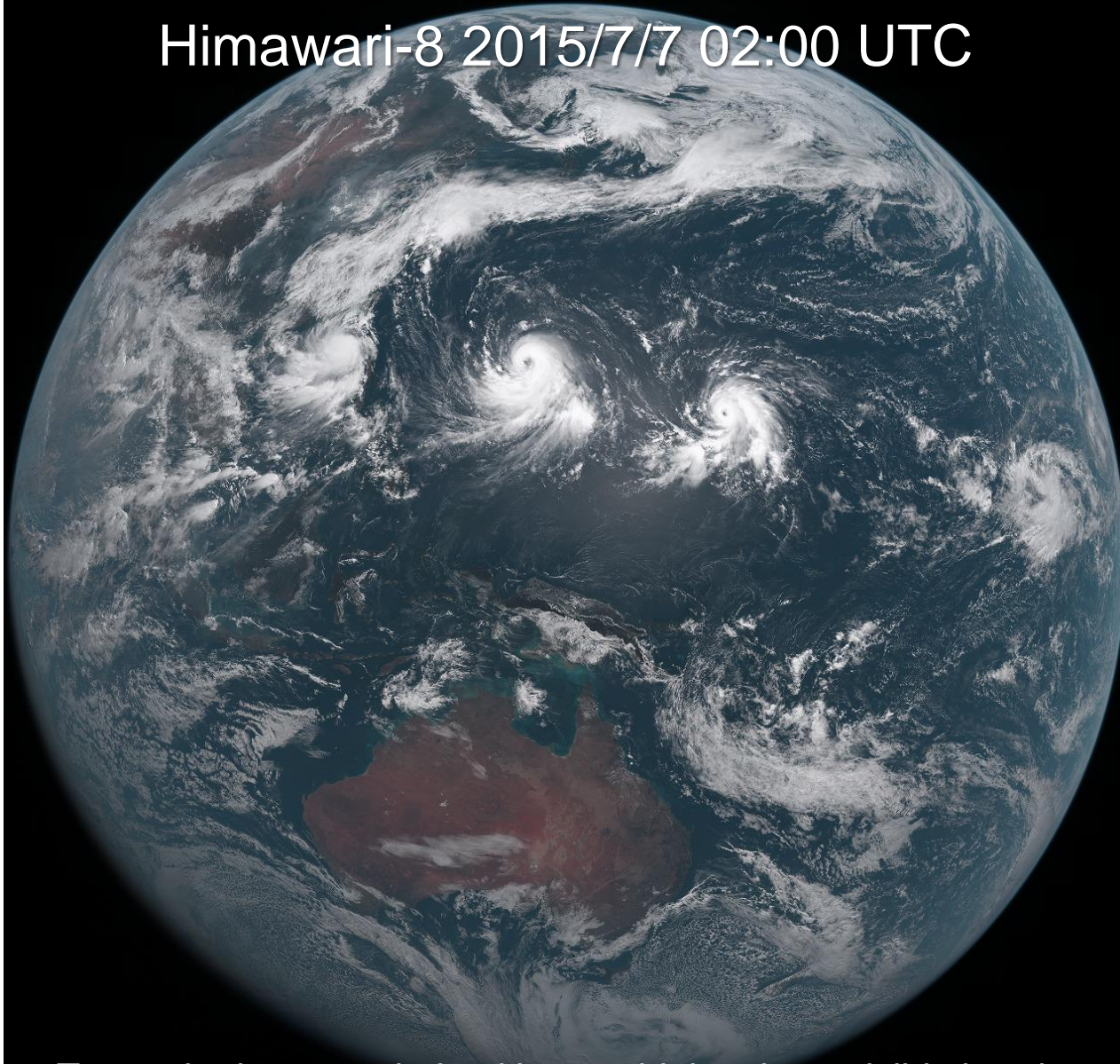
SRFs of Himawari-8/AHI (solid) and MTSAT-2/IMAGER (dashed) Visible Bands





# True Color Imagery

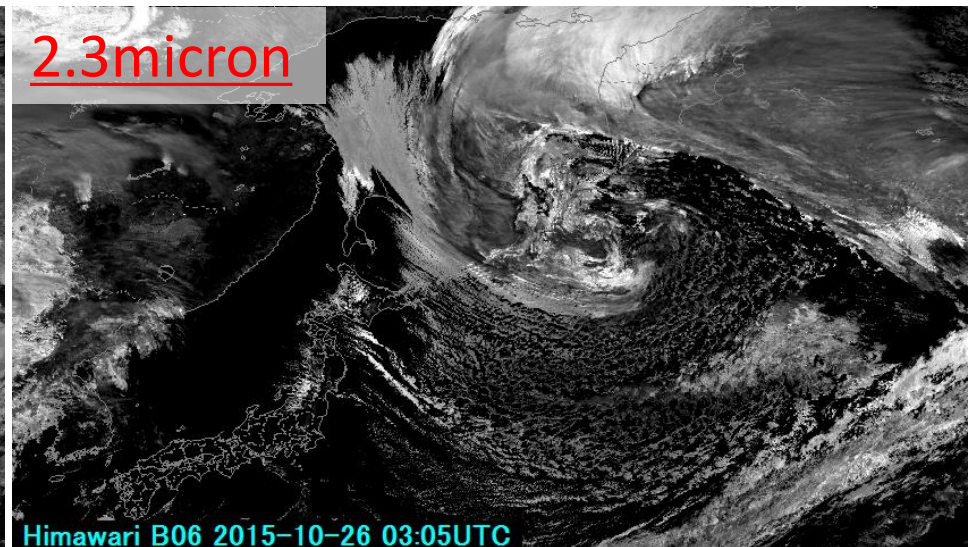
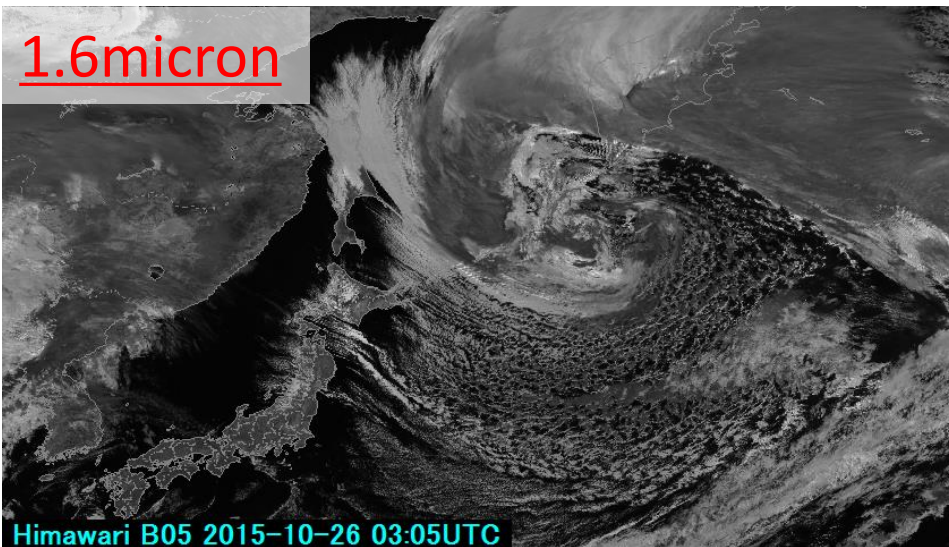
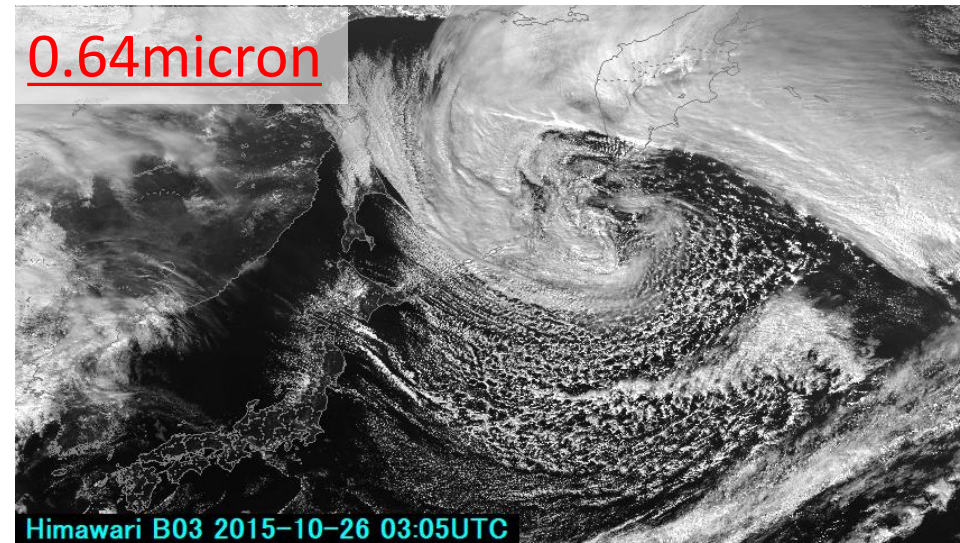
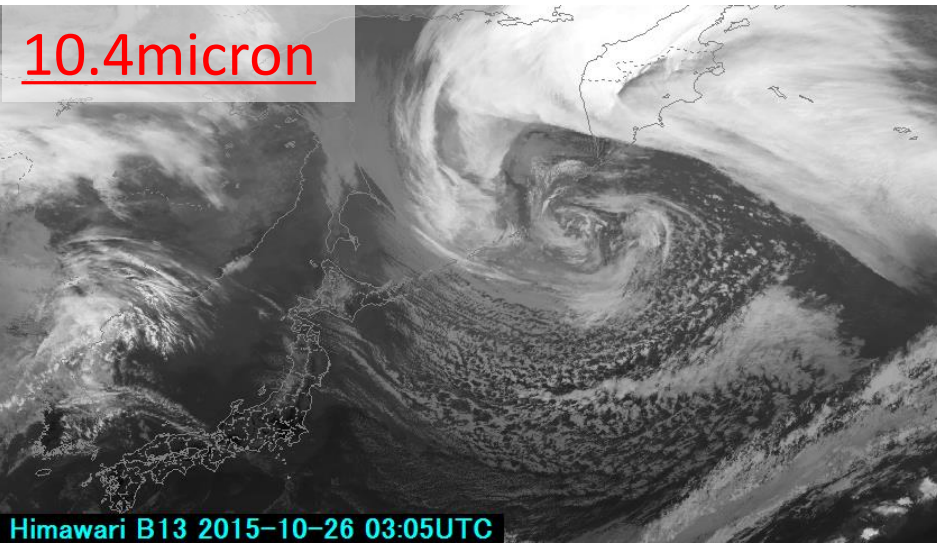
Himawari-8 2015/7/7 02:00 UTC



True color imagery derived by combining three visible bands.

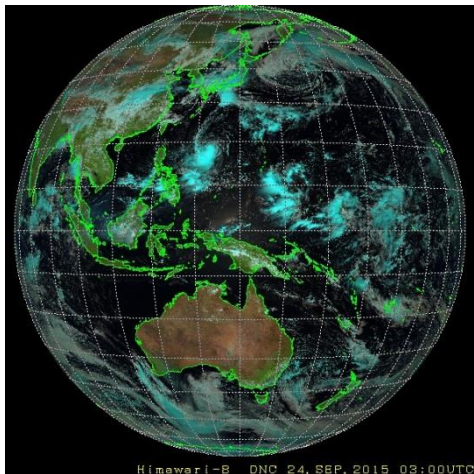


# 1.6micron band (B05) and 2.3micron band (B06)

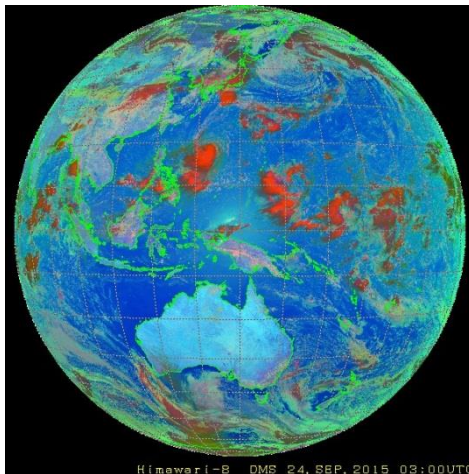




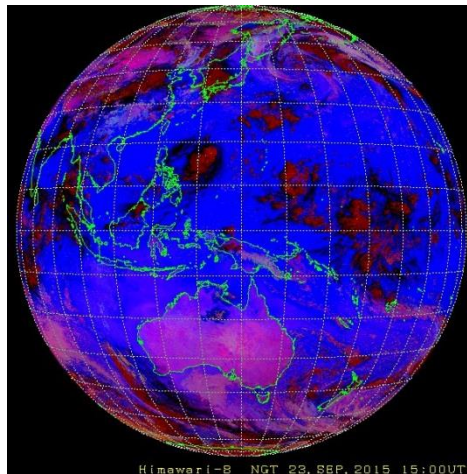
# RGBs from Himawari-8



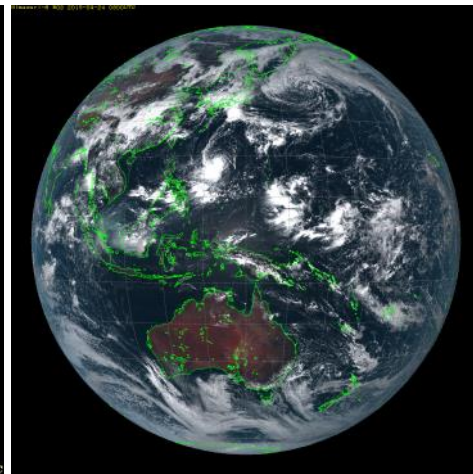
Natural Color



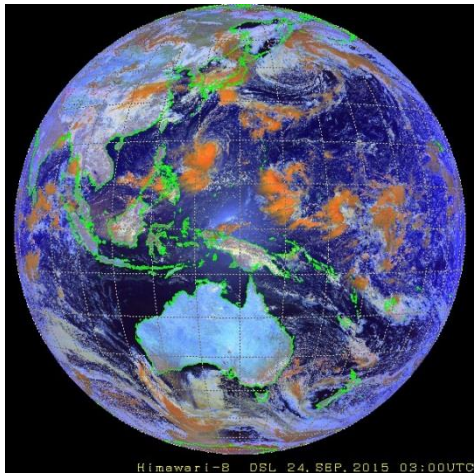
Day Microphysics



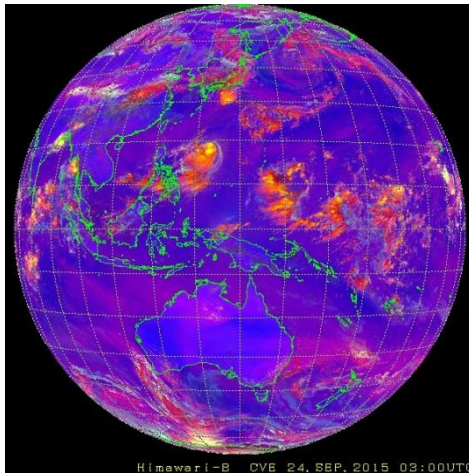
Night Microphysics



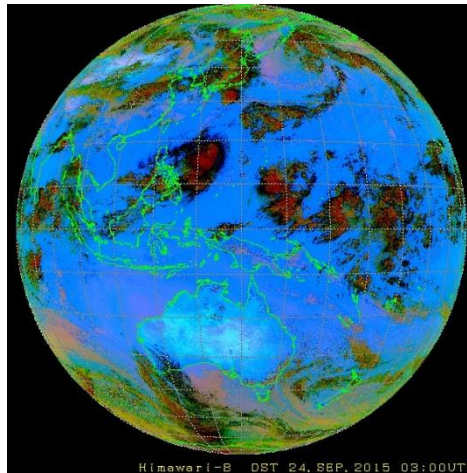
True Color



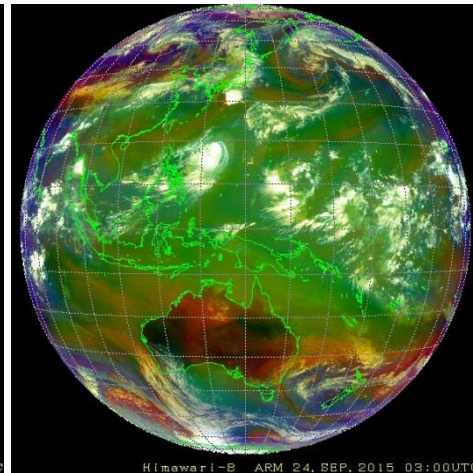
Day Snow-Fog



Day Convective Storm



Dust



Airmass

[http://www.data.jma.go.jp/mscweb/data/himawari/sat\\_img.php?area=fd\\_](http://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php?area=fd_)



# Real Time RGB Images on MSC/JMA Website

**Meteorological Satellite Center (MSC) of JMA**

Home | Himawari Image | Products | Operations | Supports

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

### Himawari Real-Time Image

The RGB composite imagery is produced by composing satellite images colored in red, green and blue.  
[User's Guide to RGB composite imagery \(Himawari RGB Training Library\)](#)

Select Area: Southeast Asia 1 | Band: Day Convective Storm RGB | Time: 04:50 UTC 02 December 2015

1 Hour | Play | Stop

**Updated every 10 minutes!**

**Day Convective Storm RGB**

- B13 (Infrared)
- B03 (Visible)
- B08 (Water Vapor)
- B07 (Short Wave Infrared)
- Day Microphysics RGB
- Night Microphysics RGB
- Dust RGB
- Airmass RGB
- Day Snow-Fog RGB
- Natural Color RGB
- True Color RGB
- Day Convective Storm RGB**
- Sandwich
- B03 combined with B13
- B03 and B13 at night

Himawari-8 CVE 02, DEC, 2015 04:50UTC

<http://www.jma-net.go.jp/msc/en/>  
search "JMA MSC"

# 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**

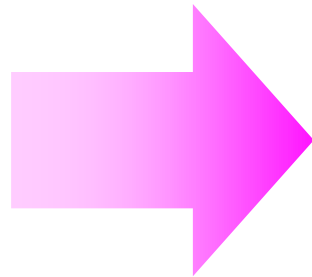
IR: 4.0 km -> **2.0 km**

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

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

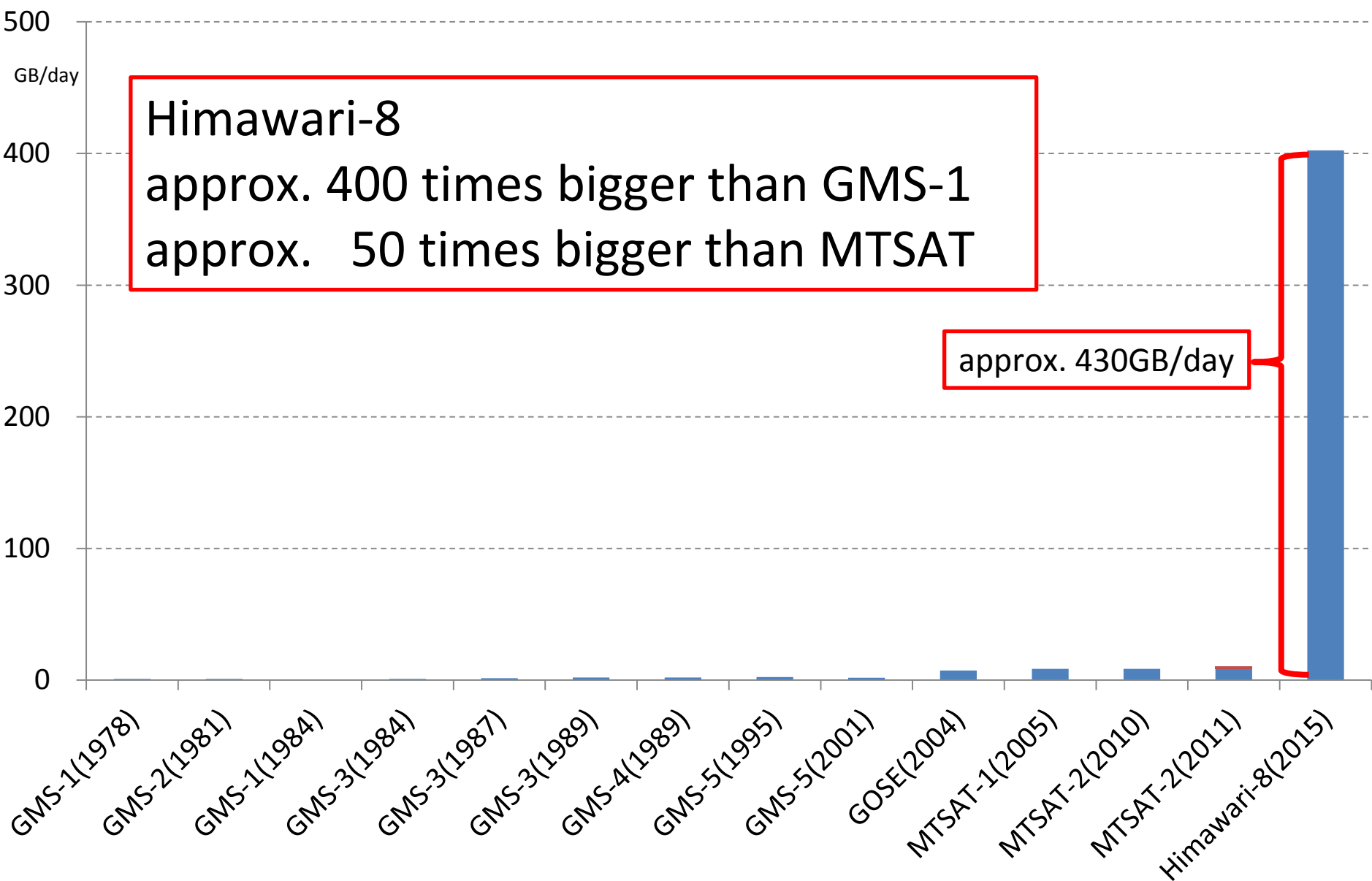


B/W TV



HD TV

# Data amount of Himawari series





# Two Ways of Data Dissemination/Distribution

## HimawariCast/HimawariCloud

**Himawari-8/9**

**Communication Satellite**

**HimawariCast**  
**service**

HRIT files,  
LRIT files,  
GPV, Obs

All imagery  
(full data)

**HimawariCloud**  
**service**



C-band antenna



LNB

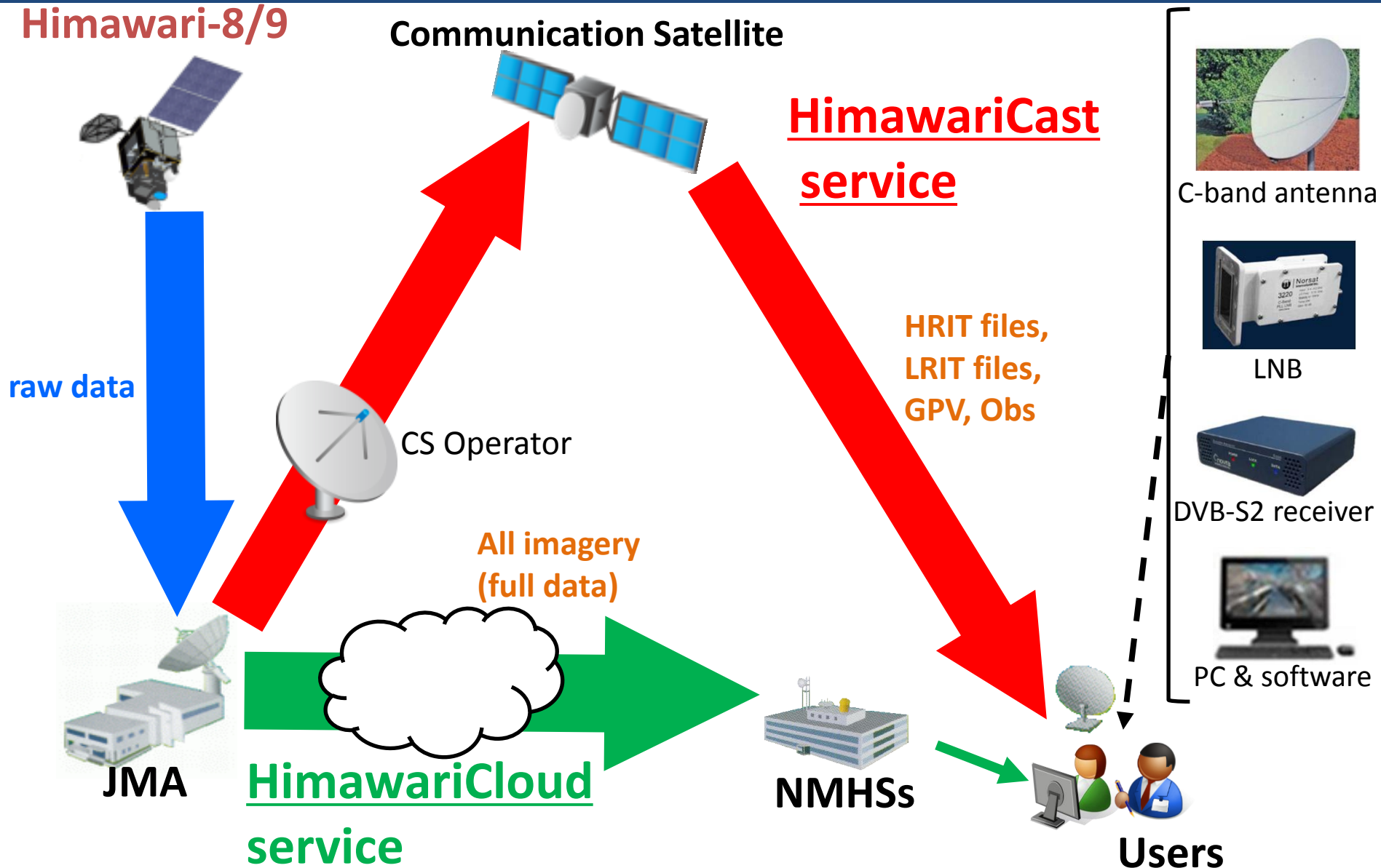


DVB-S2 receiver



PC & software

**Users**



# 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
- 14 bands (1 VIS and 13 NIR/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 NIR/IR)
- Full Specification (temporal and spatial) of Imagery

# Data Services Operated by Japanese Science Group

Himawari-8 Data Service are operated by Japanese Science Group on a voluntary basis for Non-Profit R&D Users.

- **JAXA Himawari Monitor**

<http://www.eorc.jaxa.jp/ptree/index.html>

- **NICT (National Institute of information and Communications Technology) Science Cloud**

<http://sc-web.nict.go.jp/himawari/multi-language/>

- **Chiba University Data Server**

CEReS (Center for Environmental Remote Sensing)

- **University of Tokyo**

- DIAS (Data Integration and Analysis System)**

In preparation for operation

# 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

Meteorological Satellite Center (MSC) of JMA

[Home](#) [Activities](#) [Products](#) [Operations](#) [Supports](#)

Current position: [Home](#) > [Himawari-8/9](#) > [Sample Data](#)



### Sample Data (Names/formats)

|               |                           |                                     |              |                              |                 |             |
|---------------|---------------------------|-------------------------------------|--------------|------------------------------|-----------------|-------------|
| Imager (AHI)  | Sample Data               | AHI Proxy Data<br>(For researchers) | HimawariCast | HimawariCloud<br>(For NMHSs) |                 |             |
| Names/formats | Himawari<br>Standard Data | HRIT/LRIT Data                      | NetCDF Data  | Color Image Data             | JPEG Image Data | 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 bzp2-compressed AHI Proxy data file is smaller than the AHI Observation data file.

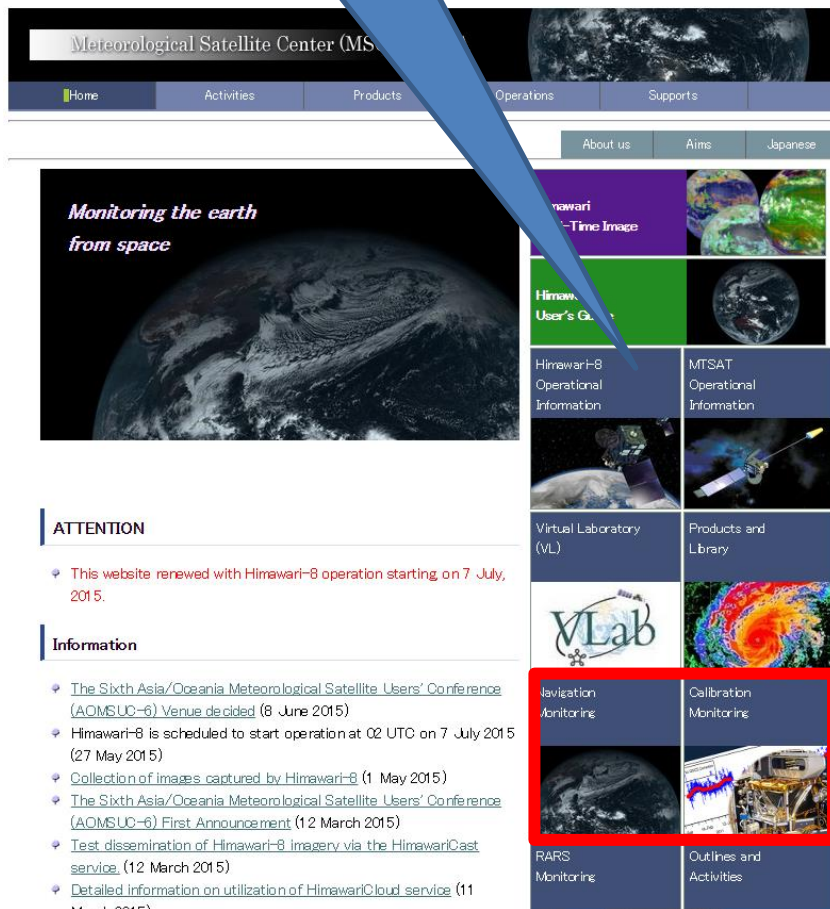
**Table 1. Names/formats of Himawari-8 and -9 observation data processed by JMA**

| Name<br>(format)  | Observation<br>area | Method       |                     |                      |             |                      |
|---|---------------------|--------------|---------------------|----------------------|-------------|----------------------|
|   |                     | For NMHSs    |                     |                      |             |                      |
|   |                     | via<br>JMBSC | via<br>HimawariCast | via<br>HimawariCloud | via<br>JDDS | via<br>WIS<br>Portal |
| <a href="#">Himawari Standard Data</a><br>(Himawari Standard<br>Format) | Full disk           | ○            | —                   | ○                    | —           | —                    |
|   | Japan area          | ○            | —                   | ○                    | —           | —                    |
|   | Target area         | ○            | —                   | ○                    | —           | —                    |
| <a href="#">HRIT Data</a><br>(HRIT File Format)                         | Full disk           | ○            | ○                   | —                    | ○           | —                    |
| <a href="#">LRIT Data</a><br>(LRIT File Format)                         | Full disk           | —            | ○                   | —                    | —           | —                    |



# 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 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

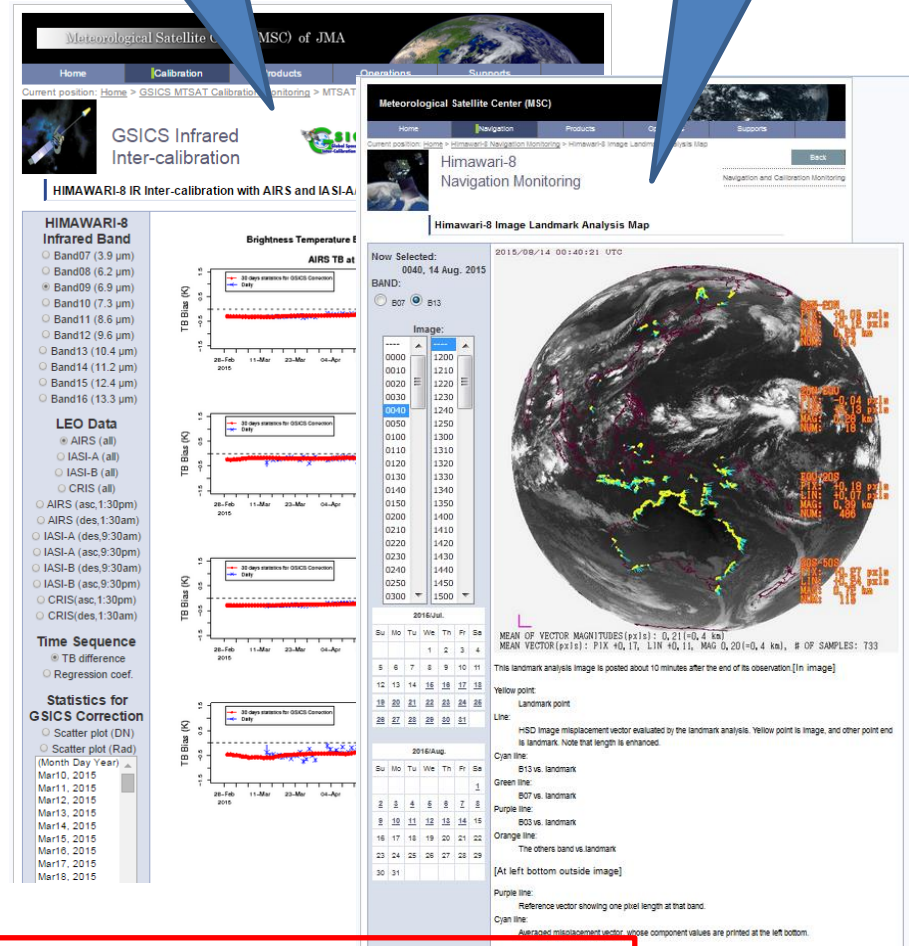
**ATTENTION**

- 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



Meteorological Satellite Center (MSC) of JMA

Home Calibration Products Operations Supports

Current position: Home > GSICS MTSAT Calibration Monitoring > MTSAT

GSICS Infrared Inter-calibration

HIMAWARI-8 IR Inter-calibration with AIRS and IASI-A

**HIMAWARI-8 Infrared Band**

- Band07 (3.9  $\mu\text{m}$ )
- Band08 (6.2  $\mu\text{m}$ )
- Band09 (6.9  $\mu\text{m}$ )
- Band10 (7.3  $\mu\text{m}$ )
- Band11 (8.6  $\mu\text{m}$ )
- Band12 (9.6  $\mu\text{m}$ )
- Band13 (10.4  $\mu\text{m}$ )
- Band14 (11.2  $\mu\text{m}$ )
- Band15 (12.4  $\mu\text{m}$ )
- Band16 (13.3  $\mu\text{m}$ )

**LEO Data**

- AIRS (all)
- IASI-A (all)
- IASI-B (all)
- CRIS (all)
- AIRS (asc, 1:30pm)
- AIRS (des, 9:30am)
- IASI-A (asc, 9:30pm)
- IASI-B (asc, 9:30am)
- IASI-B (asc, 9:30pm)
- CRIS (asc, 1:30pm)
- CRIS (des, 1:30am)

**Time Sequence**

- TB difference
- Regression coef.

**Statistics for GSICS Correction**

- Scatter plot (DN)
- Scatter plot (Rad)

(Month Day Year)

Mar10, 2015

Mar11, 2015

Mar12, 2015

Mar13, 2015

Mar14, 2015

Mar15, 2015

Mar16, 2015

Mar17, 2015

Mar18, 2015

**Brightness Temperature**

AIRS TB at

TB Bias (K)

2015

2016

2017

2018

2019

2020

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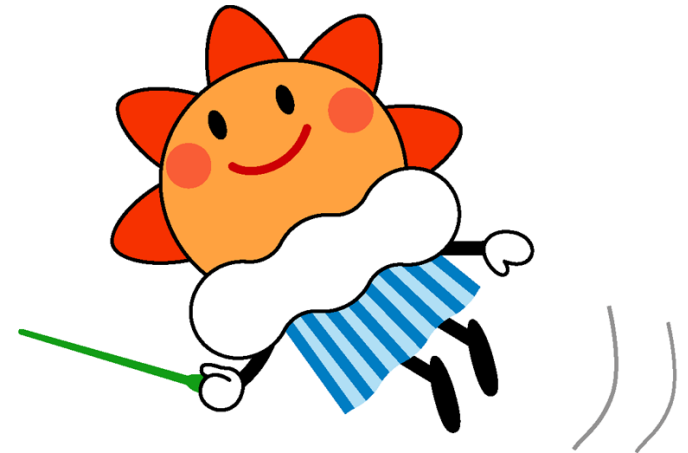
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Thank you for your kind attention!



**JMA mascot character  
“Harerun”**