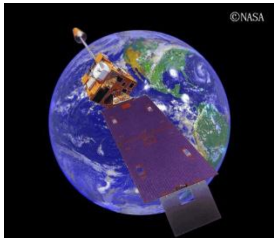
Introduction to Himawari-8/9 and its products

Koji Yamashita
Meteorological Satellite Center
Japan Meteorological Agency

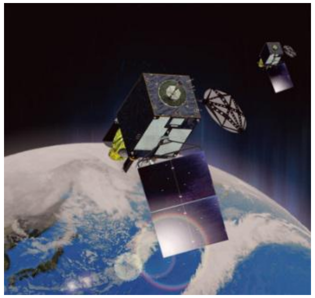
Contents

History of Japanese Geostationary-Orbit Satellites

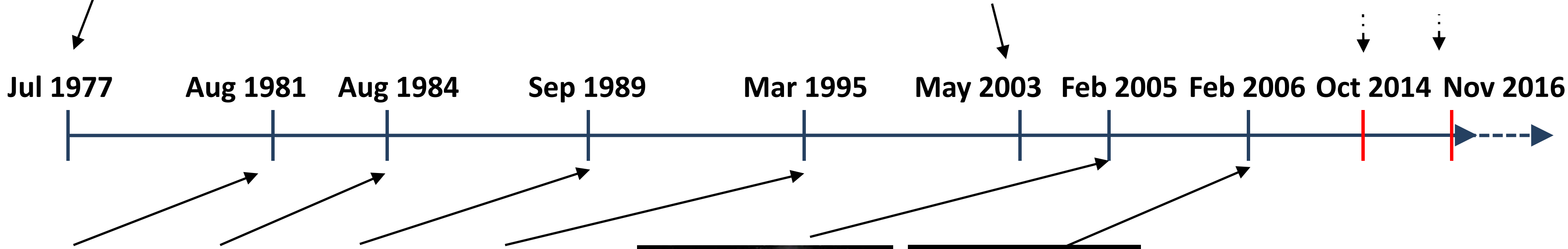
GMS (Geostationary Meteorological Satellite)
nicknamed “Himawari”



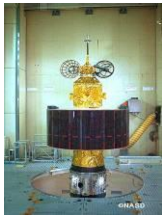
GOES-9



Himawari-8 *Himawari-9*



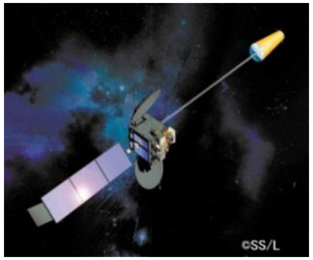
GMS-2
Himawari-2



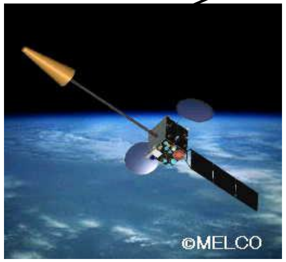
GMS-3
Himawari-3

GMS-4
Himawari-4

GMS-5
Himawari-5



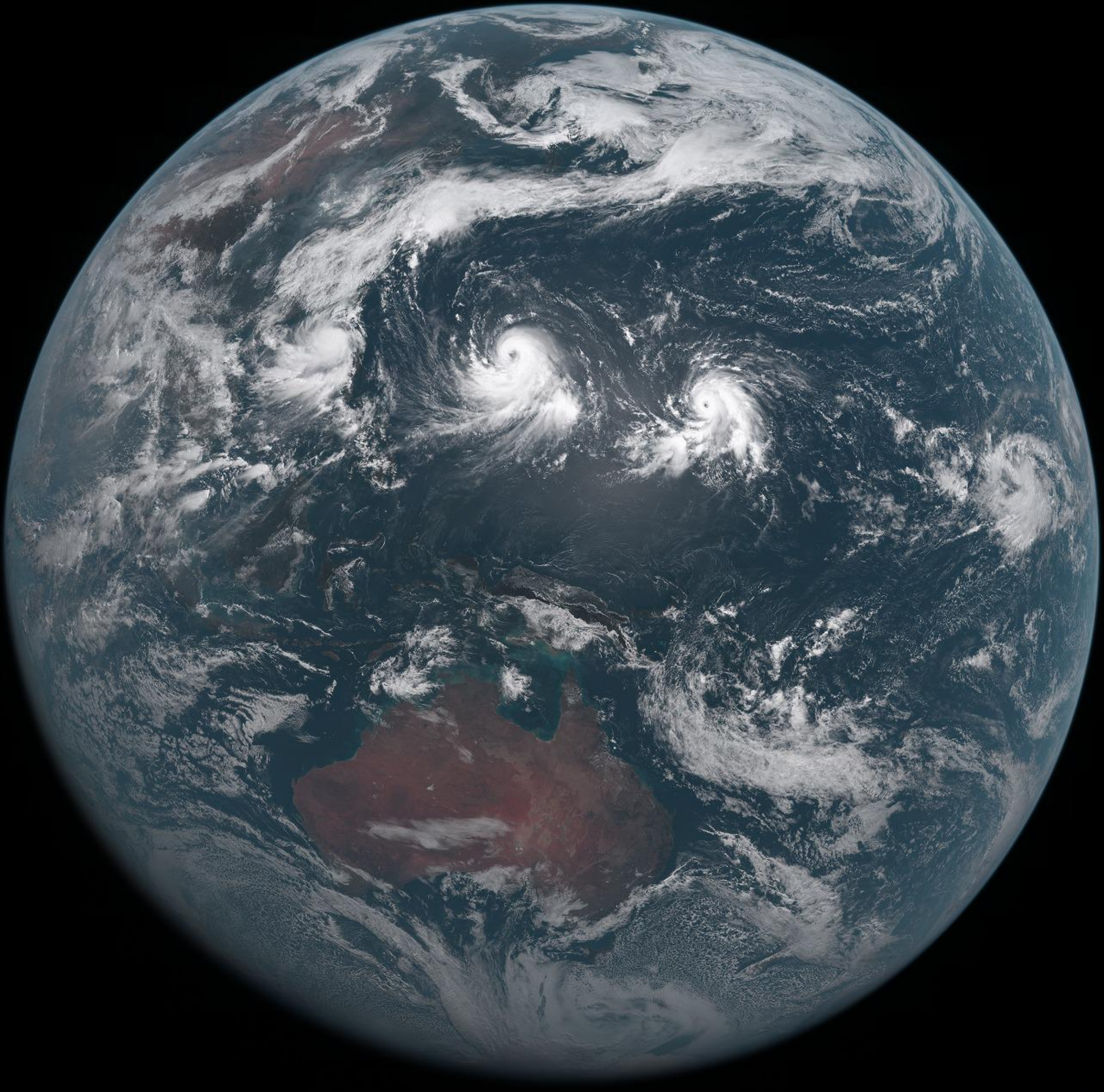
MTSAT-1R
Himawari-6



MTSAT-2
Himawari-7

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	2010~2015
Himawari-8	2015~2022
Himawari-9	2022~2029

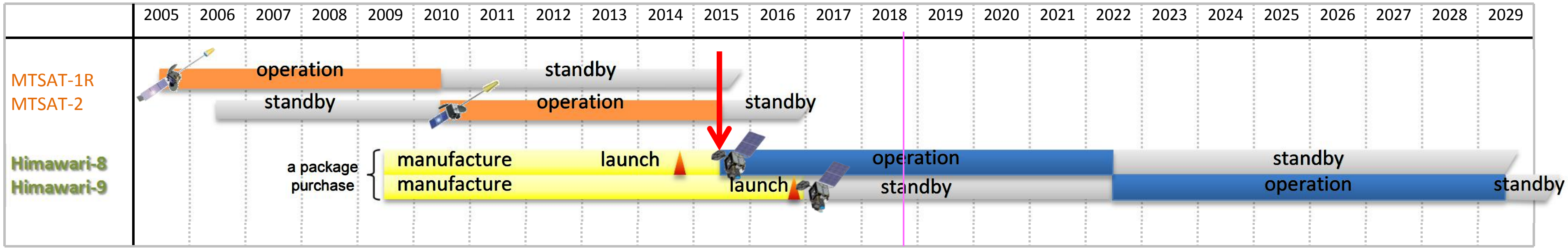
Himawari-8 began operation at 02:00 UTC on 7th July 2015.



Himawari-8/9

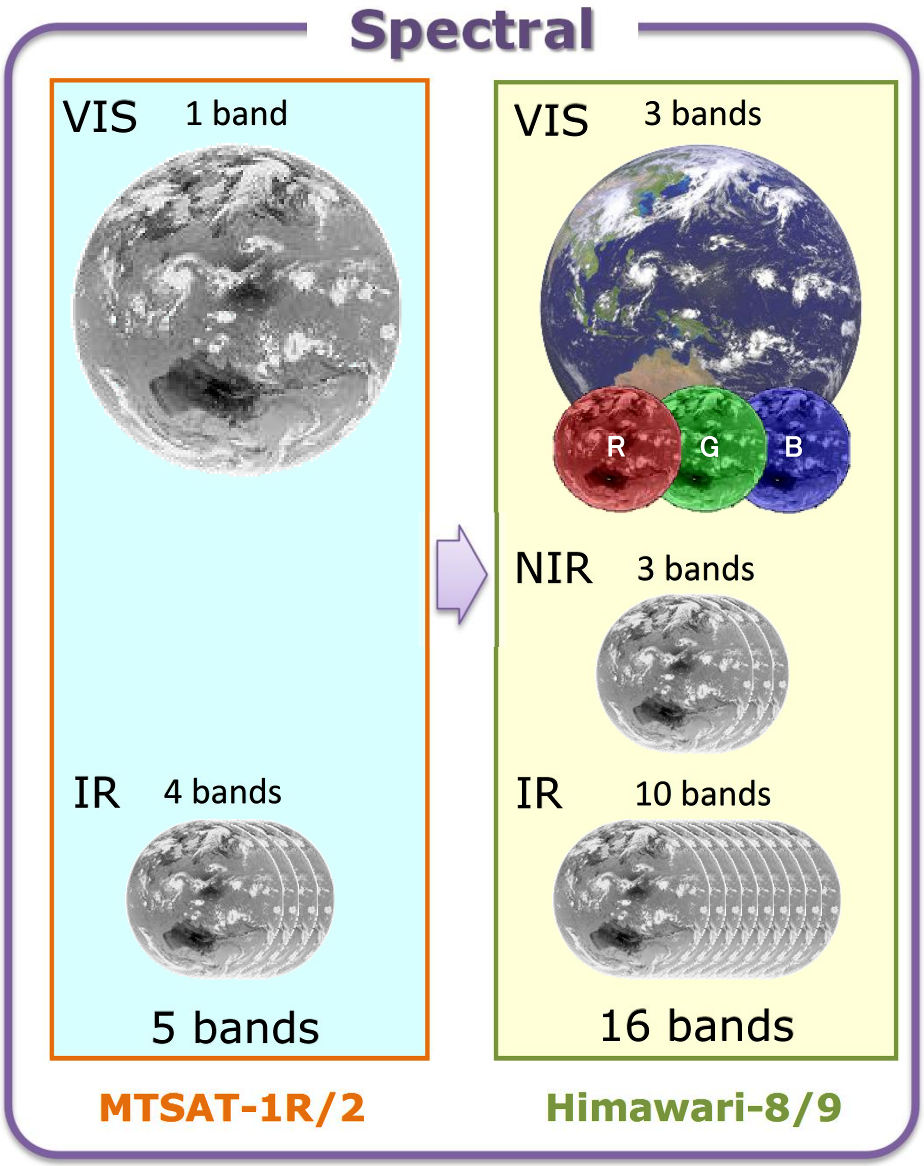
Himawari-8 began operation on 7 July 2015, replacing the previous MTSAT-2 operational satellite

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 (Data collection System) 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)



Improved Resolutions

Spectral



MTSAT-1R/2

VIS 1 band

IR 4 bands

5 bands

Himawari-8/9

VIS 3 bands

NIR 3 bands

IR 10 bands

16 bands

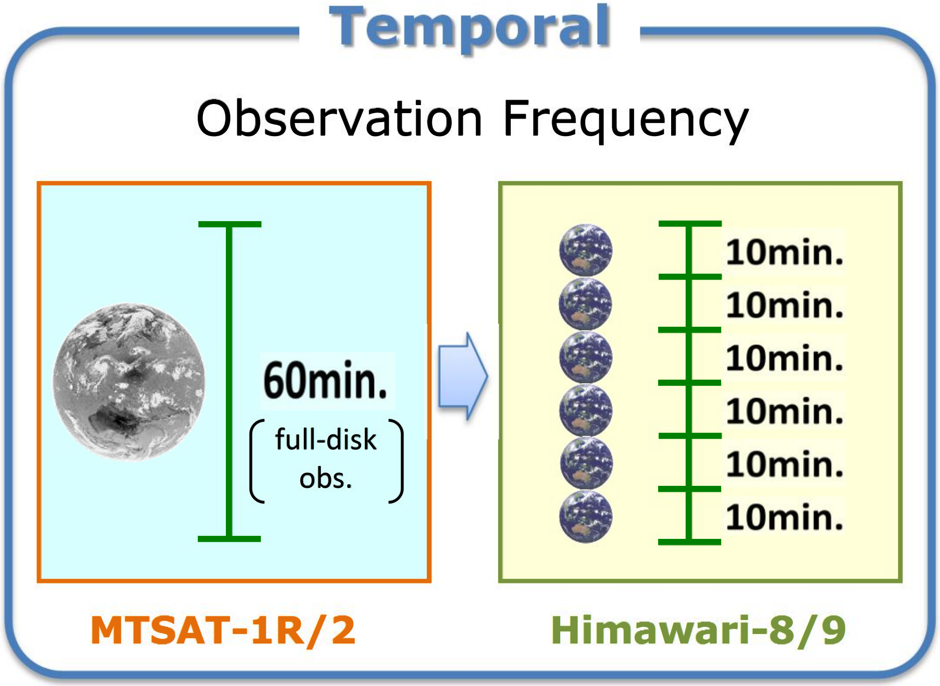
Spatial

At sub-satellite point

MTSAT-1R/2	VIS 1 km	IR 4 km
Himawari-8/9	VIS 0.5/1 km	IR 2 km

Temporal

Observation Frequency



MTSAT-1R/2

60min.

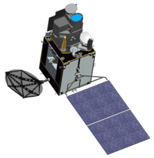
(full-disk obs.)

Himawari-8/9

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

Spectral Bands

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



cf. MTSAT-2 Bands

↓

VIS
0.68 µm

IR4
3.7 µm

IR3
6.8 µm

IR1
10.8 µm

IR2
12.0 µm

Band		Spatial Resolution	Central Wavelength	Physical Properties
1	Visible (VIS)	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 (NIR)	1 km	0.86 µm	vegetation, aerosol
5		2 km	1.6 µm	cloud phase
6			2.3 µm	particle size
7	Infrared (IR)	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, CO2

3 Visible Bands

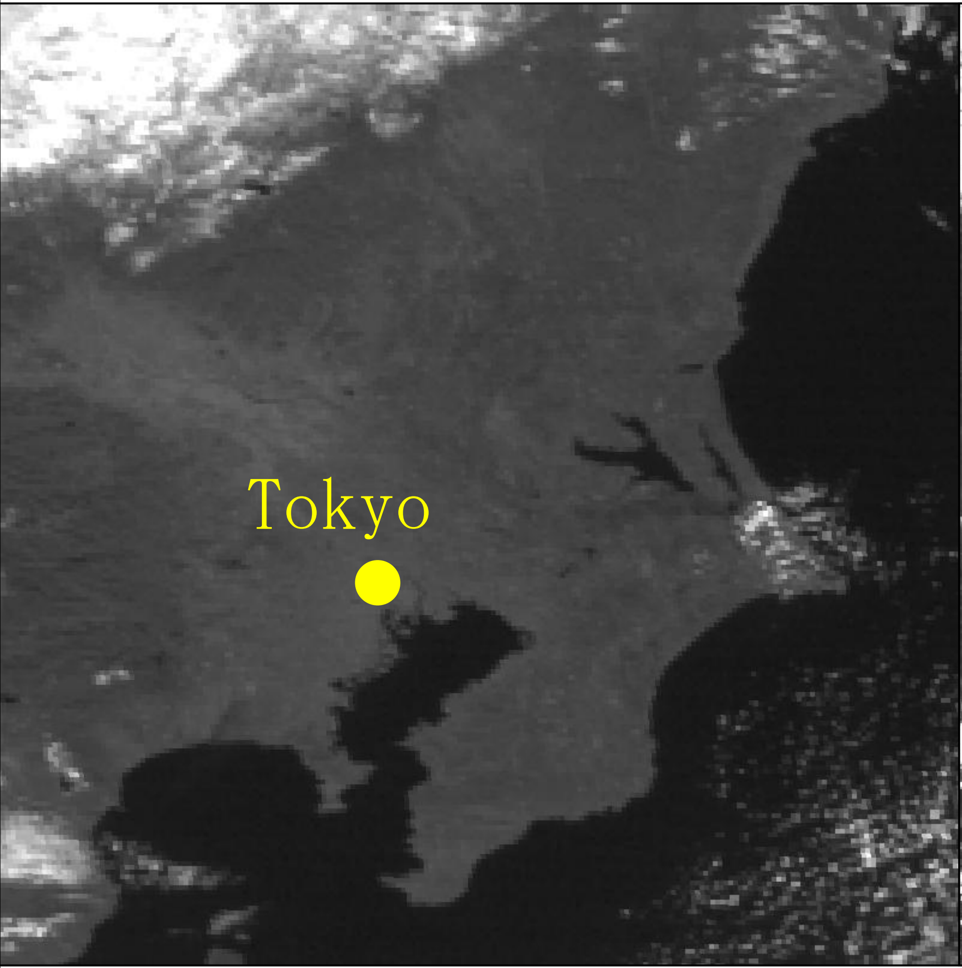
Addition of NIR Bands

Increase of WV Bands

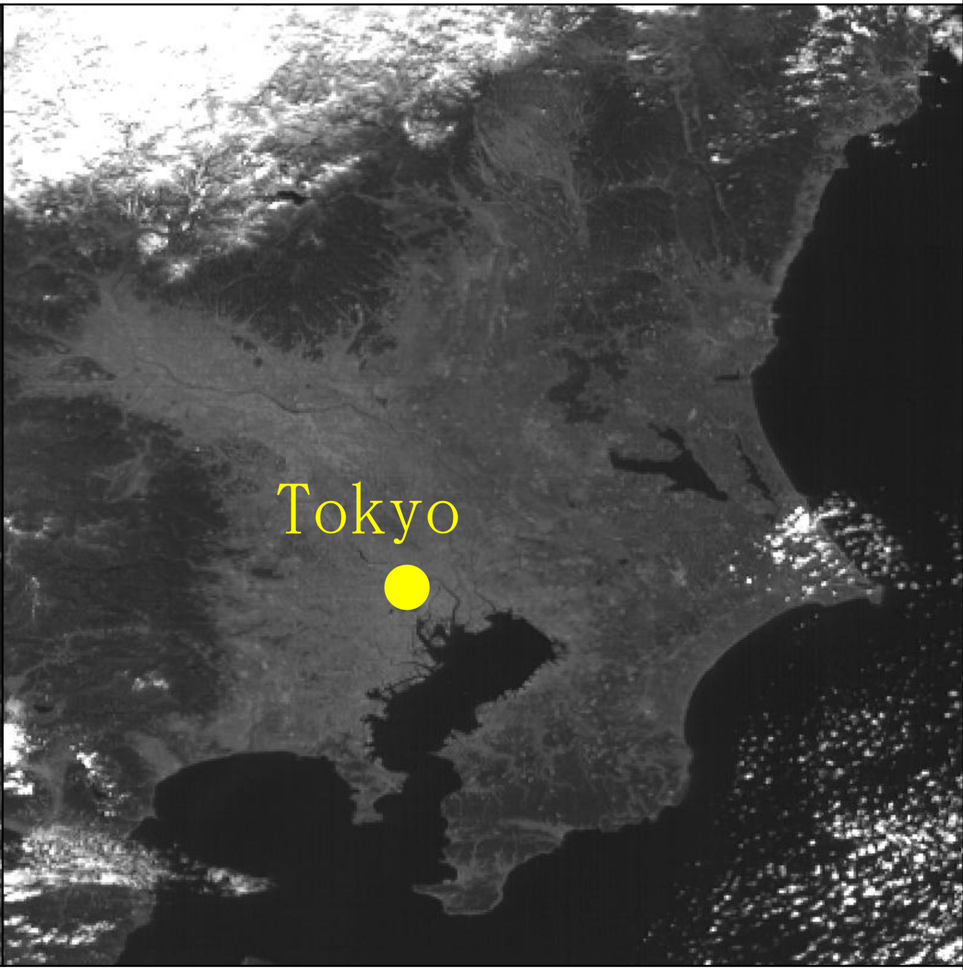
Increase of TIR Bands

Spatial Resolution

MTSAT-2 (VIS)
1km



Himawari-8 (B03)
0.5 km



03:00 UTC on 29 January 2015

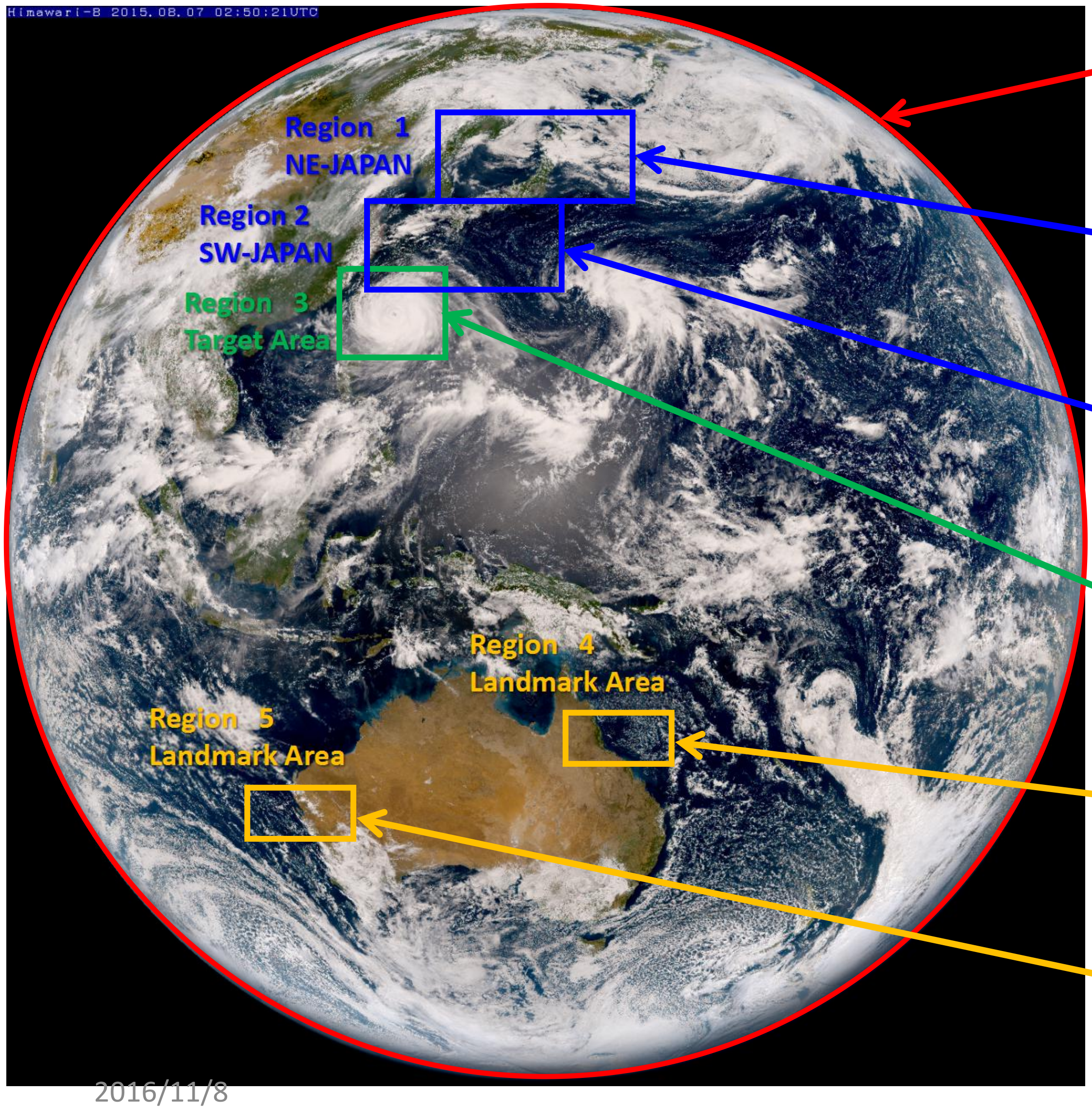
Observation Frequency

MTSAT-2 (VIS)
Hourly in Monochrome

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

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

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)

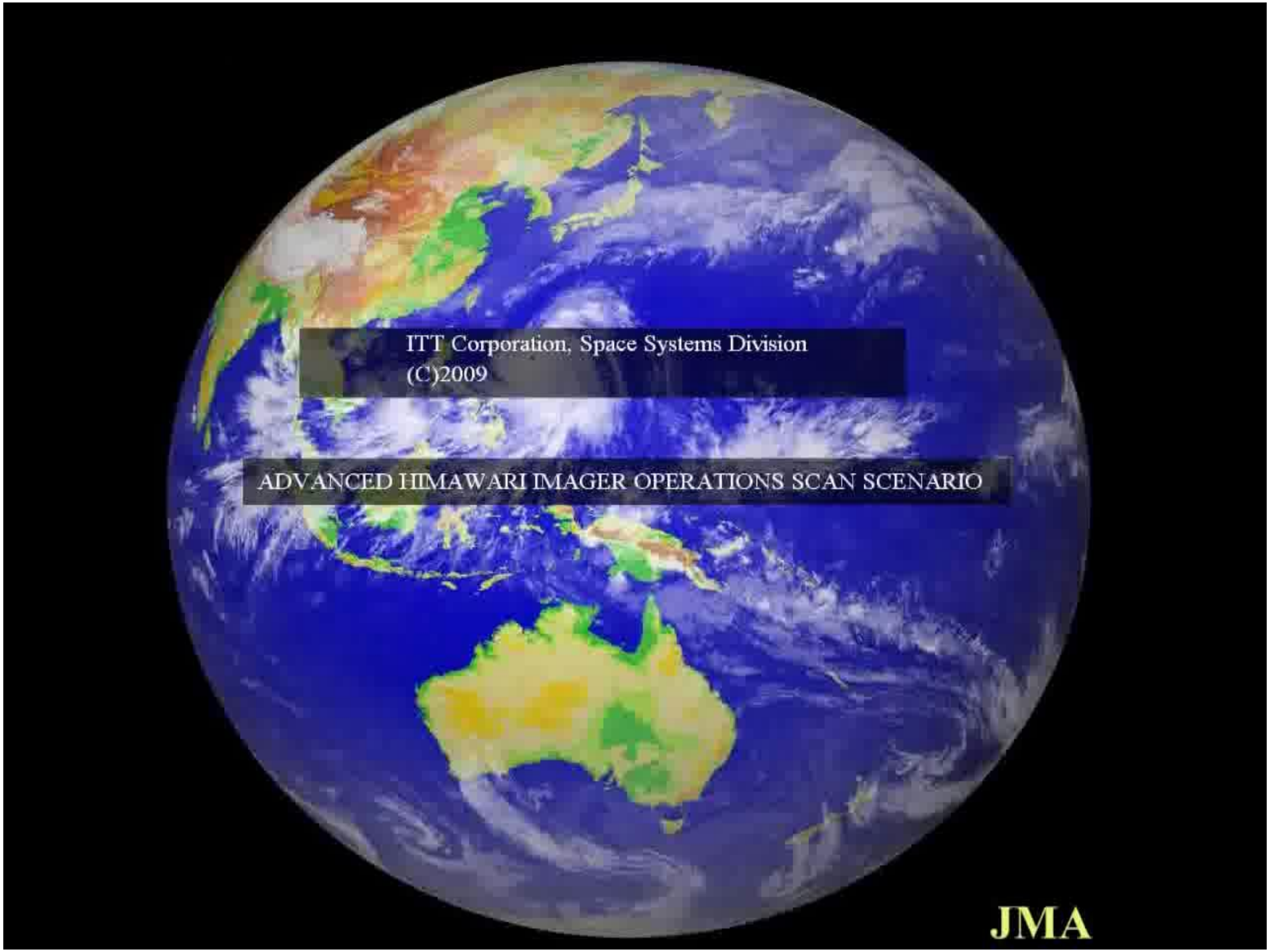
Dimension : EW x NS: 1000 x 500 km

Region 5 Landmark Area

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

Dimension : EW x NS: 1000 x 500 km

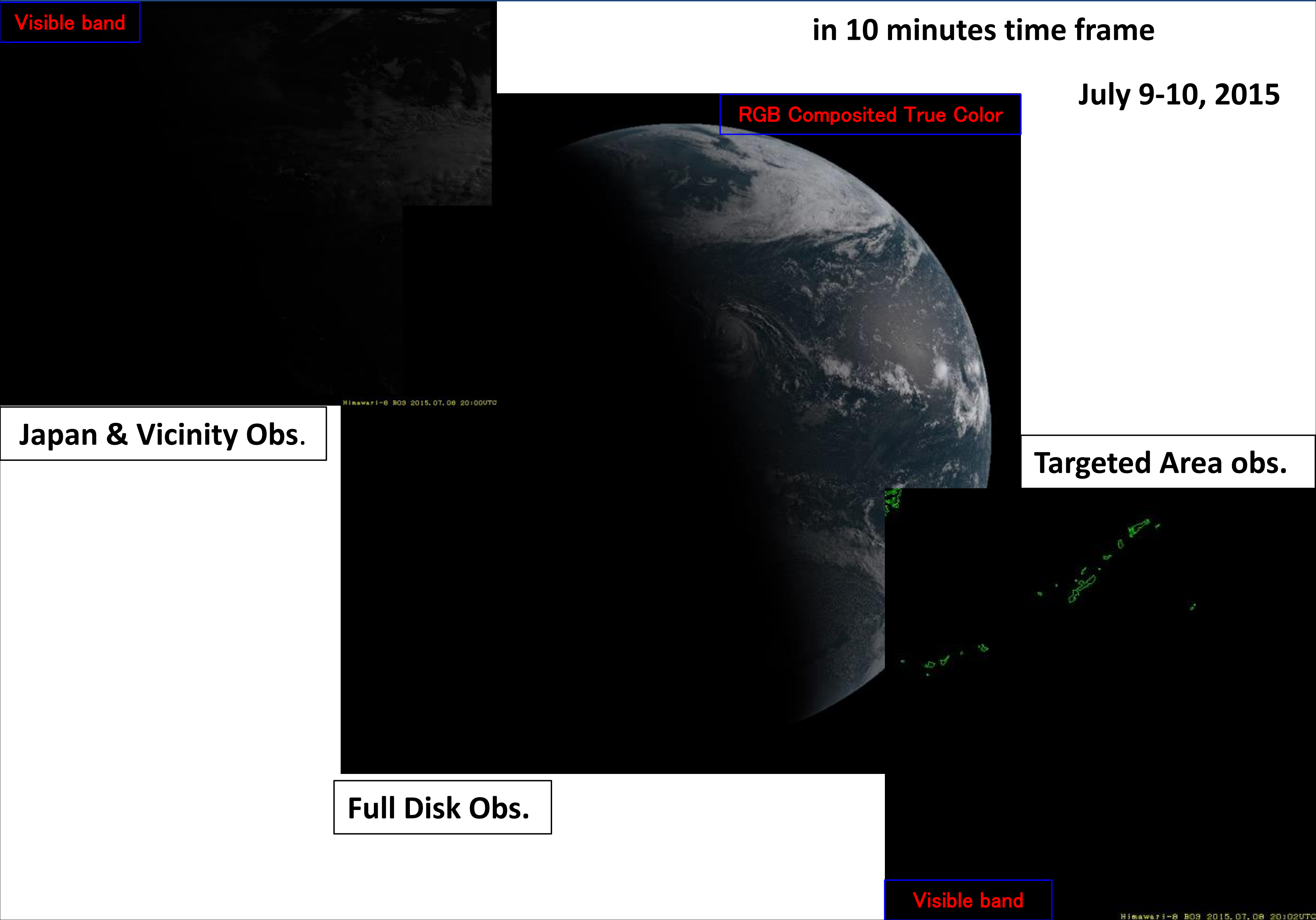
AHI Scan Scenario



Himawari-8: Observation Area and Interval

in 10 minutes time frame

July 9-10, 2015



Visible band

Japan & Vicinity Obs.

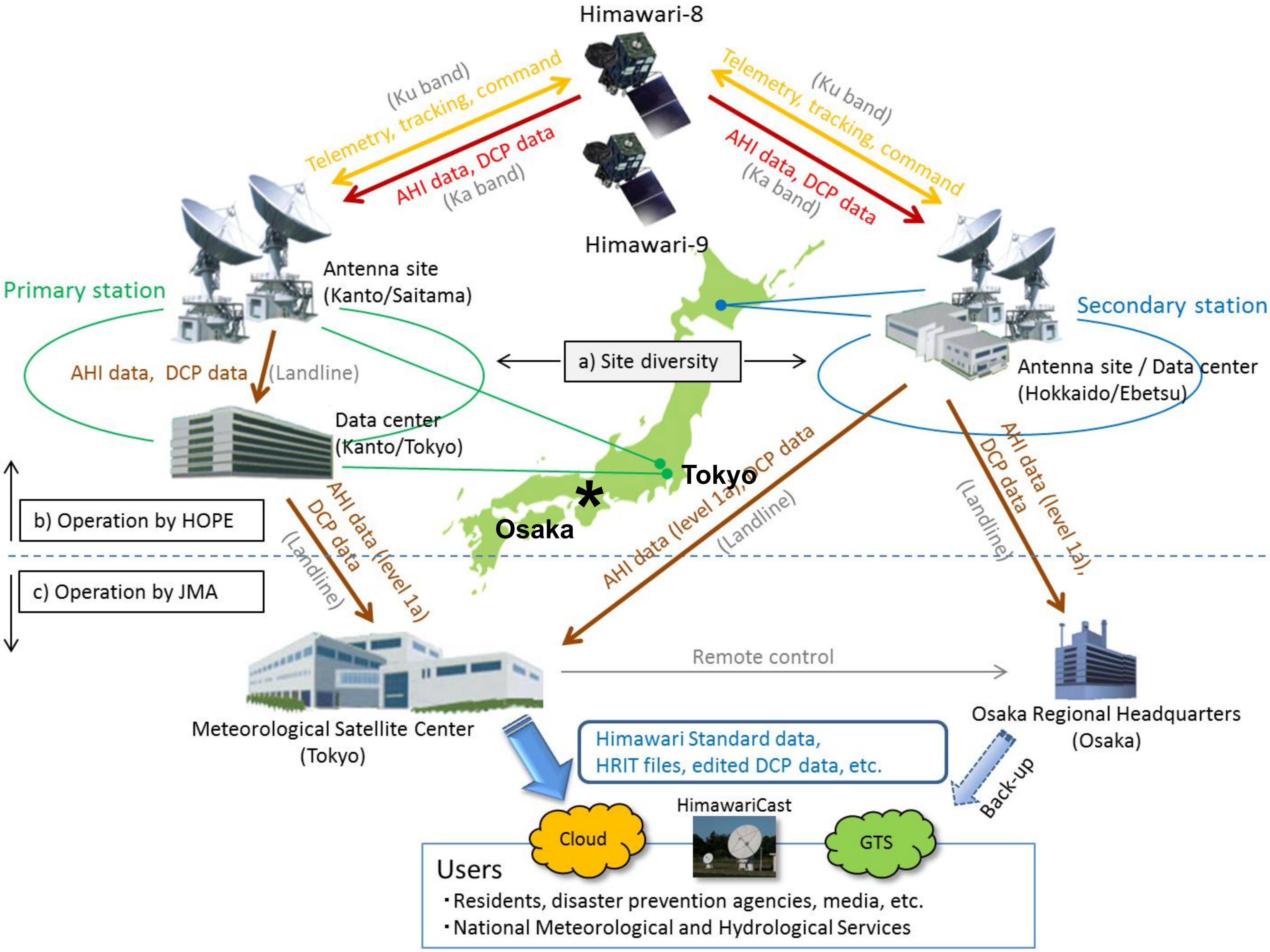
RGB Composited True Color

Full Disk Obs.

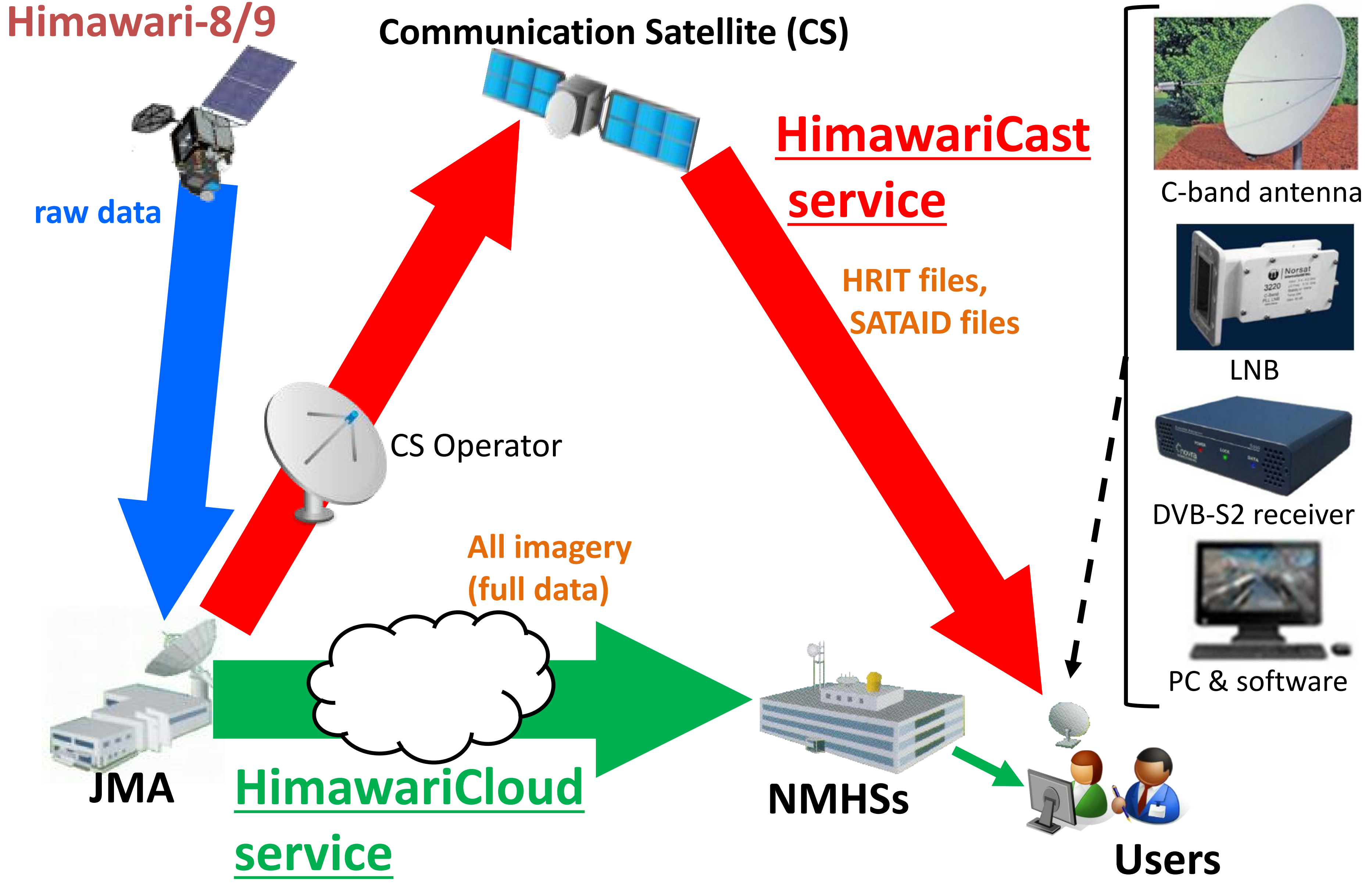
Targeted Area obs.

Visible band

Himawari-8/9 Ground Segment and Operations



Two Ways of Data Dissemination/Distribution HimawariCast/HimawariCloud



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 IR) every **10 minutes** for Full Disk
- Spatial Resolution is same as that of MTSAT **HRIT compatible**

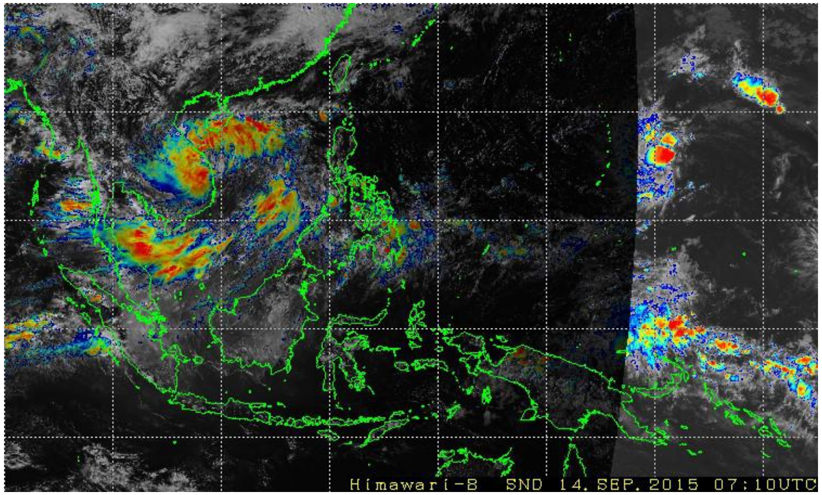
HimawariCloud via Internet Cloud

- 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	**High-speed Internet (NTT Communication)**
HimawariCast (for baseline usage)	All	HRIT files (MTSAT Compatible)	10 min	14	VIS: 1 km IR: 4 km (B07 is "2km" at night time)	**Communication Satellite (JCSAT-2B)**
Web-based Quick-Look	All	JPEG	10 min	4+	several km	

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



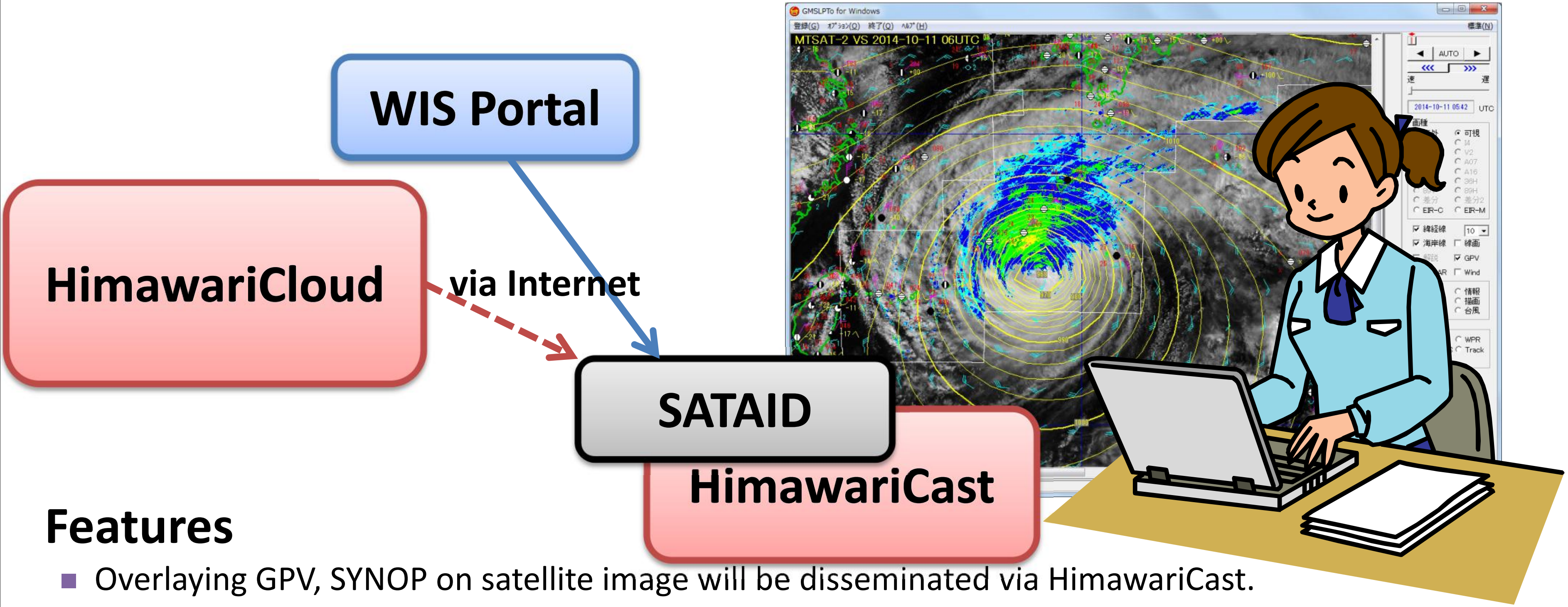
Dataset Disseminated via HimawariCast

Data type	Format	Notes
Himawari-8 imagery (full disk)	HRIT	Interval: 10 minutes Number of bands: 14 Spatial resolution: VIS: 1 km, IR: 2 - 4 km
	LRIT	Interval: 10 minutes Number of bands: 4 (VIS, IR1, IR3, IR4) Spatial resolution: 5 km
Numerical weather prediction (NWP)	SATAID	JMA Global Spectral Model (GSM) products (48-hour forecast) Interval: 6 hours Spatial resolution: 1.25 degrees
In-situ observations (SYNOP, TEMP, SHIP)	SATAID	Observation data for East Asia and Western Pacific regions Interval: 30 minutes
ASCAT ocean surface winds	SATAID	Observation data from EUMETSAT's Metop polar-orbiting satellites Interval: 30 minutes
Operation plan (MANAM)	Text	Frequency: twice a day

HimawariCast software and manuals:
http://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html

HimawariCast with SATAID

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

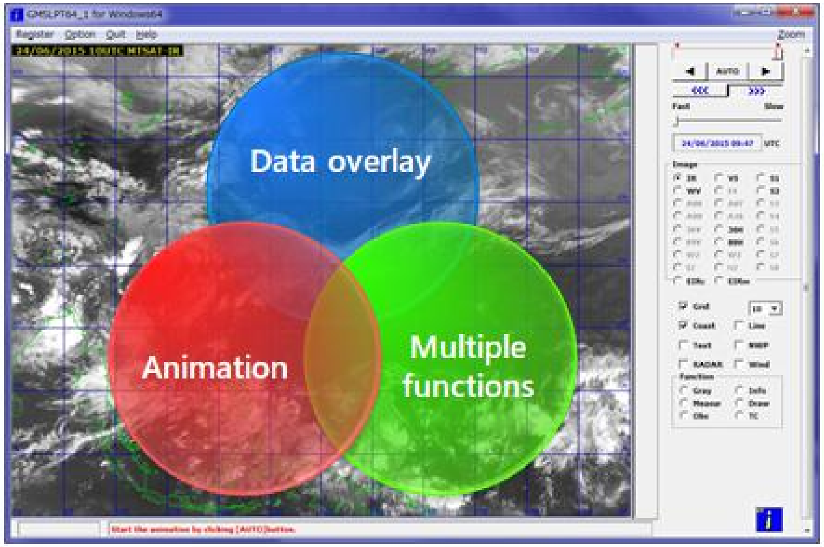


Features

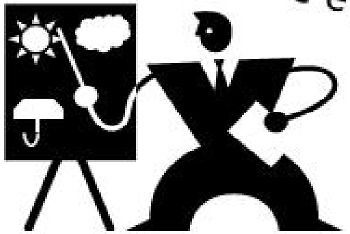
- Overlaying GPV, SYNOP on satellite image will be disseminated via HimawariCast.
- Satellite image in SATAID format can be downloaded from WIS Portal server, or you can convert from HRIT image data.
- SATAID System will be available from MSC Website with “Source Code”
- Image data format converter between 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.

What's SATAID?

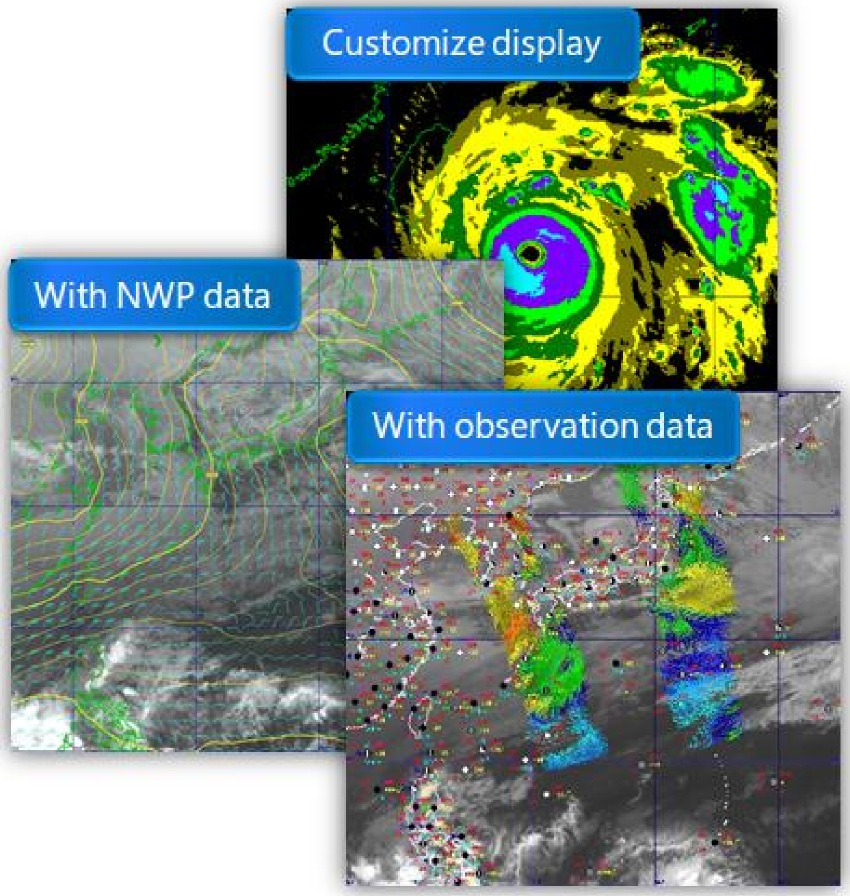
SATAID (SATellite Animation and Interactive Diagnosis) is a sophisticated display software visualizing meteorological information in multiple dimensions (spatial and temporal), which assists forecasters to analyze and monitor continually weather parameters and phenomena for better meteorological services.



Start the animation by clicking [AUTO] button.



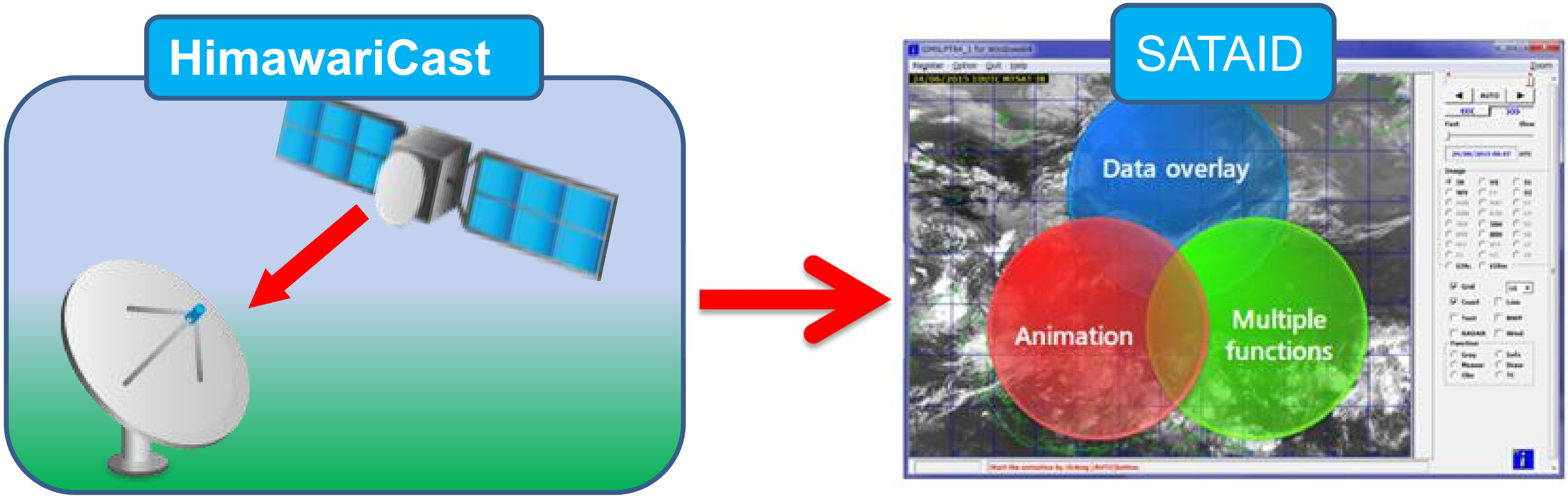
More efficiently and accurately!



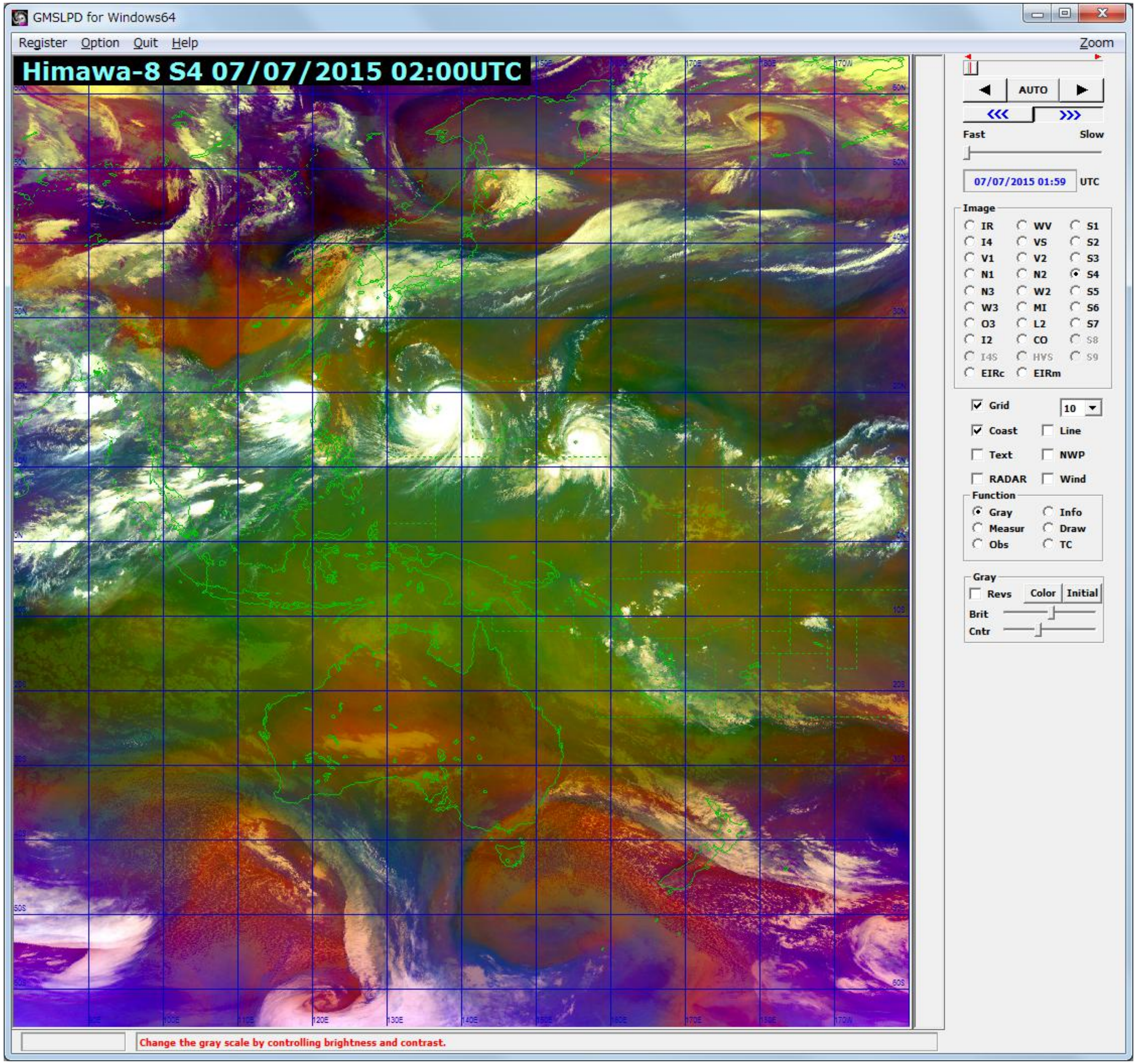
Synergy of HimawariCast and SATAID

HimawariCast assists weather monitoring and analysis with SATAID software (visualization tool).

- ✓ HimawariCast HRIT files can be converted into SATAID format.
  (JMA-prepared software also supports this conversion.)
- ✓ The latest SATAID software (Ver3.2) supports all 16 bands of Himawari-8.
- ✓ HimawariCast meteorological data can also be displayed in SATAID software.



SATAID software



Himawa-8 S4 07/07/2015 02:00UTC

07/07/2015 01:59 UTC

Change the gray scale by controlling brightness and contrast.

RGB imageries can be easily composed

WIS Portal - GISC Tokyo SATAID Service

JMA has been offering SATAID service within the framework of WMO Information System (WIS).

SATAID Service

provided by DCPCs of JMA.

Welcome!

This service provides SATellite Animation and Interactive Diagnosis (SATAID) application and SATAID data. SATAID enables the visualization and manipulation of satellite imagery, NWP (numerical weather prediction) products, observation results and data. And now JMA released the upgraded version of SATAID and its automatic downloader. The new version of the programs enables you to download 10-minute interval observation of Himawari-8 which will start operation on 7 July 2015.

- To download SATAID data, click on download page for the relevant area: ***North Central***, ***Northeast***, ***Northwest***, ***South Central***, ***Southeast***, ***Southwest***.
- To find out about data specifications, see ***Data for SATAID***.
- To find out about SATAID, see ***SATAID Application***.
- To download the SATAID program, see ***Download***.
- To find out more about using SATAID, see ***Manual***.

* Notes:

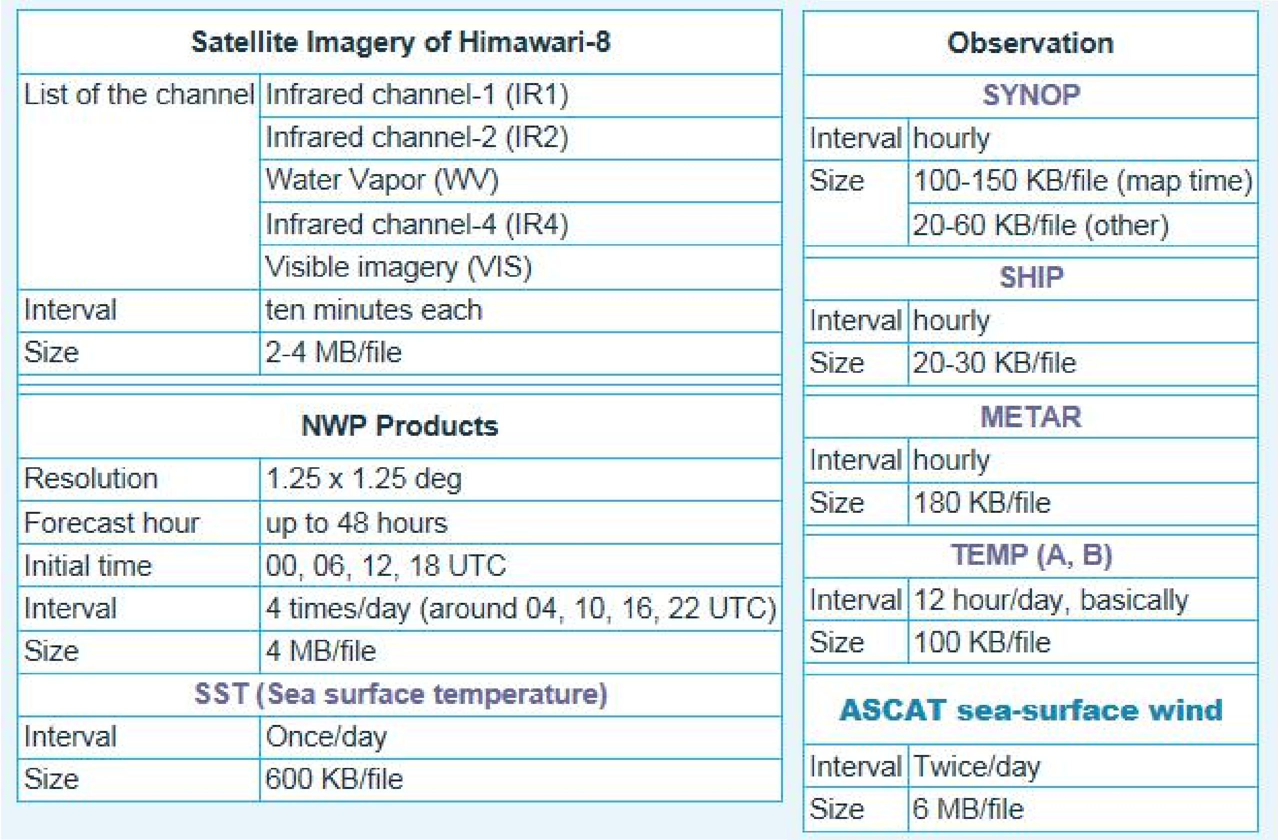
1. The scope of this service is limited to the Himawari-8 satellite coverage area.
2. The service is exclusive to registered users.
3. Users must abide by the ***SATAID Service terms of use***.

To submit operational questions, access the **ticket system** on the **GISC Tokyo Portal**. For general administrative matters (e.g., to update contact details), e-mail *wis-jma at met.kishou.go.jp*.

All Rights Reserved, Copyright © 2015 WIS Portal - GISC Tokyo (Japan Meteorological Agency). <Legal Notice>

http://www.wis-jma.go.jp/cms/sataid/

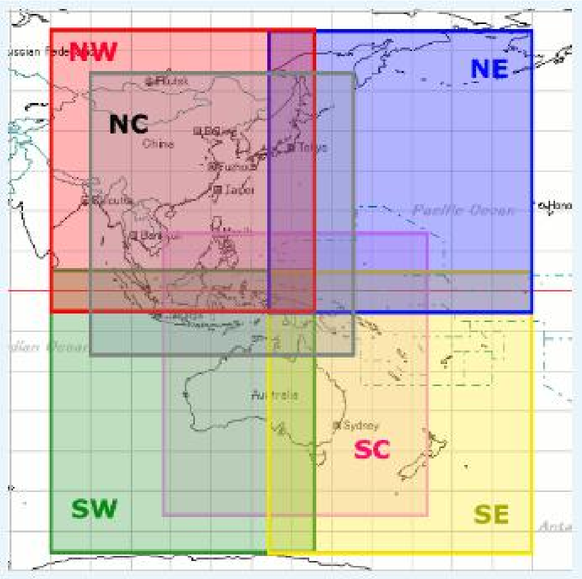
WIS Portal - GISC Tokyo SATAID Service



Satellite Imagery of Himawari-8	
List of the channel	Infrared channel-1 (IR1)
	Infrared channel-2 (IR2)
	Water Vapor (WV)
	Infrared channel-4 (IR4)
	Visible imagery (VIS)
Interval	ten minutes each
Size	2-4 MB/file

NWP Products	
Resolution	1.25 x 1.25 deg
Forecast hour	up to 48 hours
Initial time	00, 06, 12, 18 UTC
Interval	4 times/day (around 04, 10, 16, 22 UTC)
Size	4 MB/file
SST (Sea surface temperature)	
Interval	Once/day
Size	600 KB/file

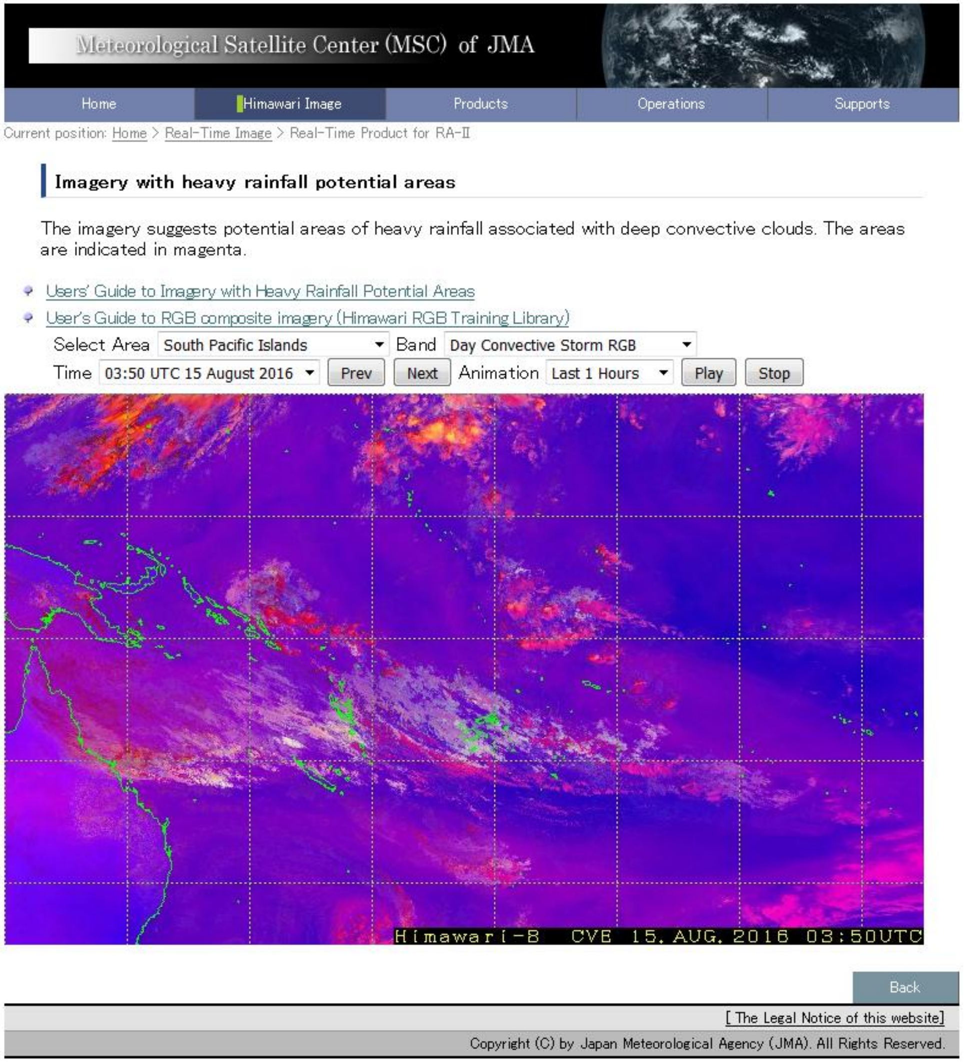
Observation	
SYNOP	
Interval	hourly
Size	100-150 KB/file (map time)
	20-60 KB/file (other)
SHIP	
Interval	hourly
Size	20-30 KB/file
METAR	
Interval	hourly
Size	180 KB/file
TEMP (A, B)	
Interval	12 hour/day, basically
Size	100 KB/file
ASCAT sea-surface wind	
Interval	Twice/day
Size	6 MB/file



SATAID application and data download tool: http://www.wis-jma.go.jp/cms/sataid/app/download/
SATAID quick guide and operational manual: http://www.wis-jma.go.jp/cms/sataid/manual/

Note that low-resolution and small number of bands are provided by the WIS Portal

Web-based Quick-Look


Meteorological Satellite Center (MSC) of JMA

Current position: Home > Real-Time Image > Real-Time Product for RA-II

Imagery with heavy rainfall potential areas

The imagery suggests potential areas of heavy rainfall associated with deep convective clouds. The areas are indicated in magenta.

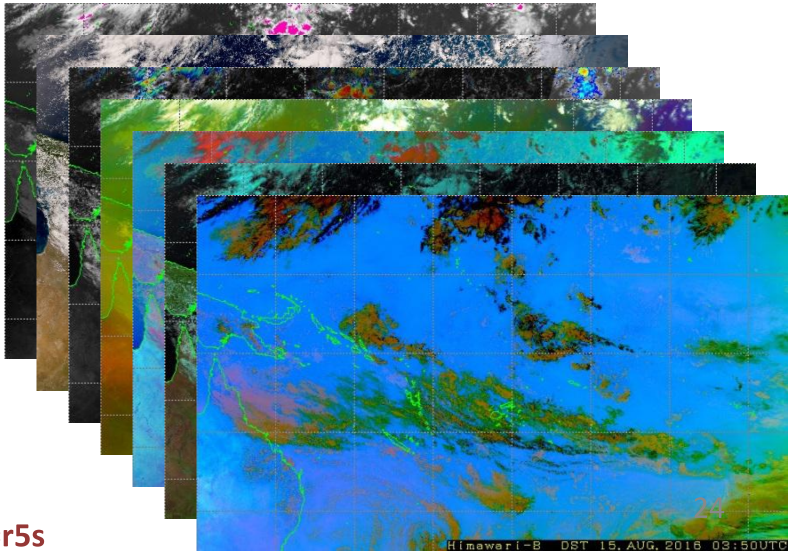
- Users' Guide to Imagery with Heavy Rainfall Potential Areas
- User's Guide to RGB composite imagery (Himawari RGB Training Library)

Select Area: South Pacific Islands
Band: Day Convective Storm RGB
Time: 03:50 UTC 15 August 2016
Animation: Last 1 Hours

[The Legal Notice of this website]

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

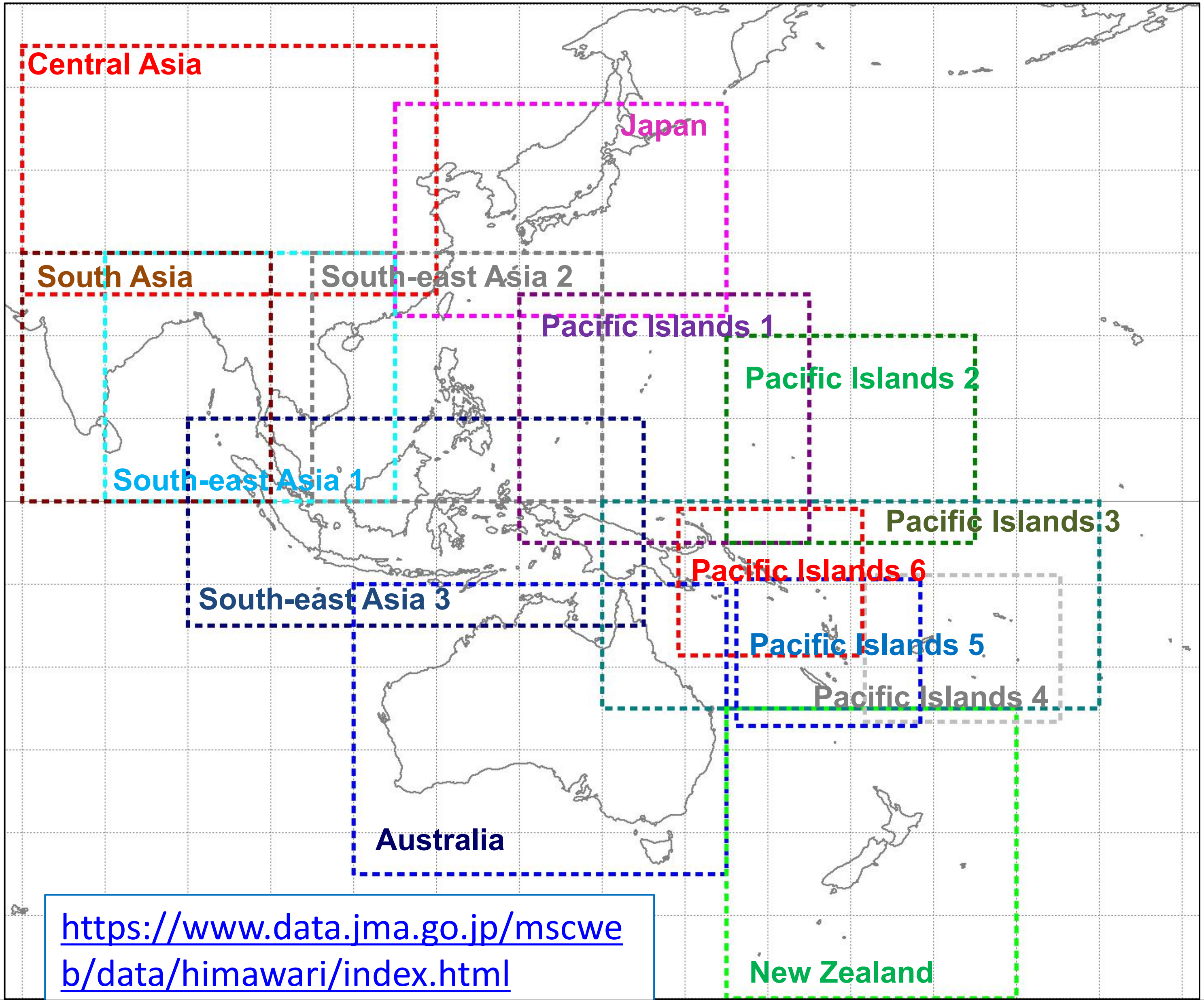
- ➢ RGB composite imagery based on the WMO standard recipe are produced from Himawari-8 imagery.
- ➢ Products are provided for supporting SWFDP in RA II/RA V region.
- ➢ IR(10.4µm), IR(3.9µm), WV(6.2µm), VIS(0.64µm), Heavy Rainfall Potential Areas and Sandwich Imagery are also provided.



RGB Imagery available on:

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

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



https://www.data.jma.go.jp/mscweb/data/himawari/index.html

Resolution
0.05degree

Central Asia
Japan
South Asia
South-east Asia 1
South-east Asia 2
South-east Asia 3
Pacific Islands 1
Pacific Islands 2
Pacific Islands 3
Australia
New Zealand

Resolution
0.037degree

Pacific Islands 4
Pacific Islands 5
Pacific Islands 6

Provision of Himawari Data for Researcher

- **JAXA (Japan Aerospace Exploration, Earth Observation Research Center)**
  - http://www.eorc.jaxa.jp/ptree/index.html
  - You must register to download data from JAXA's site.
- **NICT (National Institute of Information and Communications Technology)**
  - **Real-time data**
    - http://himawari8.nict.go.jp/
  - **Archived data (Japanese page)**
    - http://sc-web.nict.go.jp/himawari/himawari-data-archive.html

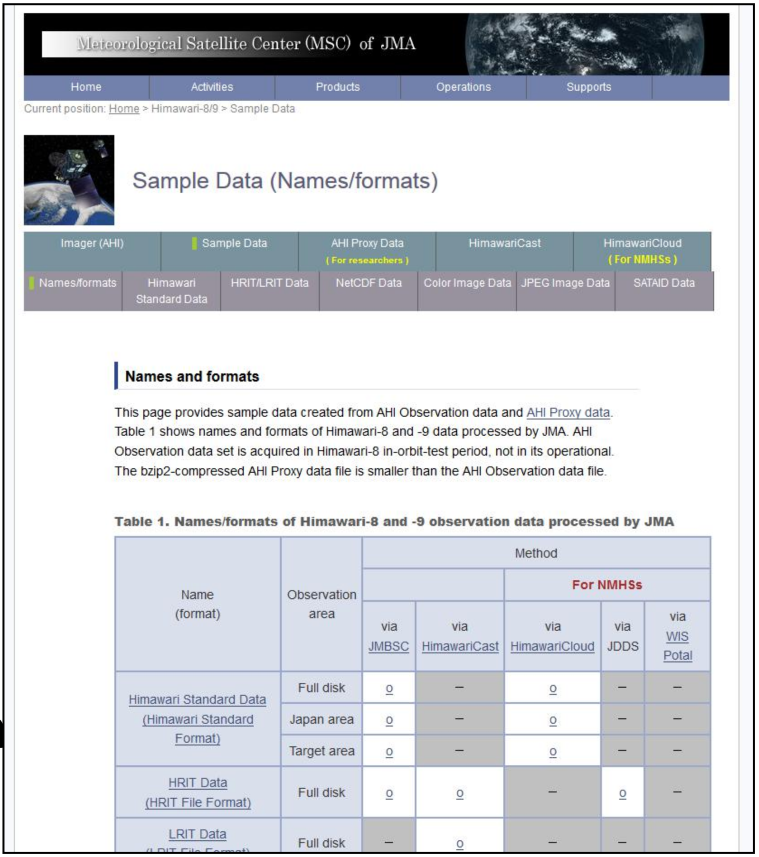
Data format	Obs. Area	Size（non-compress）		Note
Himawari Standard Data (HSD)	Full disk Japan area Target area	330 GB per day 80 GB per day 10 GB per day	2.3 GB per 10min. 140 MB per 2.5min. 80 MB per 2.5min.	－Full disk：　every 10 min. －Japan area：every 2.5 min. －16 bands
PNG	Full disk Japan area Target area	10 GB per day 2.5 GB per day 0.5 GB per day	140 MB per 10min. 7.5 MB per 2.5min. 1.5 MB per 2.5min.	－Full disk：　every 10 min. －Japan area：every 2.5 min. －True color image only （composite of 3 visible bands ）
NetCDF	Japan area Target area	160 GB per day 50 GB per day	280 MB per 2.5min. 90 MB per 2.5min.	－Japan area：every 2.5 min. －16 bands

Himawari-8/9 Users Support Information

https://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
    - From HSD or HRIT to NetCDF Data
    - From HSD or HRIT to SATAID Data
    - From HSD to HRIT Data etc.



Current position: Home > Himawari-8/9 > Sample Data

Sample Data (Names/formats)

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 Potal
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	Full disk	–	o	–	–	–

Feel free to contact:

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

Next to Satellite derived products!

Eruption of Mt. Shiveluch in Kamchatka
March 25, 2015
Footage from Himawari-8 Test Observation (Band-3 (0.64**µm**), 2.5 min.)

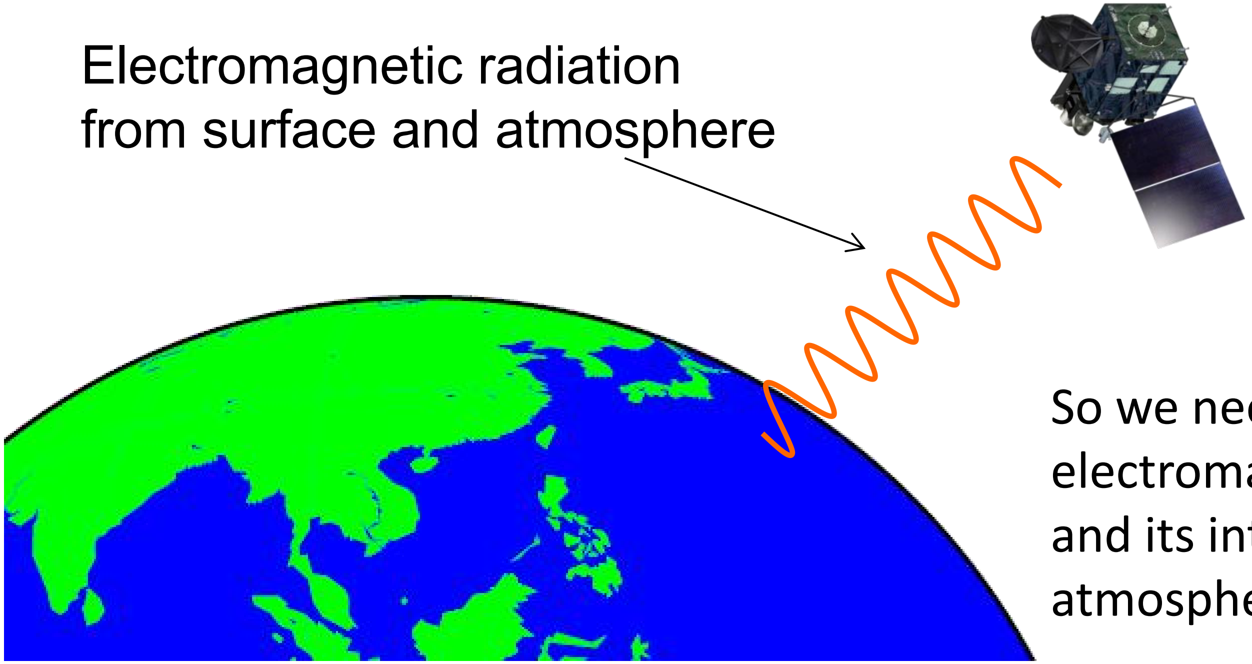
Contents

2. Satellite derived products

- ➢ Introduction to Satellite Remote Sensing
- ➢ Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Clear Sky Radiance
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

Satellite Remote Sensing of the Earth

- Observing surface and atmosphere of the Earth from space by using electromagnetic radiation



Electromagnetic radiation
from surface and atmosphere

So we need to understand electromagnetic radiation and its interaction with atmosphere.

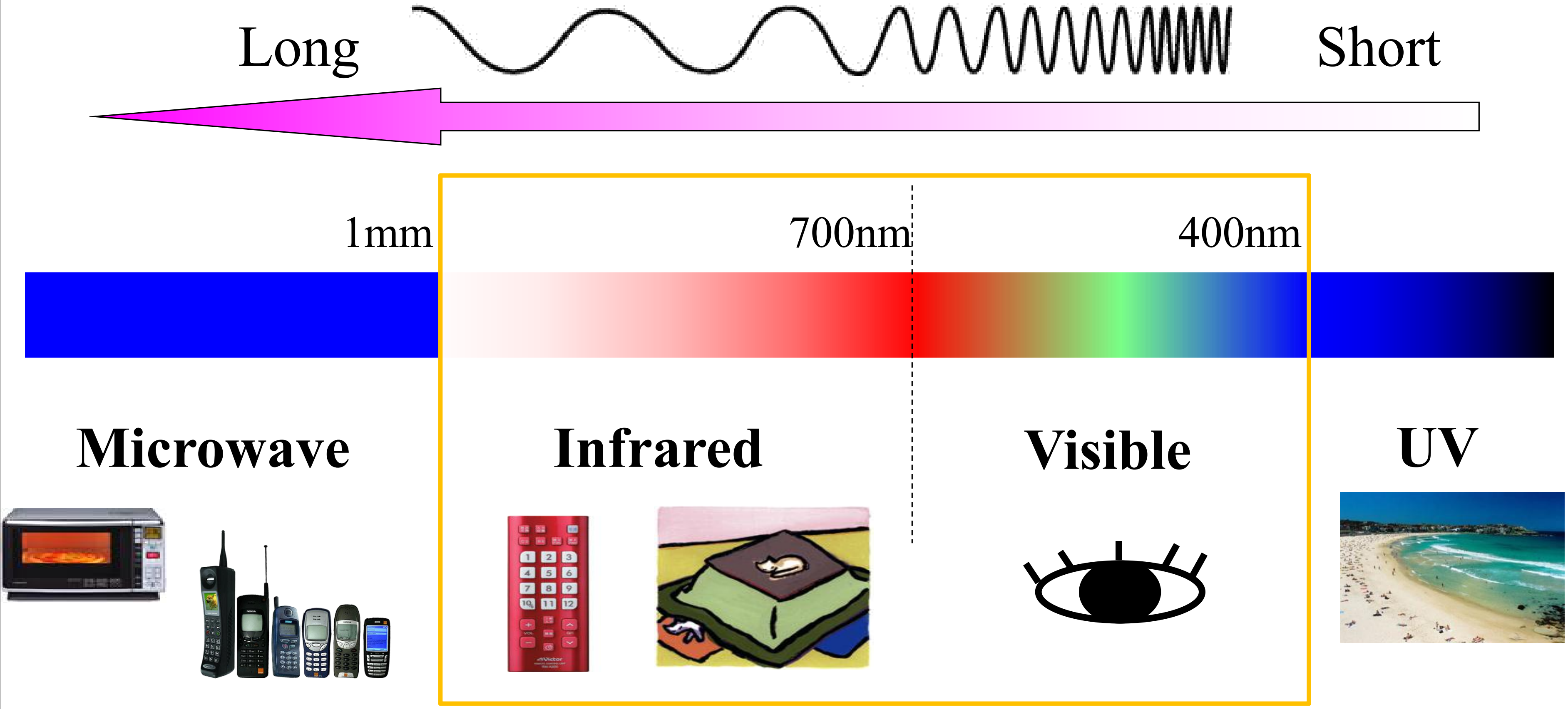
Electromagnetic Radiation

$$c = \upsilon\lambda$$

c : speed of light in vacuum (=2.9979 x 10^8 [ms^{-1}])

ν : frequency of electromagnetic radiation [$Hz=s^{-1}$]

λ : wavelength of electromagnetic radiation [m]



Long

Short

1mm

700nm

400nm

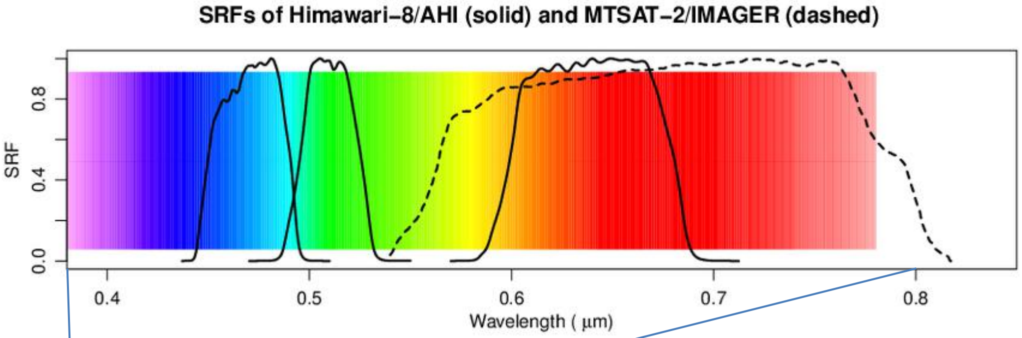
Microwave

Infrared

Visible

UV

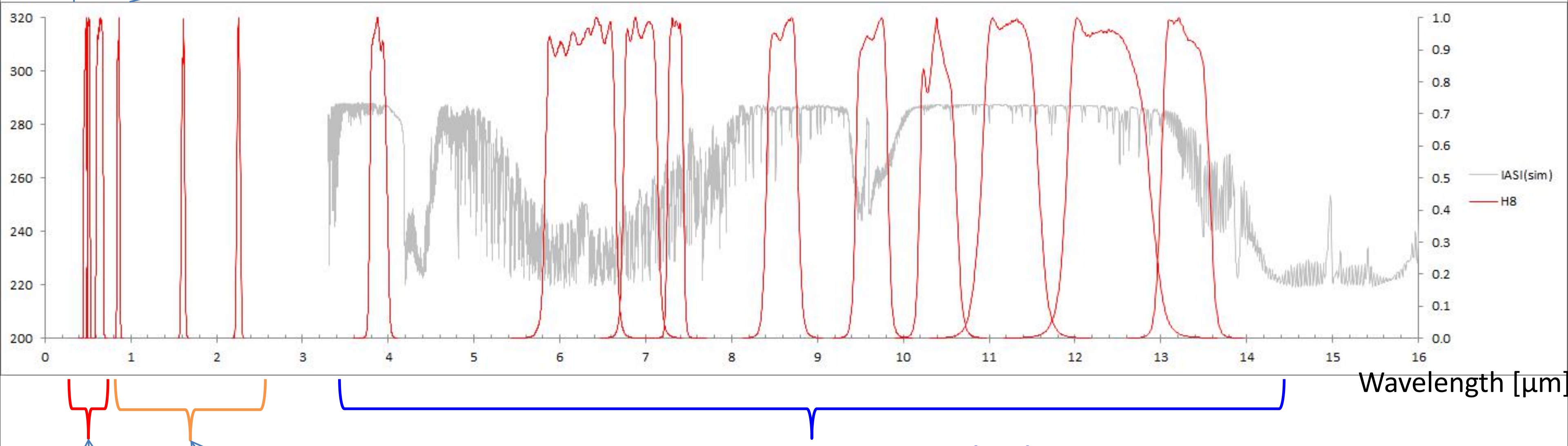
Himawari-8 AHI 16 Bands



Himawari-8 observes <u>visible to infrared</u> radiation from the Earth.

Visible (VIS) Bands

SRF (Spectral Response Function): relative spectral sensitivity



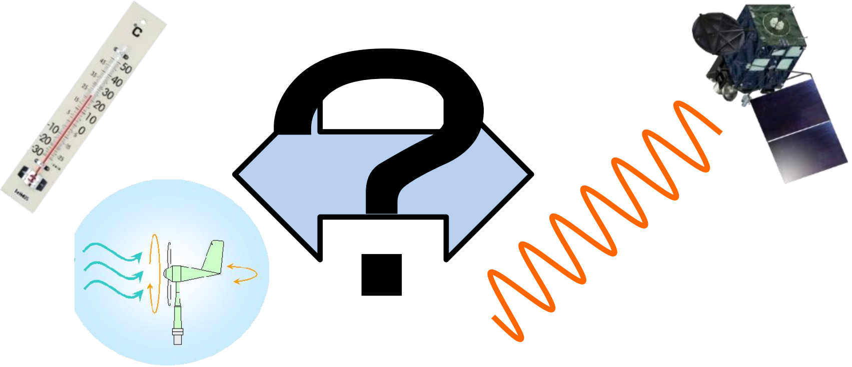
Infrared (IR) bands

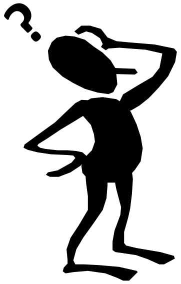
Near Infrared (NIR) bands

Visible (VIS) Bands

Required Information vs Observation

- Required Information
  - Wind speed
  - Temperature
  - Cloud height
  - …
- Observation
  - Electromagnetic wave

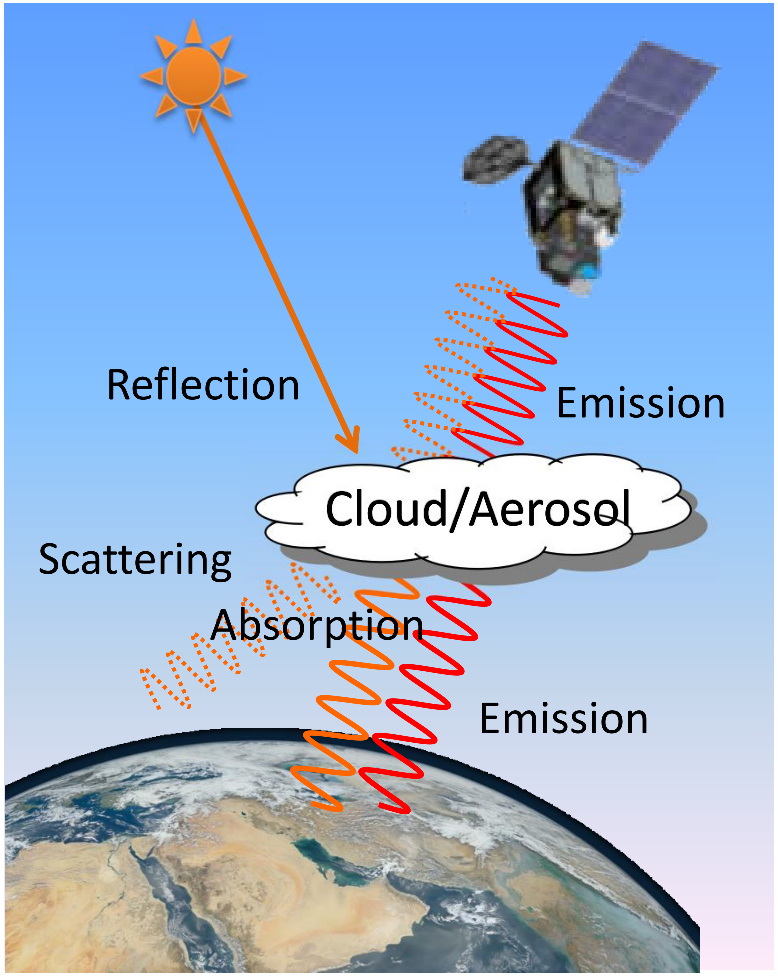




How can we derive the required info?

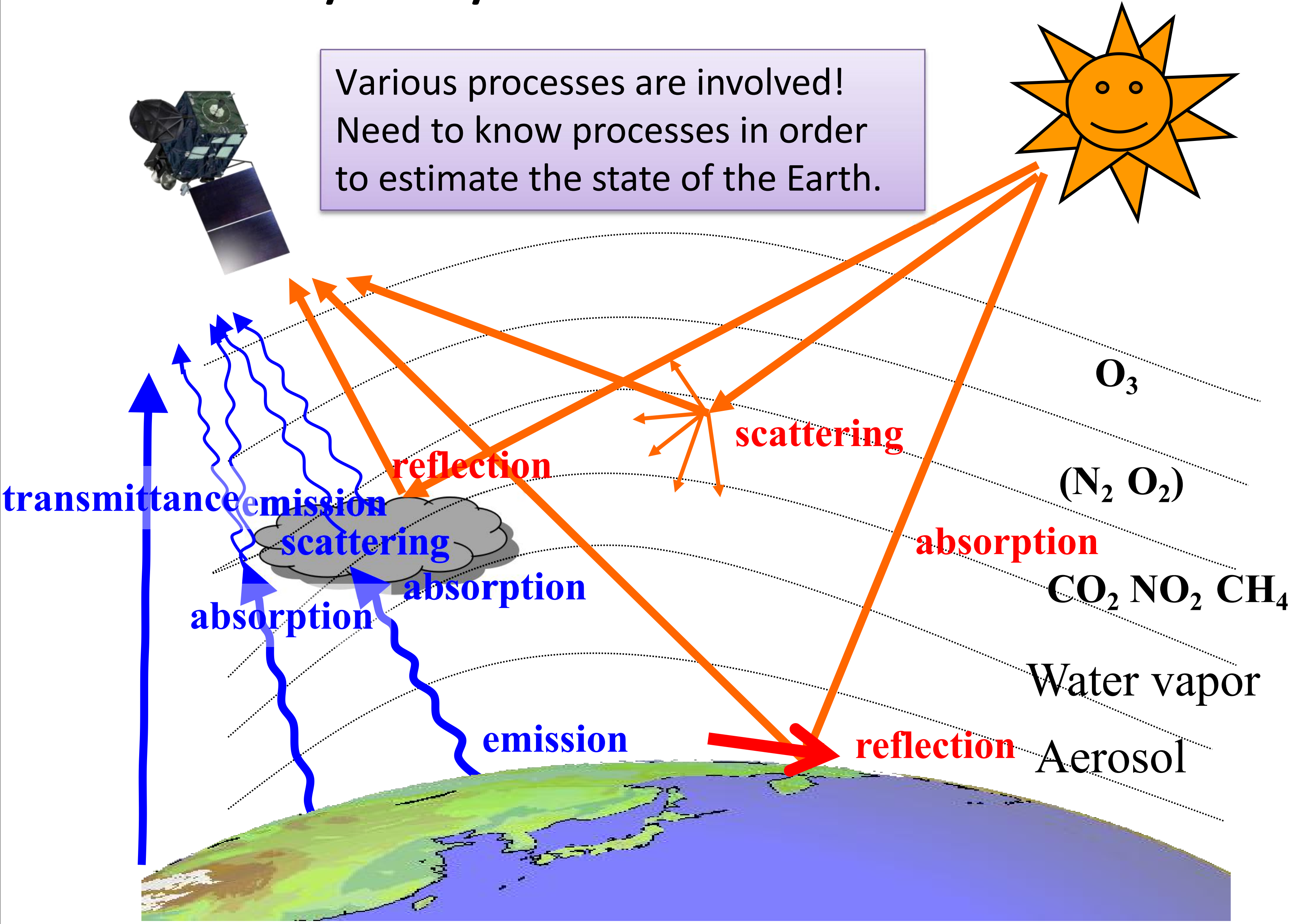
Retrieval: estimating state of the atmosphere and earth surface from satellite observation

- Observed EM radiation
  - Integration of various radiative processes (e.g. reflection of solar radiation on clouds)
  - Lots of information on gases, clouds, aerosol, earth surface, etc.
- Not straightforward to isolate what we need from the integration, but possible
  - E.g. retrieval of cloud top temperature

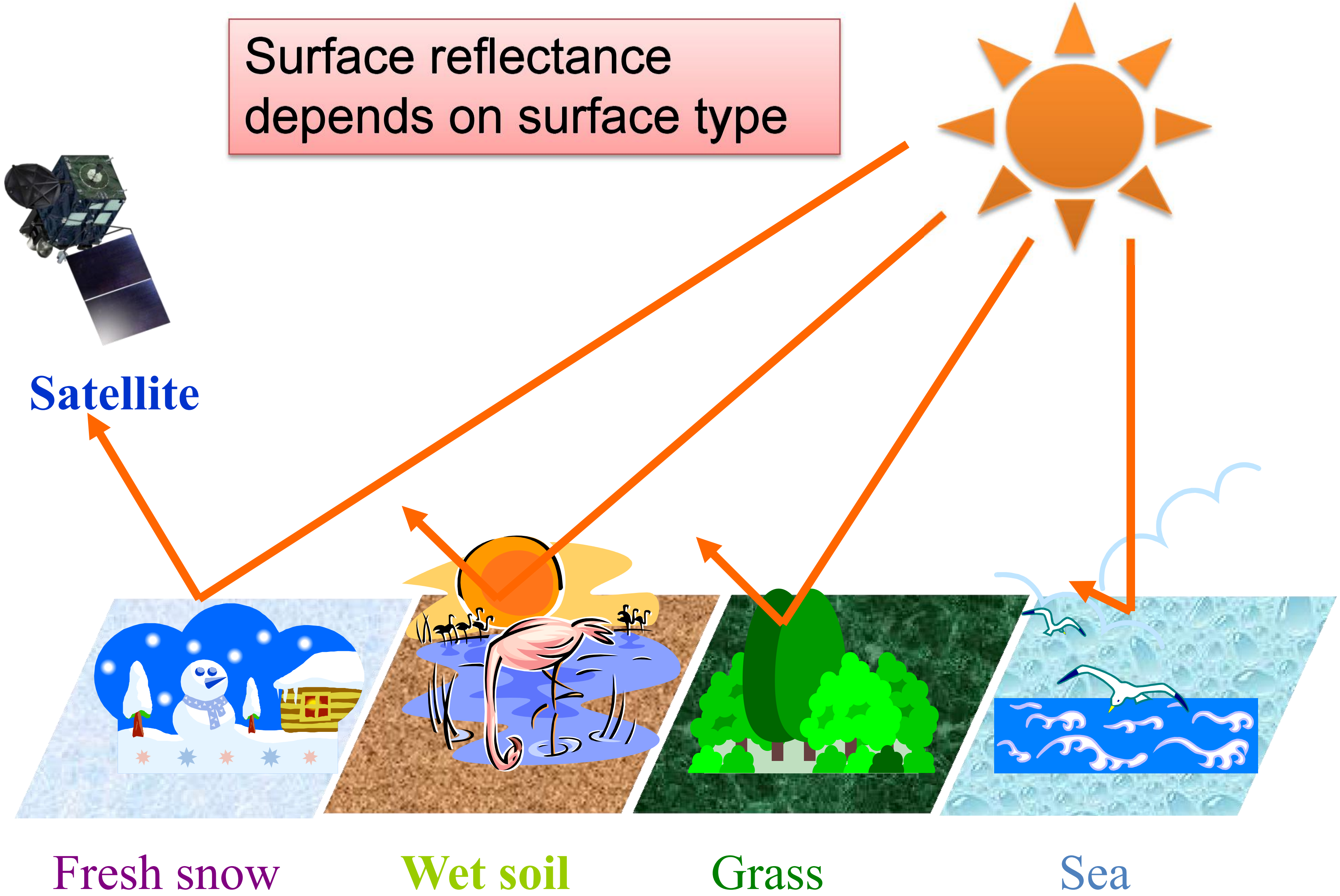


VIS/NIR/IR Radiative Processes

Various processes are involved!
Need to know processes in order to estimate the state of the Earth.



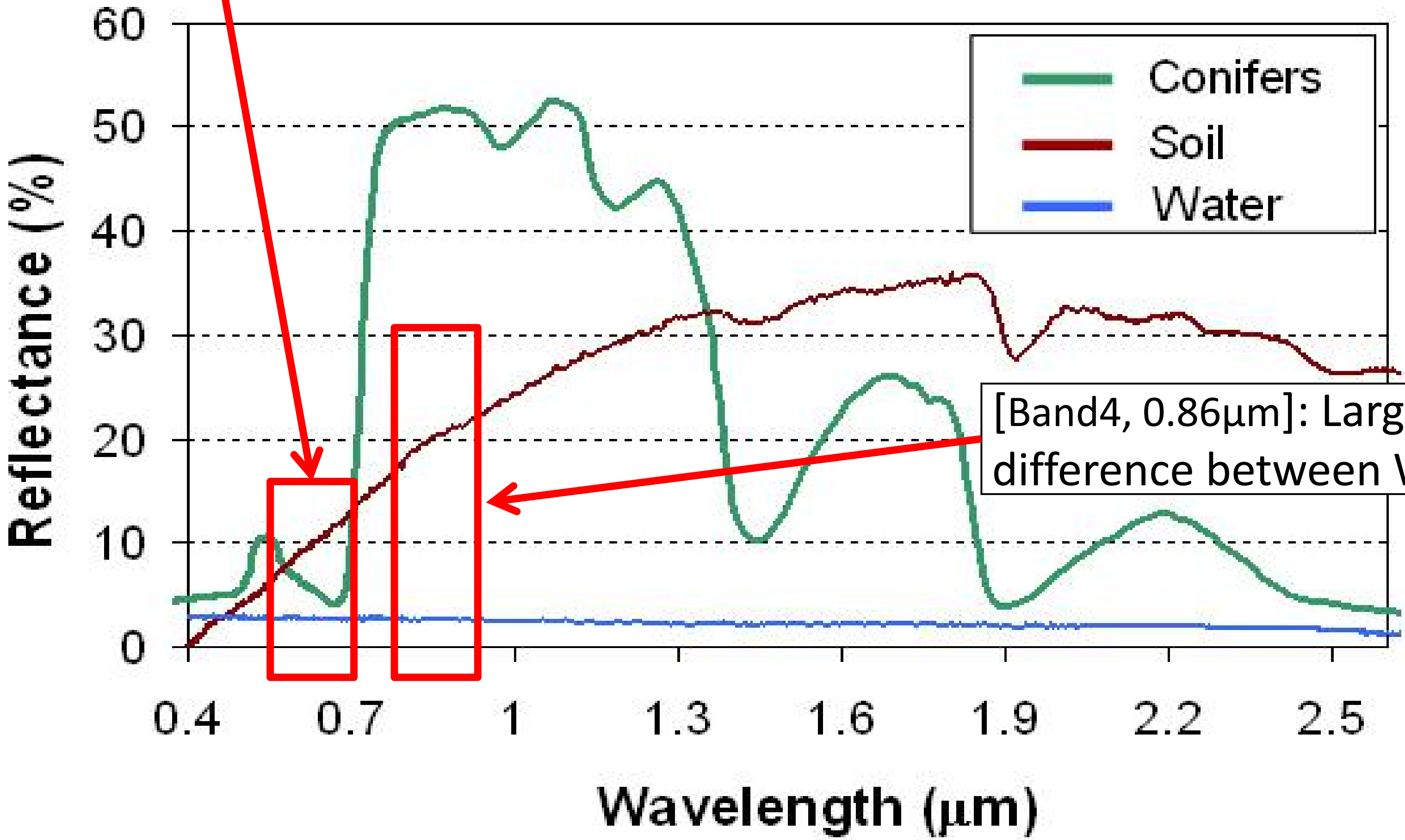
Surface Reflection



Spectral surface reflectance (Water and Soil)

[Band 3, 0.64μm]:
Smaller difference
between Water/Soil

Surface reflectance depends also on wavelength.
Spectral difference can be used for surface type estimation.

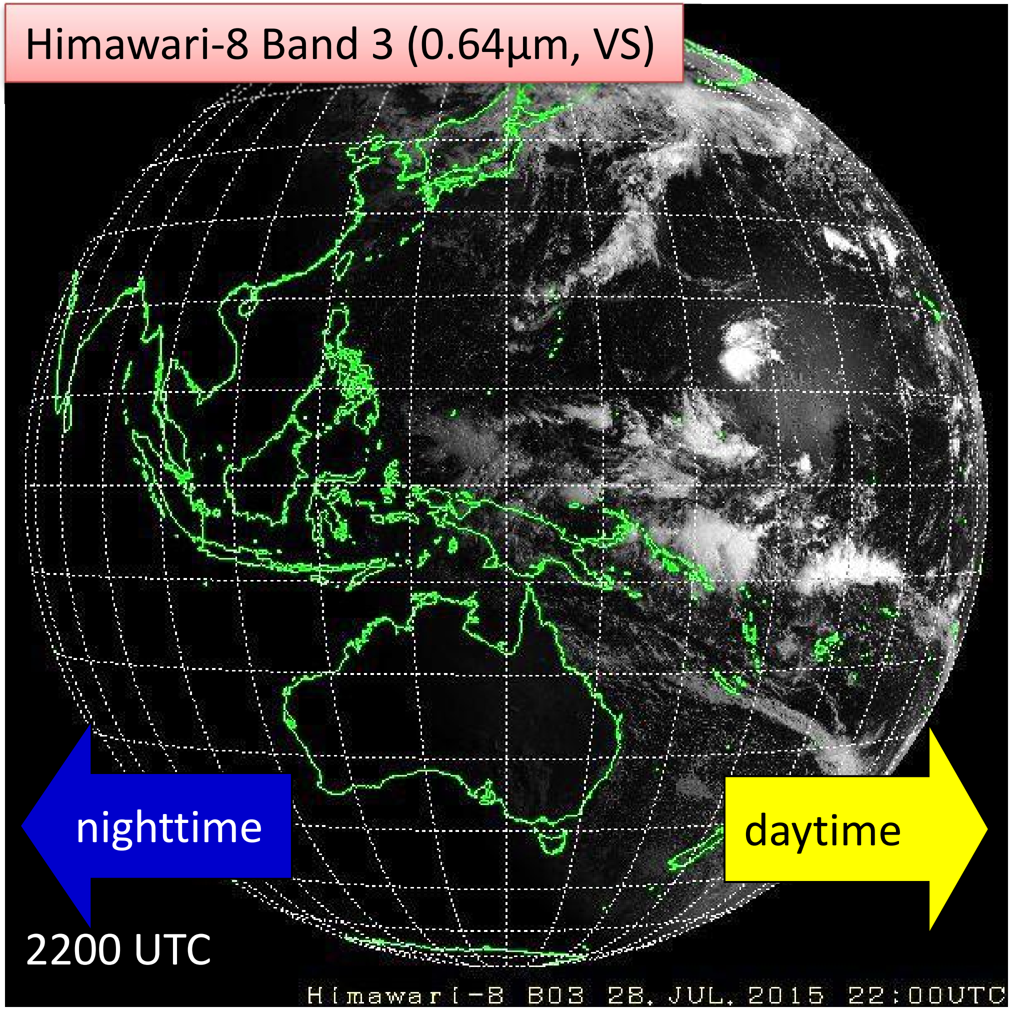


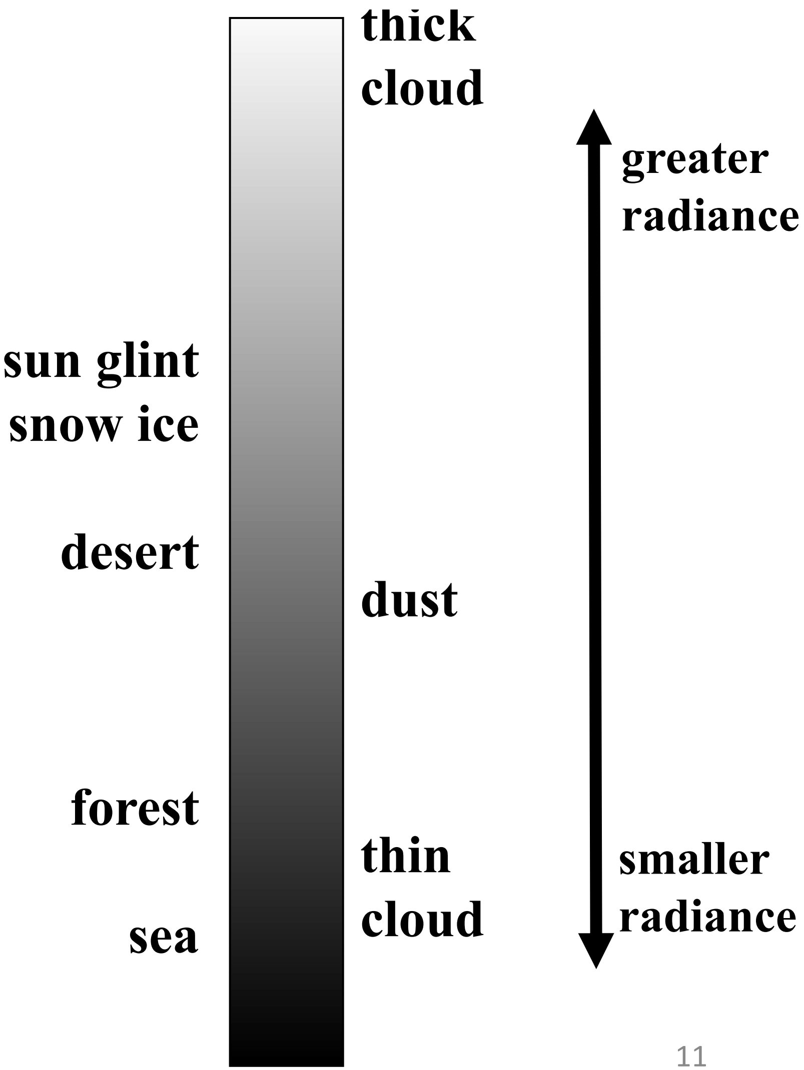
[Band4, 0.86μm]: Larger
difference between Water/Soil

EUMETRAIN - Monitoring Vegetation From Space (http://www.eumetrain.org/data/3/36/print.htm)

VIS band image

- ✓ Solar radiation reflected (or scattered) by surface, cloud, aerosol, etc.
- ✓ Intensity of reflected radiation depends on property of surface, cloud, aerosol, etc.




thick cloud

greater radiance

sun glint
snow ice

desert

dust

forest

thin cloud

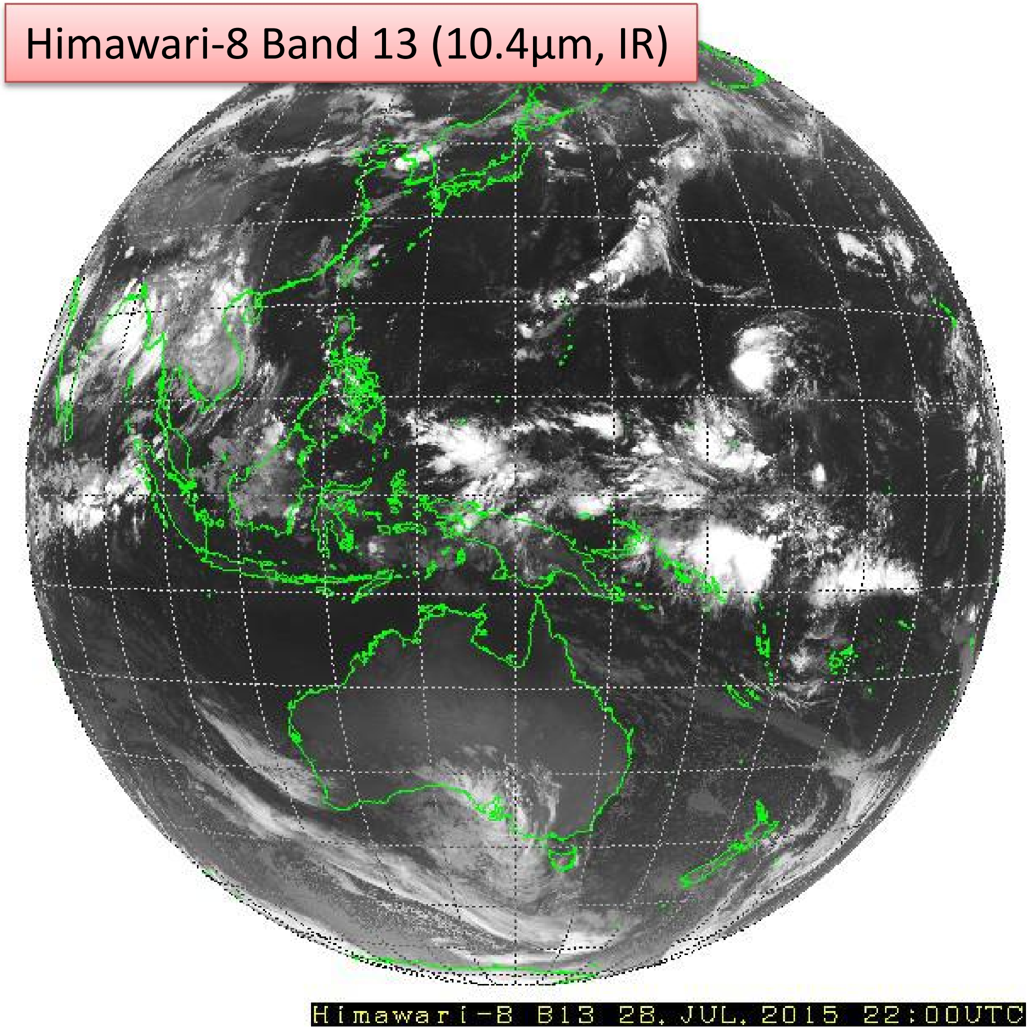
smaller radiance

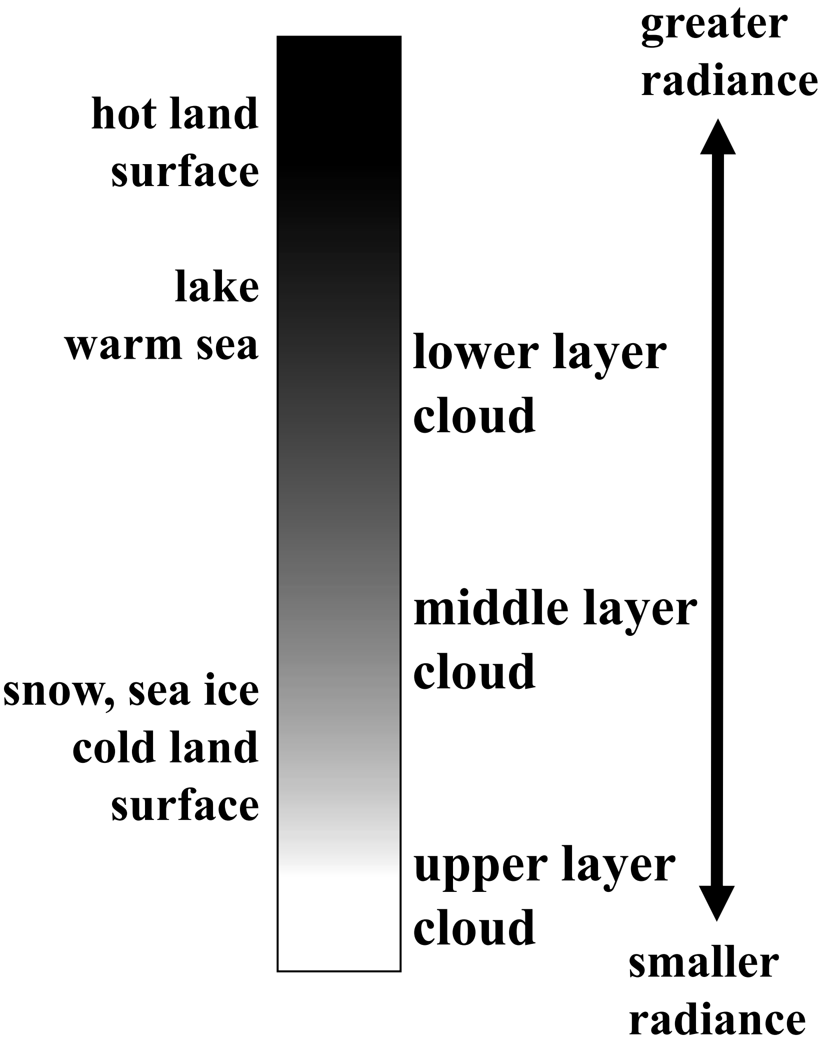
sea

IR band Image

- ✓ Thermal radiation emitted by surface, atmosphere, cloud, etc.
- ✓ Thermal radiation indicates temperature of surface, atmosphere, cloud, etc.

Himawari-8 Band 13 (10.4µm, IR)

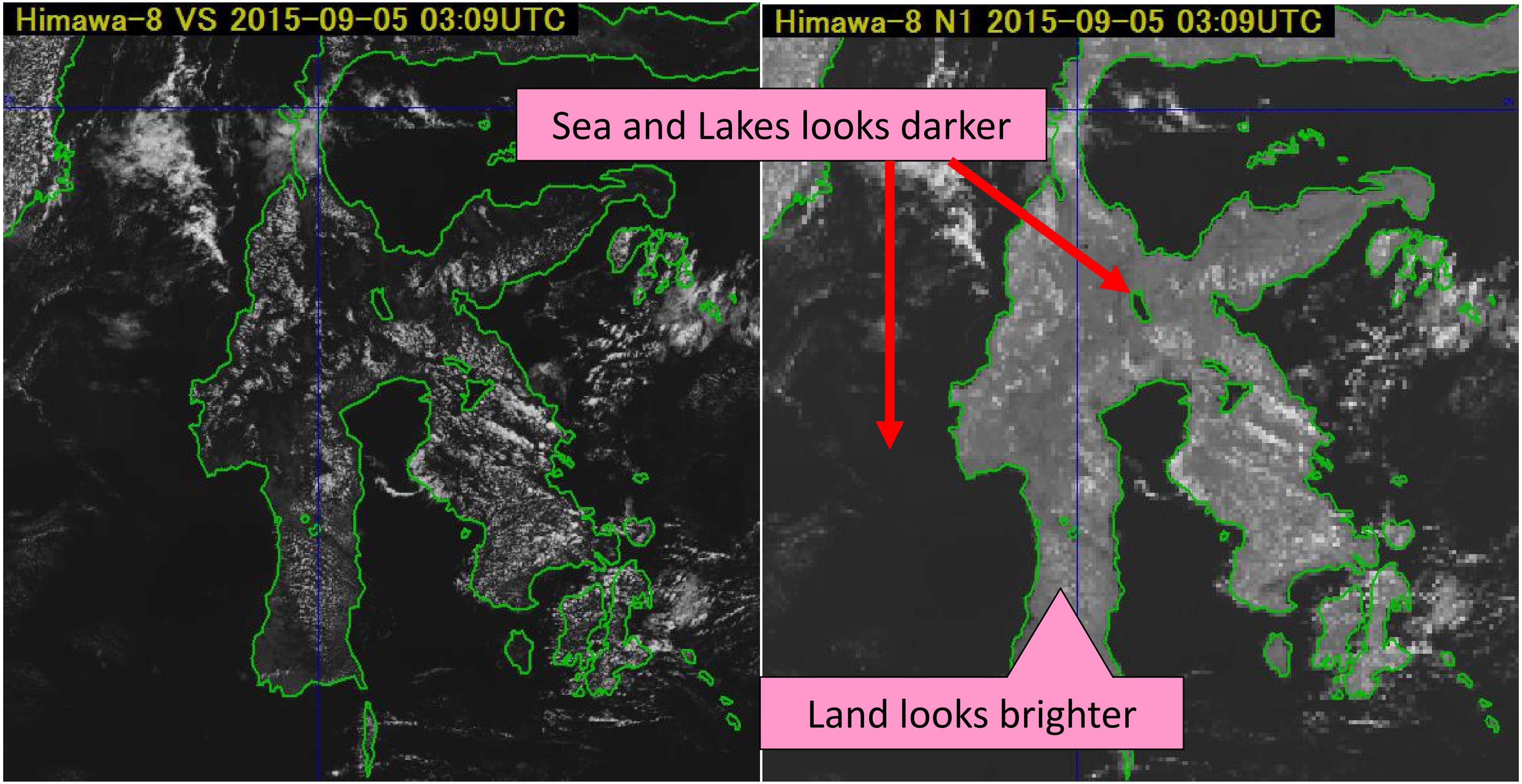




Surface reflectance property (Water/Soil): VIS vs NIR

Visible
Band3 (0.64μm, VS)

Near-Infrared
Band4 (0.86μm, N1)



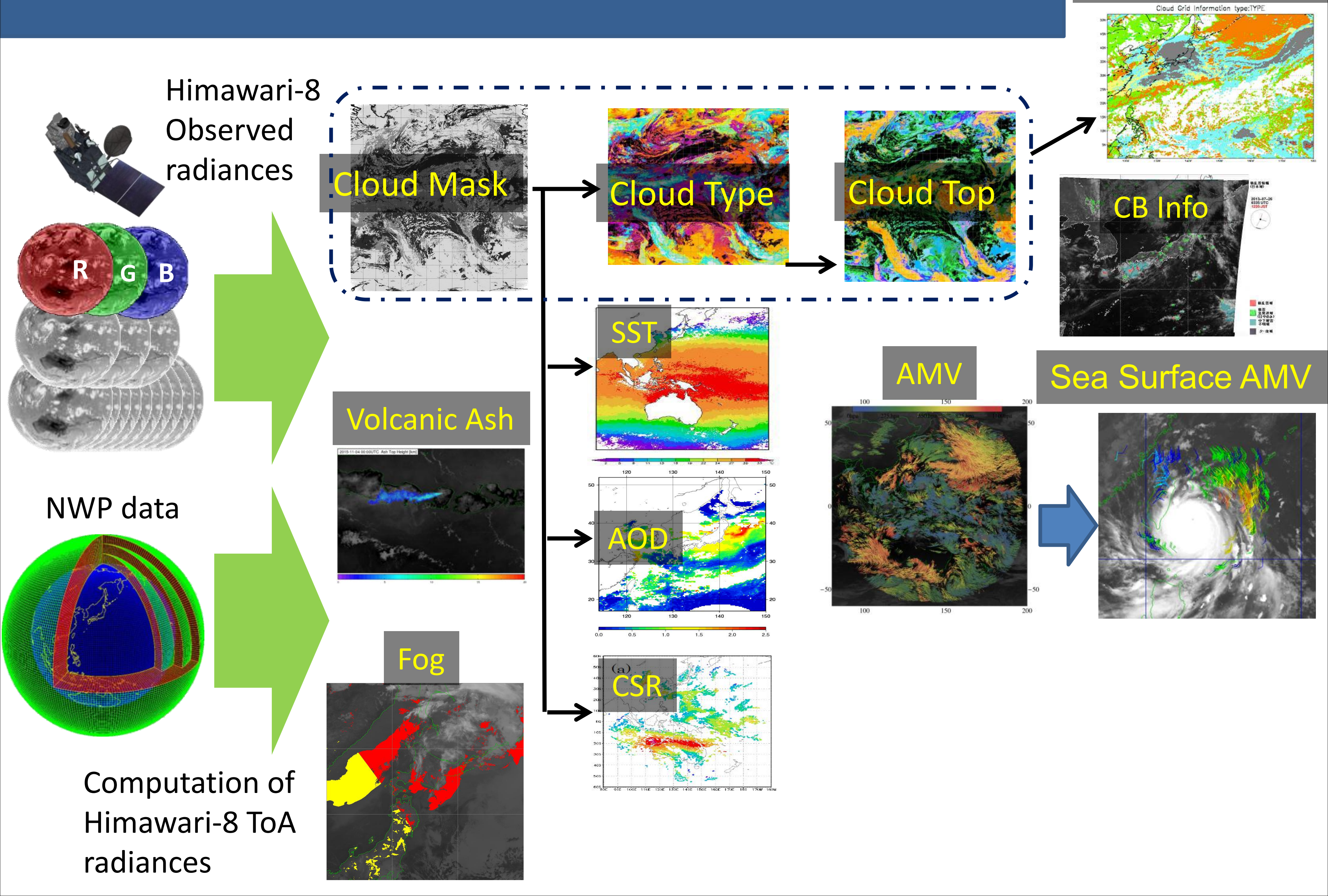
Sea and Lakes looks darker

Land looks brighter

2. Satellite derived products

- Introduction to Satellite Remote Sensing
- Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Clear Sky Radiance
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

Himawari-8 Geophysical Products



Himawari-8 Observed radiances

NWP data

Computation of Himawari-8 ToA radiances

Cloud Mask

Cloud Type

Cloud Top

Gridded Cloud Info

CB Info

SST

AOD

CSR

Volcanic Ash

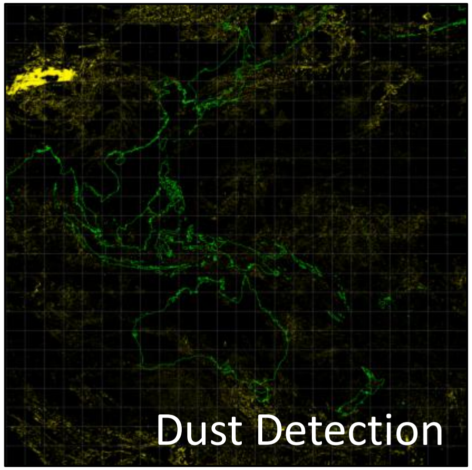
Fog

AMV

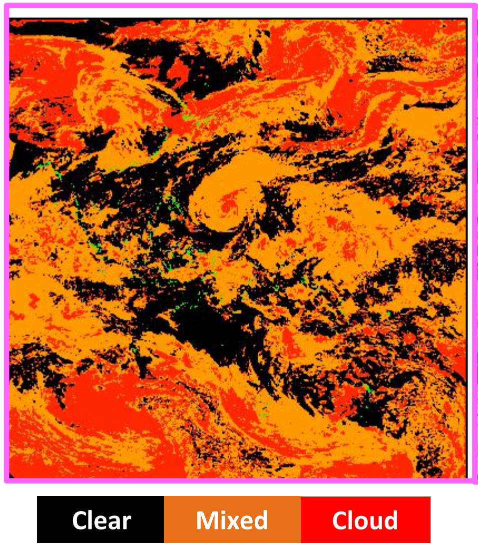
Sea Surface AMV

High-resolution Cloud Analysis Information (HCAI)

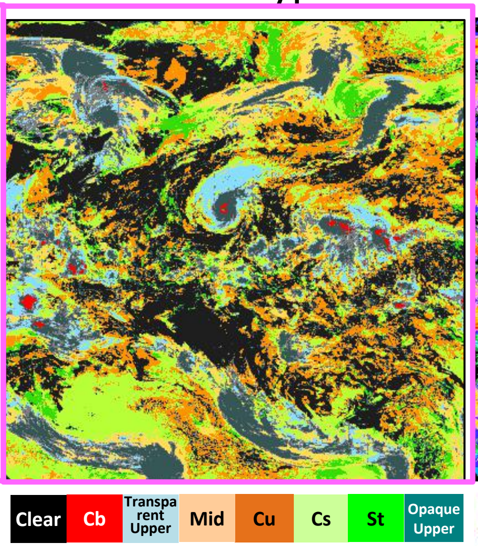
- **Cloud products (cloud-mask, -type, -top height), snow/dust detection and image quality information**
  - ✓ latitude-longitude grid in 0.02 degree
  - ✓ 60.01° S – 60.01 ° N, 79.99° E– 159.99 ° W
  - ✓ produced hourly basis
- **The ATBDs (Algorithm theoretical basis documents) was published in March 2016**
  - https://www.data.jma.go.jp/mscweb/en/product/library/note/index.html#No61



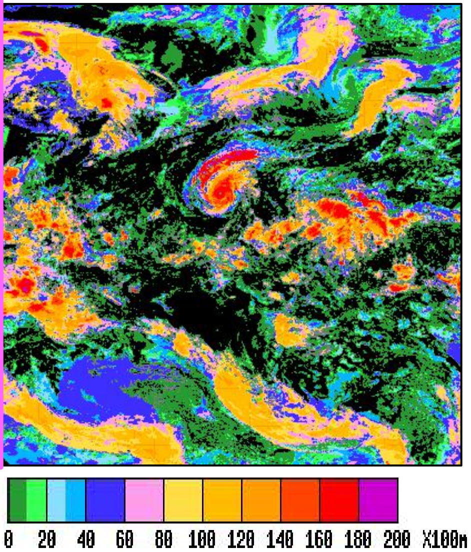
Cloud Mask

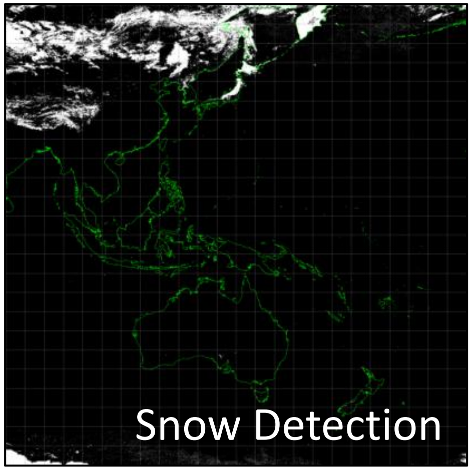


Cloud Type



Cloud Top Height



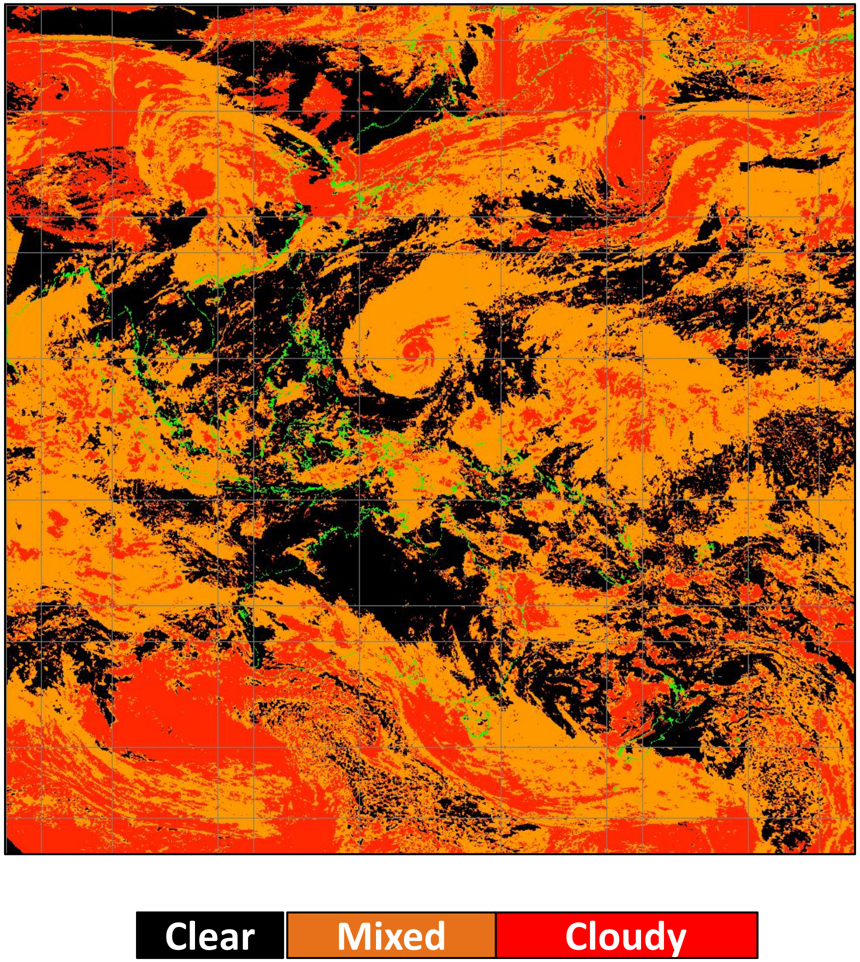


02UTC on 10 April 2015

HCAI Cloud Mask

Cloud Mask
Clear (no cloud) and no dust
Clear-cloudy mixed and no dust
Cloudy and no dust
Clear and dust
Clear-cloudy mixed and dust
Cloudy and dust

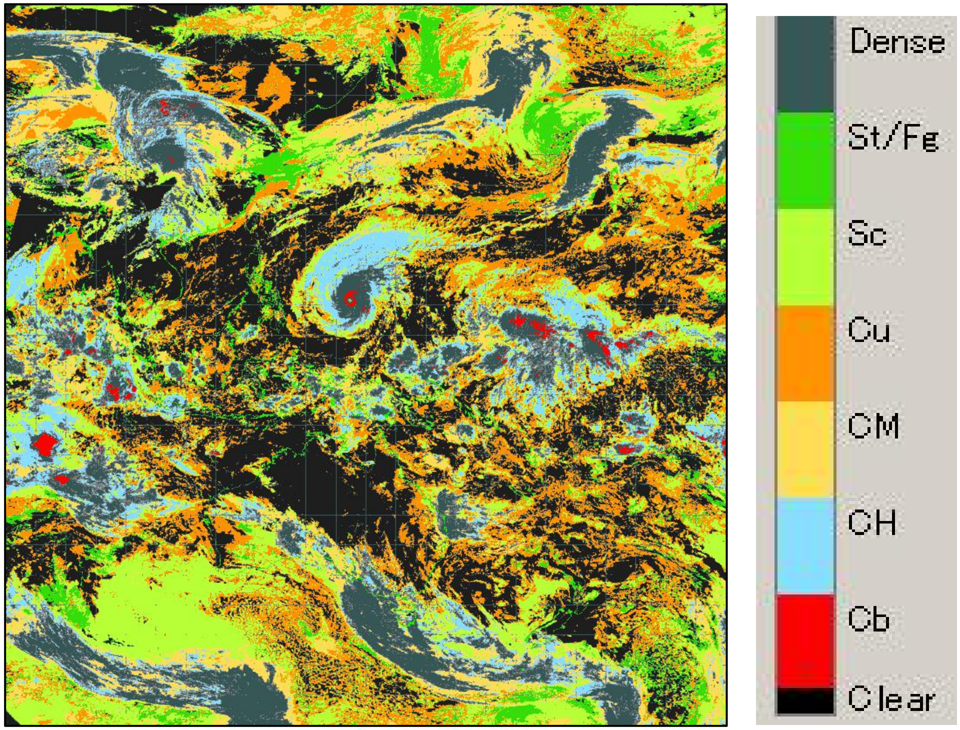
HCAI cloud mask includes dust information



HCAI Cloud Type

HCAI cloud type is easy-to-understand (forecaster-friendly)

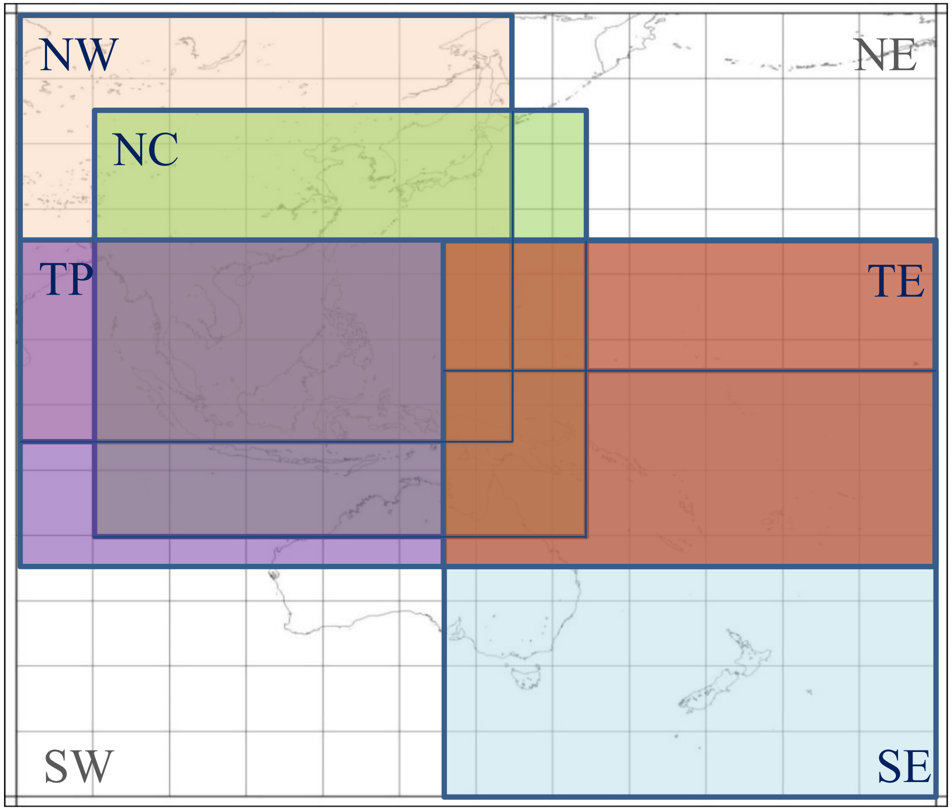
Cloud Type
Clear (no cloud)
Cumulonimbus
Dense cloud
Upper cloud
Middle cloud
Cumulus
Stratocumulus
Stratus or Fog



“Cumulus”	Convective cloud with cloud-top height below 600hPa
“Dense cloud”	Cloud with cloud-top height above 400hPa, except for cumulonimbus and cloud categorized into “upper cloud”
“Middle cloud”	Cloud with cloud-top height between 400 and 600hPa
“Upper cloud”	Single layer cloud with cloud-top height above 400hPa

Product regions and file size

- Select one of the product regions
- Provided HCAI product for JMA Data Dissemination System (JDDS) users



Area Name		Latitude	Longitude	File size / hr.	Compressed file size / hr. (Download file size)
FD	Full Domain	60N-60S	80E-200E	180 MB	29.5 MB
NC	North Central	45N-20S	90E-155E	50 MB	10 MB
NW	Northwest	60N-5S	80E-145E	50 MB	10 MB
SE	Southeast	5N-60S	135E-200E	50 MB	10 MB
TP	Tropical	25N-25S	80E-200E	75 MB	15 MB
TE	Tropical East	25N-25S	135E-200E	40 MB	7.5 MB
NE	Northeast	60N-5S	135E-200E	50 MB	10 MB
SW	Southwest	5N-60S	80E-145E	50 MB	10 MB

If you are interested in the HCAI product,

- Please let us know preferable subset region,
- We will send you sample files and document.

Point of Contact

metsat@met.kishou.go.jp

2. Satellite derived products

- Introduction to Satellite Remote Sensing
- Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Clear Sky Radiance
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

Heavy Rainfall Potential Areas

- What it is?
  - Imagery to support to detect heavy rainfall area outside of radar detection range.
  - The imagery is updated every 10 mins.
  - The imagery is available on JMA MSC web site.
    - https://www.data.jma.go.jp/mscweb/data/himawari/sat_hrp.php?area=r2s
  - Southeast Asia and South Pacific islands areas are supported.

- Background
  - The product supports for one of the WMO projects, SWFDP（Severe Weather Forecasting Demonstration Project）

- Rainfall potential areas based on data from the AHI are compared on a pixel-by-pixel basis to rainfall retrieval data from microwave imagers on board the polar orbiting satellites in the Global Satellite Mapping of Precipitation (*GSMaP) .

- User's guide is also on the above web site.

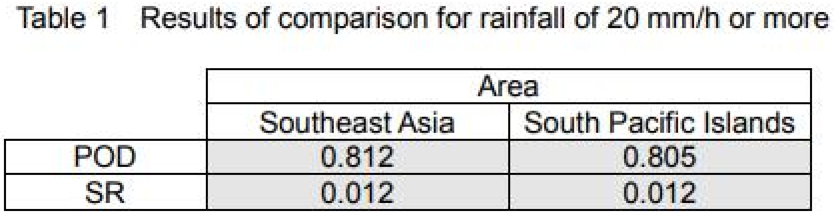
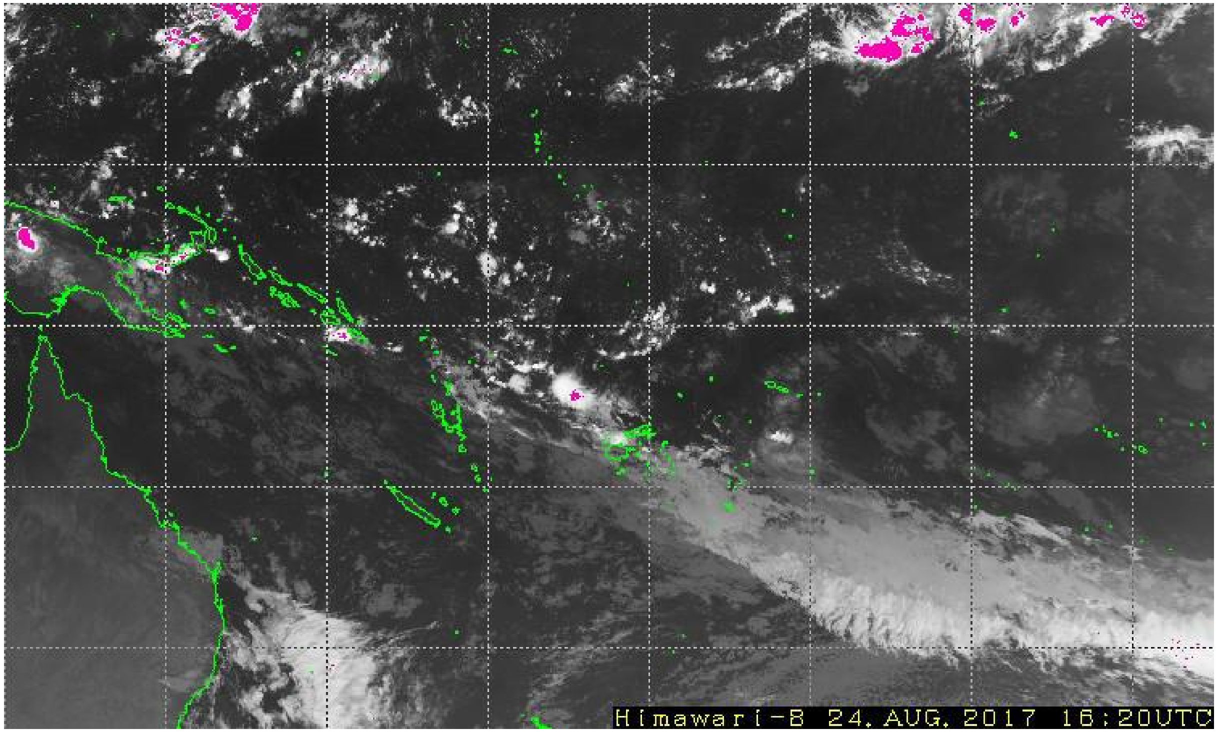


Table 1 Results of comparison for rainfall of 20 mm/h or more

	Area	
	Southeast Asia	South Pacific Islands
POD	0.812	0.805
SR	0.012	0.012

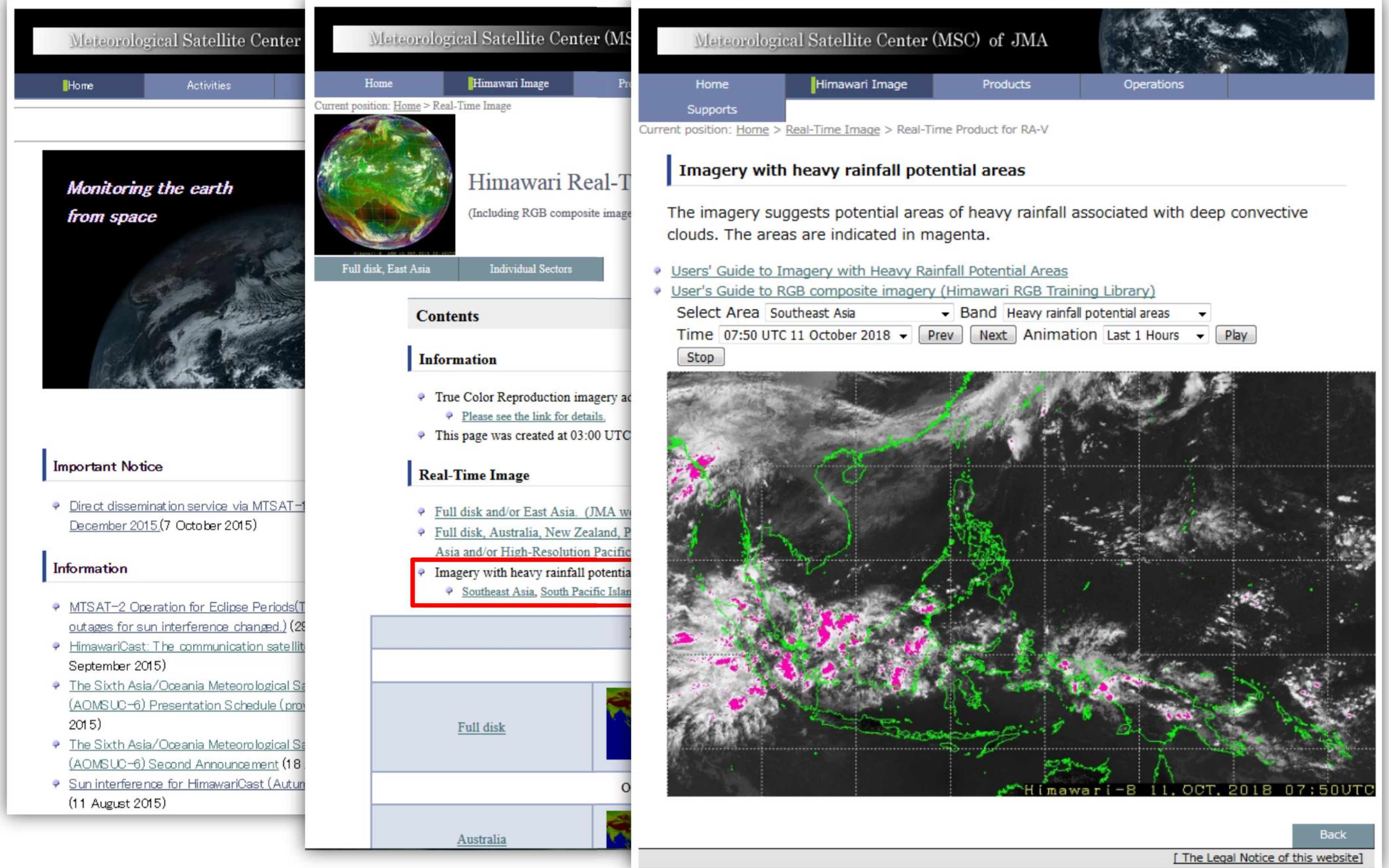
*The GSMaP Project is sponsored by JST-CREST and promoted by the JAXA Precipitation Measuring Mission (PMM) Science Team.

The heavy rainfall potential areas imagery



- Note that the imagery is a POTENTIAL area with heavy rainfall.
- Generally, it is difficult to know precipitation amount from geostationary satellite imager VIS/IR bands data.

Heavy rainfall potential area on JMA website



Meteorological Satellite Center

Home | Activities

Monitoring the earth
from space

Important Notice

- Direct dissemination service via MTSAT-1 December 2015 (7 October 2015)

Information

- MTSAT-2 Operation for Eclipse Periods(T outages for sun interference changed) (2
- HimawariCast: The communication satellit September 2015)
- The Sixth Asia/Oceania Meteorological Sa (AOMSUC-6) Presentation Schedule (pro 2015)
- The Sixth Asia/Oceania Meteorological Sa (AOMSUC-6) Second Announcement (18
- Sun interference for HimawariCast (Autu (11 August 2015)

Meteorological Satellite Center (MS

Home | Himawari Image | Pr

Current position: Home > Real-Time Image

Himawari Real-T

(Including RGB composite image

Full disk, East Asia | Individual Sectors

Contents

Information

- True Color Reproduction imagery ac
  - Please see the link for details.
- This page was created at 03:00 UTC

Real-Time Image

- Full disk and/or East Asia. (JMA w
- Full disk, Australia, New Zealand, P Asia and/or High-Resolution Pacific
- Imagery with heavy rainfall potentia
  - Southeast Asia, South Pacific Islan

Full disk

O

Australia

Meteorological Satellite Center (MSC) of JMA

Home | Himawari Image | Products | Operations | Supports

Current position: Home > Real-Time Image > Real-Time Product for RA-V

Imagery with heavy rainfall potential areas

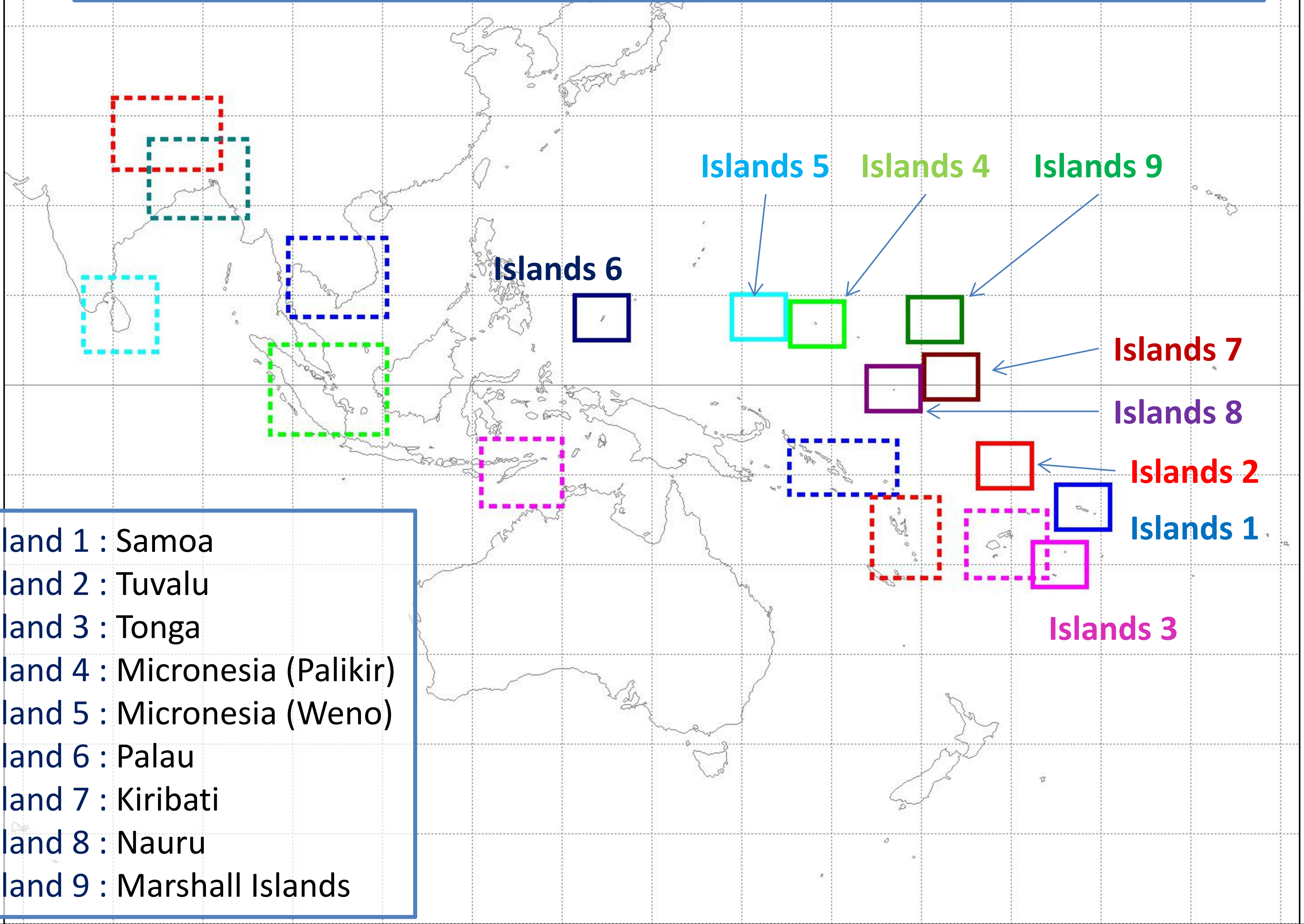
The imagery suggests potential areas of heavy rainfall associated with deep convective clouds. The areas are indicated in magenta.

- Users' Guide to Imagery with Heavy Rainfall Potential Areas
- User's Guide to RGB composite imagery (Himawari RGB Training Library)

Select Area: Southeast Asia
Band: Heavy rainfall potential areas
Time: 07:50 UTC 11 October 2018
Animation: Last 1 Hours

[The Legal Notice of this website]

Imagery with heavy rainfall potential areas for Pacific Islands



Island 1 : Samoa
Island 2 : Tuvalu
Island 3 : Tonga
Island 4 : Micronesia (Palikir)
Island 5 : Micronesia (Weno)
Island 6 : Palau
Island 7 : Kiribati
Island 8 : Nauru
Island 9 : Marshall Islands

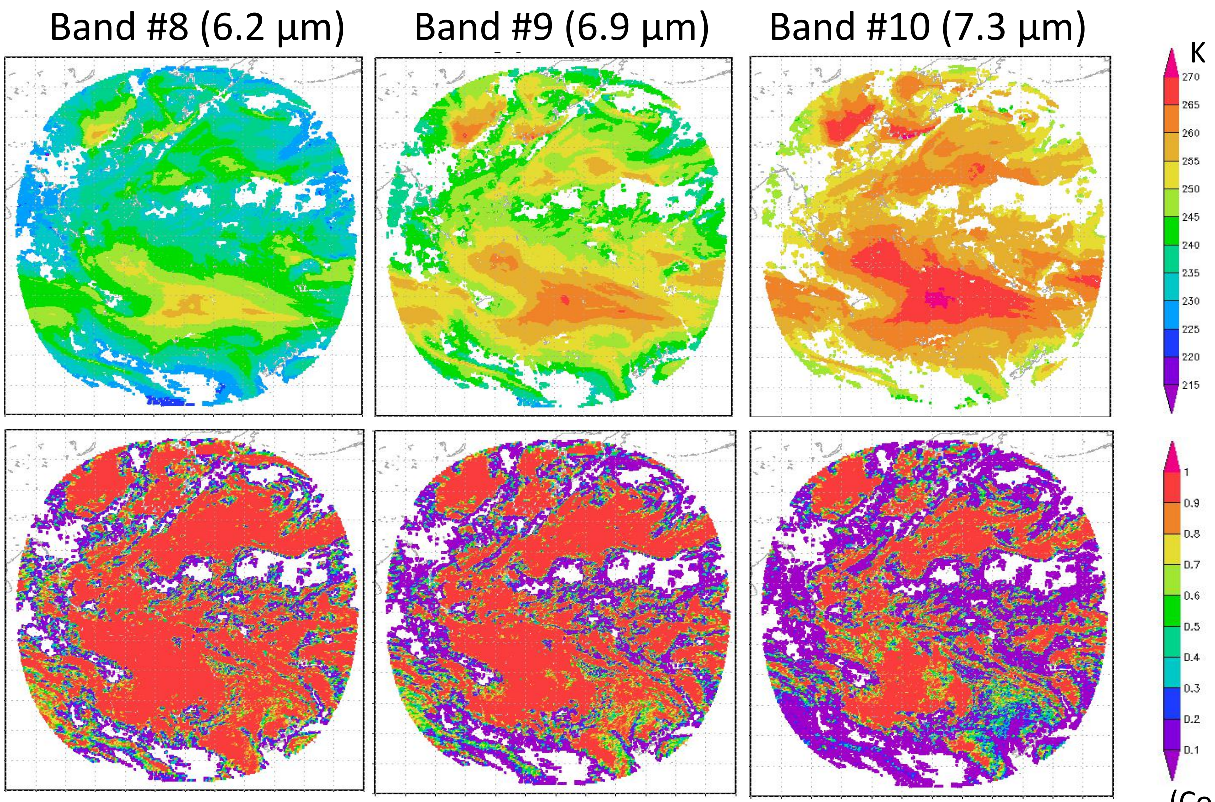
2. Satellite derived products

- Introduction to Satellite Remote Sensing
- Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Clear Sky Radiance
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

Clear Sky Radiance (CSR)

➢ Area averaged clear sky brightness temperature

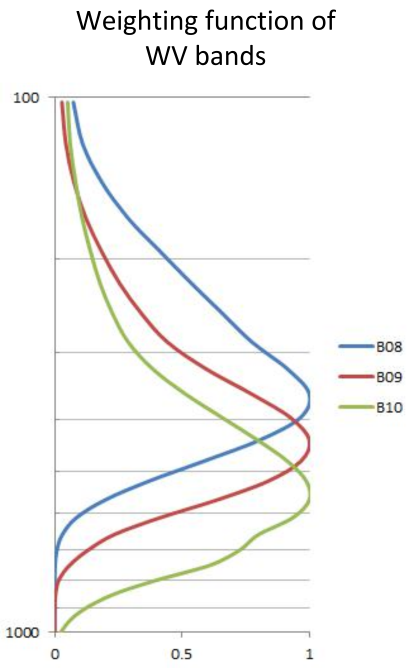
- ✓ All IR bands (3.9, 6.2, 6.9, 7.3, 8.6, 9.6, 10.4, 11.2, 12.4, 13.3 µm)
- ✓ Full disk, **hourly produced** and distributed via GTS mainly for NWP community
- ✓ Spatial resolution (averaging size): 16 x 16 pixel (IR) (i.e. **32 x 32 km** @SSP)
- ✓ **Band dependent** clear pixel ratios for clear pixel detection
- ✓ *Provided to NWP centers via GTS and WIS service*



Brightness Temperature

Clear Pixel Ratio

00 UTC on
15 August 2015



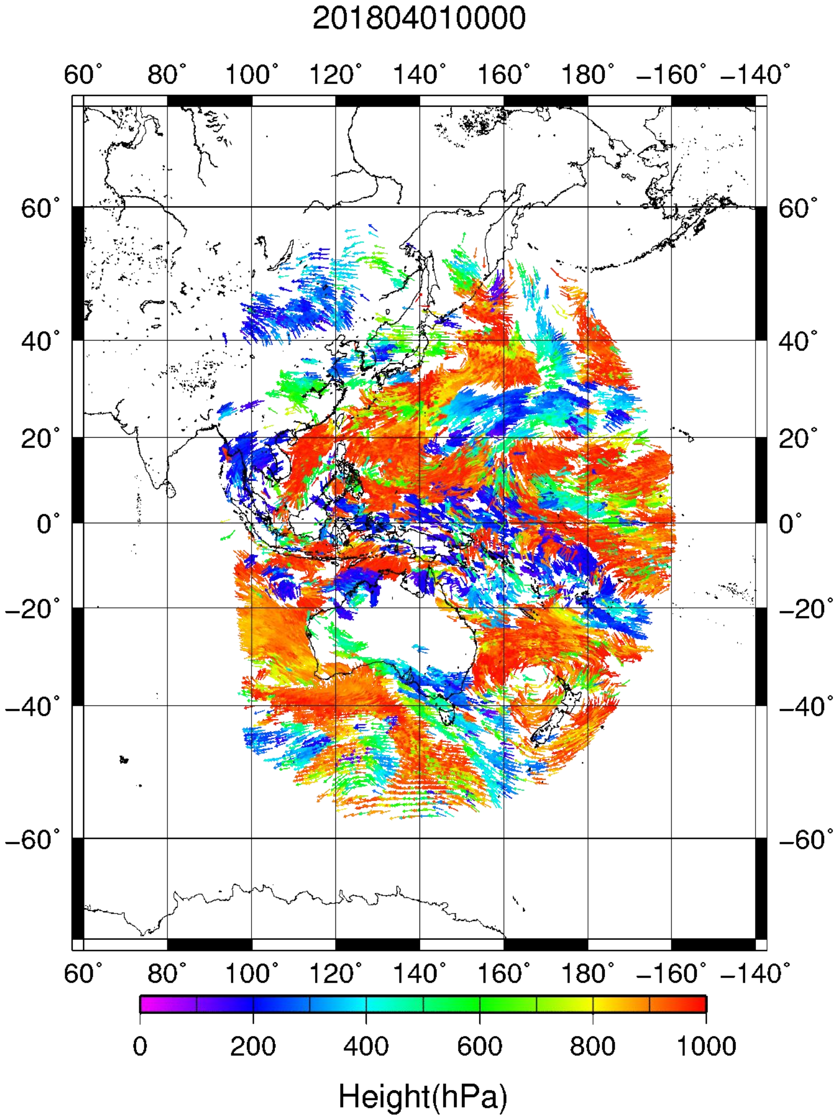
(Courtesy of D. Uesawa)

2. Satellite derived products

- ➢ Introduction to Satellite Remote Sensing
- ➢ Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Clear Sky Radiance
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

Atmospheric Motion Vectors (AMV)

VIS(band03)



Red←lower level

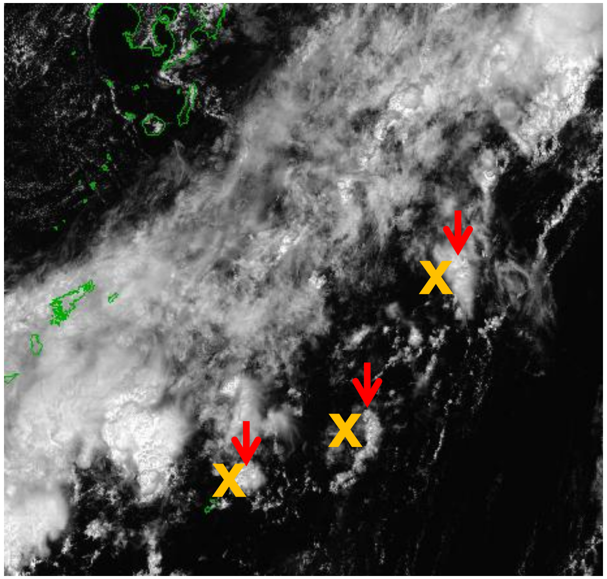
blue←upper level

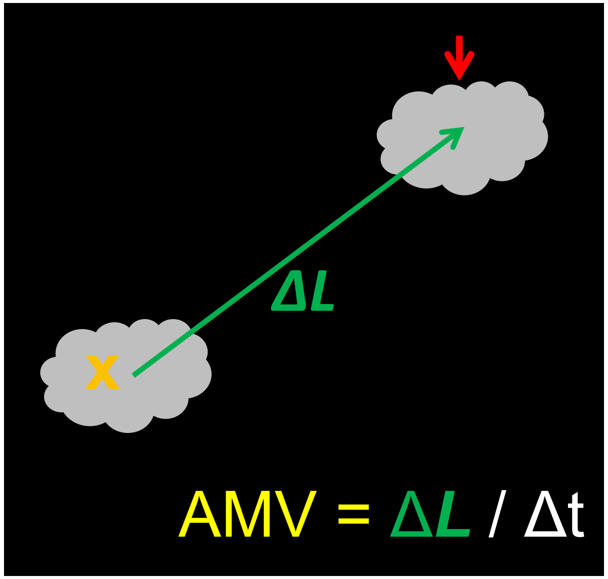
Overview of Calculation for AMV

1. Using two sequential satellite images, track cloud pattern and obtain a mobile vector of the cloud (*ΔL*).
2. To obtain velocity of the cloud, divide the cloud mobile vector by time difference (Δt) between the two images.

$$AMV = \Delta L/\Delta t$$

L : cloud mobile vector,   Δt : time difference





Atmospheric Motion Vector (AMV)

Himawari-8 AMVs

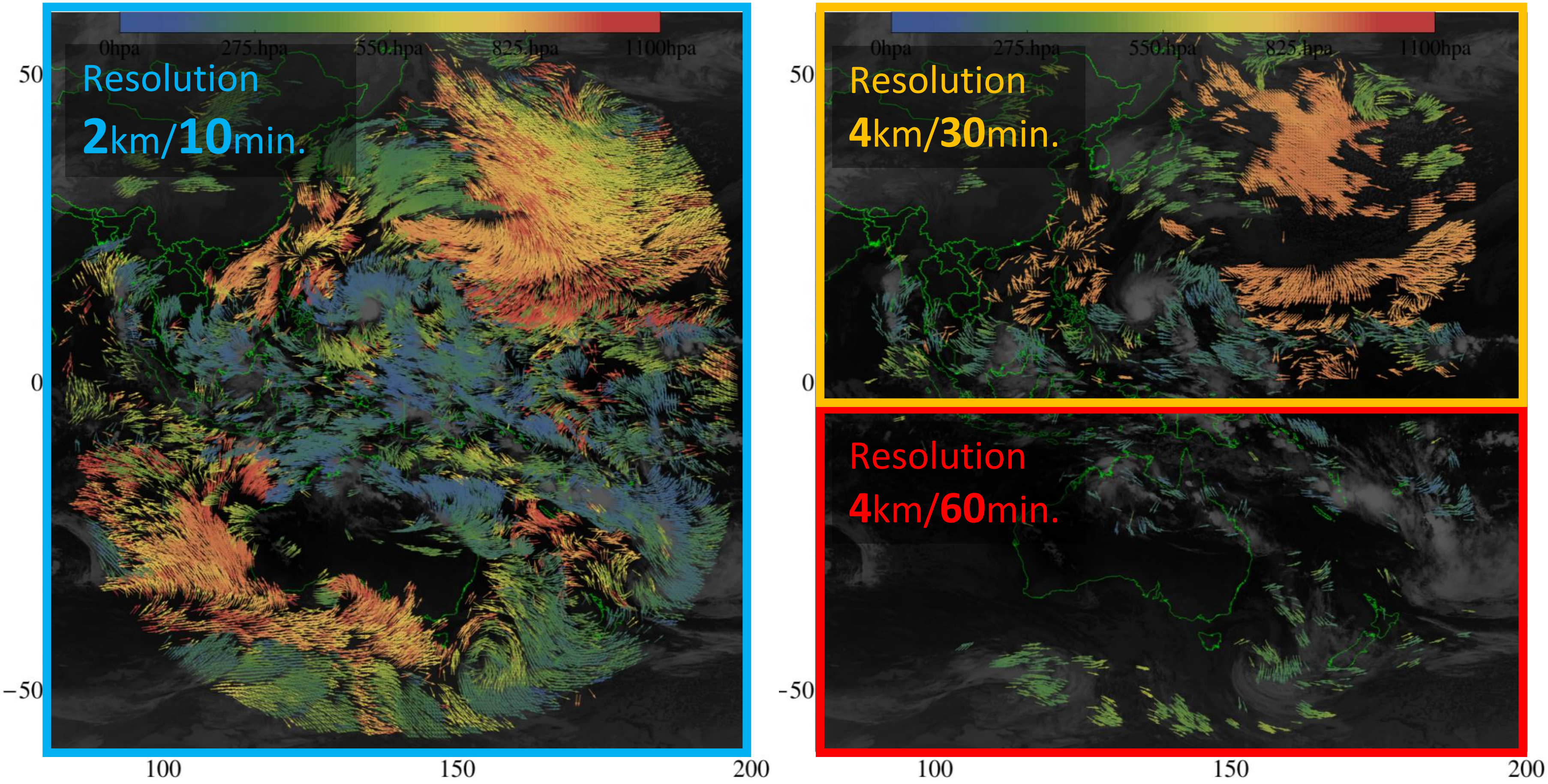
derived from new algorithm

(Shimoji 2014, IWW 12)

MTSAT-2 AMVs

derived from heritage algorithm

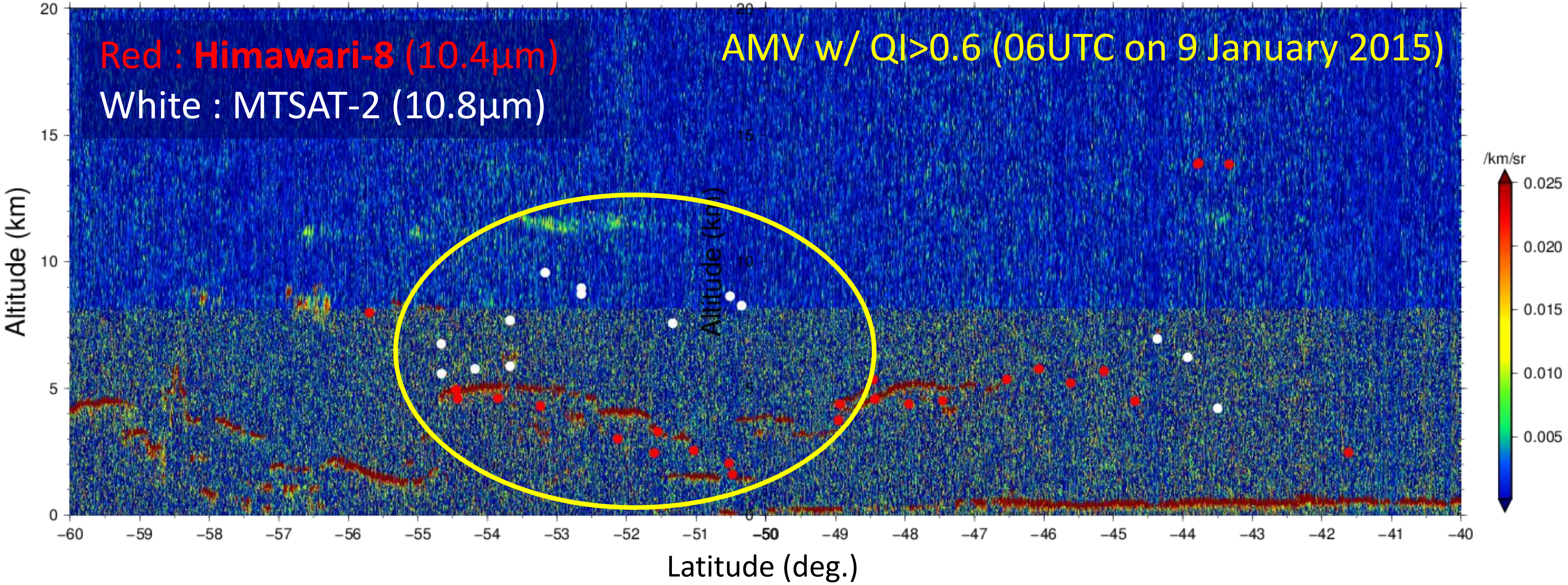
(Oyama 2010, MSC technical report)



Himawari-8 and MTSAT-2 IR AMV (QI>60, 17 UTC on 14 January 2015)

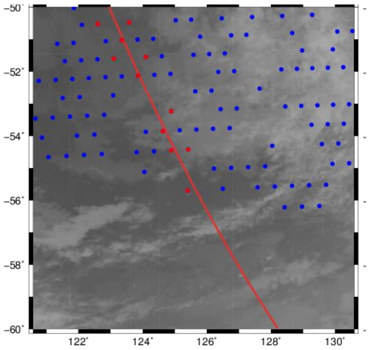
Improvement of Mid-Layer AMV Retrieval

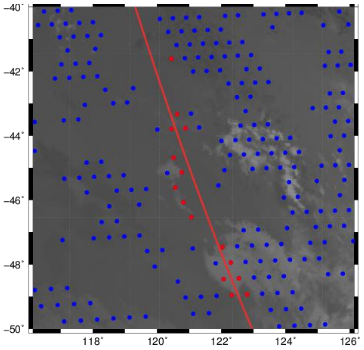
Calipso 523 nm total backscatter

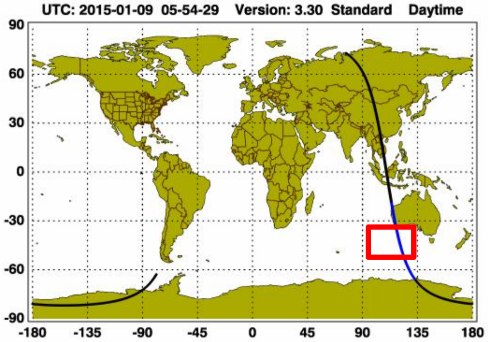


Red : **Himawari-8** (10.4µm)
White : MTSAT-2 (10.8µm)

AMV w/ QI>0.6 (06UTC on 9 January 2015)







Provision for AMV

Himawari-8/9 atmospheric motion vector products generated by JMA

AMV type	Height range	Periodicity	Image interval	Target size (pixels)	Distribution
10.4 µm (IR)	125 – 1,100 hPa	Hourly	10 minutes	7 x 7	BUFR via GTS
0.64 µm (2km VIS)	125 – 1,100 hPa	Hourly	10 minutes	7 x 7	BUFR via GTS
6.2 µm (WV1)	125 – 400 hPa	Hourly	10 minutes	7 x 7	BUFR via GTS
6.9 µm (WV2)	125 – 500 hPa	Hourly	10 minutes	7 x 7	BUFR via GTS
7.3 µm (WV3)	125 – 600 hPa	Hourly	10 minutes	7 x 7	BUFR via GTS
3.9 µm (IR)	125 – 1,100 hPa	Hourly	10 minutes	7 x 7	Internal use only

WIS Service for AMV

JMA has been also offering AMV within the framework of WIS. You can get it from the WIS Portal-GISC Tokyo, internet service. The URL of WIS Portal is as below.

http://www.wis-jma.go.jp/cms/

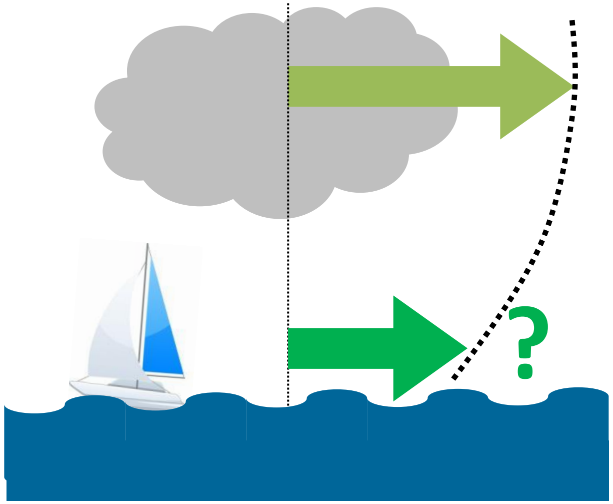
For example, you can find and download Himawari-8 AMV immediately.

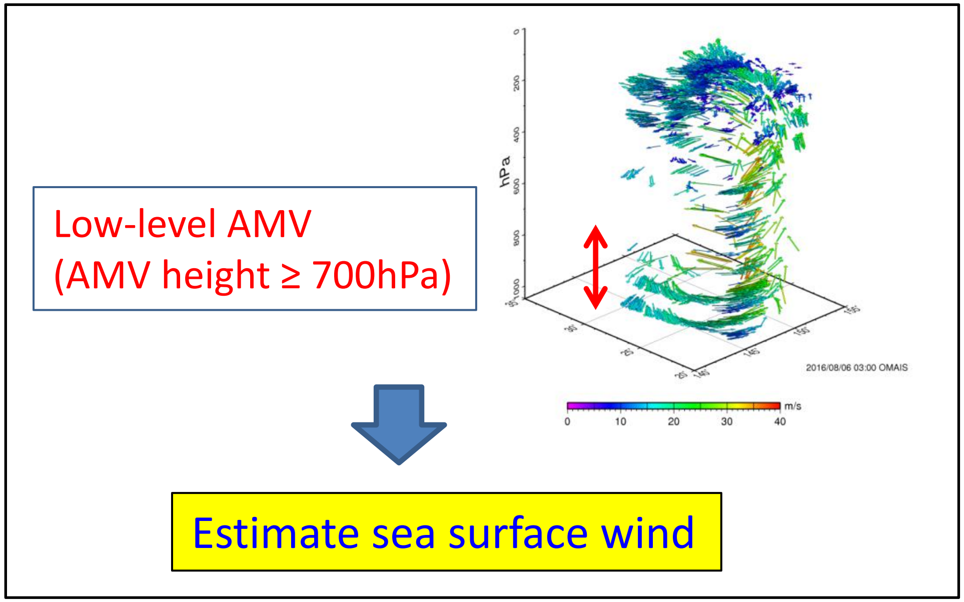
http://www.wis-jma.go.jp/data/browse?ContentType=HTML&start=0&Satellite=Himawari&Category=Satellite&Type=BUFR&Access=Open

Low level AMV for typhoon analysis

Forecasters estimate intensity of tropical cyclones using surface wind information. In-situ observations such as vessels and buoys are sparse especially on the ocean. ASCAT ocean vector winds are very useful for the analysis, but the number of observations is not sufficient.

If we can estimate sea surface wind from AMV assigned to low altitude, it will be helpful for typhoon analysis.

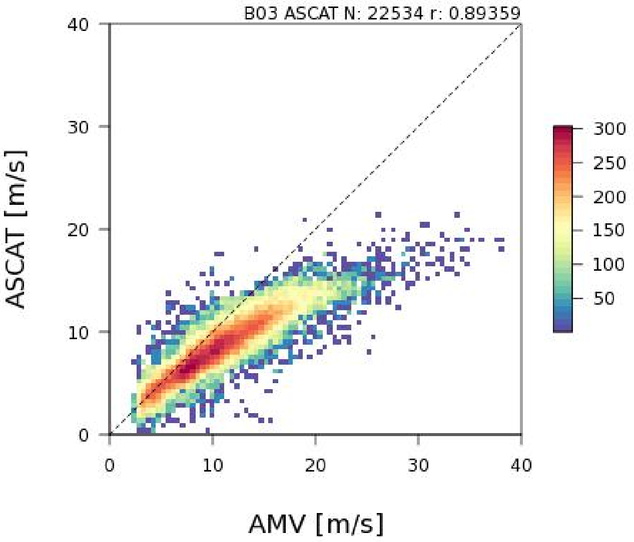




Low-level AMV
(AMV height ≥ 700hPa)

Estimate sea surface wind

Estimation and accuracy of the sea surface wind



Wind speed correlation between low-level AMV (Band 03, AMV height ≥ 700hPa, QI w/o forecast ≥ 0.8) and ASCAT

- Between ASCAT sea ocean vector winds and low-level AMV (≥ 700hPa), there is good correlation.
- Adjusting low-level AMVs to ASCAT with using linear regression equation, wind speed over the ocean is estimated with reducing factor 0.7-0.8.

We can simply evaluate sea surface wind speed by the following:

ASCAT wind speed ~ low-level AMV x 0.76

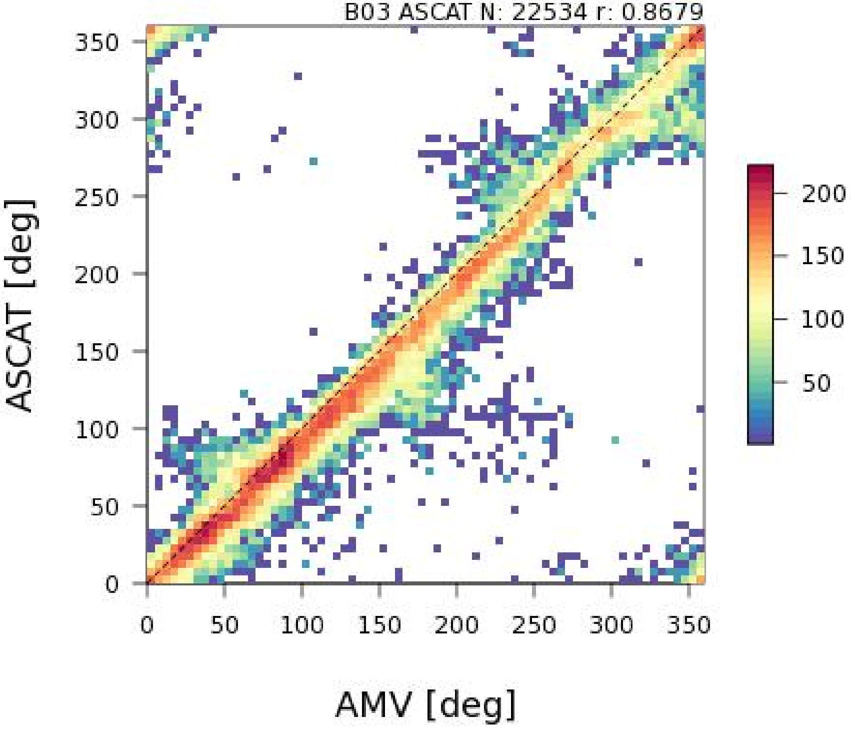
Accuracy of the estimated sea surface wind from low-level AMV against ASCAT wind

AMV>=5m/s	RMSE [m/s]	Bias [m/s]
B3 (0.64um)	1.54	-0.322
B7 (3.9um)	1.63	-0.441
B13 (10.4um)	1.72	-0.630

RMSEs are calculated for low-level AMVs that speed are above 5m/s , QI(w/o forecast) ≥ 80%

http://cimss.ssec.wisc.edu/iwwg/iww13/proceedings_iww13/papers/session6/IWW13_Session6_4_Nonaka_final_update.pdf

Comparison between low-level AMV and sea wind - wind direction -

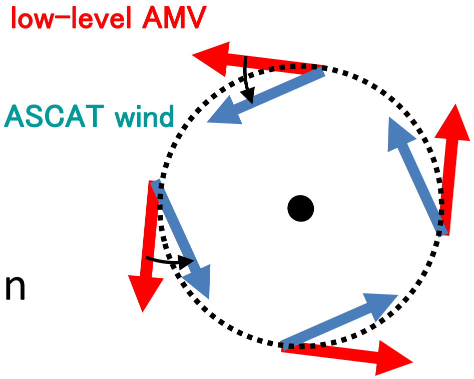


Wind direction correlation between low-level AMV (Band 03, AMV height ≥ 700hPa, QI w/o forecast ≥ 0.8) and ASCAT

Wind direction difference between ASCAT and low-level (≥700hPa) AMV

AMV>=5m/s	SD [deg]	Bias [deg]
B03 (0.64um)	14.7	**8.18**
B07 (3.9um)	17.2	**9.23**
B13 (10.4um)	18.6	**8.57**

These values are calculated for low-level AMVs that speed are more than 5m/s , QI(w/o forecast) ≥ 0.8



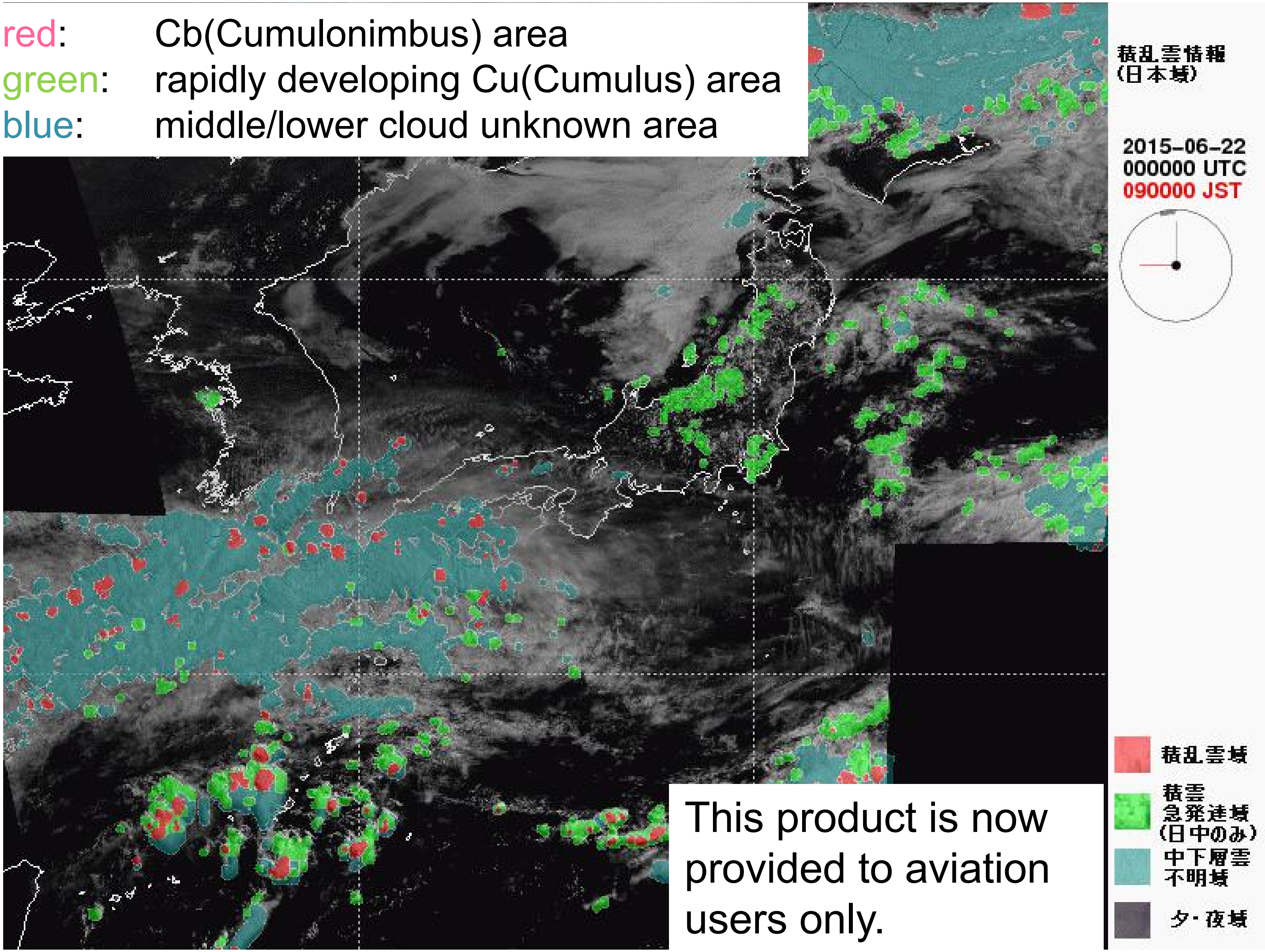
Low-level AMV directs outward more than about 8 to 9 degrees than ASCAT ocean vector winds.

2. Satellite derived products

- ➢ Introduction to Satellite Remote Sensing
- ➢ Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

Rapidly Developing Cumulus Area (RDCA)

red: Cb(Cumulonimbus) area
green: rapidly developing Cu(Cumulus) area
blue: middle/lower cloud unknown area

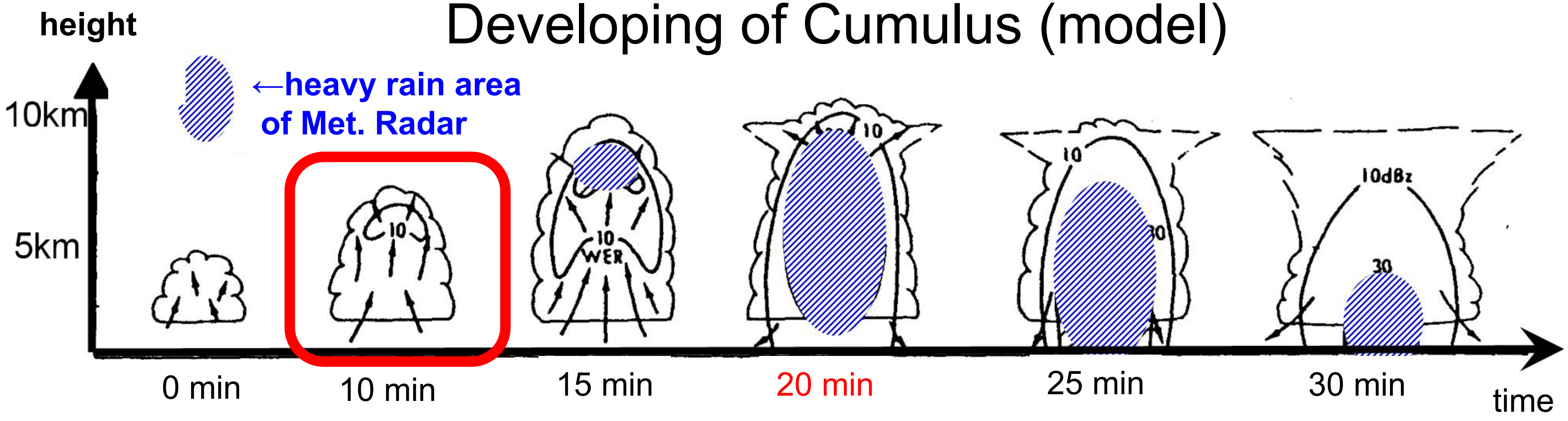


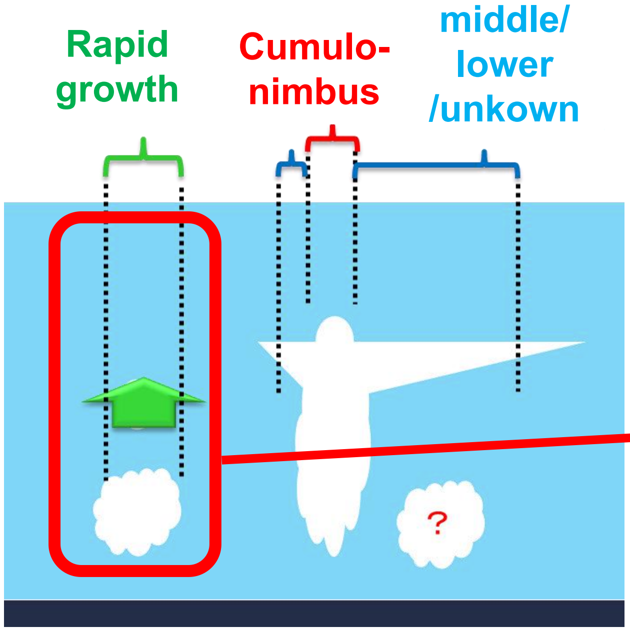
This product is now provided to aviation users only.

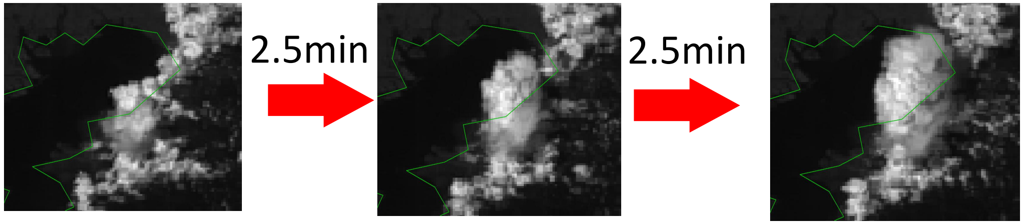
(movie)

Developing Cumulus and Radar Echo

Developing of Cumulus (model)



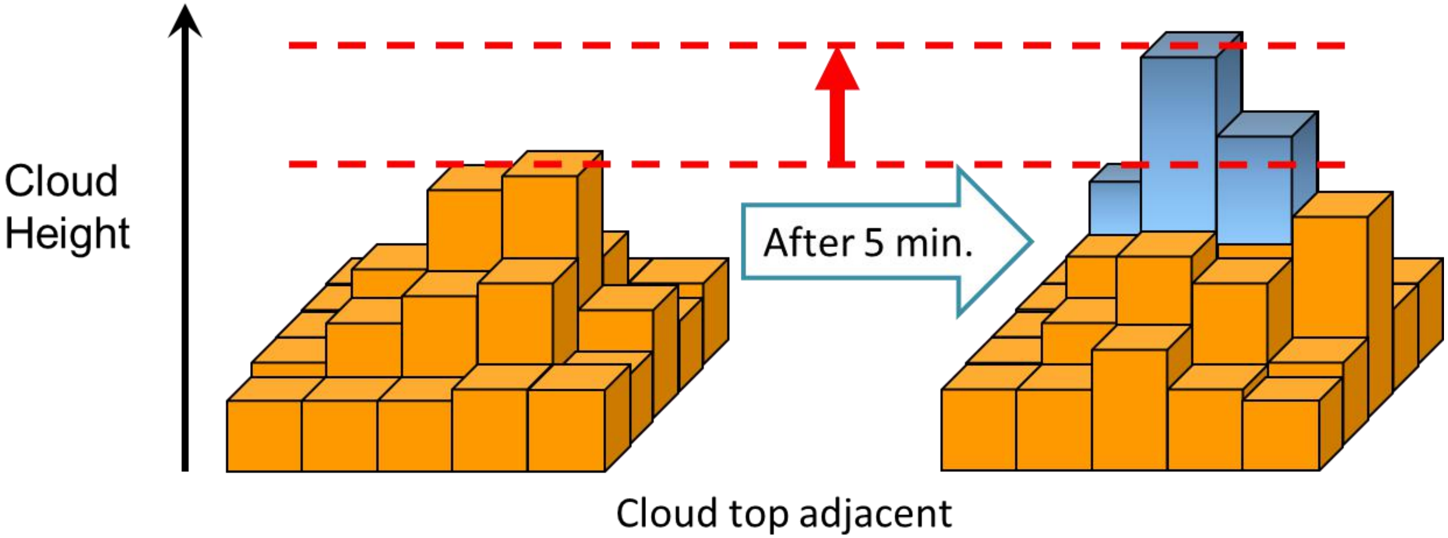




If we can detect cumulus that is growing rapidly, we get to know thunderstorm coming earlier than the radar !

Prepare for thunderstorm!

Concept of RDCA Detection



Concept of RDCA detection

Rapidly developing cumulus

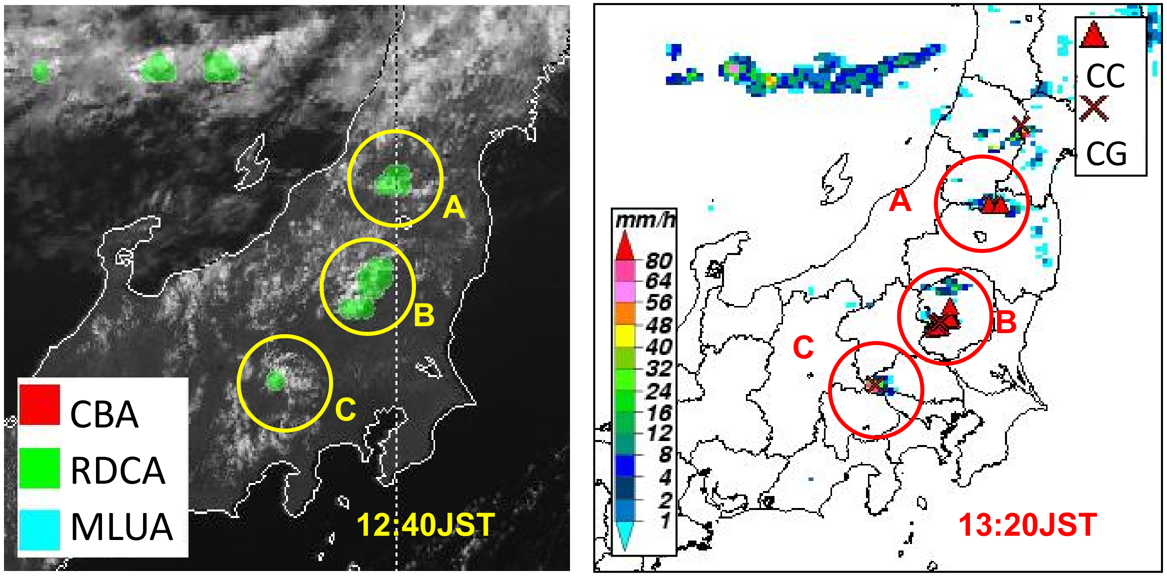
✓cloud top is getting high

✓increasing asperity of cloud top

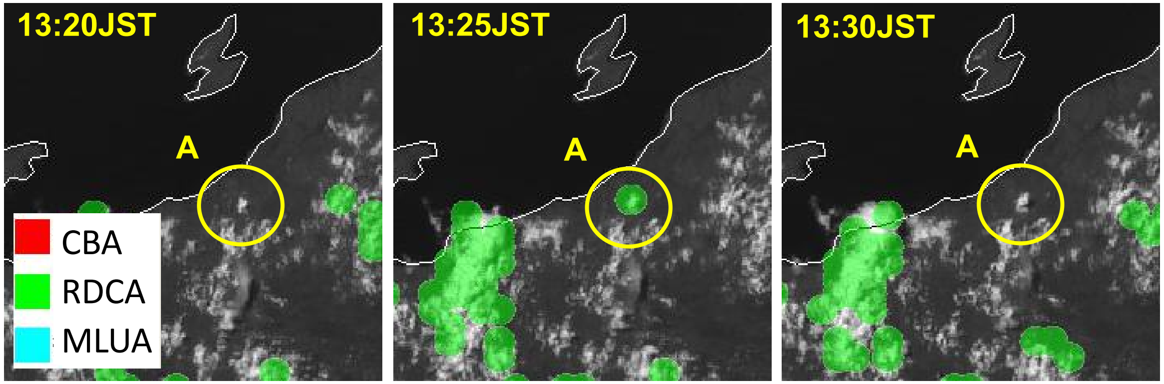
✓cloud microphysical parameters transition

Characteristics of RDCA

- The isolated Cb cloud can be detected with high accuracy by RDCA
- The detection accuracy is low for Cbs located on the mixed area with low level clouds and middle – high clouds.
- Some cumulus clouds detected by RDCA do not develop to Cbs, and decay.



Left: RDCA detection incl. heat lightning at 12:40 UTC on 14 July 2011 by MTSAT-1R
Right: Radar and lightning detection 40 minutes after the left figure



A case of RDCA detection which did not develop to cumulonimbus (11 July 2011)

🟥 CBA	CB(Cumulonimbus) Area
🟩 RDCA	Rapidly Developing Cu(Cumulus) Area
🟦 MLUA	Middle/Lower cloud Unknown Area

2. Satellite derived products

- ➢ Introduction to Satellite Remote Sensing
- ➢ Himawari-8 products
  - ✓ Cloud Mask, Type, Phase and Top height
  - ✓ Heavy Rainfall Potential Area
  - ✓ Atmospheric Motion Vector
  - ✓ Rapidly Developing Cumulus Area
  - ✓ Aerosol Optical Depth
  - ✓ Volcanic Ash
  - ✓ Sea Surface Temperature
  - ✓ Fog

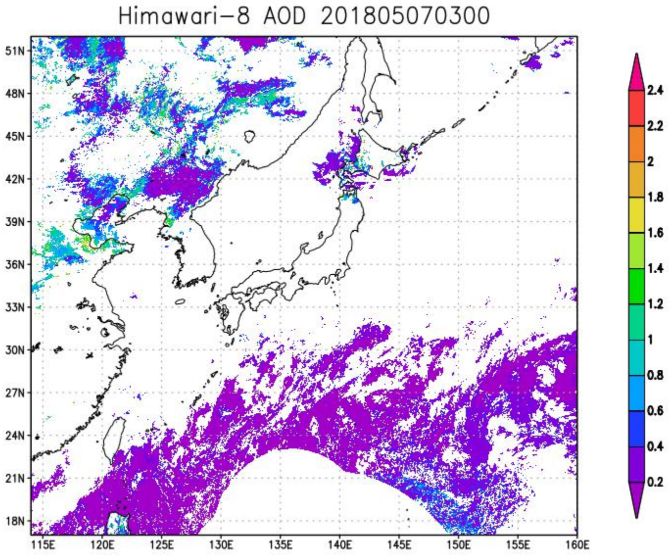
Aerosol Optical Depth product (Asian Dust: internal use)

- **Aerosol Optical Depth and Angstrom exponent**
  (the latter is derived only over the ocean)

- **Retrieval algorithm: LUT**
  - ✓ 0.64, 0.86 µm (ocean), 0.64, 2.3 µm (land)
  - ✓ Aerosol type is assumed to be Asian dust
  - ✓ NOT optimized for other aerosol types (e.g. haze)

- **Internal use (Asian dust monitoring)**
  - Plan for introducing a JAXA algorithm in the AOD product on December 2018
- **AHI aerosol products for data assimilation**
  - ✓ Under development in collaboration with JAXA

- **Volcanic ash retrieval algorithm would be applied to retrieve aerosol during nighttime**



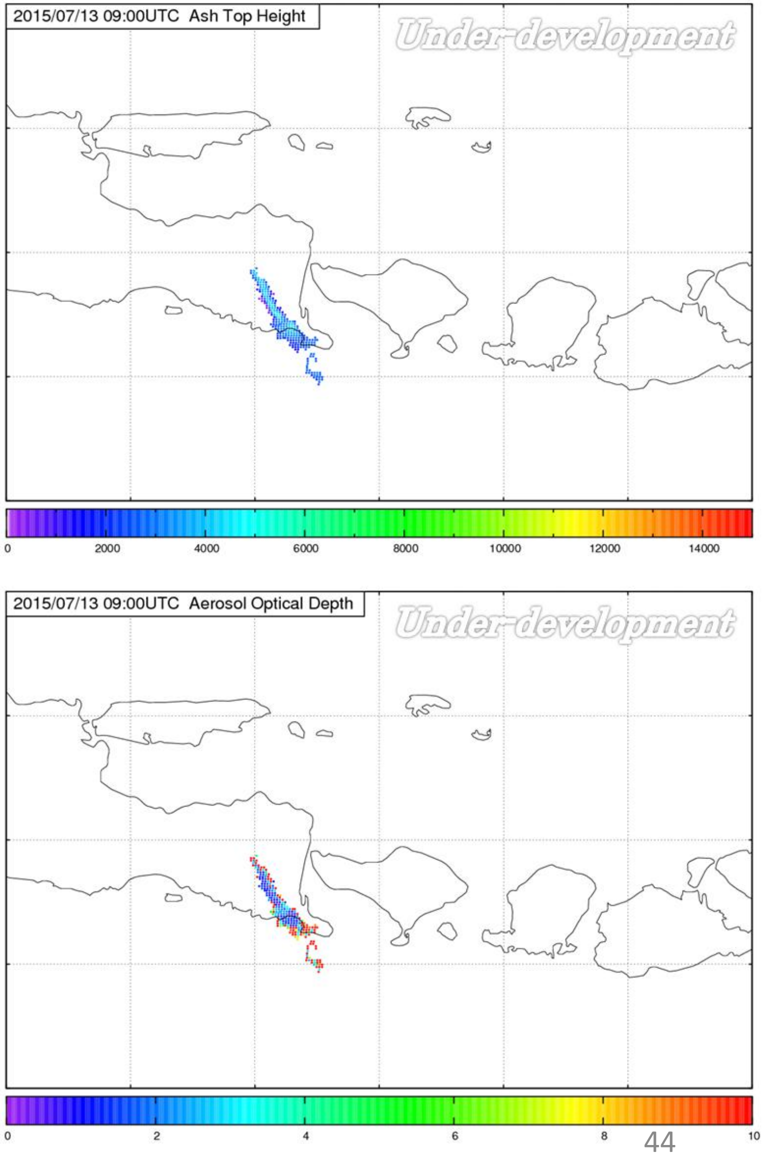
Volcanic Ash (Under-development)

- **Adoption of NOAA/NESDIS Algorithm**
  - ✓ Under implementation VOLCAT software developed by NOAA/NESDIS for **Himawari-8 volcanic ash product** at JMA/MSC

    - Many thanks to NOAA, Dr. Pavolonis and Dr. Sieglaff

- **Expected Products**
  - ✓ Ash top height
  - ✓ Mass-loading
  - ✓ Aerosol Optical depth
  - ✓ Ash probability
  - ✓ Effective particle radius

- **Evaluation and Validation**
  - ✓ Preliminary products will be provided to JMA's Tokyo VAAC (Volcanic Ash Advisory Center) for testing

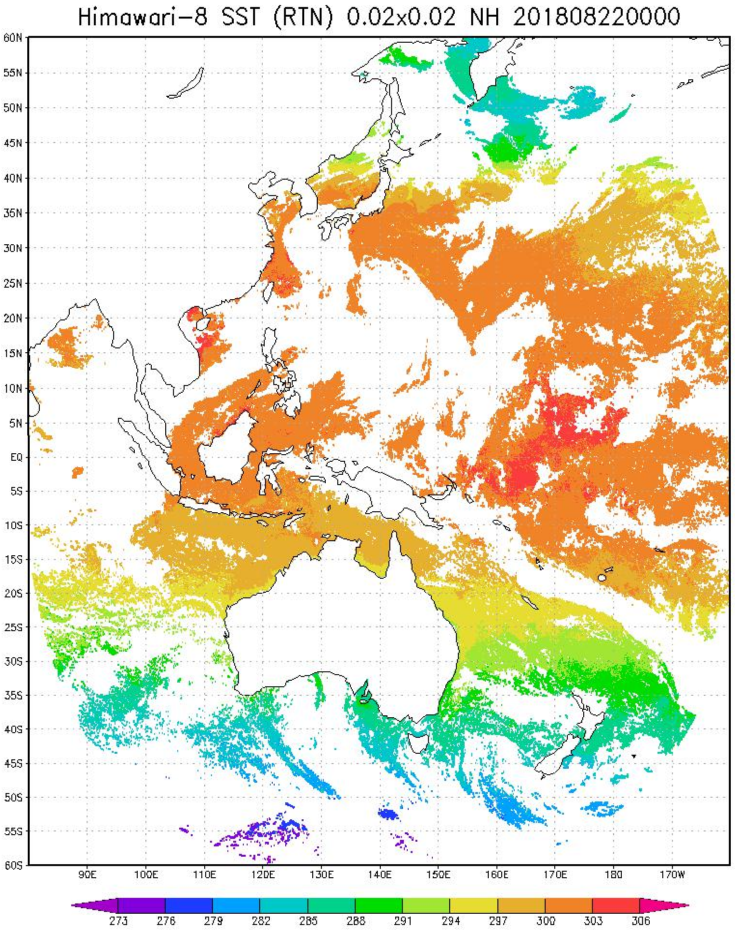


Preliminary results of VOLCAT for the eruption of Raung (Indonesia) on 13 July 2015.

Sea Surface Temperature (internal use)

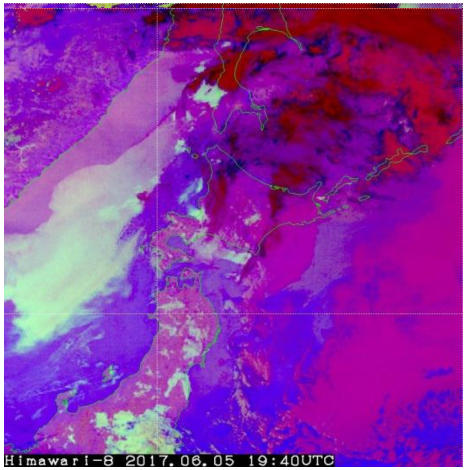
- **Retrieval algorithm: LUT**
  - ✓ Using an algorithm developed by JAXA (Kurihara et al., 2016)
  - ✓ 3.9, 8.6, 10.4, 11.2, 12.4 µm
  - ✓ Hourly, 0.02deg horizontal resolution

- **Internal use**
  - ✓ This product is used to obtain the sea surface temperature around Japan.

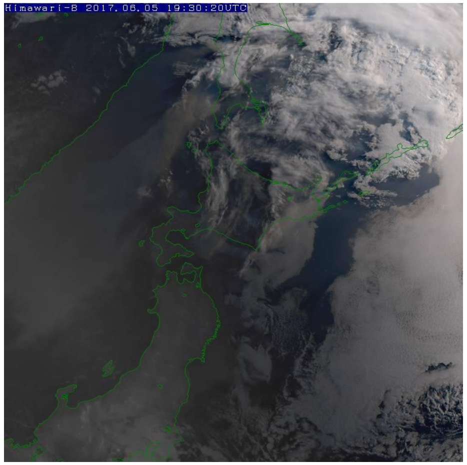


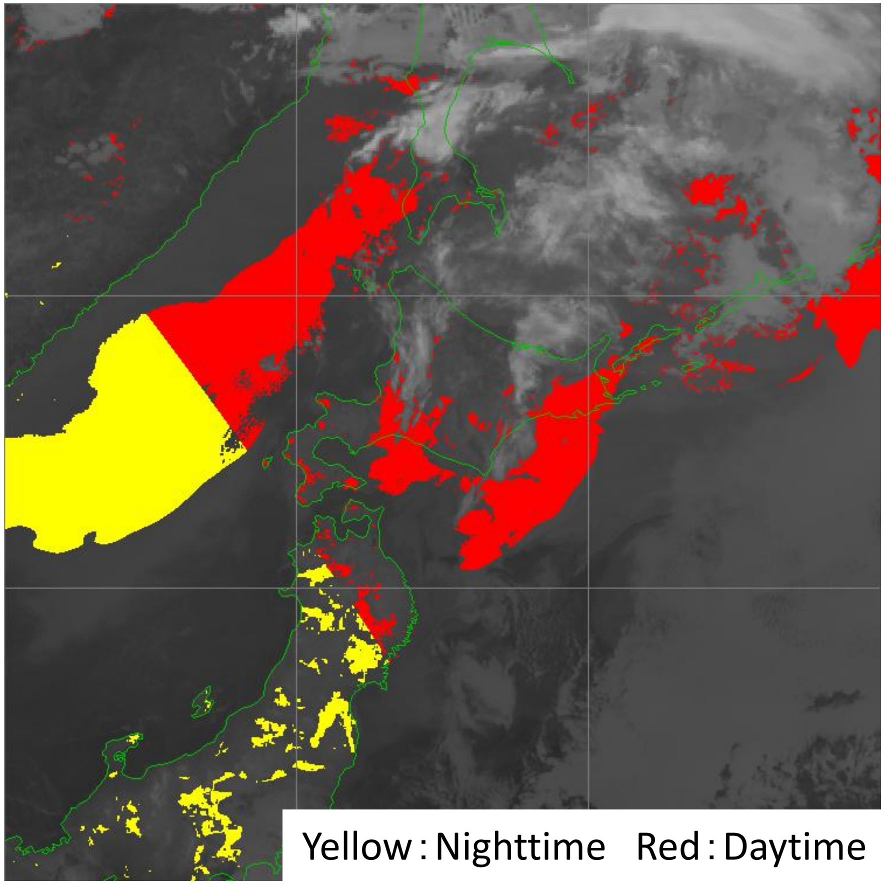
Fog Detection Product（Under-development)

Night Microphysics RGB



True Color Reproduction Image



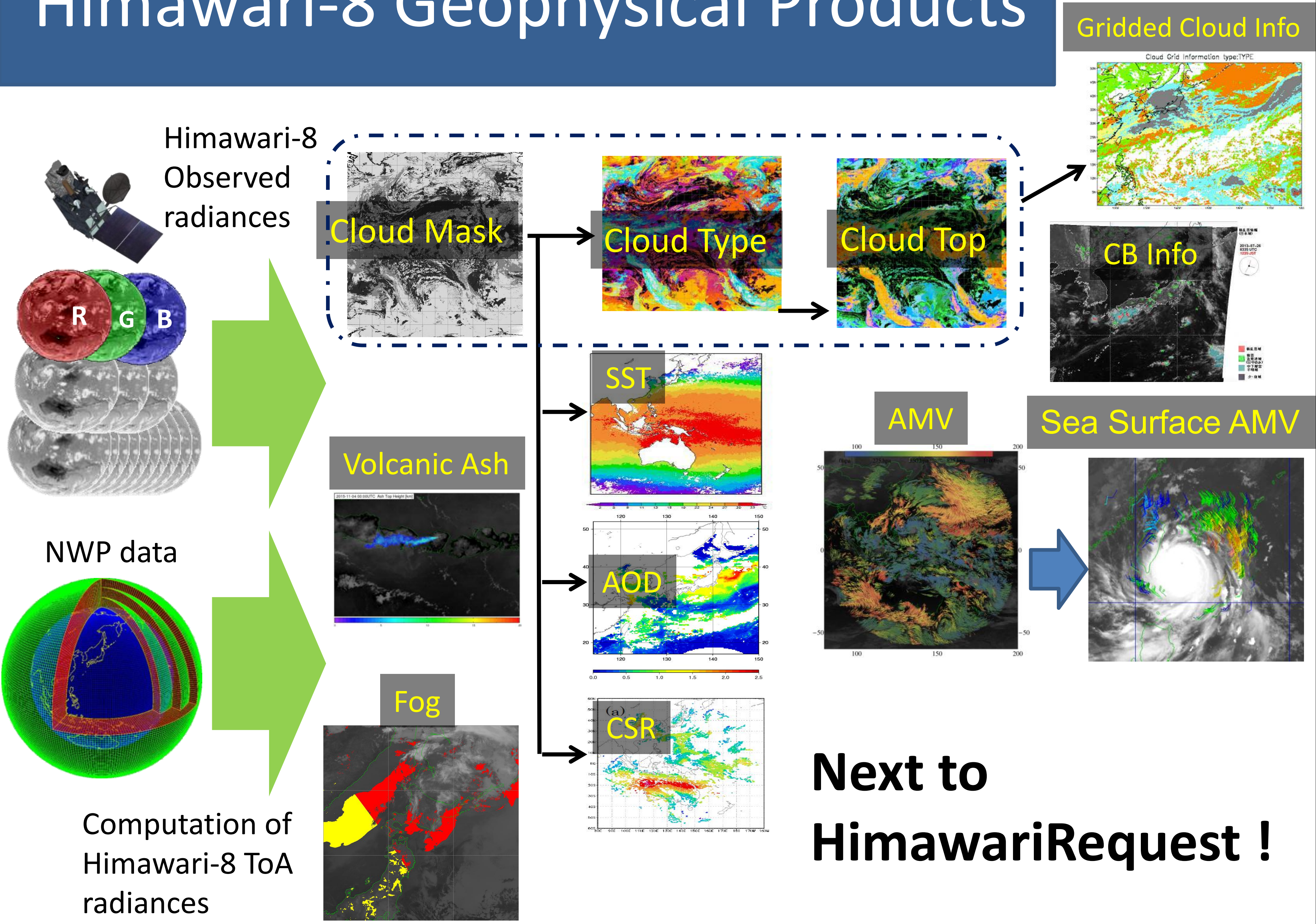


Yellow : Nighttime　Red : Daytime

- ✓ latitude-longitude grid in 0.02 degree
- ✓ produced every 10 minutes

2017.06.05.1600UTC～2017.06.05.2350UTC

Himawari-8 Geophysical Products



Himawari-8 Observed radiances

NWP data

Computation of Himawari-8 ToA radiances

Cloud Mask

Cloud Type

Cloud Top

Gridded Cloud Info

CB Info

SST

AOD

CSR

Volcanic Ash

Fog

AMV

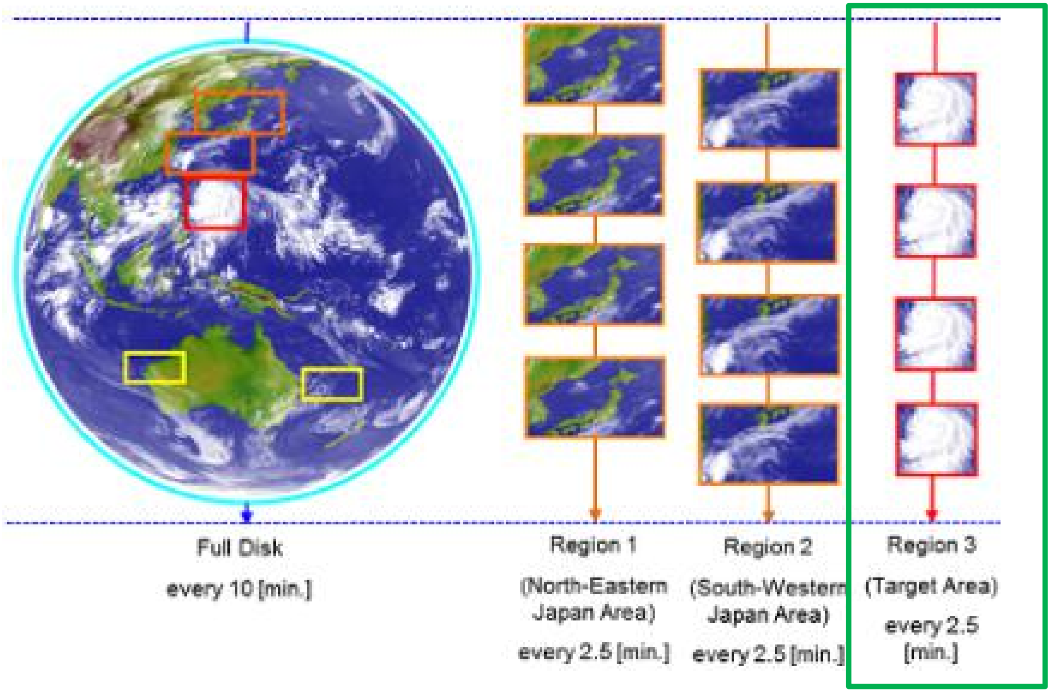
Sea Surface AMV

Next to HimawariRequest !

Contents

Launch of the Service

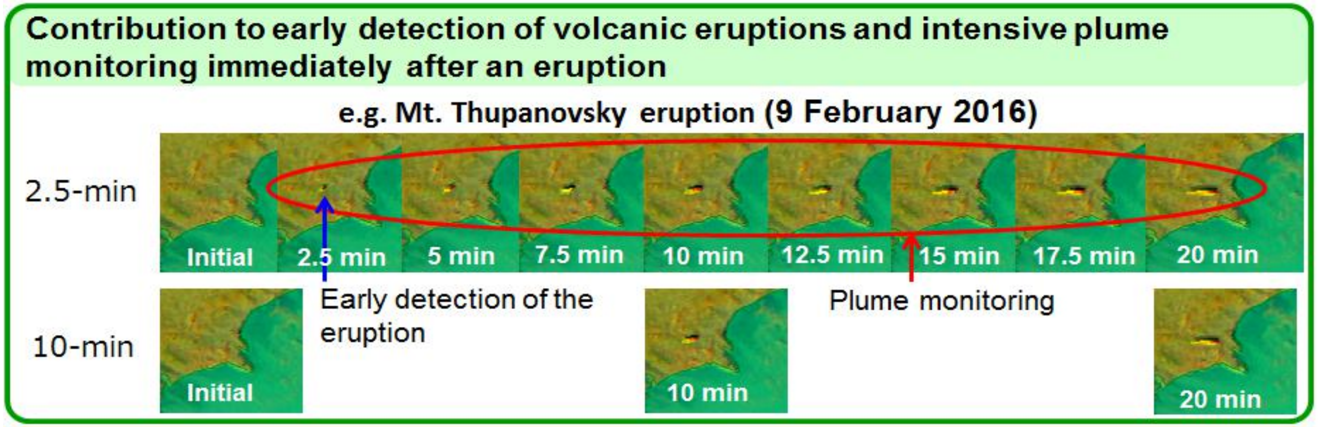
- In January 2018, JMA launched a new international service "HimawariRequest", in collaboration with the Australian Bureau of Meteorology (AuBoM).
- The service allows NMHS users in WMO RA II and RA V to request Himawari-8/9 Target Area observation covering a 1000 km x 1000 km area every 2.5 minutes.



Users are able to request Target Area observation conducted every 2.5 min!

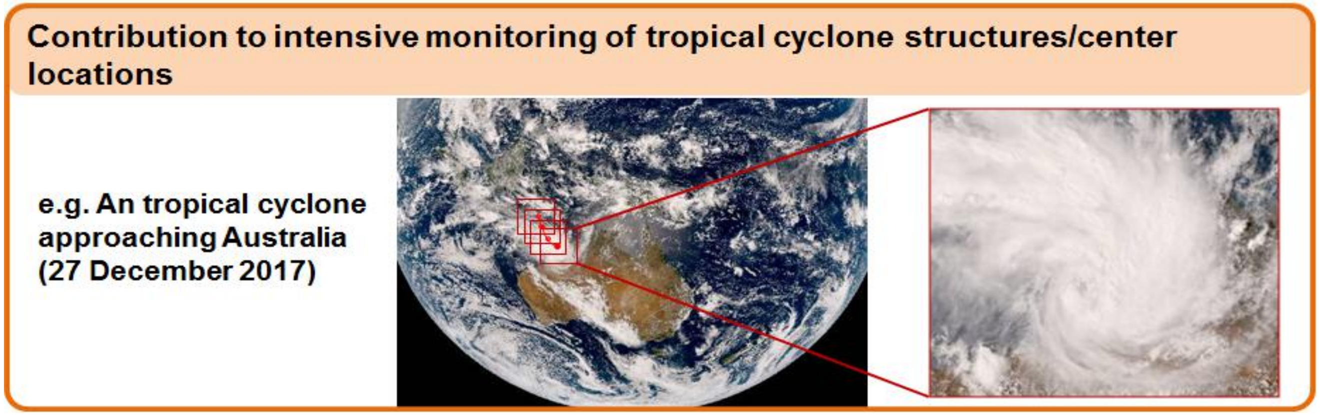
Rapid Scan Benefit

- Target Area observation provides better insight for extreme events such as tropical cyclones or volcanic eruptions.
- JMA utilizes Target Area observation for its services, including typhoon monitoring within the responsibility area of the Regional Specialized Meteorological Center (RSMC) Tokyo - Typhoon Center.



Contribution to early detection of volcanic eruptions and intensive plume monitoring immediately after an eruption

e.g. Mt. Thupanovsky eruption (9 February 2016)



Contribution to intensive monitoring of tropical cyclone structures/center locations

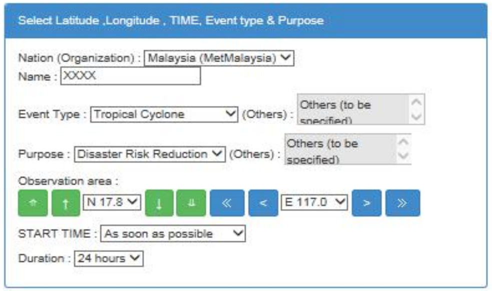
e.g. An tropical cyclone approaching Australia (27 December 2017)

Request Webtool

- For easy and smooth request process, JMA prepared an webtool for HimawariRequest users.

- The webtool assists users to:
  - Select a center position
  - Specify start/end times
  - Create a request email

- The webtool is provided to each registered user.



Select Latitude ,Longitude , TIME, Event type & Purpose

Nation (Organization) : Malaysia (MetMalaysia)
Name : XXXX
Event Type : Tropical Cyclone (Others) : Others (to be specified)
Purpose : Disaster Risk Reduction (Others) : Others (to be specified)
Observation area :
N 17.8
E 117.0
START TIME : As soon as possible
Duration : 24 hours

HimawariRequest Form

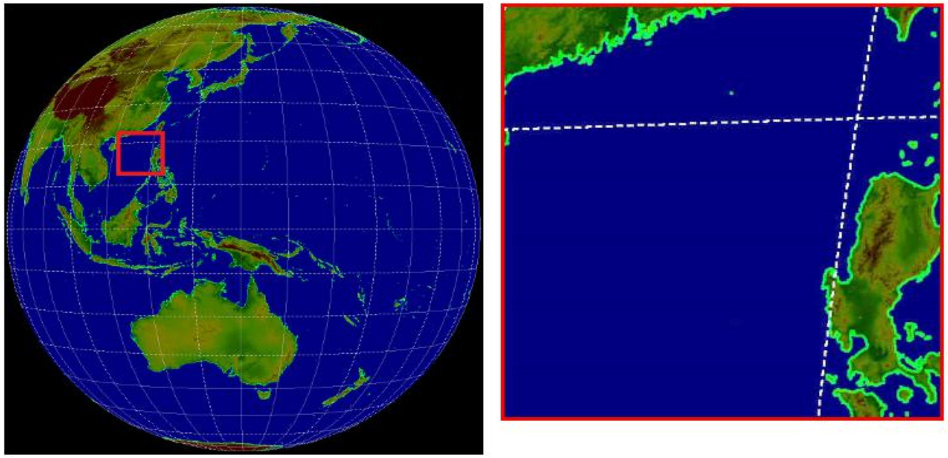
Nation (Organization) : Malaysia (MetMalaysia)
Personal Name: XXXX

Event Type : Tropical Cyclone
Purpose : Disaster Risk Reduction

Latitude & Longitude : (17.8,117.0)

Start Time [UTC] : As soon as possible
End Time [UTC]:2018/09/29 06:00
Duration : 24hours

✉ : Send HimawariRequest e-mail (to hima_req@ml.kishou.go.jp)

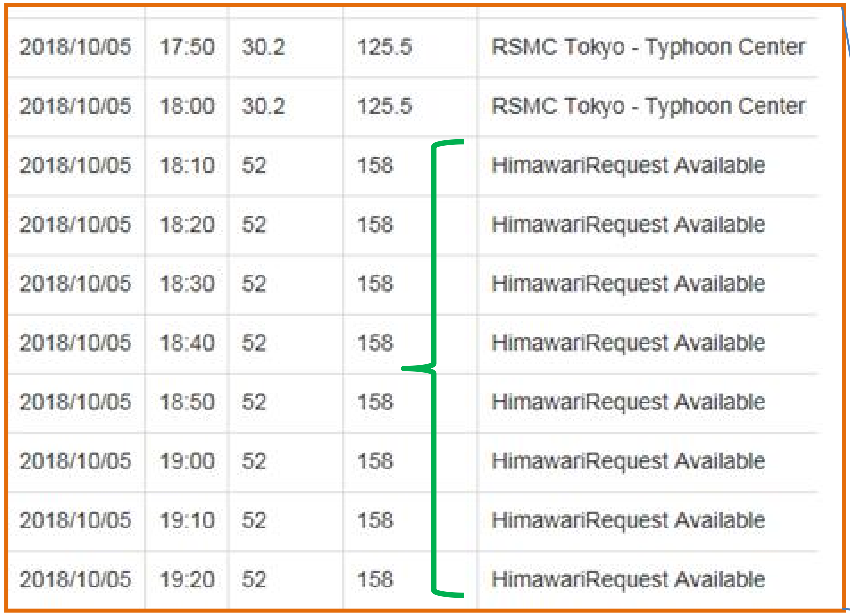


Visualization of Observation Availability

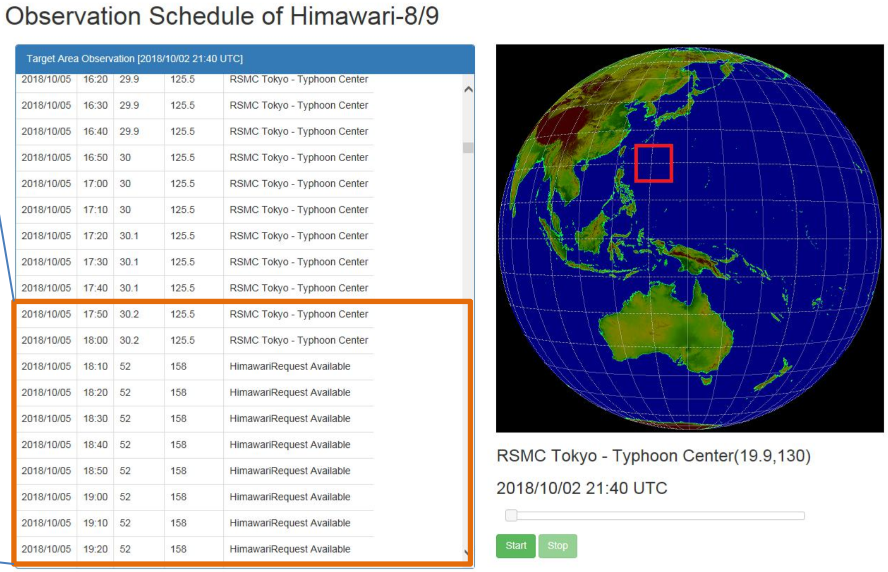
Schedule of Target Area observations available on the webtool

- Users are able to check whether their requests are to be accepted.

Example of Target Area observation schedule



2018/10/05	17:50	30.2	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	18:00	30.2	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	18:10	52	158	HimawariRequest Available
2018/10/05	18:20	52	158	HimawariRequest Available
2018/10/05	18:30	52	158	HimawariRequest Available
2018/10/05	18:40	52	158	HimawariRequest Available
2018/10/05	18:50	52	158	HimawariRequest Available
2018/10/05	19:00	52	158	HimawariRequest Available
2018/10/05	19:10	52	158	HimawariRequest Available
2018/10/05	19:20	52	158	HimawariRequest Available



Observation Schedule of Himawari-8/9

Target Area Observation [2018/10/02 21:40 UTC]

2018/10/05	16:20	29.9	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	16:30	29.9	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	16:40	29.9	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	16:50	30	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	17:00	30	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	17:10	30	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	17:20	30.1	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	17:30	30.1	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	17:40	30.1	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	17:50	30.2	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	18:00	30.2	125.5	RSMC Tokyo - Typhoon Center
2018/10/05	18:10	52	158	HimawariRequest Available
2018/10/05	18:20	52	158	HimawariRequest Available
2018/10/05	18:30	52	158	HimawariRequest Available
2018/10/05	18:40	52	158	HimawariRequest Available
2018/10/05	18:50	52	158	HimawariRequest Available
2018/10/05	19:00	52	158	HimawariRequest Available
2018/10/05	19:10	52	158	HimawariRequest Available
2018/10/05	19:20	52	158	HimawariRequest Available

RSMC Tokyo - Typhoon Center(19.9,130)

2018/10/02 21:40 UTC

These time slots are expected to accept user's request!

Procedure for RA II

User of RA II or USA

1. E-mails request to JMA via the webtool

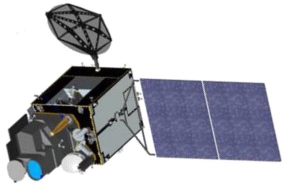
MSC/JMA

2. E-mails reply
   - Accepted/Not accepted
   - Accepted period

(Accepted Case)

3. Changes relevant JMA system settings

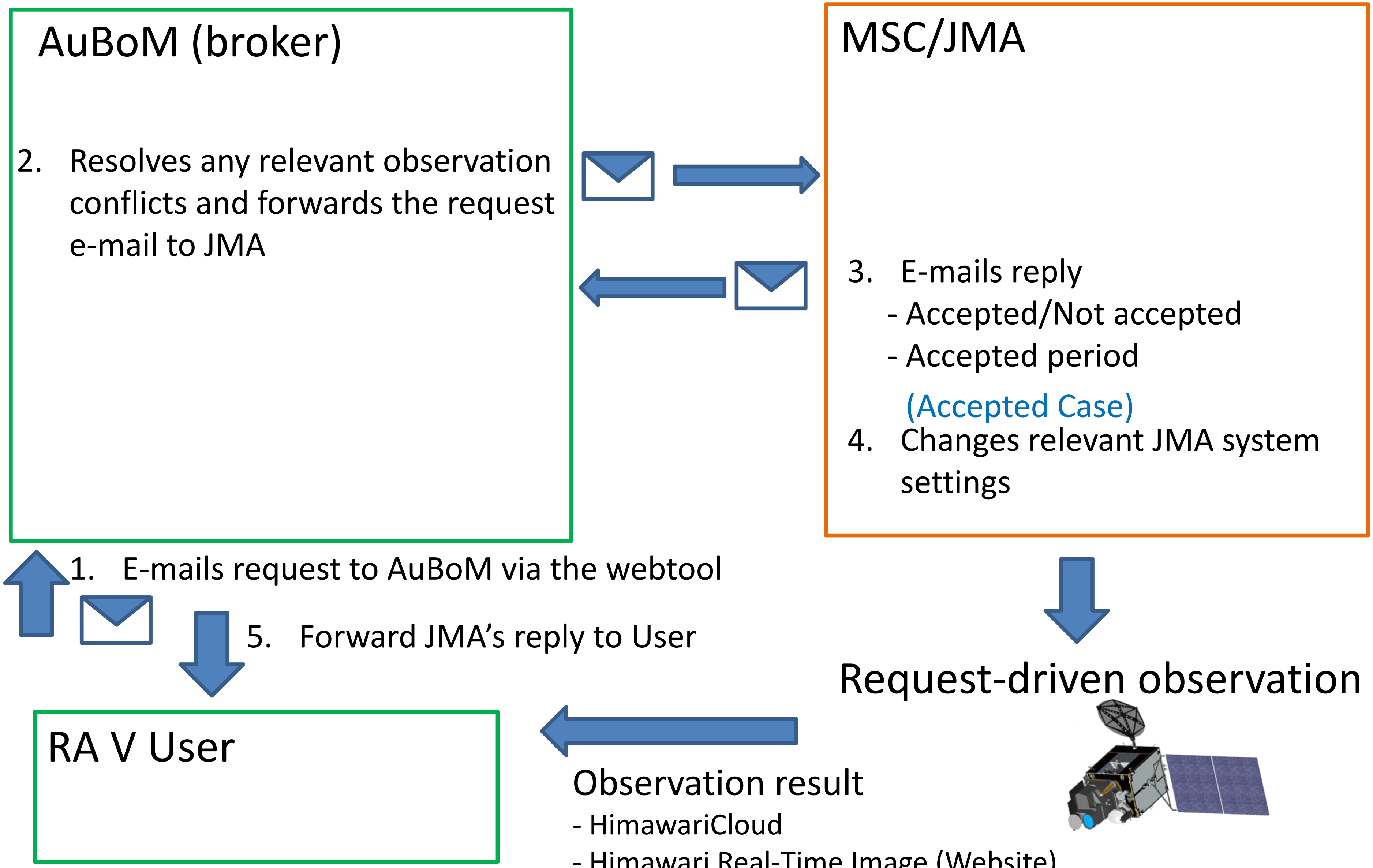
Request-driven observation



Observation result

- HimawariCloud
- Himawari Real-Time Image (Website)

Procedure for RA V



AuBoM (broker)

2. Resolves any relevant observation conflicts and forwards the request e-mail to JMA

MSC/JMA

3. E-mails reply
   - Accepted/Not accepted
   - Accepted period

(Accepted Case)

4. Changes relevant JMA system settings

1. E-mails request to AuBoM via the webtool

5. Forward JMA's reply to User

Request-driven observation

RA V User

Observation result
- HimawariCloud
- Himawari Real-Time Image (Website)

Current Status (As of September 2018)

12 Registrations

the Solomon Islands, Myanmar, Australia, Hong Kong, Bangladesh, New Zealand, Malaysia, Samoa, Nepal, Thailand, Fiji and Russia

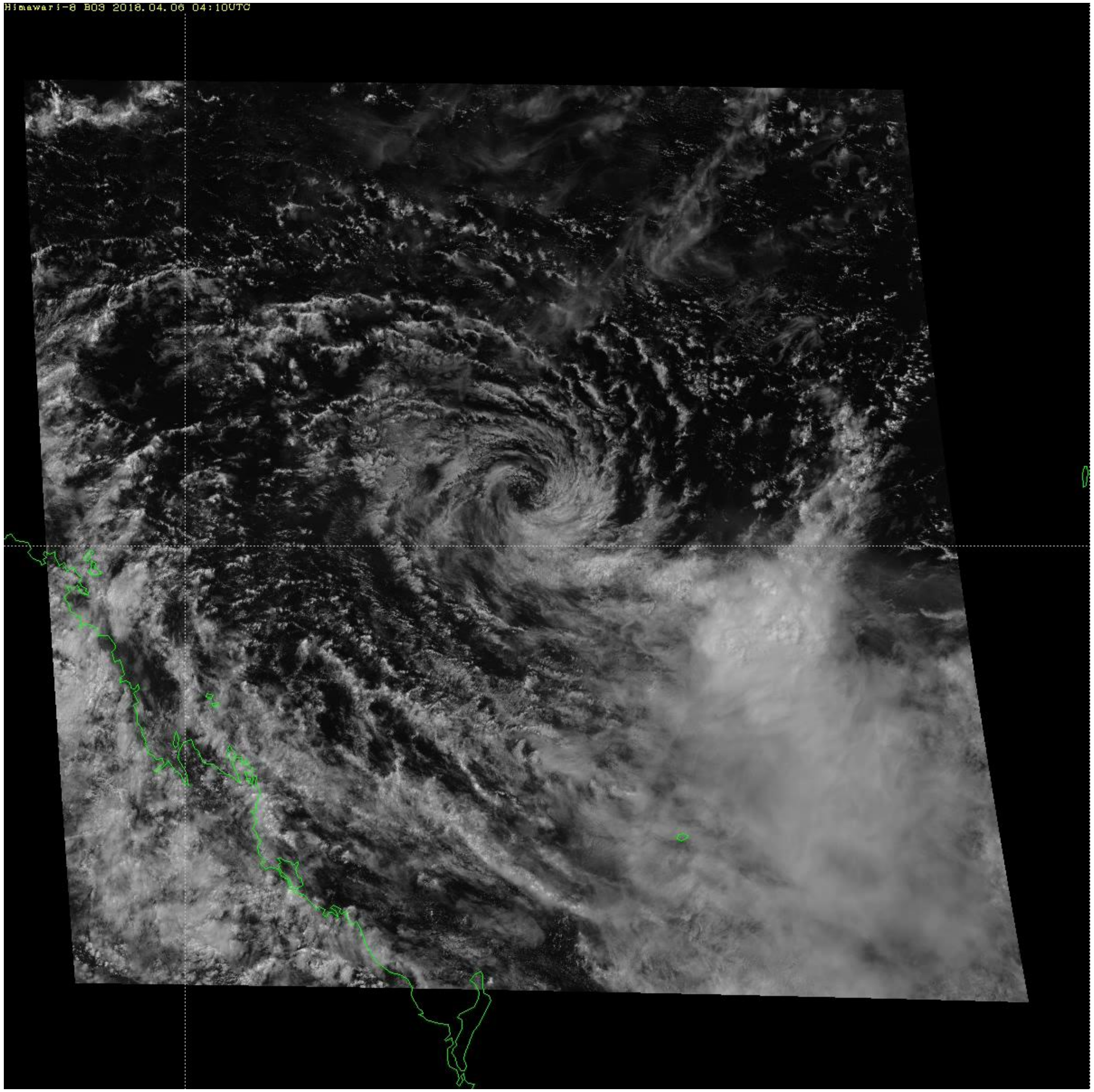
9 Users (preparations for request submission were complete

the Solomon Islands, Hong Kong, New Zealand, Nepal, Australia, Malaysia, Fiji, Thailand and Russia

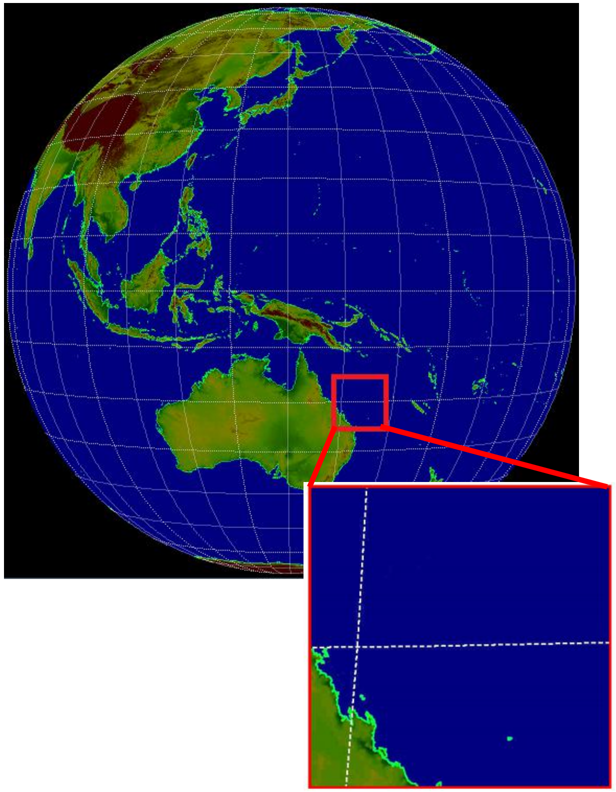
JMA expects the HimawariRequest service to support disaster risk reduction activities in the Asia Oceania region.

Further information on HimawariRequest including its service description and registration form is available at JMA's webpage:
https://www.jma.go.jp/jma/jma-eng/satellite/HimawariRequest.html

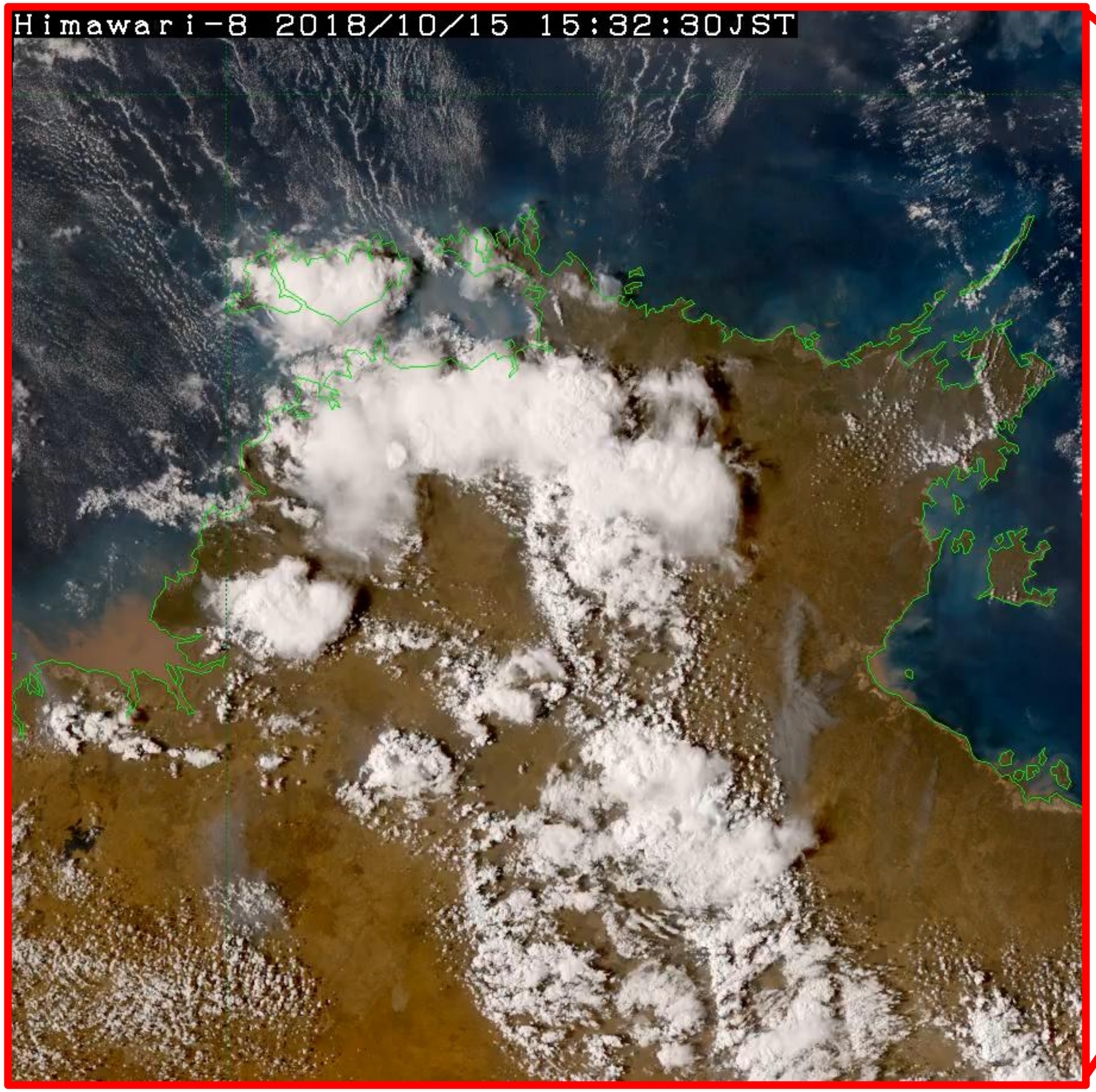
Test Observation with AuBOM



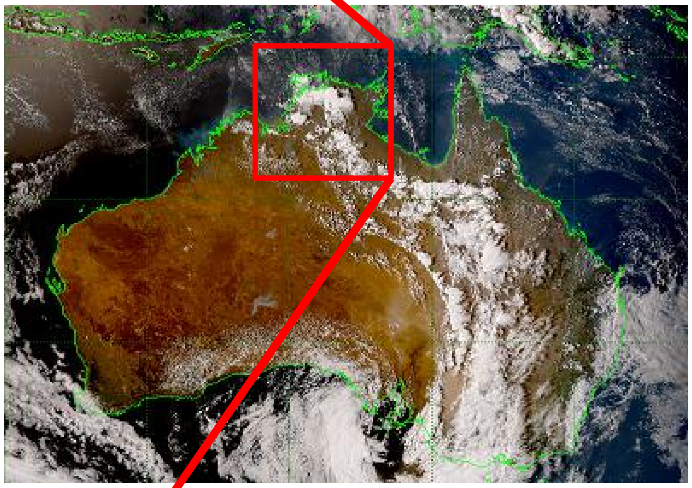
April 6th, 2018
04:00UTC - 05:00UTC
Tropical Storm IRIS



Observation with AuBOM



October 15th, 2018
convective cloud activity
around Darwin



Today’s finished !

Contents

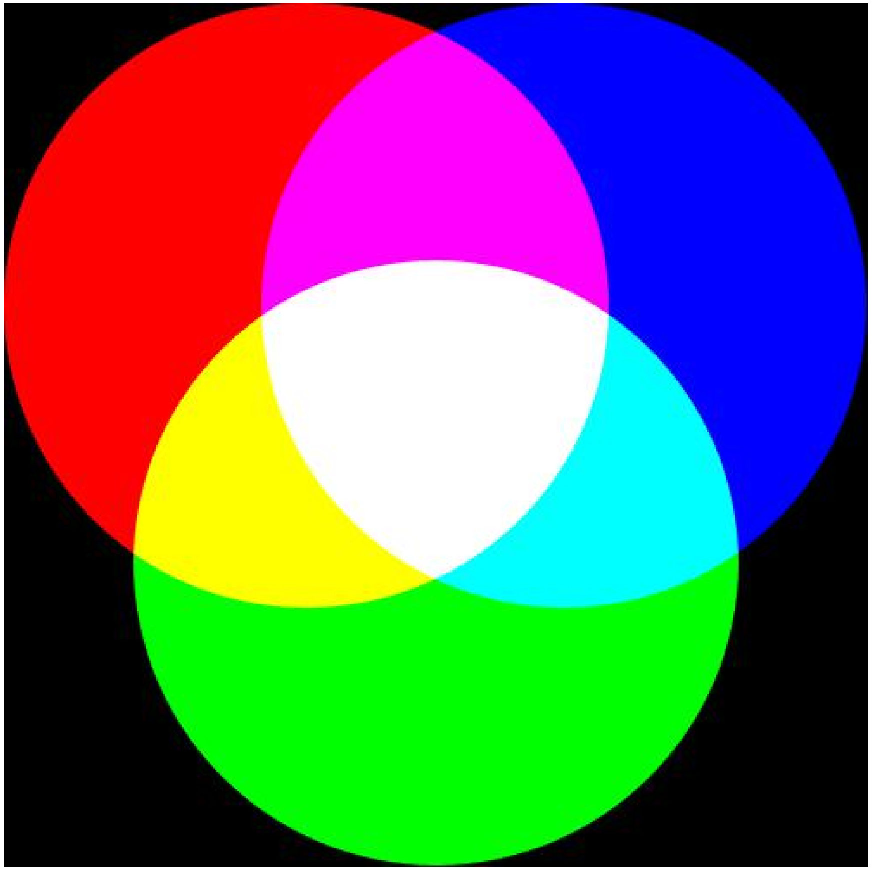
1. **Overview of Himawari-8 and -9**
2. **Satellite derived products**
3. **Target Area observation for HimawariRequest**
4. **RGB Imageries**
5. **Usage of Himawari-8 and -9 Products for typhoon**

4. RGB Imageries

- Introduction to RGB Imagery
- Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB

What's RGB?

- Red (R), green (G) and blue (B), which are the three primary colors of light, constitute color space expressing additive color composite
- RGB compositing is a technique to display a color using this property of the three primary colors of light



three primary colors RGB

Why RGB composite imagery?

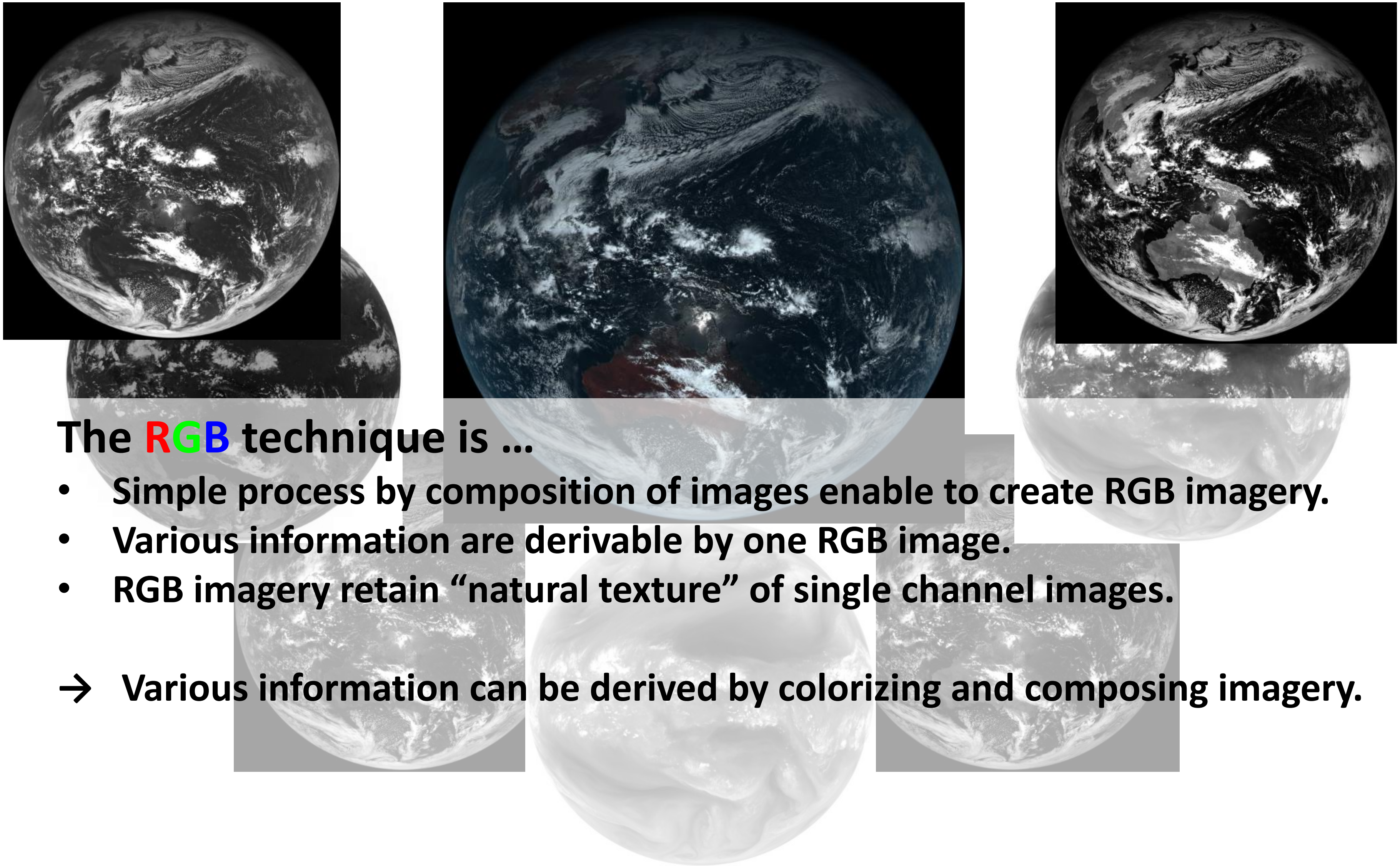
Band	Himawari-8/ -9	MTSAT- 1R/-2	MSG	Physical Properties for Imagery	
1	0.46 µm			aerosol B	Visible
2	0.51 µm			aerosol G	
3	0.64 µm	0.68 µm	0.635 µm	low cloud, fog R	
4	0.86 µm		0.81 µm	vegetation, aerosol	Near Infrared
5	1.6 µm		1.64 µm	cloud phase	
6	2.3 µm			particle size	
7	3.9 µm	3.7 µm	3.92 µm	low cloud, fog, forest fire	Infrared
8	6.2 µm	6.8 µm	6.25 µm	upper level moisture	
9	6.9 µm			mid- and level moisture	
10	7.3 µm		7.35 µm	mid- level moisture	
11	8.6 µm		8.70 µm	cloud phase, SO2	
12	9.6 µm		9.66 µm	ozone content	
13	10.4 µm	10.8 µm	10.8 µm	cloud imagery, information of cloud top	
14	11.2 µm			cloud imagery, sea surface temperature	
15	12.4 µm	12.0 µm	12.0 µm	cloud imagery, sea surface temperature	
16	13.3 µm		13.4 µm	cloud top height	

Each band (channel) has different properties, as shown in the left figure.

Note:

- In this presentation, some channel length use “MSG”.
- Some band length of MSG are different from “Himawari-8”.

There are too many channels!



The RGB technique is …

- **Simple process by composition of images enable to create RGB imagery.**
- **Various information are derivable by one RGB image.**
- **RGB imagery retain “natural texture” of single channel images.**

→ Various information can be derived by colorizing and composing imagery.

Advantage of RGB image

- Without RGB image...

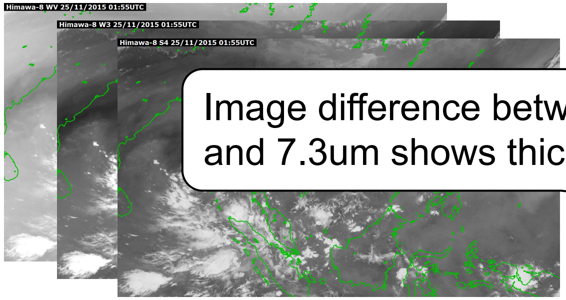


Image difference between 6.2um and 7.3um shows thick clouds...

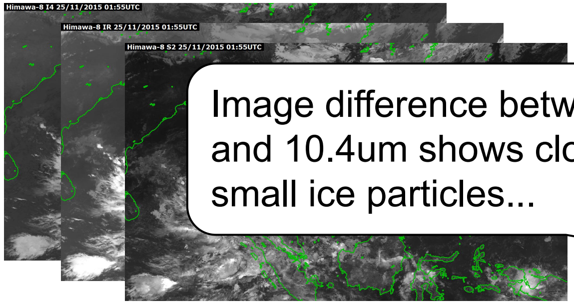


Image difference between 3.9um and 10.4um shows cloud top with small ice particles...

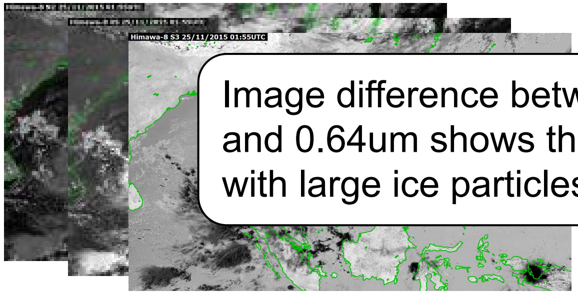
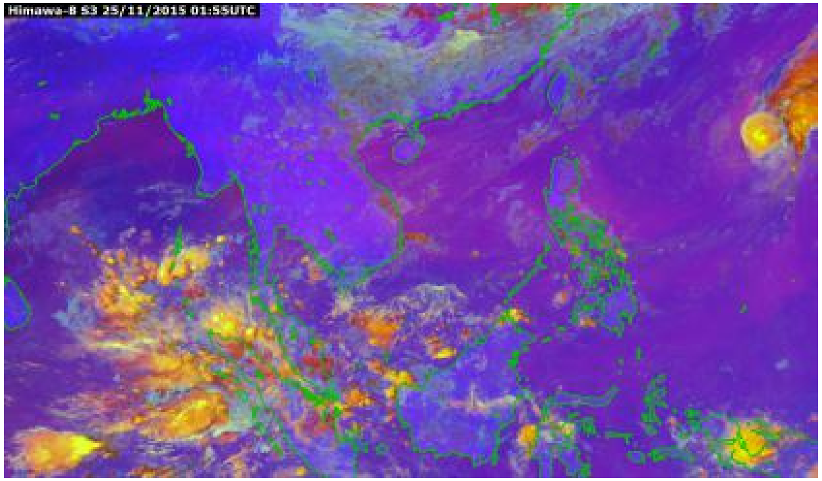


Image difference between 1.6um and 0.64um shows thick cloud top with large ice particles...

How complicated!

- With RGB image...



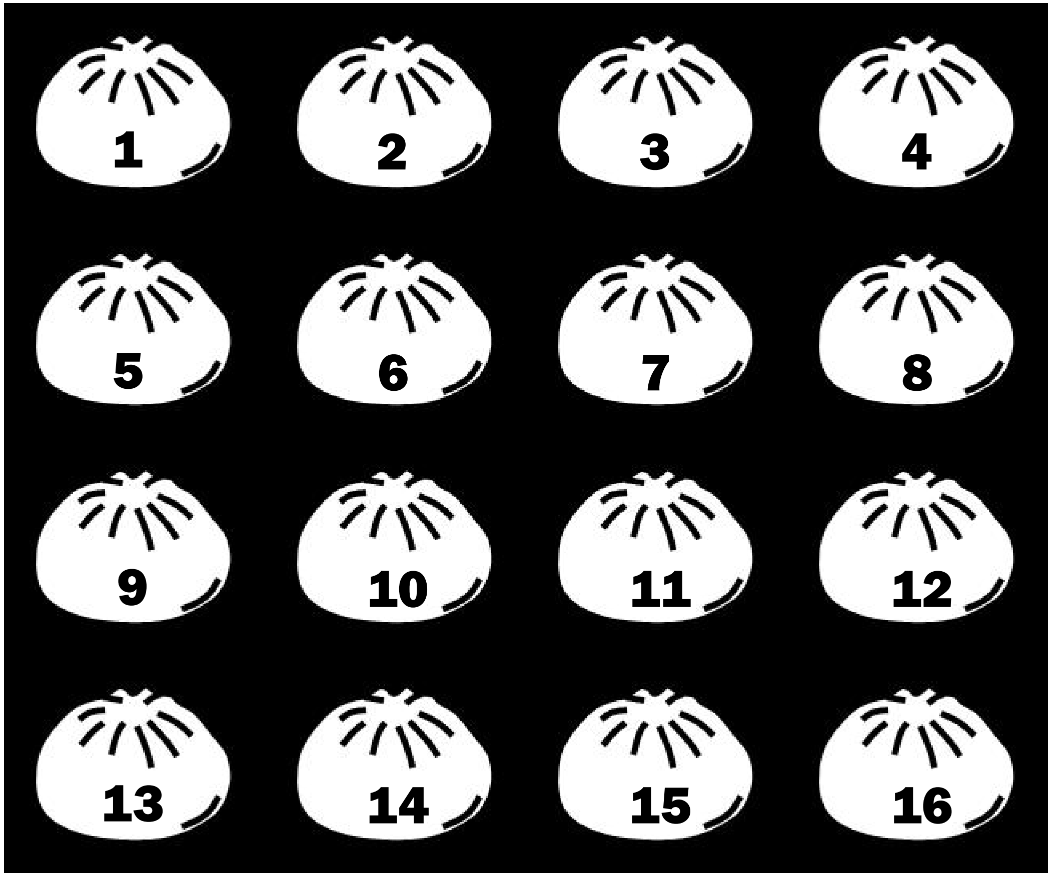
Red: Deep precipitating cloud top with large ice particles

Yellow: Cb cloud with strong updrafts and severe weather

Easy to understand!

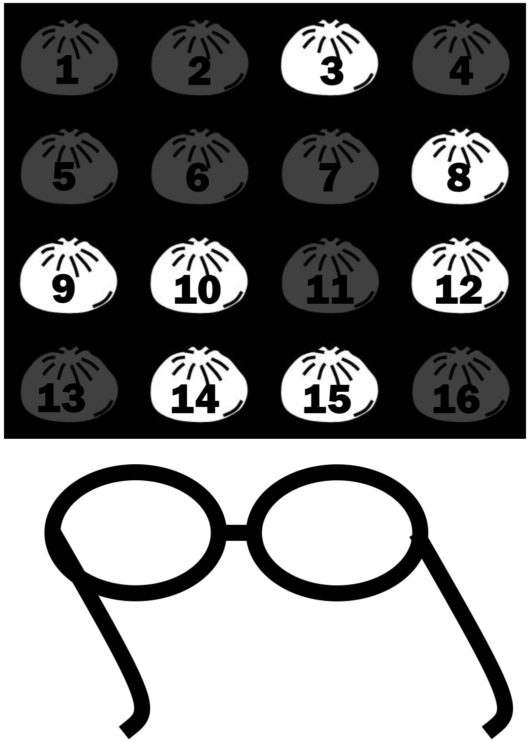
Understanding RGB concept

Find “**Hot**”, “**Juicy**”, “**Vegetable**” buns!

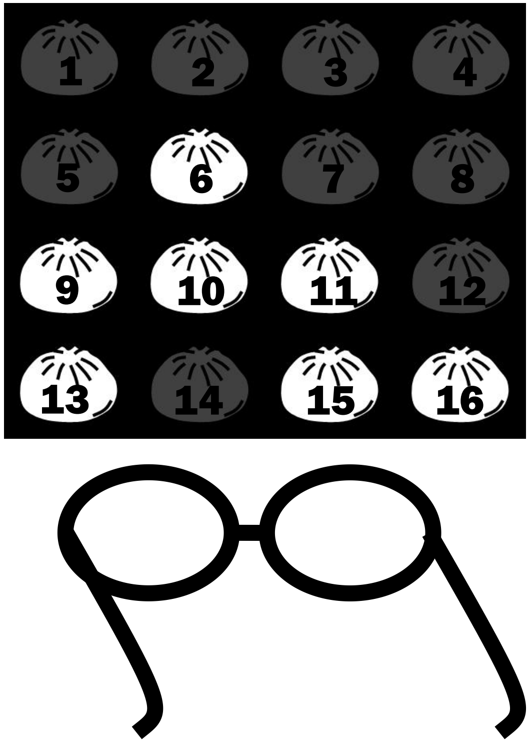


Use Special Glasses!

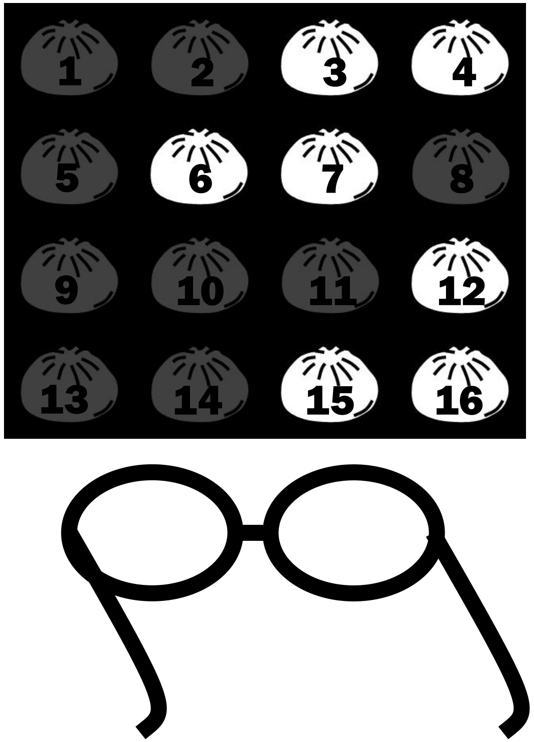
through
“**Hot**” vision glasses



through
“**Juicy**“ vision glasses



through
“**Vegetable**“ vision glasses

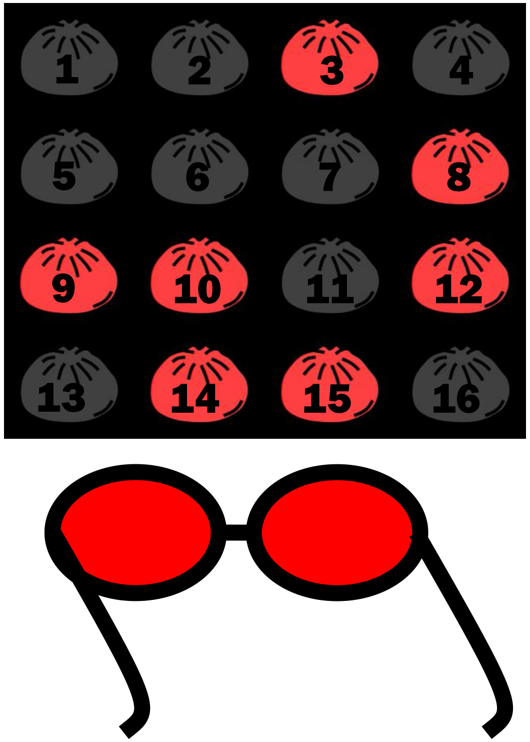


Find “**Hot**”, “**Juicy**”,
“**Vegetable**” buns!

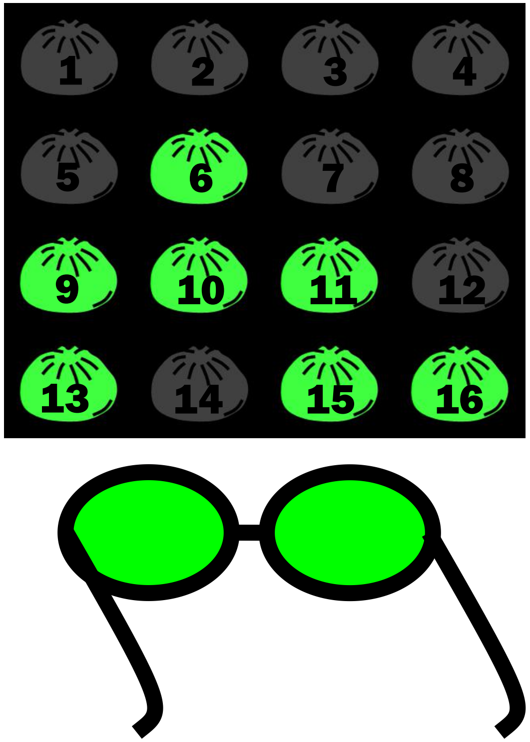
... It is possible to find, but a little troublesome!

Use Colors!

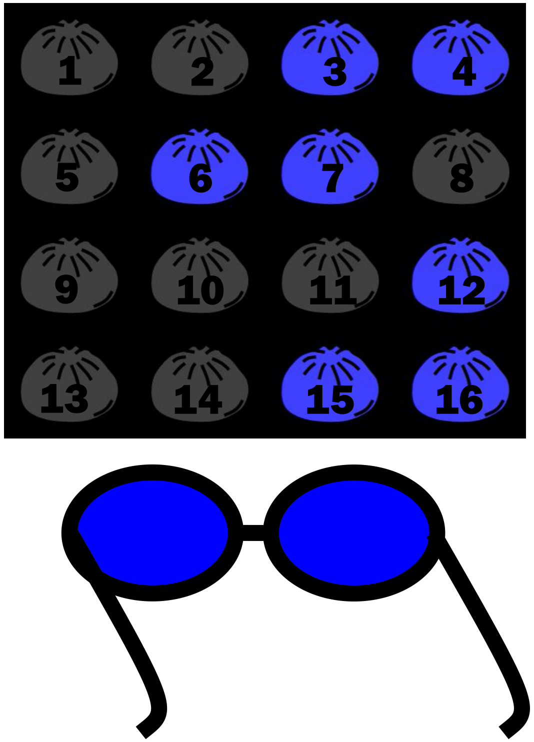
through
“**Hot**” vision glasses



through
“**Juicy**“ vision glasses



through
“**Vegetable**“ vision glasses



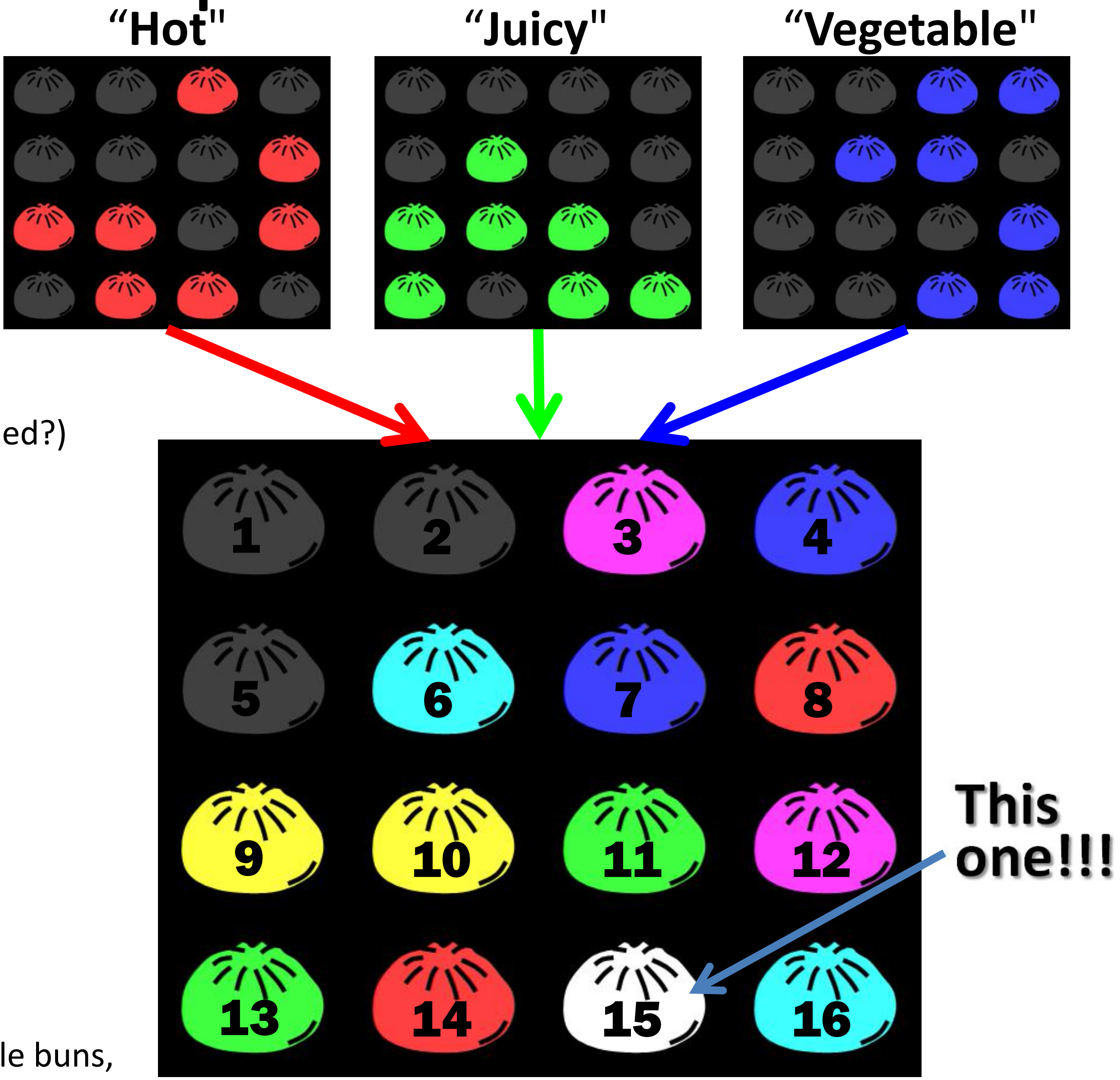
Find “**Hot**”, “**Juicy**”,
“**Vegetable**” buns!

Let’s color each pair of glasses
in **red**, **green**, and **blue** !

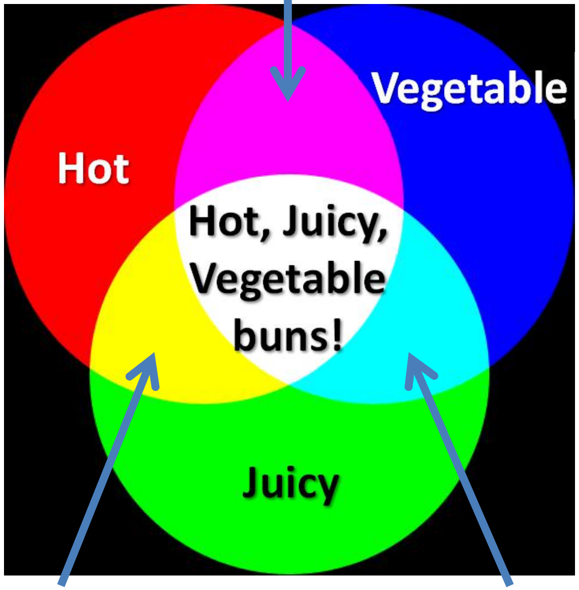
Compose!

RGB composite

Hot, Juicy, Vegetable buns appear white and you can find it **at a glance**!



Hot and Vegetable buns, but not Juicy (dried?)

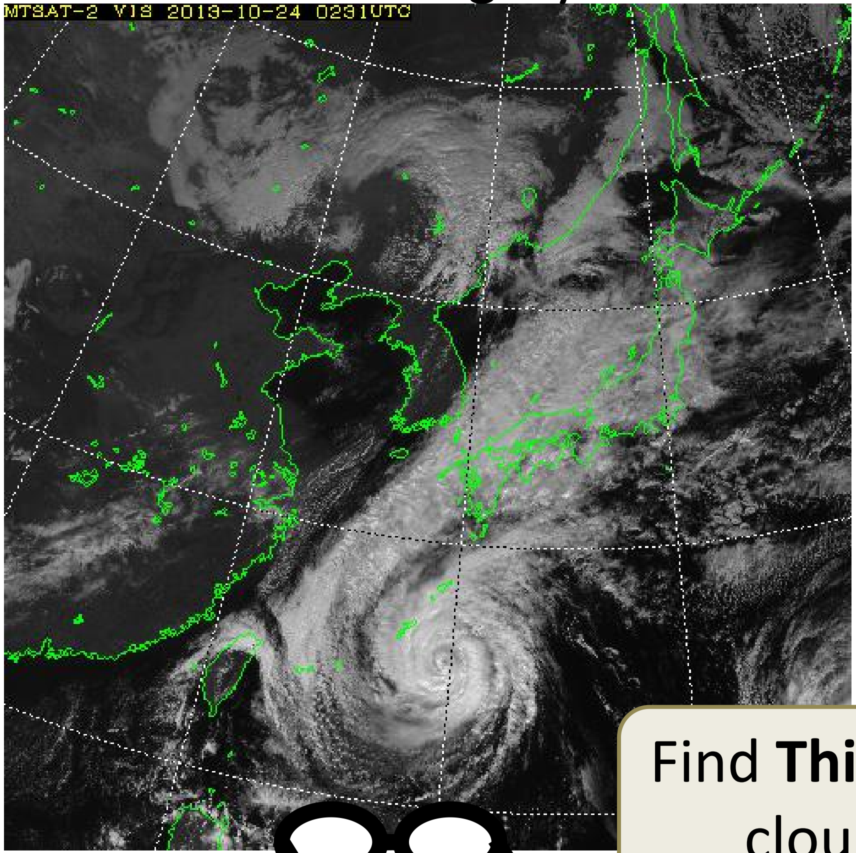


Hot and Juicy, but not Vegetable buns

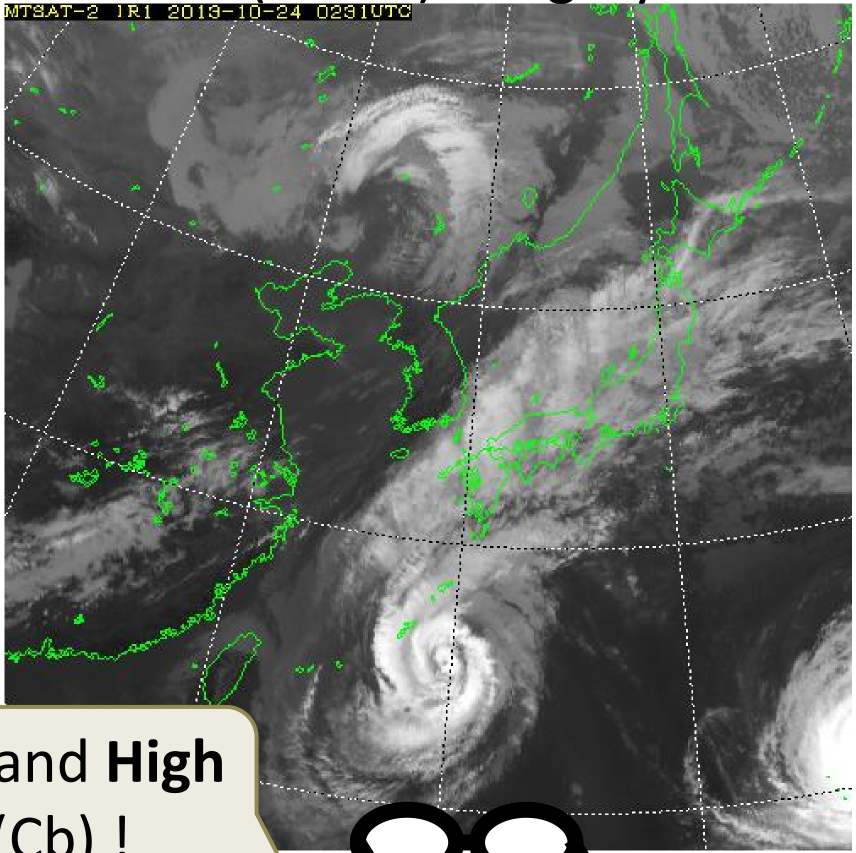
Juicy and Vegetable buns, but not Hot (Cold?)

Application to Satellite Imageries

VIS imagery



IR(11um) imagery



Find **Thick** and **High** clouds (Cb) !

“**Thick cloud**” vision glasses

Thicker clouds looks whiter

“**High cloud**” vision glasses

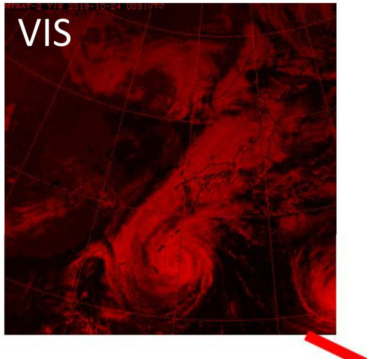
Higher (Lower brightness temperature) clouds looks whiter

Application to Satellite Imageries

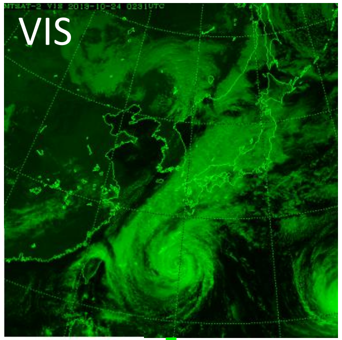
RGB composite

Thick and high cloud (Cb) areas appear white!

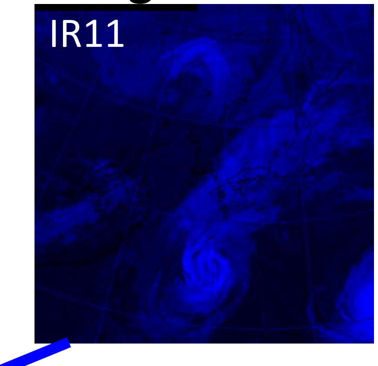
"**Thick**" cloud

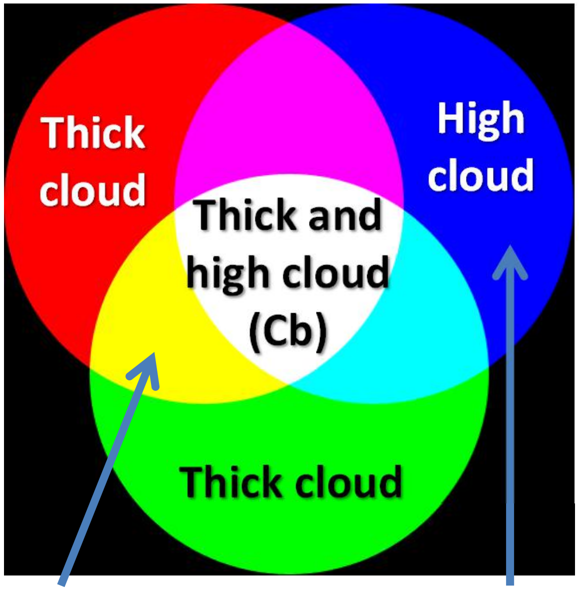


"**Thick**" cloud



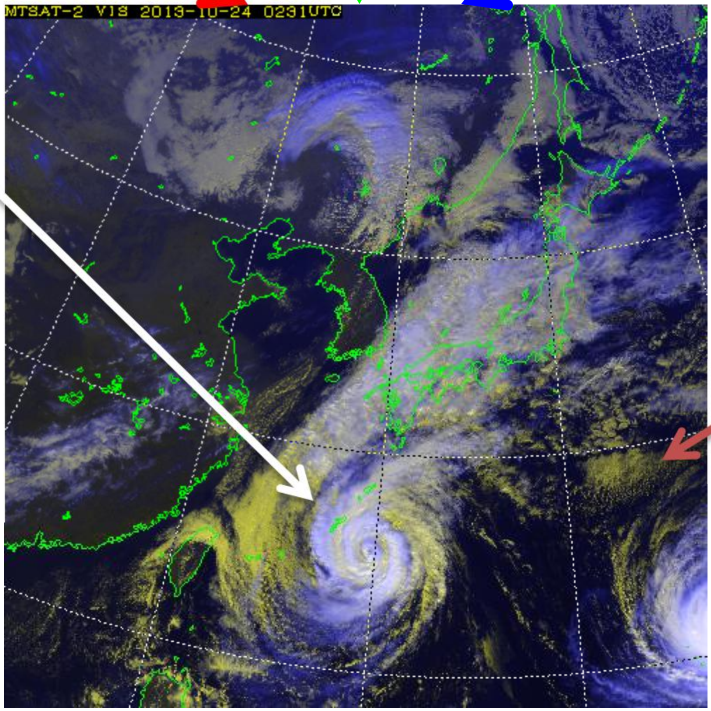
"**High**" cloud





Thick, but not high cloud (Low level clouds)

High, but not thick cloud (Cirrus)



If you want to focus on the low level clouds, look at yellow area.

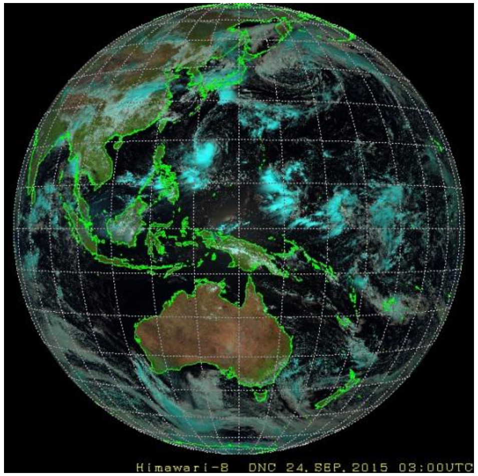
RGB technique

- Allocate the three primary colors of red, green and blue for multiple bands of satellite images and compose them
- Since various information are derivable by one RGB composite imagery, it is very useful for monitoring by forecasters
- The European Organization for the Exploitation of Meteorological Satellites has been developing the composites (EUMETSAT recipes)

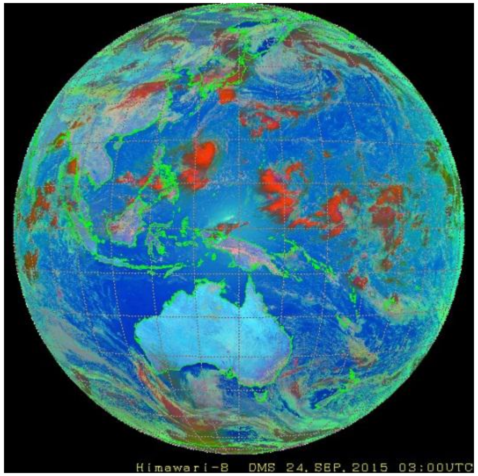
4. RGB Imageries

- Introduction to RGB Imagery
- Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB

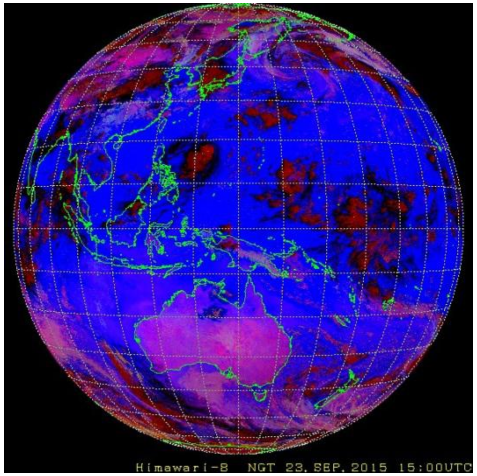
RGB recipes



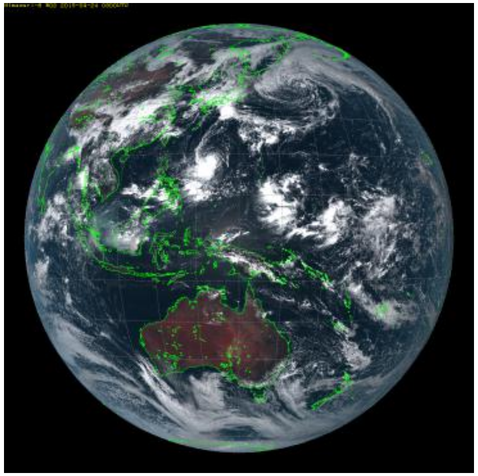
Natural Color



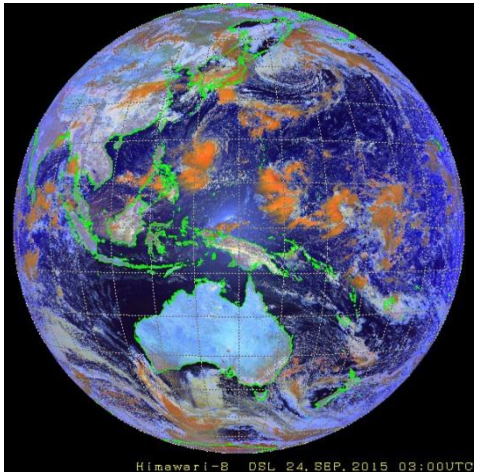
Day Microphysics



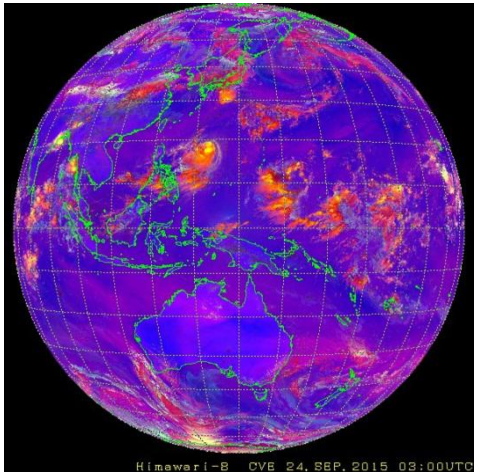
Night Microphysics



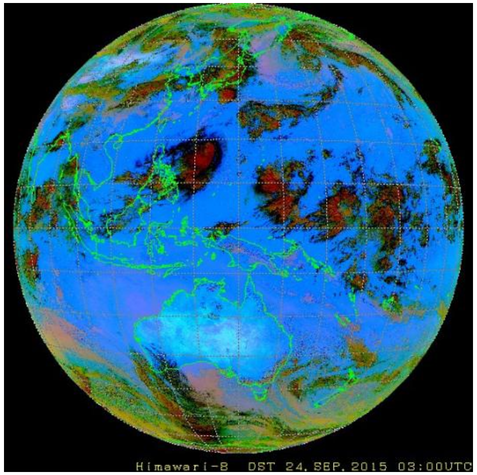
True Color



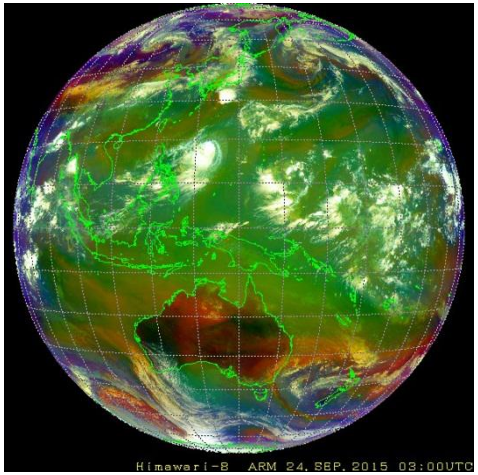
Day Snow-Fog



Day Convective Storm



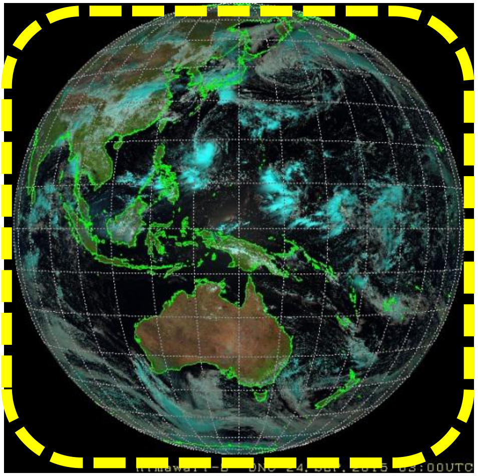
Dust



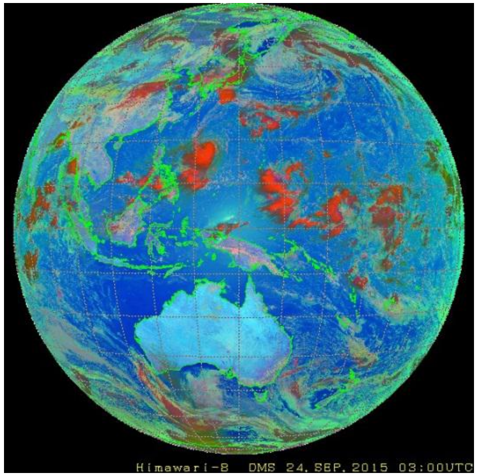
Airmass

https://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php?area=fd_

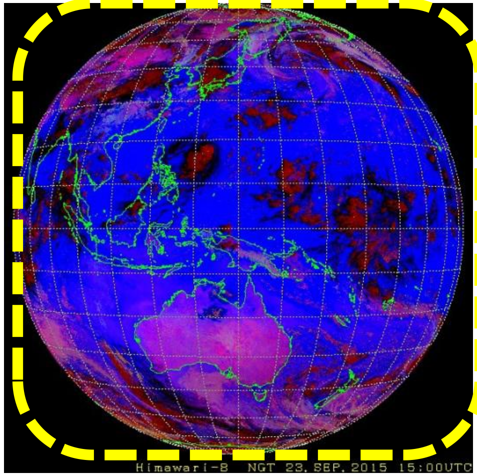
RGB recipes



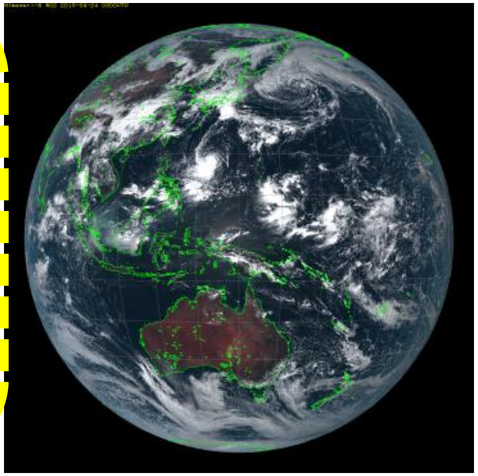
1.Natural Color



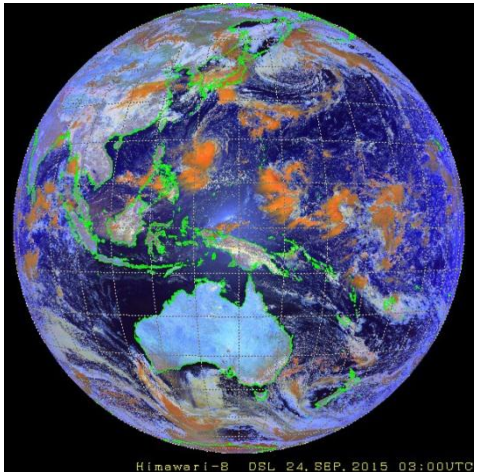
Day Microphysics



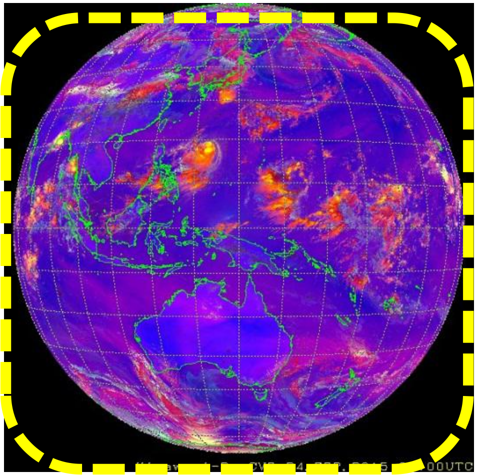
3.Night Microphysics



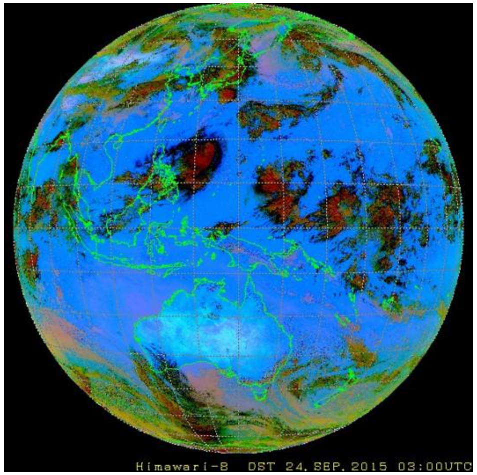
True Color



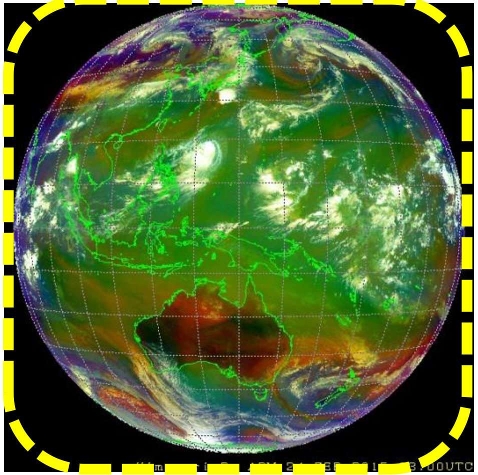
Day Snow-Fog



4.Day Convective Storm



Dust



2.Airmass

Another RGB recipe: 5.Differential Water Vapor RGB

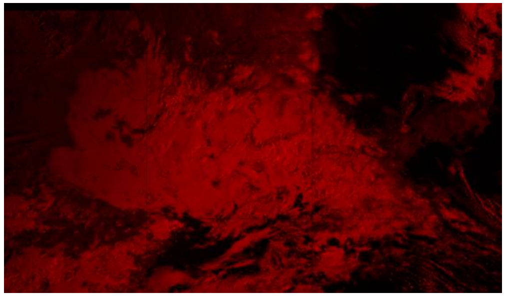
4. RGB Imageries

- ➢ Introduction to RGB Imagery
- ➢ Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB

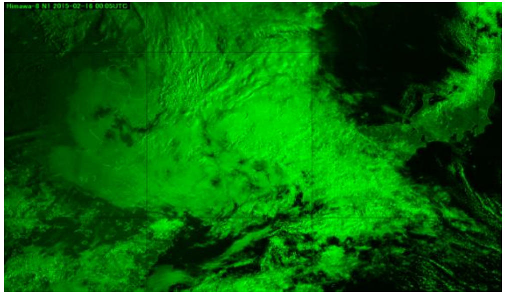
Day Natural Colors RGB
Detection of snow/ice, vegetation and clouds

Meteorological Satellite Center, JMA

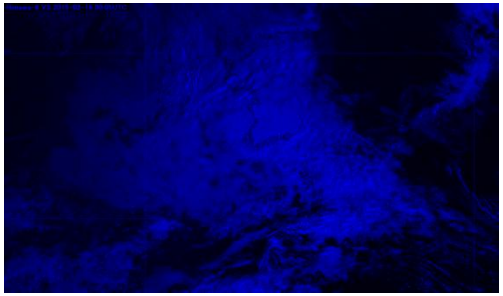
What’s Day Natural Colors RGB?



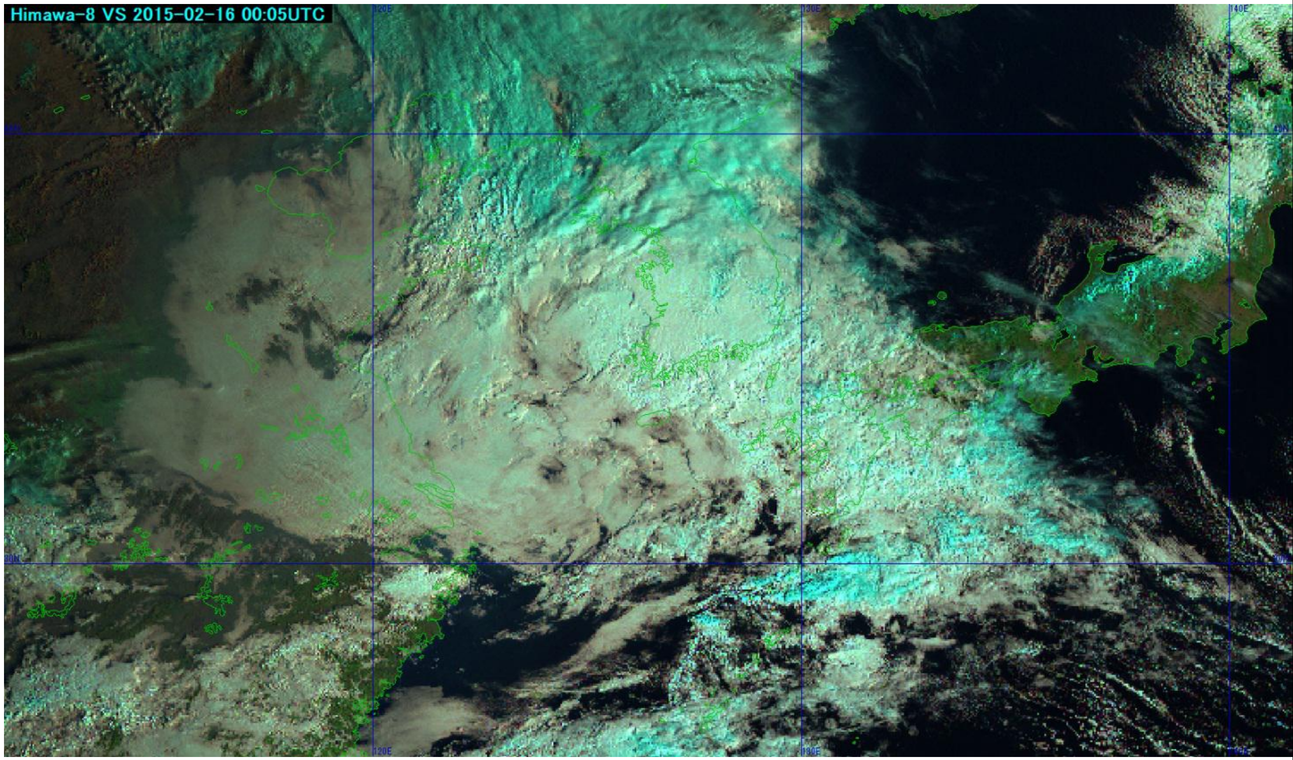
R : B05(N2 1.6)
Range : 0～100 [%] Gamma : 1.0



G : B04(N1 0.86)
Range : 0～100 [%] Gamma : 1.0

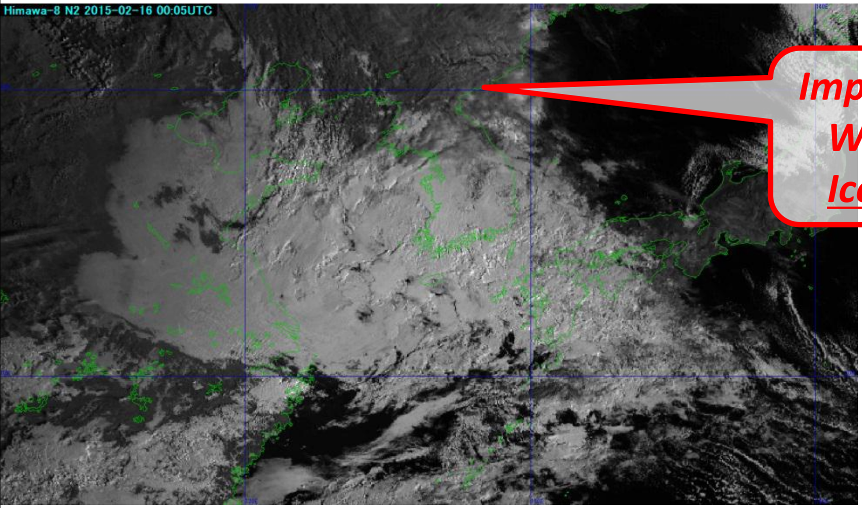


B : B03(VS 0.64)
Range: 0～100 [%] Gamma : 1.0



- ✓ Detection of vegetation, desert and snow/ice areas
- ✓ Distinguish between ice and water clouds
- ✓ Daytime only

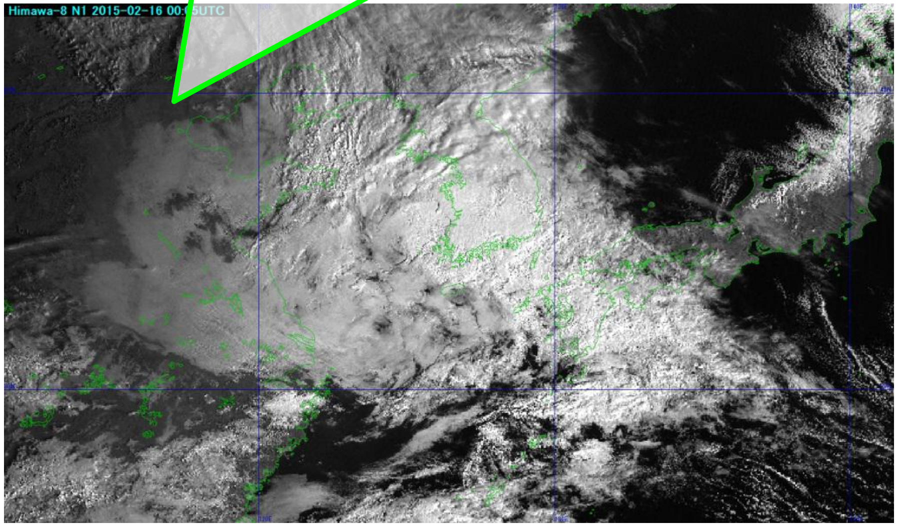
Characteristics and Basis of Three Components



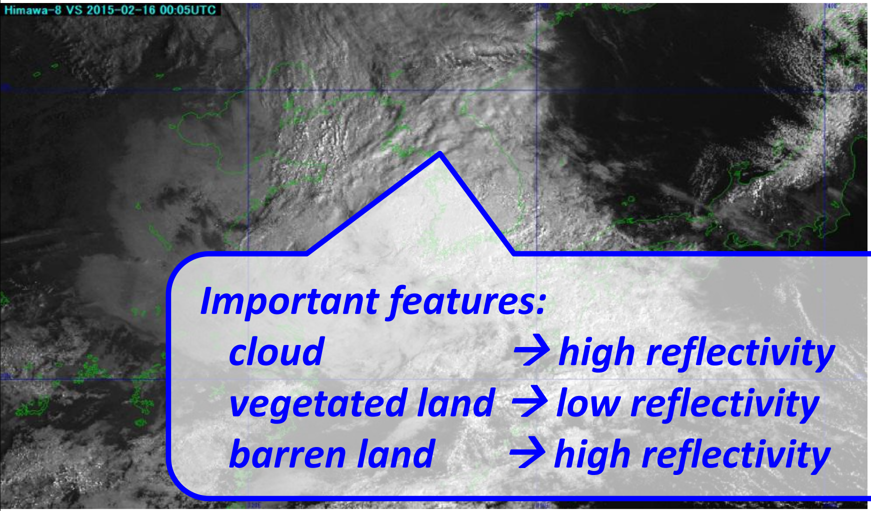
Important features:
Water cloud → high reflectivity
Ice cloud, snow, ice → low reflectivity

R : B05(N2 1.6) Range : 0～100 [%] Gamma : 1.0

Important features:
cloud → high reflectivity
vegetated land → high reflectivity
barren land → high reflectivity



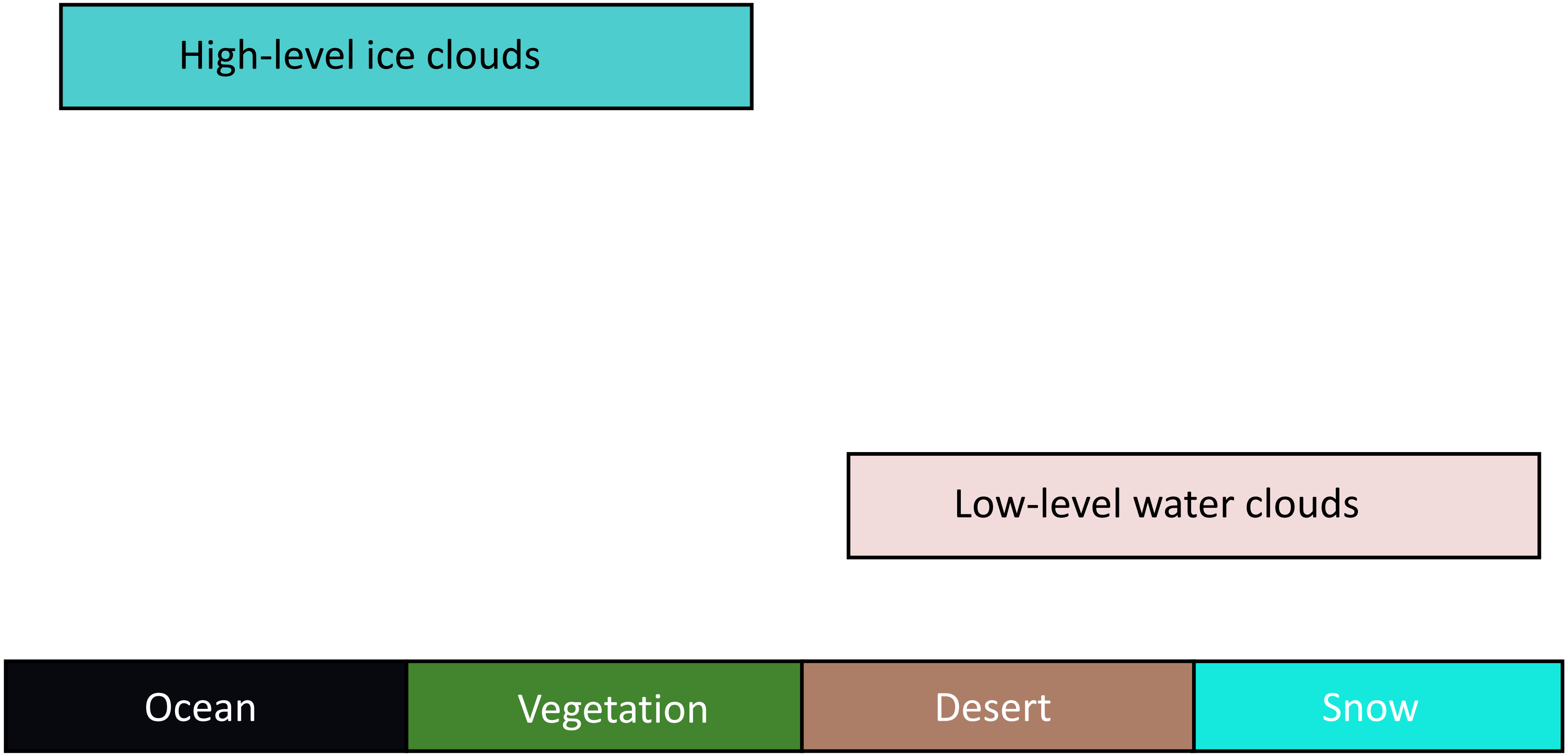
G : B04(N1 0.86) Range : 0～100 [%] Gamma : 1.0



Important features:
cloud → high reflectivity
vegetated land → low reflectivity
barren land → high reflectivity

B : B03(VS 0.64) Range : 0～100 [%] Gamma : 1.0

Interpretation of Colors
“Day Natural Colors”



High-level ice clouds

Low-level water clouds

Ocean

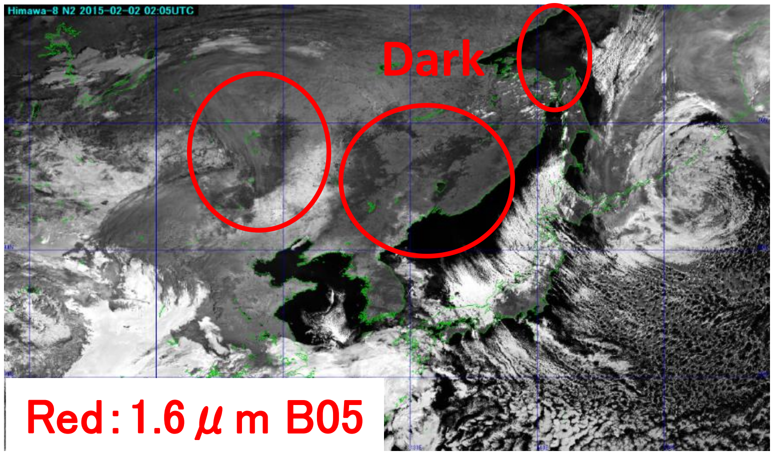
Vegetation

Desert

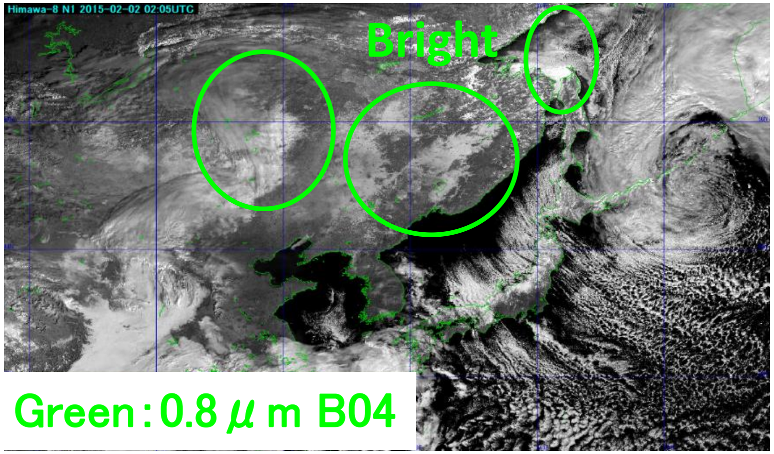
Snow

Note: Based on SEVIRI/EUMETSAT interpretation

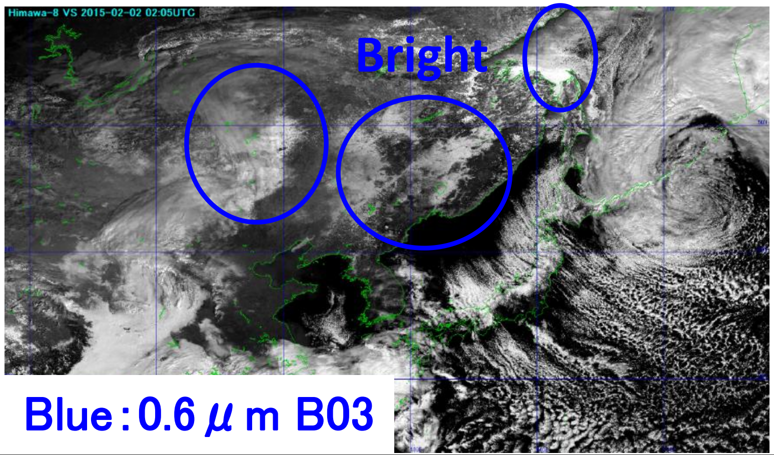
Basis of snow/ice detection on RGB



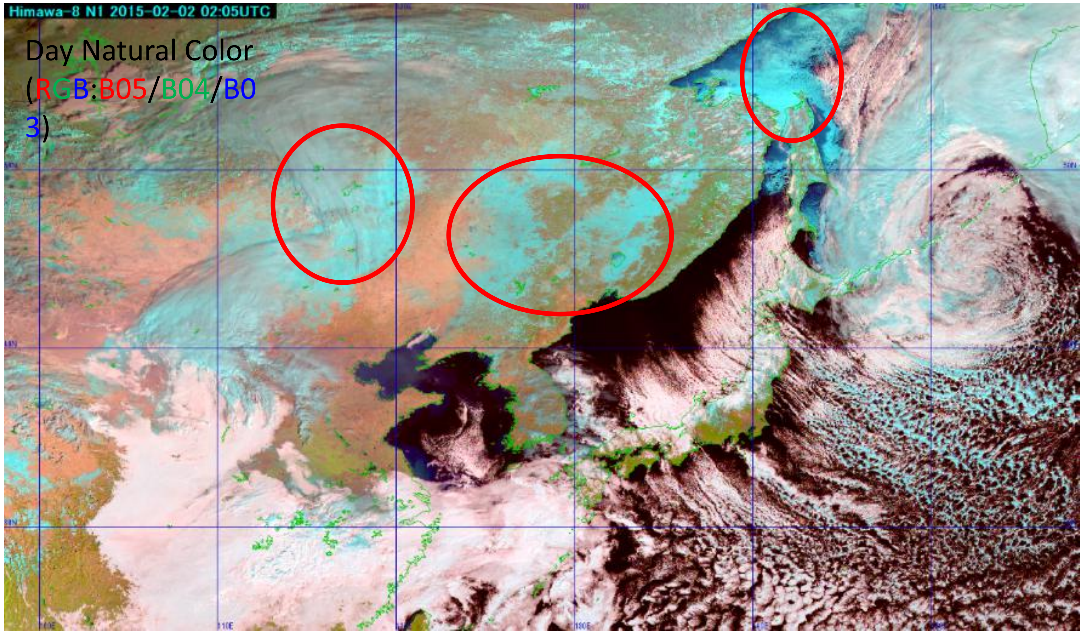
Red : 1.6 μm B05



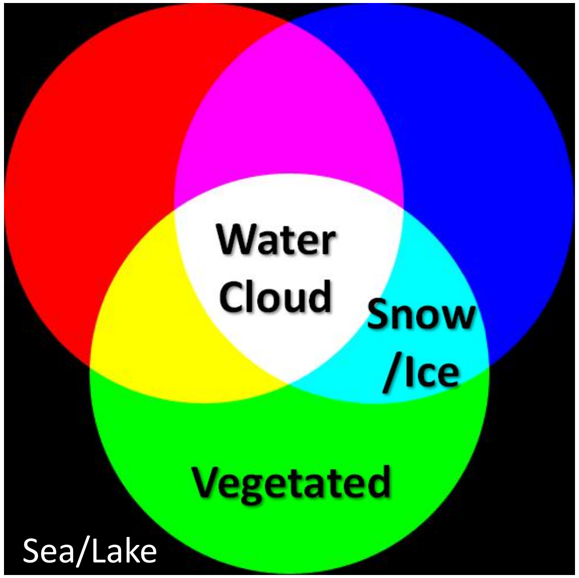
Green : 0.8 μm B04



Blue : 0.6 μm B03

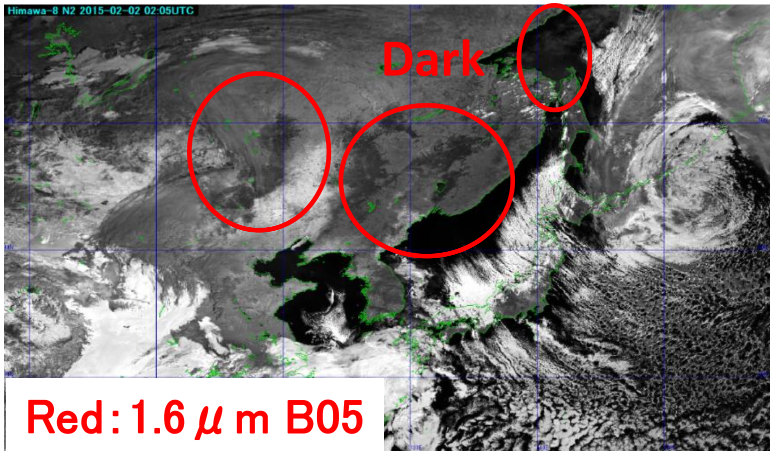


Day Natural Color (RGB:B05/B04/B03)

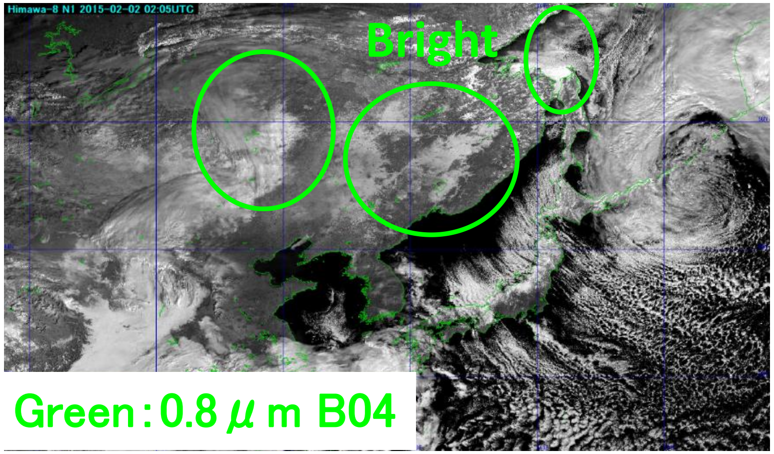


Red beam: Dark
Green beam: Bright
Blue beam: Bright

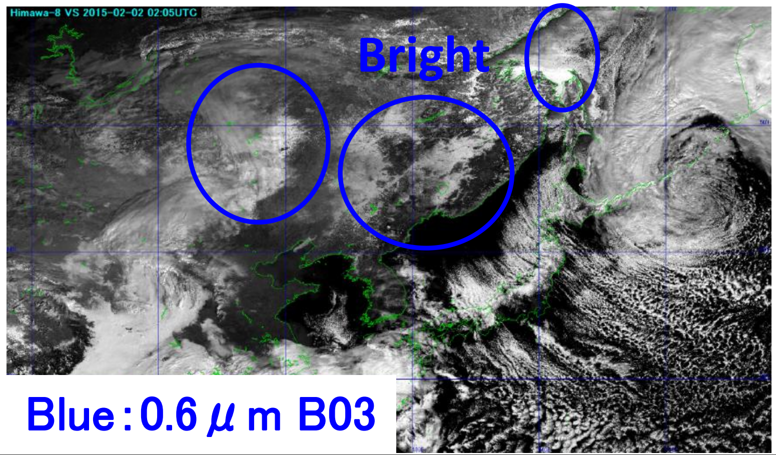
Basis of snow/ice detection on RGB



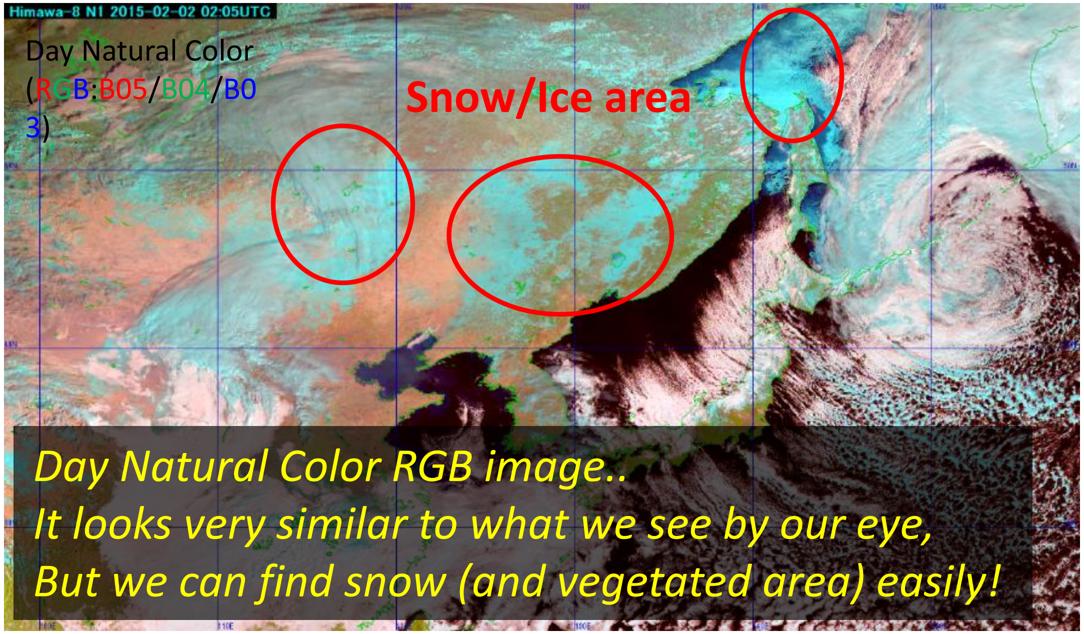
Red : 1.6 μ m B05



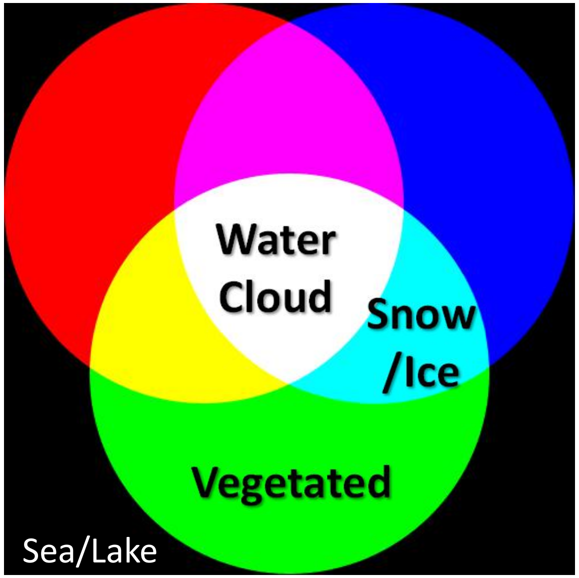
Green : 0.8 μ m B04

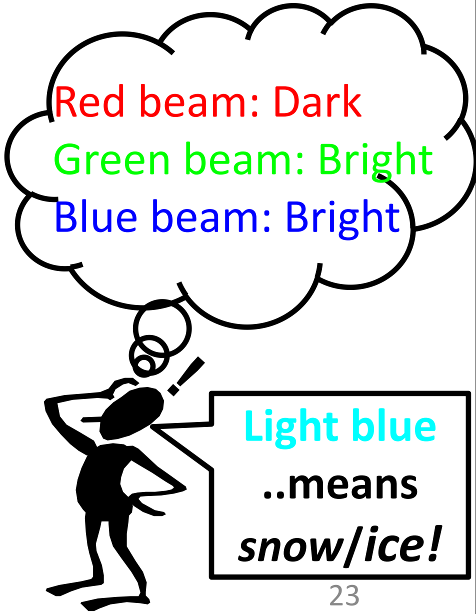


Blue : 0.6 μ m B03



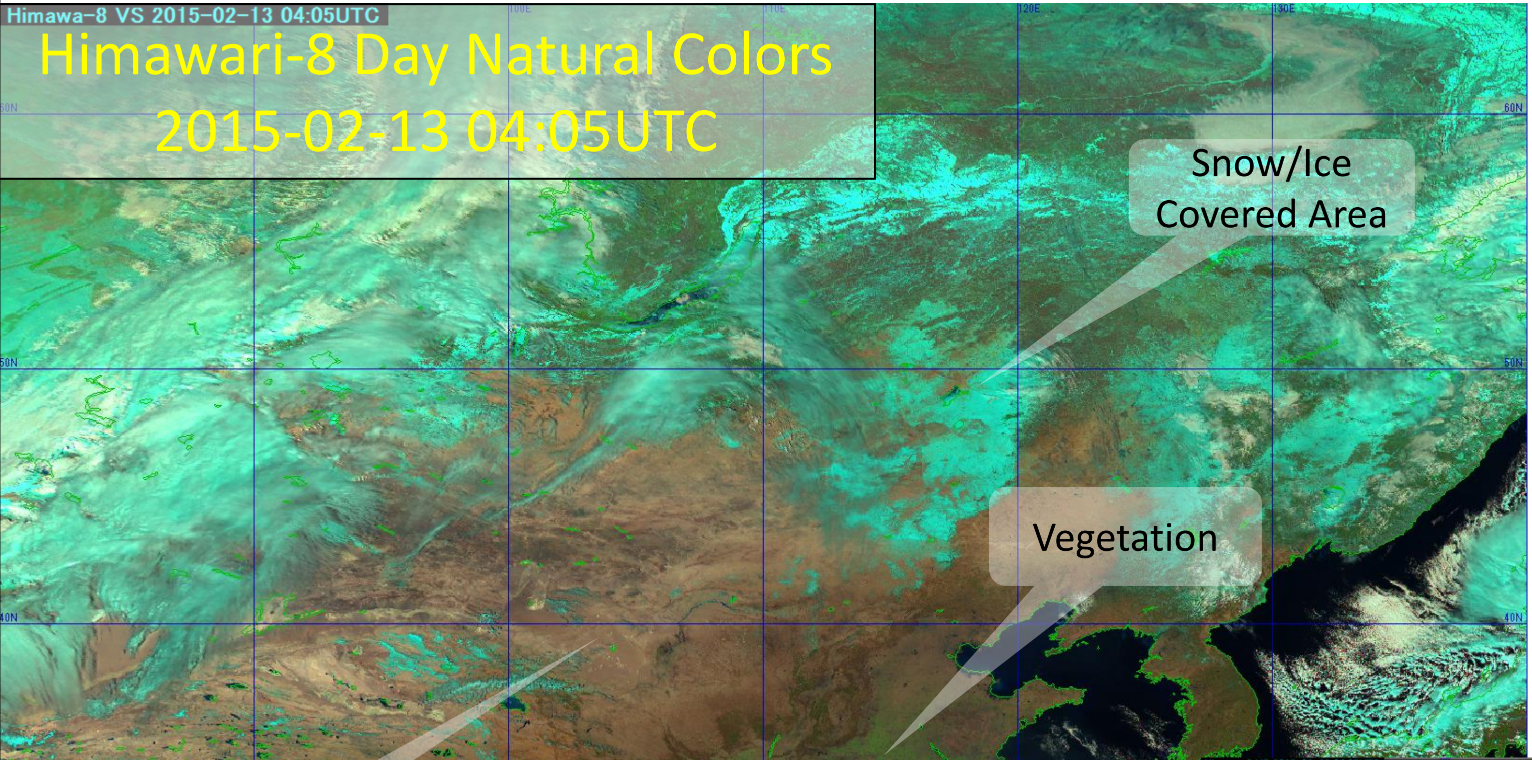
Day Natural Color RGB image..
It looks very similar to what we see by our eye,
But we can find snow (and vegetated area) easily!

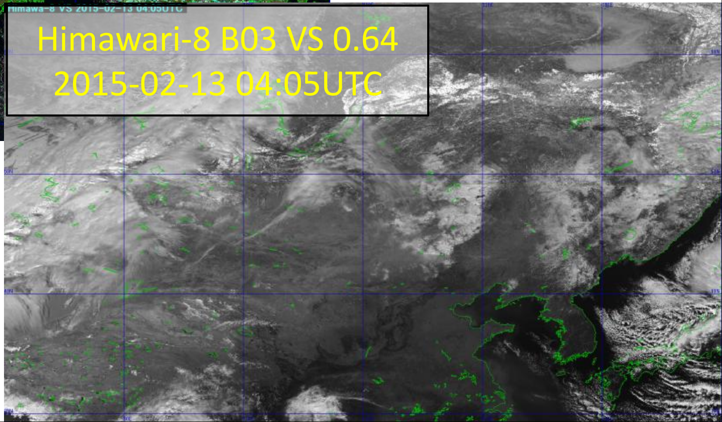




Example of Day Natural Colors RGB

Vegetation, Snow/Ice Covered Area (Vicinity of China and Mongolia)

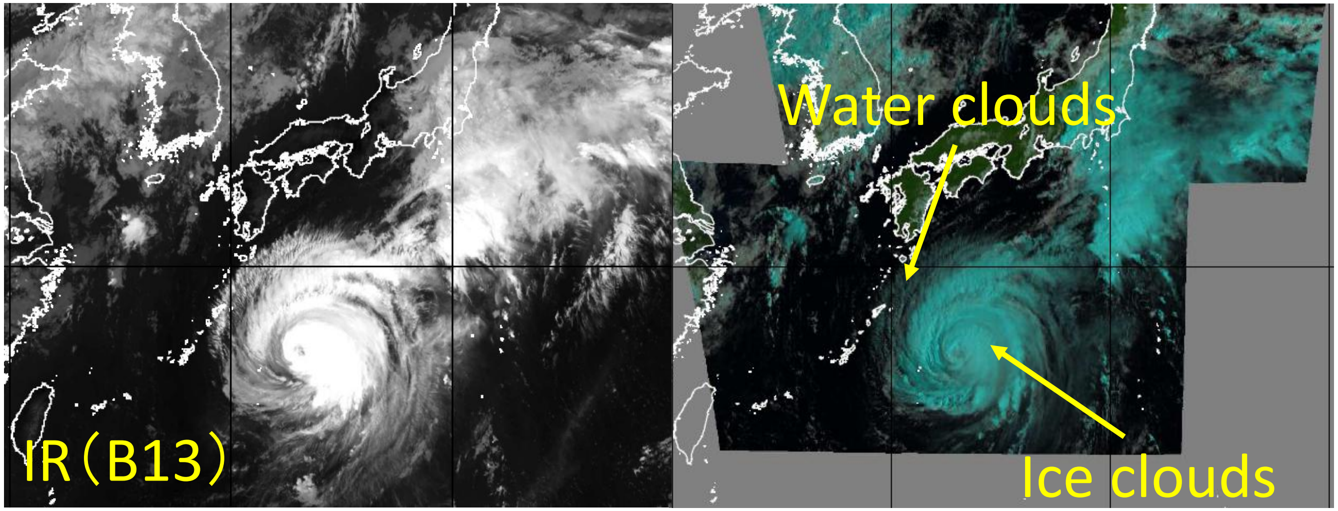




Vegetation appears green
Desert or bare ground appear brown

Day Natural Colors RGB
Detection of snow/ice, vegetation and clouds
Summary

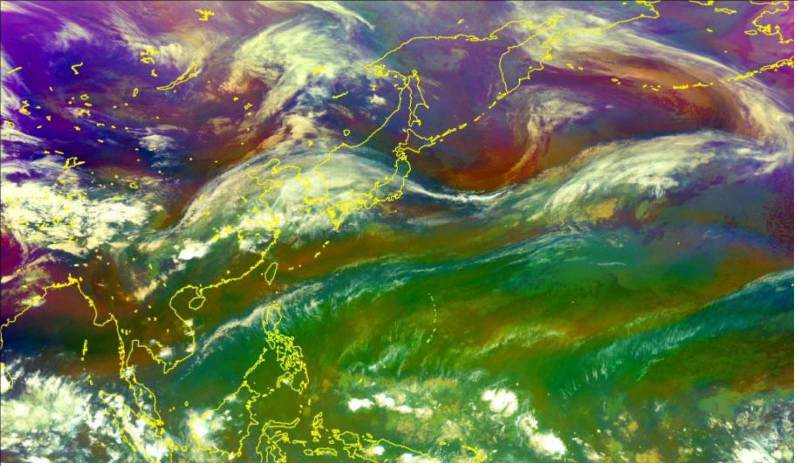
- ✓ Available to distinguish vegetation, desert and snow/ice
- ✓ Easy to distinguish between high-level ice clouds and low-level water clouds
- ✓ Day-time only



Typhoon JEBI (T3021)
00UTC 3 September, 2018

4. RGB Imageries

- Introduction to RGB Imagery
- Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB



Airmass RGB

Analysis of air mass and jet stream

Meteorological Satellite Center, JMA

Airmass

- R : WV6.2(B08)-WV7.3(B10)

  Range : -25.8～0.0 [K]   Gamma : 1.0

- G : IR9.6(B12)-IR10.4(B13)

  Range : -41.5～4.3 [K]   Gamma : 1.0

- B : WV6.2(B08)

  Range : 208.0～242.6 [K]   Gamma : 1.0

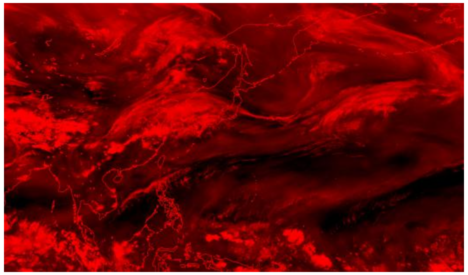
- Applications

  ･Air mass(cold/warm) analysis

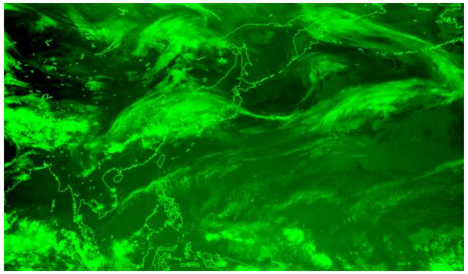
  ･Jet stream analysis related to upper vortices

Airmass

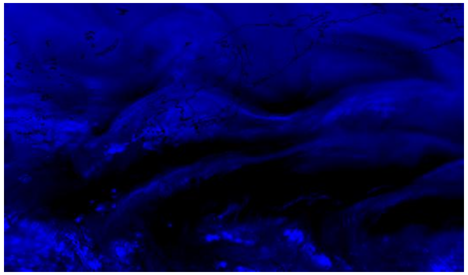
WV6.2(B08)-WV7.3(B10)

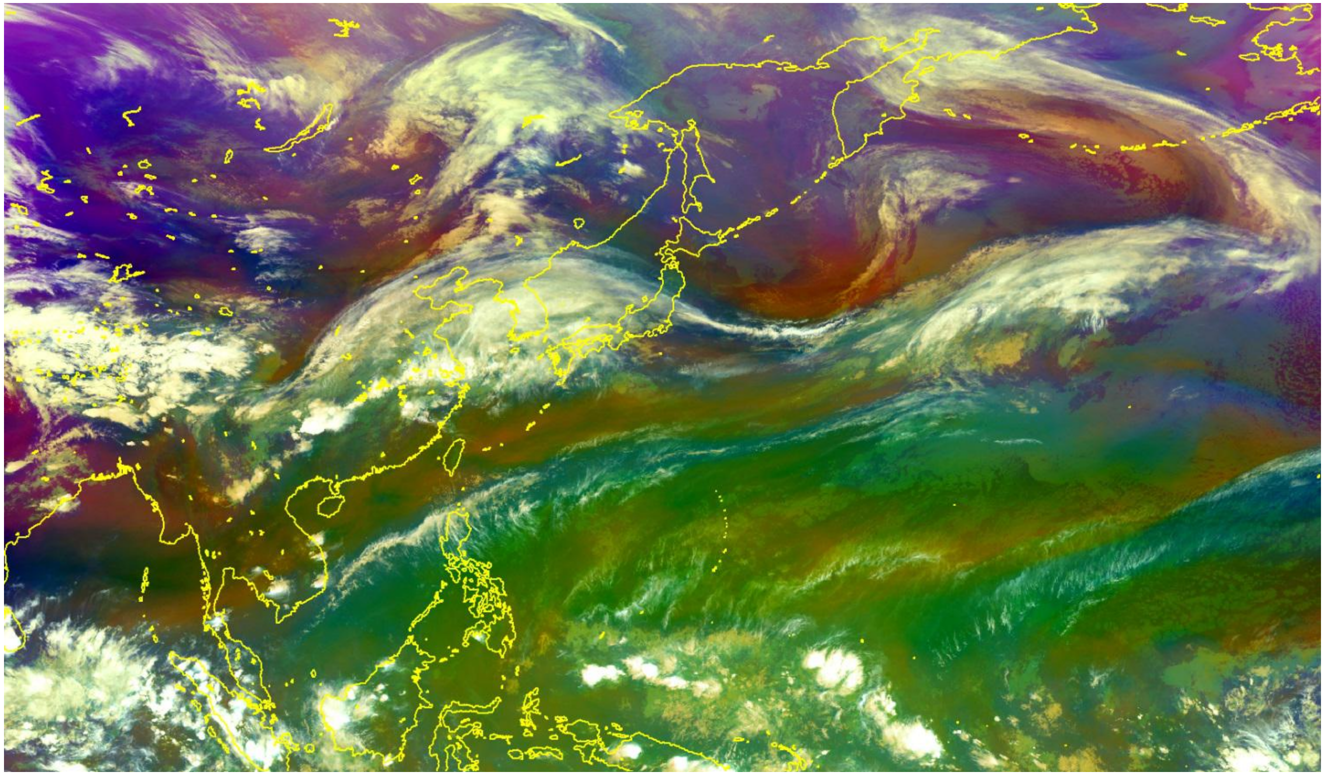


IR9.6(B12)-IR10.4(B13)



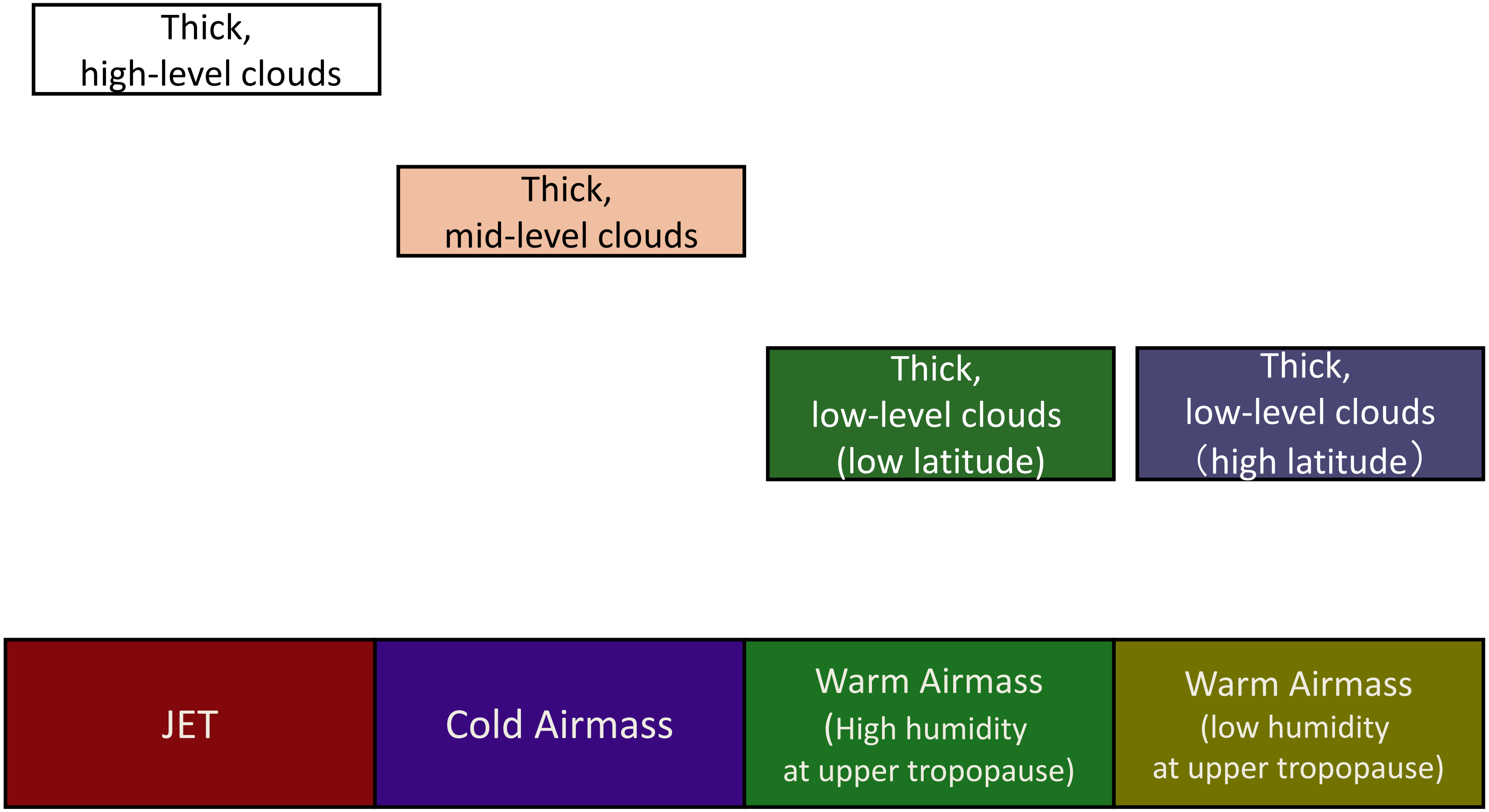
WV6.2(B08)





Himawari-8 Apr. 6 2016 11:55 UTC

Interpretation of Colors for “Airmass”



Thick, high-level clouds

Thick, mid-level clouds

Thick, low-level clouds (low latitude)

Thick, low-level clouds（high latitude）

JET

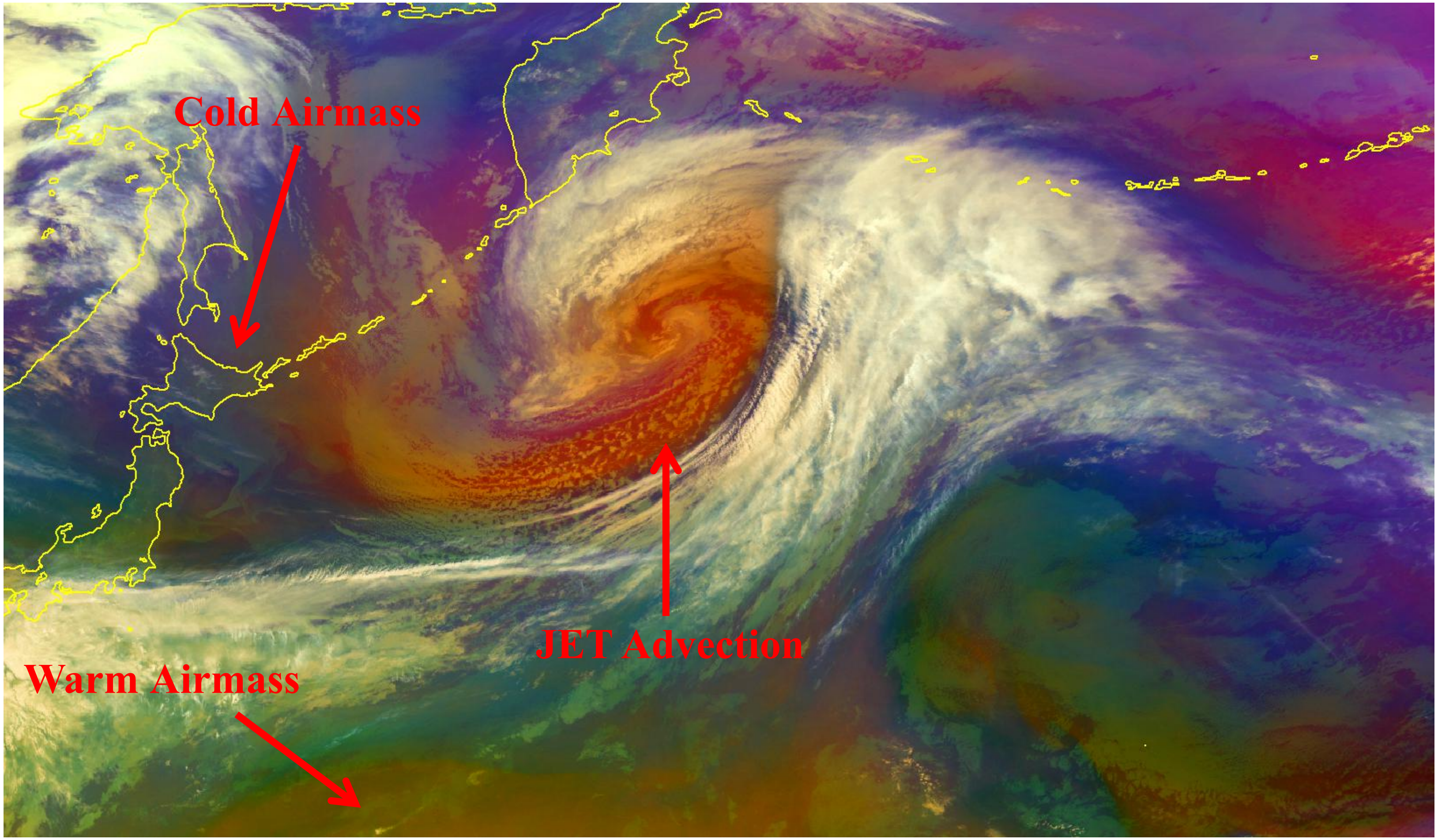
Cold Airmass

Warm Airmass (High humidity at upper tropopause)

Warm Airmass (low humidity at upper tropopause)

Interpretation courtesy EUMETSAT

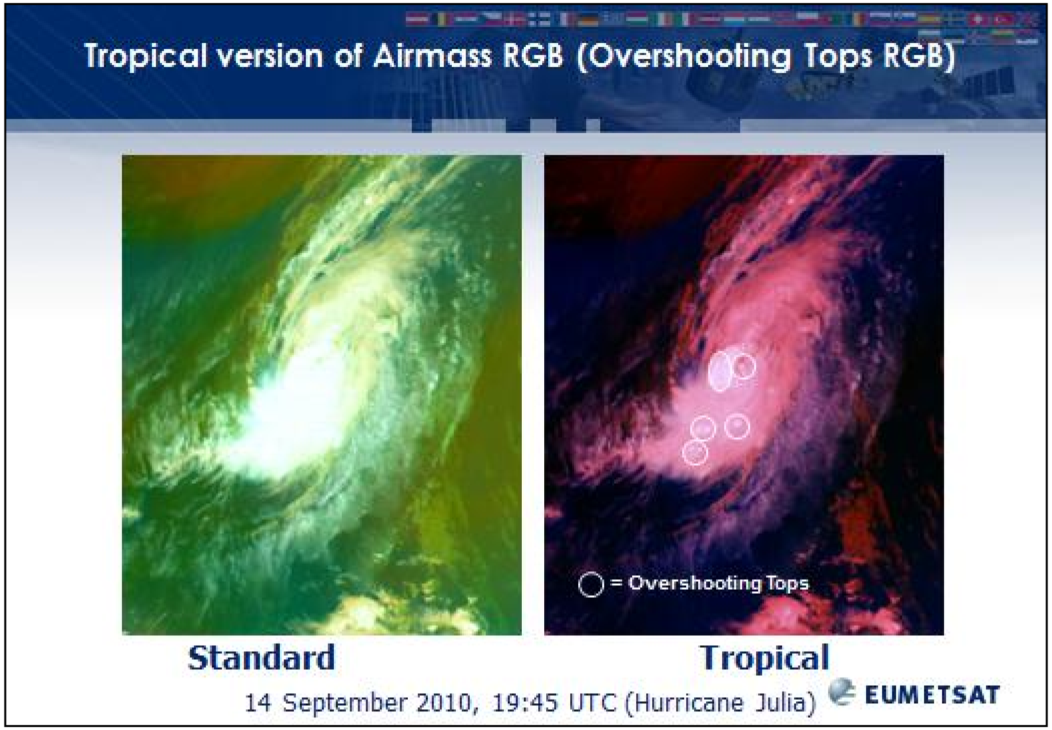
Airmass



Himawari-8 Apr. 10 2017 11:55 UTC

Tropical version of Airmass RGB (Overshooting Tops RGB)

Presentation@RGB Experts and Developers Workshop 2017
"Tropical versions of the Airmass, Night Microphysics and Convection RGBs" by Dr. Kerkmann (EUMETSAT)

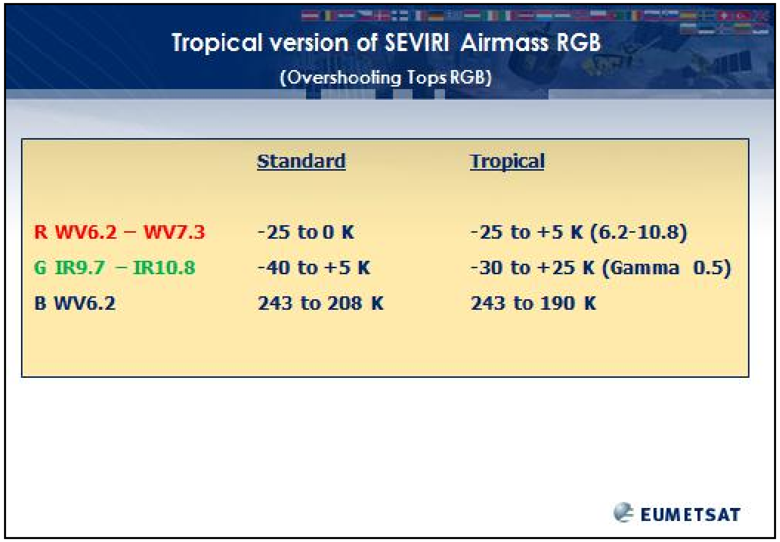


Tropical version of Airmass RGB (Overshooting Tops RGB)

Standard **Tropical**

14 September 2010, 19:45 UTC (Hurricane Julia)

EUMETSAT



Tropical version of SEVIRI Airmass RGB

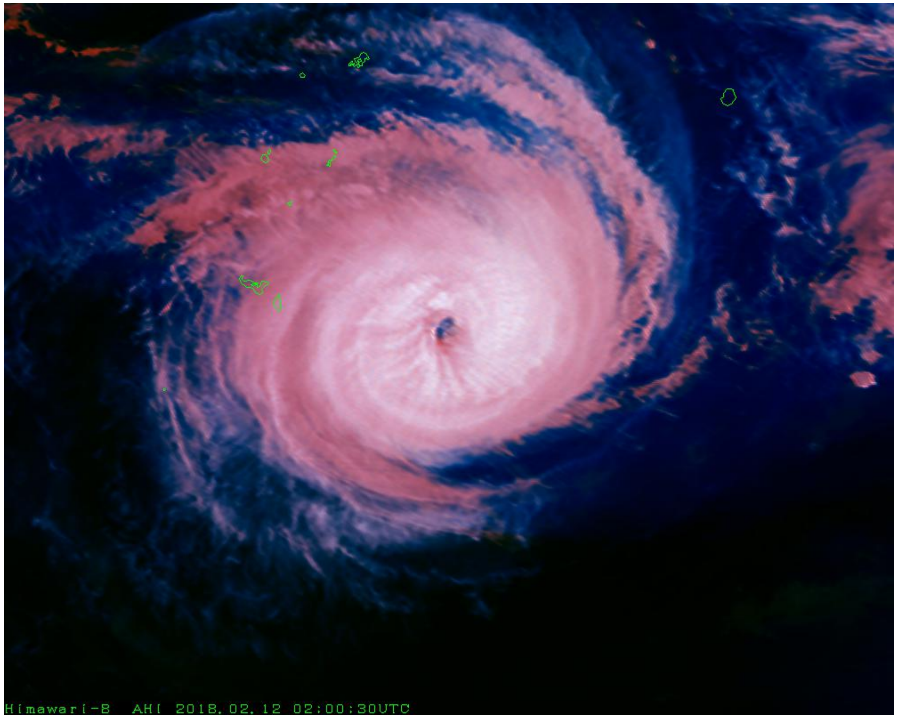
(Overshooting Tops RGB)

	Standard	Tropical
R WV6.2 – WV7.3	-25 to 0 K	-25 to +5 K (6.2-10.8)
G IR9.7 – IR10.8	-40 to +5 K	-30 to +25 K (Gamma 0.5)
B WV6.2	243 to 208 K	243 to 190 K

EUMETSAT

Tropical version of Airmass RGB tuned for Himawari-8

Case study of Cyclone approaching Tonga, February 11, 2018



🟪 High-level ice clouds

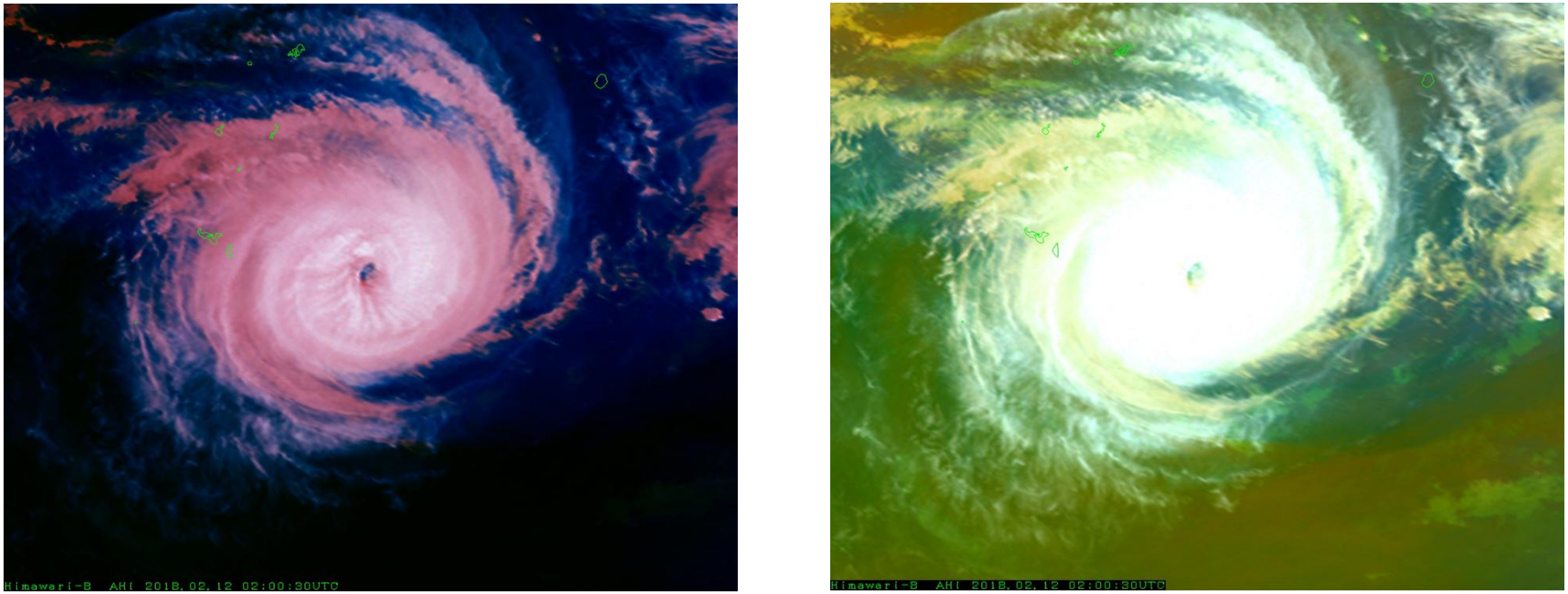
⬜ Very High-level ice clouds (overshooting tops)

🟥 Mid-level clouds

⬛ Ocean/Land, Low

Tropical Airmass RGB **(JMA tropical version tuned using recent tuning method (2017).)**	**Range**	**Gamma**
IR(WV)6.2 – IR10.4 BTD	**-25.8 to 4.7**	**1.0**
IR9.6 –IR10.4 BTD	**-31.2 to 25.5**	**0.5**
IR(WV)6.2 BT	**190.2 to 242.6K**	**1.0**

Comparison of Tropical version vs Normal Airmass RGB



Clearer overshooting tops and very high cloud area

Tropical Airmass RGB **(JMA tropical version tuned using recent tuning method (2017).)**	**Range**	**Gamma**	**Airmass RGB** **(JMA version tuned using recent tuning method (2017).)**	**Range**	**Gamma**
IR(WV)6.2 – IR10.4 BTD	**-25.8 to 4.7**	**1.0**	**IR(WV)6.2 – IR(WV)7.3 BTD**	**-25.8 to 0**	**1.0**
IR9.6 –IR10.4 BTD	**-31.2 to 25.5**	**0.5**	**IR9.6 –IR10.4 BTD**	**-41.5 to 4.3**	**1.0**
IR(WV)6.2 BT	**190.2 to 242.6K**	**1.0**	**IR(WV)6.2 BT**	**208 to 242.6K**	**1.0**

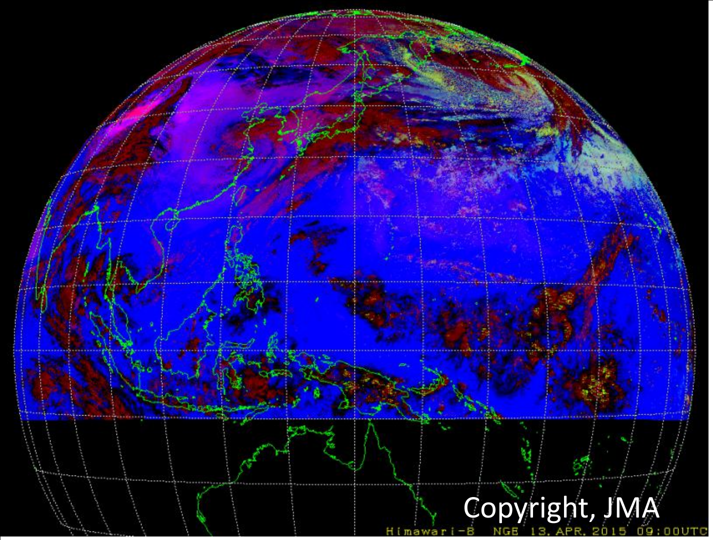
Airmass (summary)

This RGB scheme is…

- available for air mass analysis
- available for jet stream analysis
- available day and night
- available for detection of overshooting tops of cumulonimbus and very high cloud area by threshold adjustment of parameters

4. RGB Imageries

- Introduction to RGB Imagery
- Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB



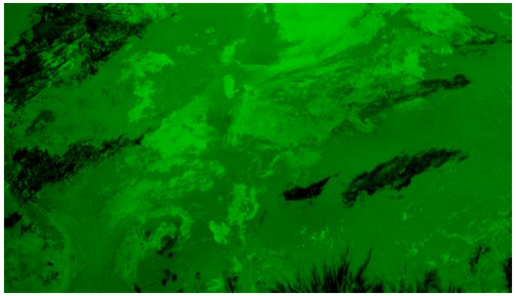
Night Microphysics RGB
Nephanalysis in night time

Meteorological Satellite Center, JMA

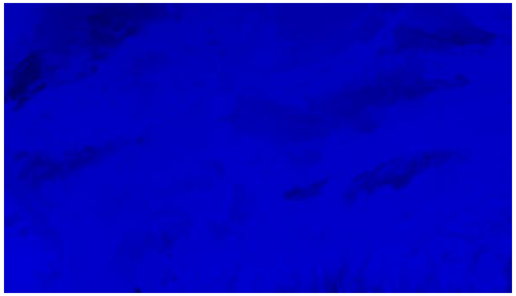
What’s Night Microphysics RGB?

2015-02-16 10UTC

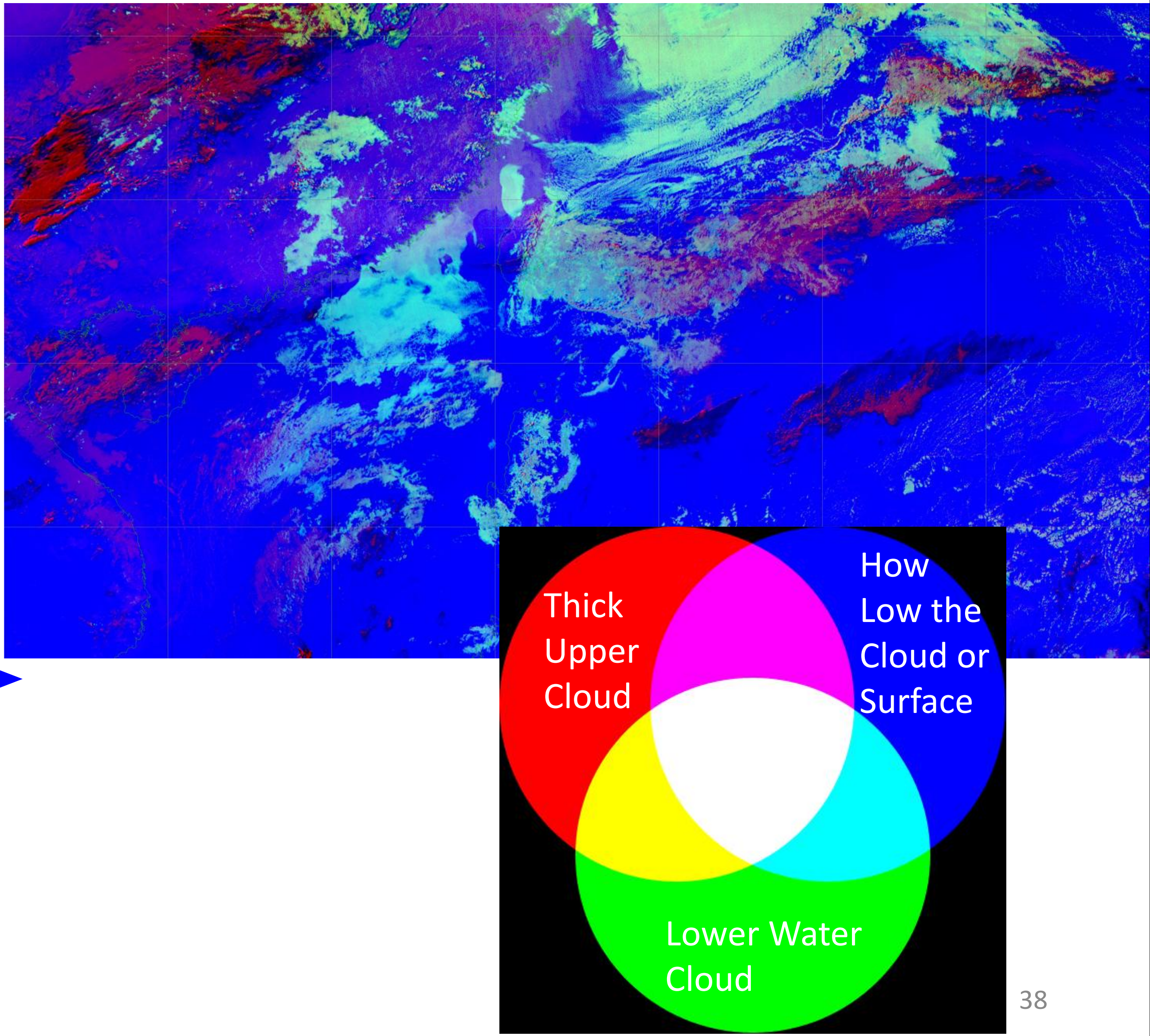
R : B15(I2 12.3)-B13(IR 10.4)
Range : -4～2 [K]   Gamma : 1.0



G : B13(IR 10.4)-B07(I4 3.9)
Range : 0～10 [K]   Gamma : 1.0



B : B13(IR 10.4)（Reverse）
Range : 243～293 [K]   Gamma : 1.0



Interpretation of Colors for "Night Microphysics"

Cold, thick, high-level cloud

Very cold (< -50° C), thick, high-level cloud

Thin Cirrus cloud

Thick, mid-level cloud

Thin, mid-level cloud

Low-level cloud
(high latitudes)

Low-level cloud
(low latitudes)

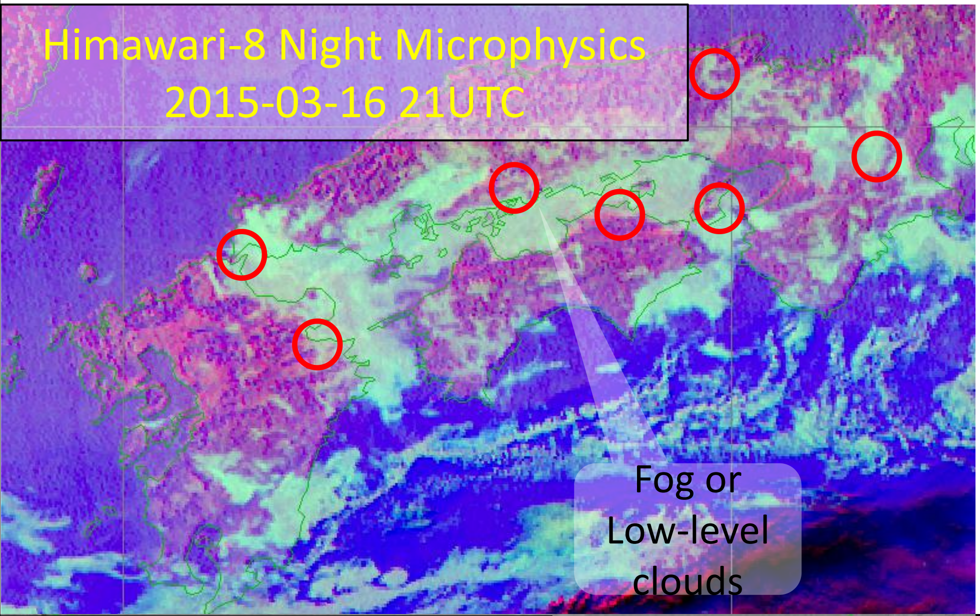
Ocean

Land

Note: Based on SEVIRI/EUMETSAT interpretation

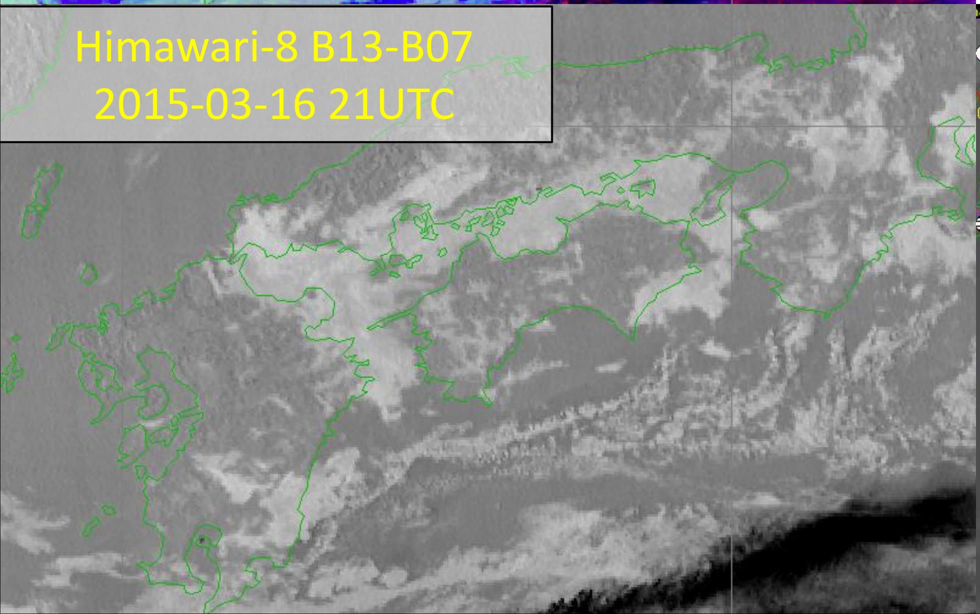
Example of Night Microphysics RGB

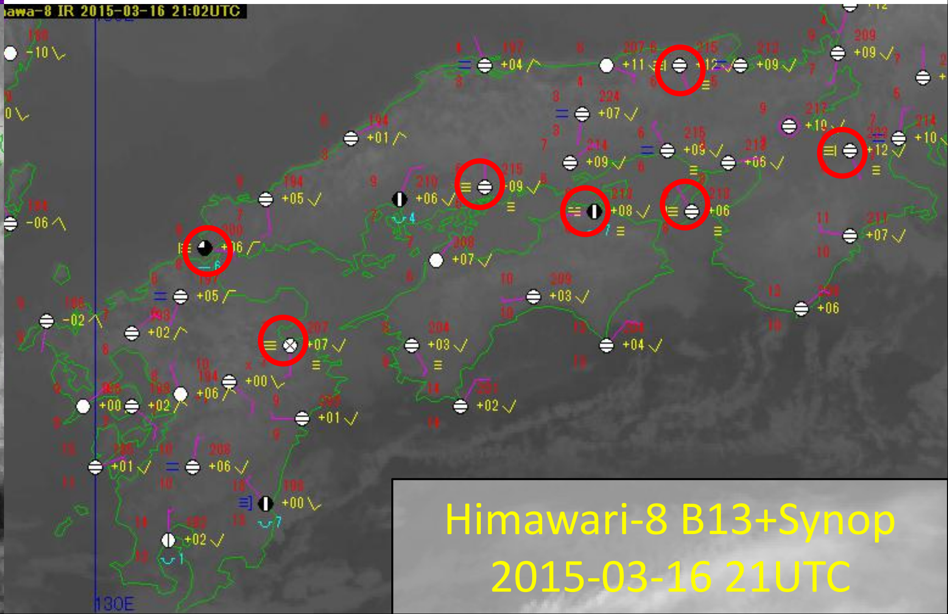
Fog/Low-level Clouds of “Setonai-kai (Inland Sea of Japan)”


Himawari-8 Night Microphysics
2015-03-16 21UTC

(Lower right) Fog/ low-level clouds were observed at some stations (around red oval). However, fog/ low-level clouds are not clear in the IR image.

(Upper and lower left) Smooth, greenish white areas in Night Microphysics RGB correspond to whitish fog/ low-level clouds in B13-B07 differential image.


Himawari-8 B13-B07
2015-03-16 21UTC

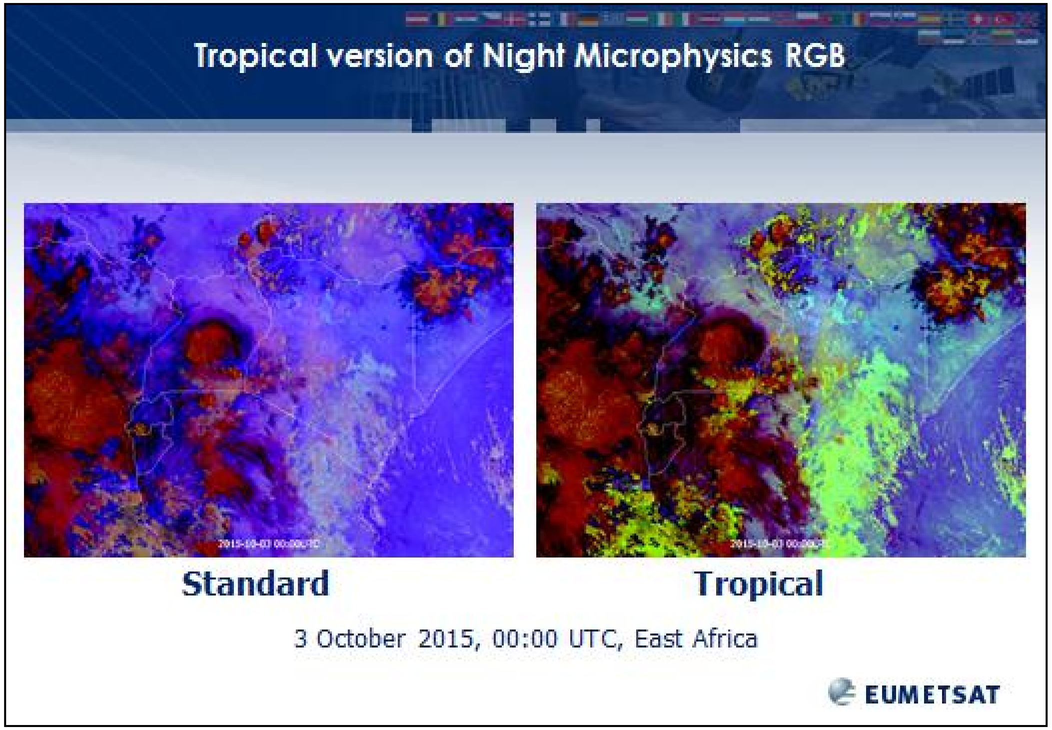


Himawari-8 B13+Synop
2015-03-16 21UTC

Tropical version of Night Microphysics RGB

Presentation@RGB Experts and Developers Workshop 2017

"Tropical versions of the Airmass, Night Microphysics and Convection RGBs" by Dr. Kerkmann (EUMETSAT)

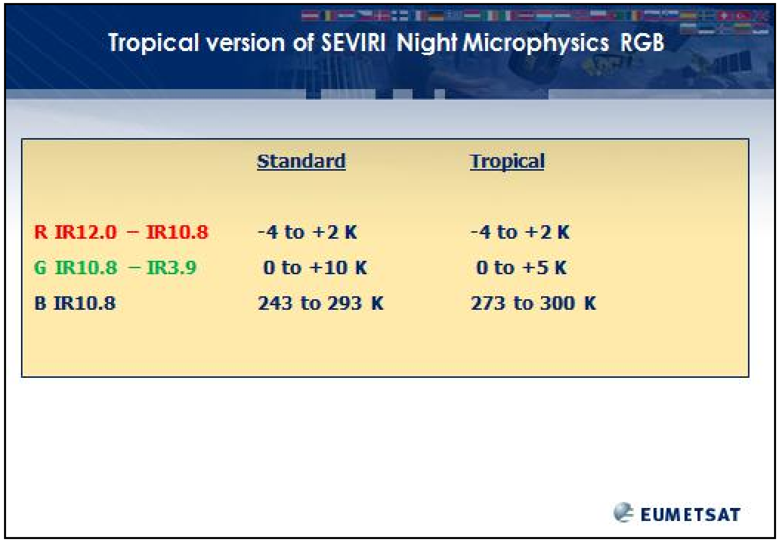


Tropical version of Night Microphysics RGB

Standard **Tropical**

3 October 2015, 00:00 UTC, East Africa

EUMETSAT

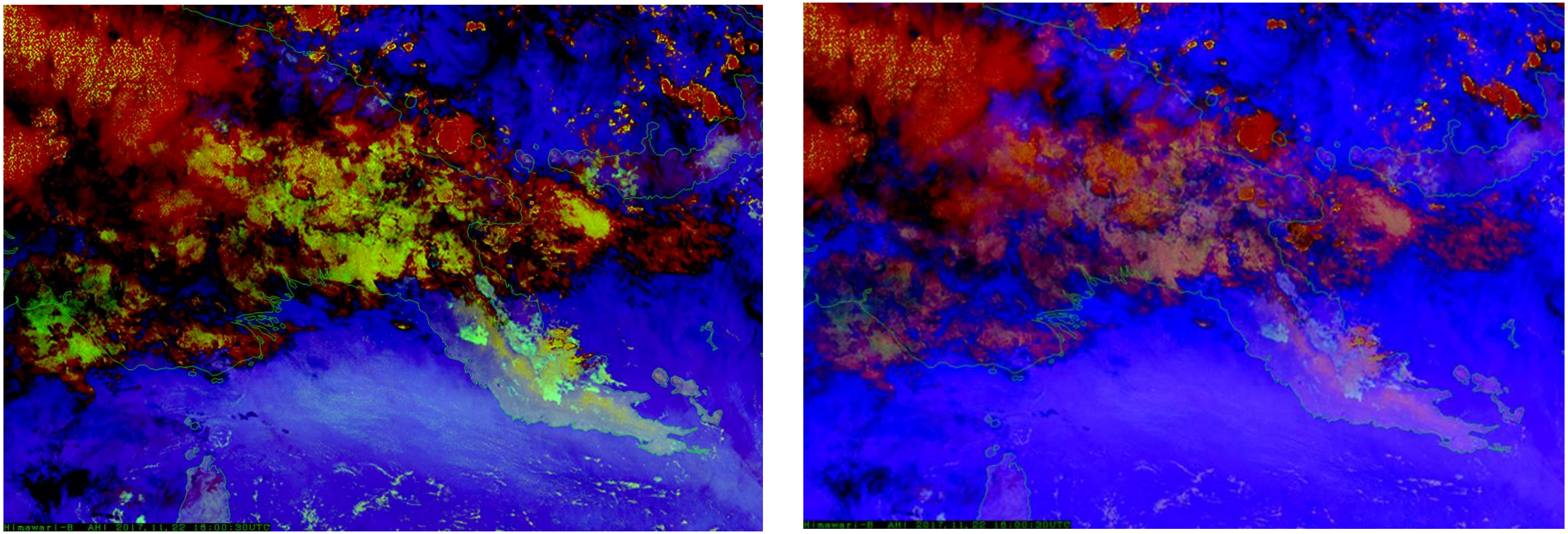


Tropical version of SEVIRI Night Microphysics RGB

	Standard	Tropical
R IR12.0 – IR10.8	-4 to +2 K	-4 to +2 K
G IR10.8 – IR3.9	0 to +10 K	0 to +5 K
B IR10.8	243 to 293 K	273 to 300 K

EUMETSAT

Comparison of Tropical version vs Normal Night Microphysics RGB



Better contrast for fog/ low cloud !

Tropical Night Microphysics RGB (JMA tropical version tuned using recent tuning method (2017).)	**Range**	**Gamma**	**Night Microphysics RGB** (JMA version tuned using recent tuning method (2017).)	**Range**	**Gamma**
IR12.4 – IR10.4 BTD	**-7.5 to 3.0**	**1.0**	**IR12.4 – IR10.4 BTD**	**-7.5 to 3.0**	**1.0**
IR10.4 – IR3.9 BTD	**-2.9 to 2.2**	**1.3**	**IR10.4 – IR3.9 BTD**	**-2.9 to 7.0**	**1.0**
IR10.4 BT	**273.3 to 300.1K**	**1.0**	**IR10.4 BT**	**243.7 to 293.2K**	**1.0**

Night Microphysics RGB Summary

This RGB scheme is …

- effective for low cloud detection in night time (especially St/Fog)
- effective for distinction of thick Cb and low level cloud (Fog/St) in night time

4. RGB Imageries

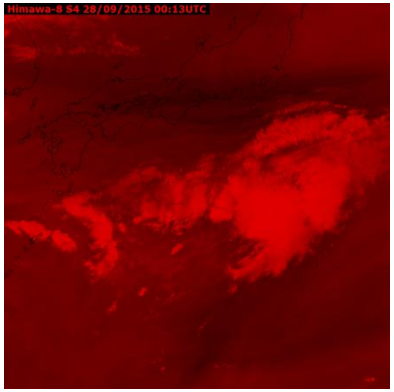
- Introduction to RGB Imagery
- Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB

Day Convective Storm RGB
Detection of Cumulonimbus Cloud

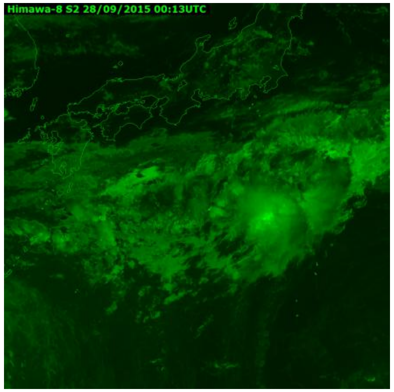
Meteorological Satellite Center, JMA

What’s Day Convective Storm RGB?

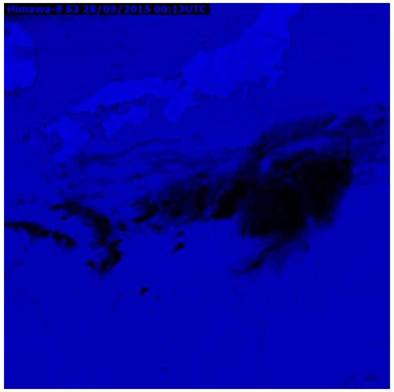
R :
B08(WV6.2) – B10(W3 7.3)
Range : -35～5 [K]
Gamma : 1.0

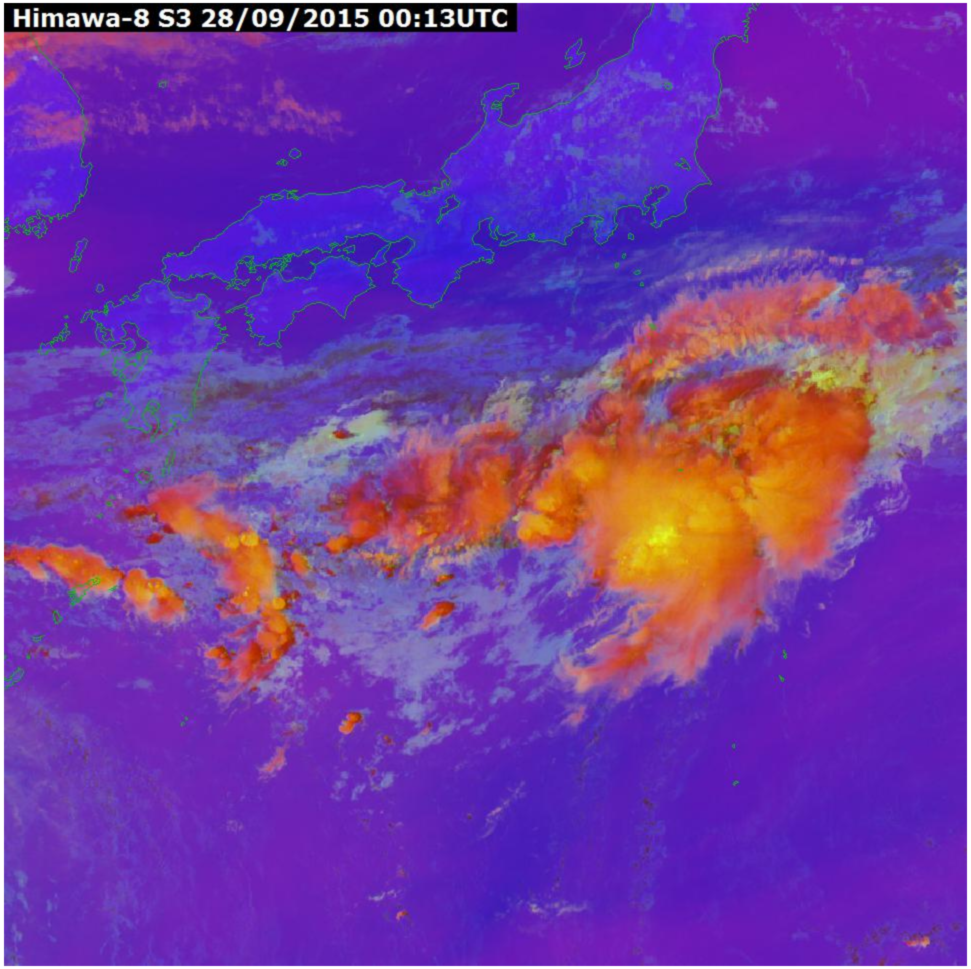


G :
B07(I4 3.9)-B13 (IR10.4)
Range : -5～60 [K]
Gamma : 0.5

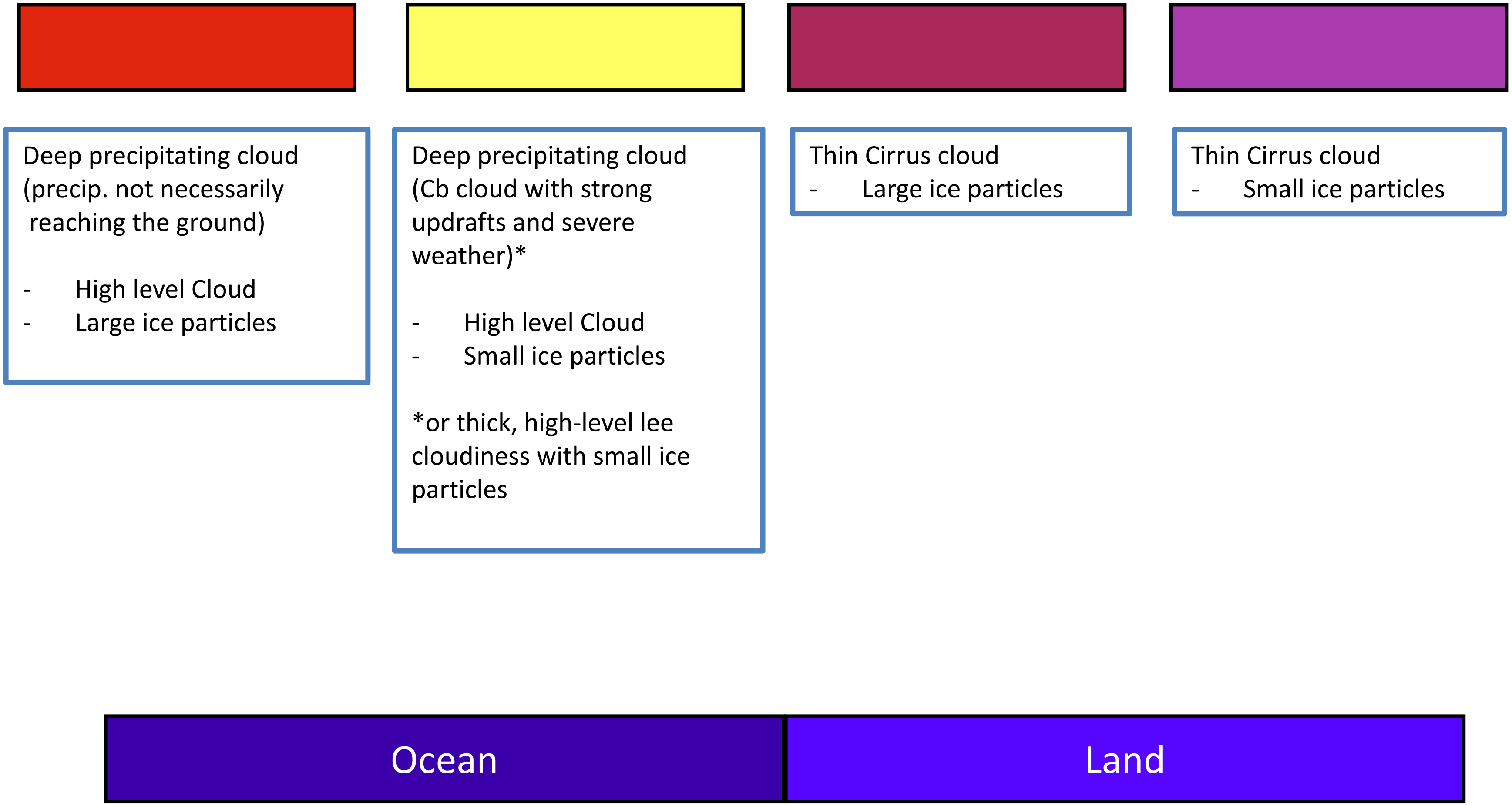


B :
B05(NIR1.6)-B03(VIS0.6)
Range : -75～25 [%]
Gamma : 1.0





Interpretation of Colors for “Day Convective Storms”

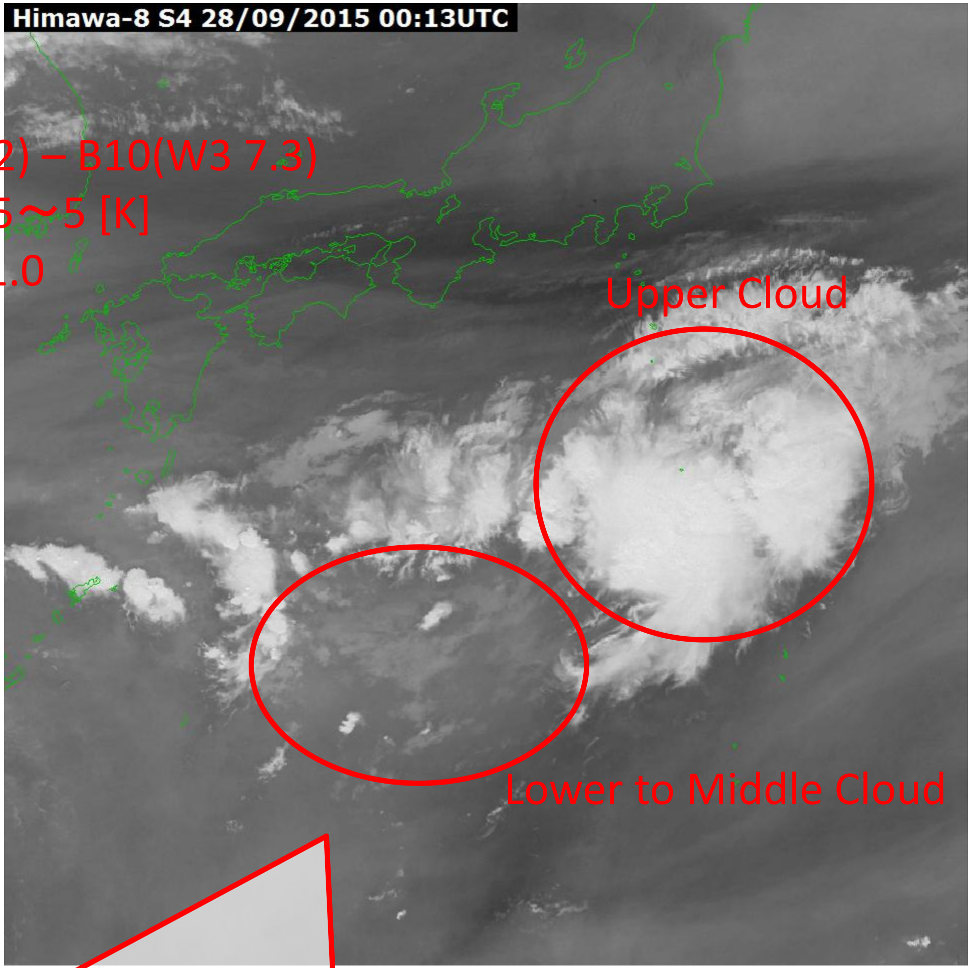


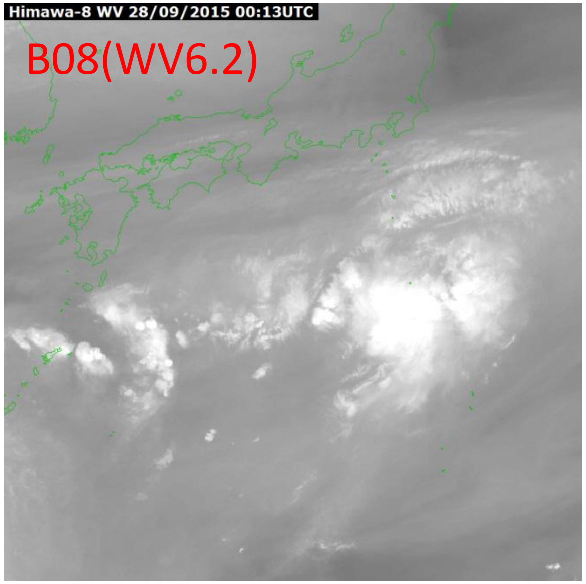
🟥	🟨	🟥	🟪
Deep precipitating cloud (precip. not necessarily reaching the ground) - High level Cloud - Large ice particles	Deep precipitating cloud (Cb cloud with strong updrafts and severe weather)* - High level Cloud - Small ice particles *or thick, high-level lee cloudiness with small ice particles	Thin Cirrus cloud - Large ice particles	Thin Cirrus cloud - Small ice particles

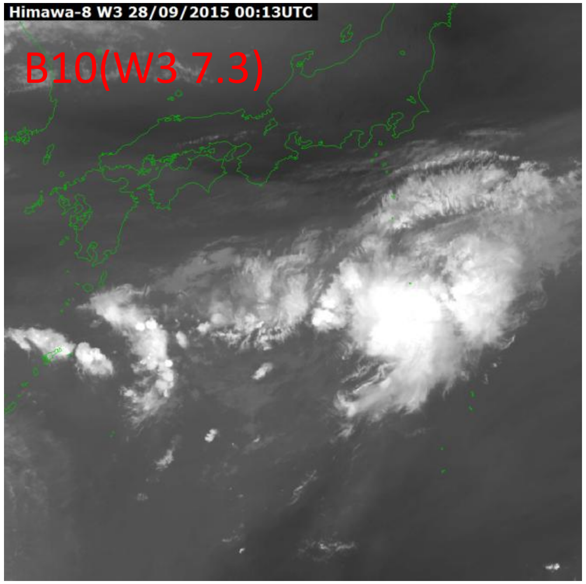
Note: Based on SEVIRI/EUMETSAT interpretation

Red Beam (for thick upper cloud detection)

R :
B08(WV6.2) – B10(W3 7.3)
Range : -35～5 [K]
Gamma : 1.0





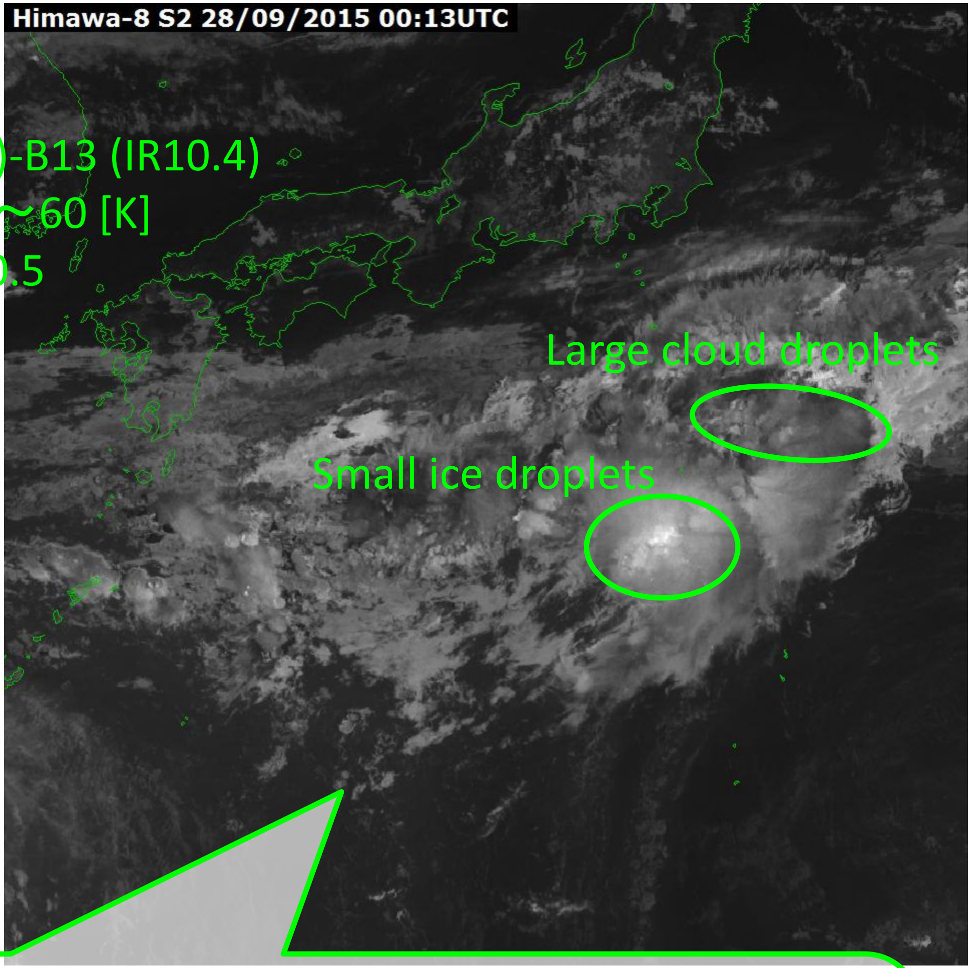


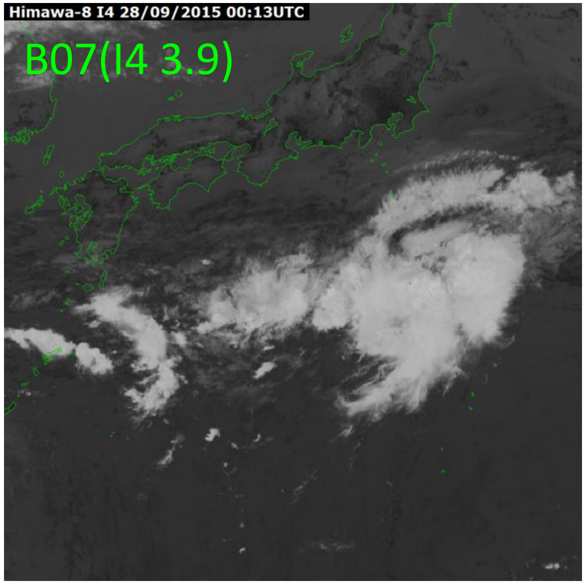
Important features:

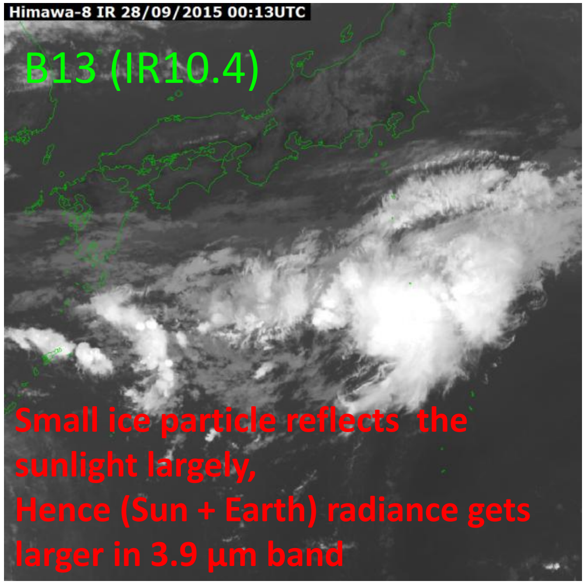
- ***(Thick) upper cloud → smaller difference (bright)***
- ***(Thick) lower cloud → larger difference (dark)***

Green Beam (for small droplets cloud detection)

G :
B07(I4 3.9)-B13 (IR10.4)
Range : -5～60 [K]
Gamma : 0.5







Small ice particle reflects the sunlight largely,
Hence (Sun + Earth) radiance gets larger in 3.9 μm band

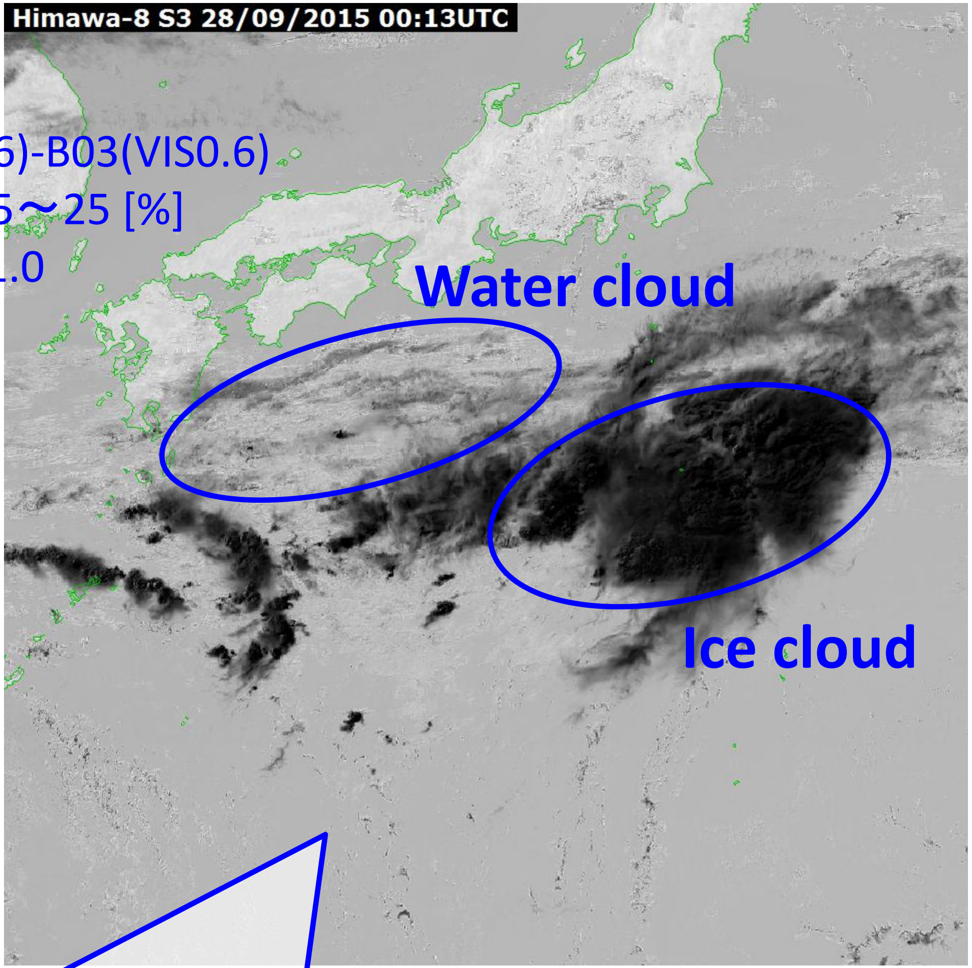
Important features:

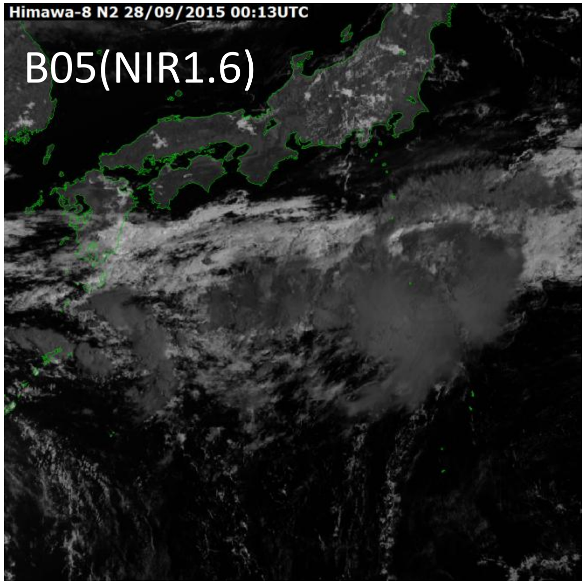
Small cloud droplets (with ice phase)
→ large difference (bright)

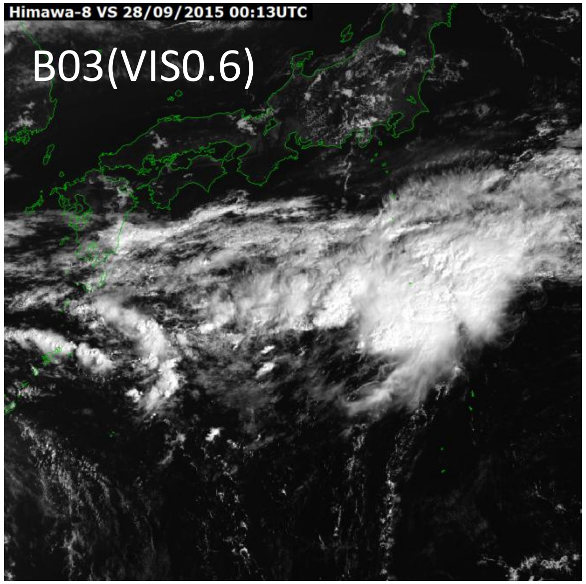
Large cloud droplets with ice phase
→ smaller difference (dark)

Blue Beam (for ice cloud detection)

B :
B05(NIR1.6)-B03(VIS0.6)
Range : -75～25 [%]
Gamma : 1.0





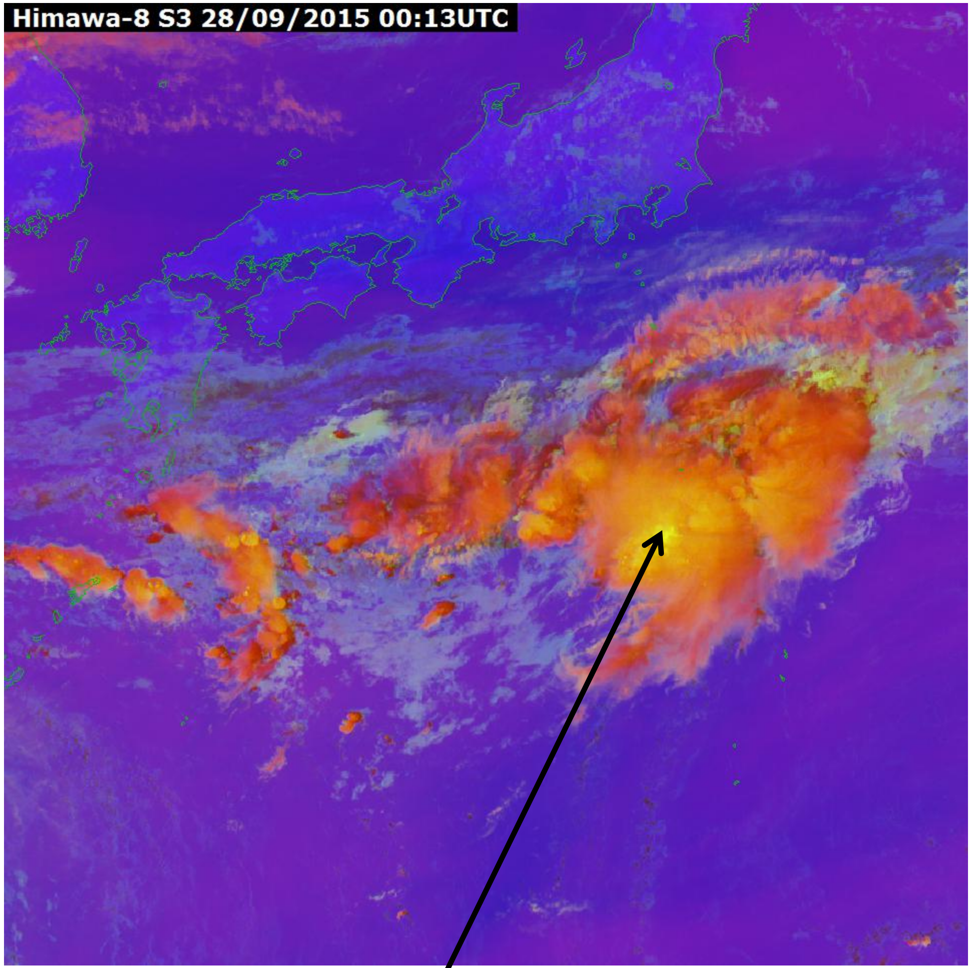


Important features:

Water Cloud → smaller difference (bright)

Ice Cloud → large (negative) difference (dark)

RGB composite

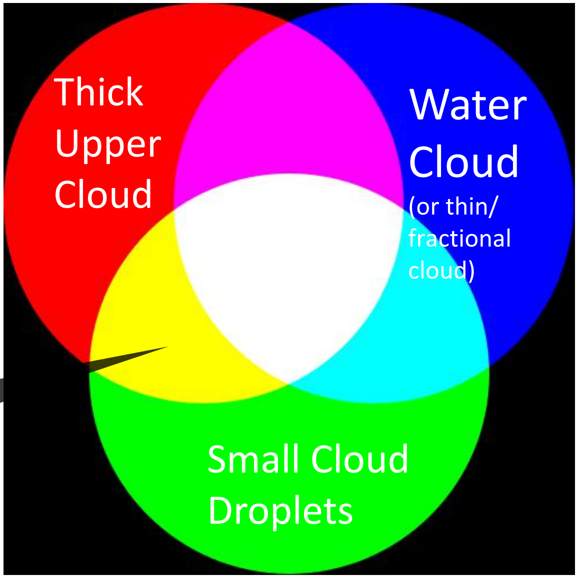


🟥 Deep precipitating cloud

🟥 Thin Cirrus cloud (Large ice particles)

🟪 Thin Cirrus cloud (Small ice particles)

Each beam represents..

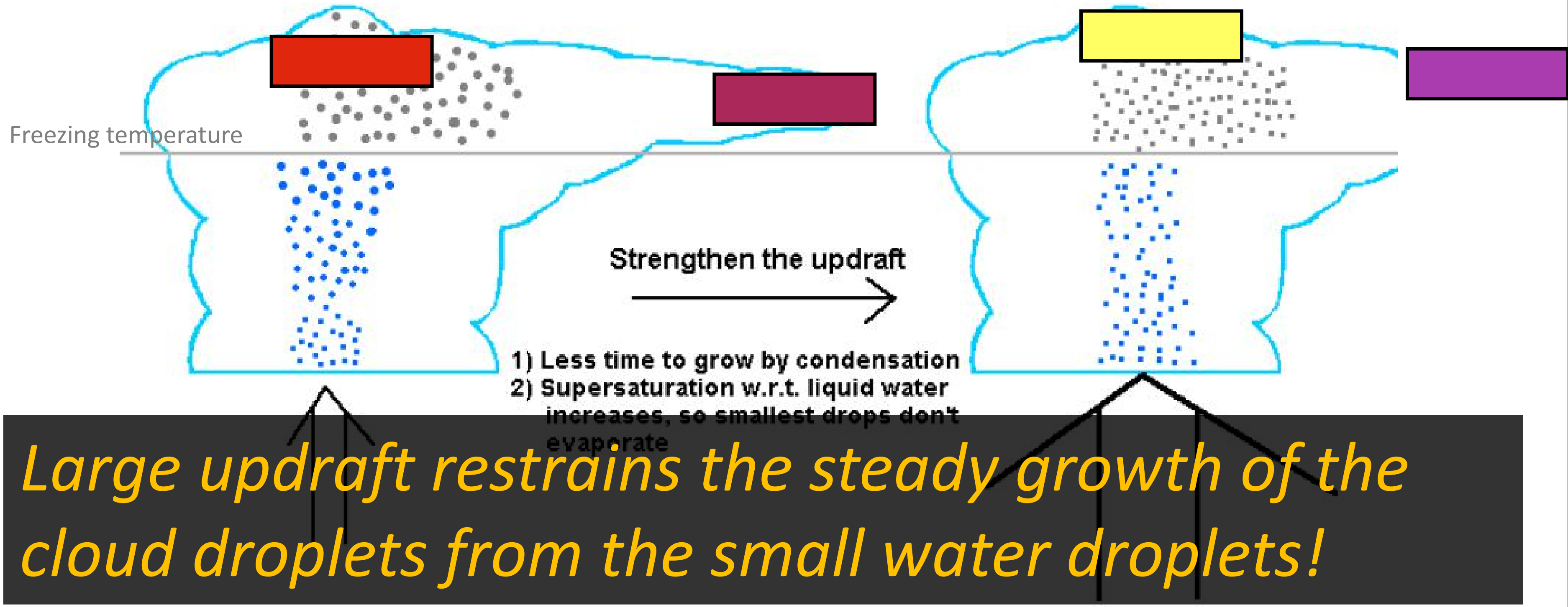


Cb cloud with strong updrafts and severe weather

***Thick, high, small droplets and ice* cloud is shown as yellow!**

Australian Government
Bureau of Meteorology

Why the cloud of “*thick, high, small droplets, ice*“ corresponds to convective storm?



Large updraft restrains the steady growth of the cloud droplets from the small water droplets!

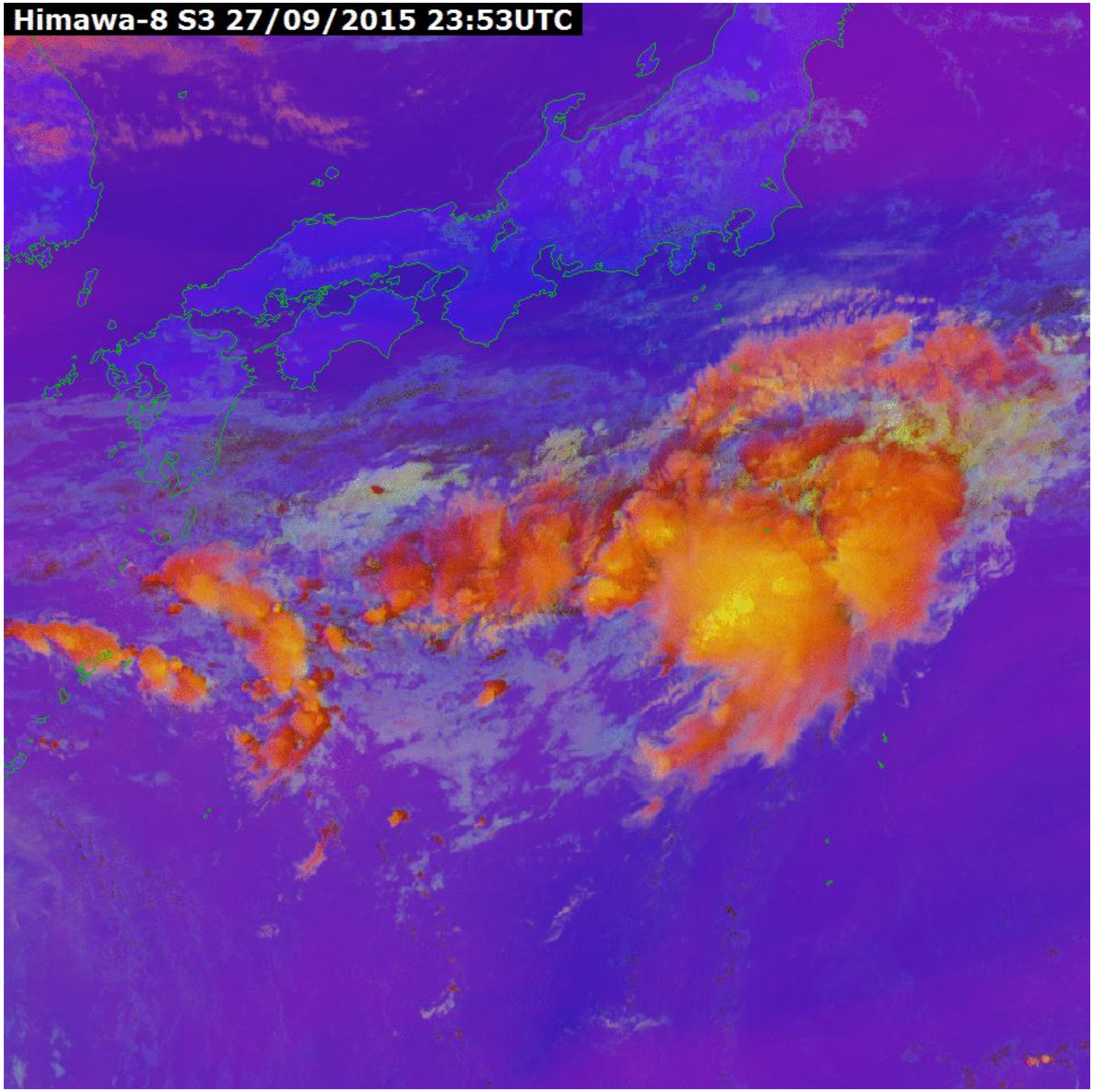
Ocean | **Land**

Combining beams

- 🟨 Yellow is made by mixing red and green
- 🟪 Magenta is made by mixing red and blue
- 🟦 Cyan is made by mixing green and blue

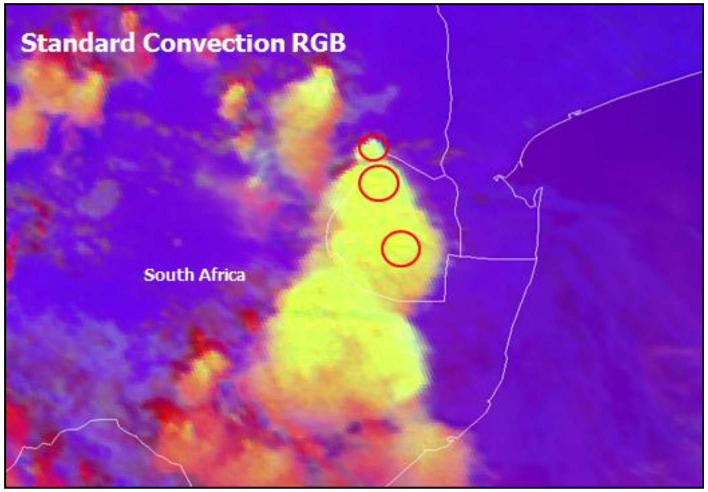
image from "Understanding Convective Clouds through the eyes of MSG", J. Kerkmann EUMETSAT

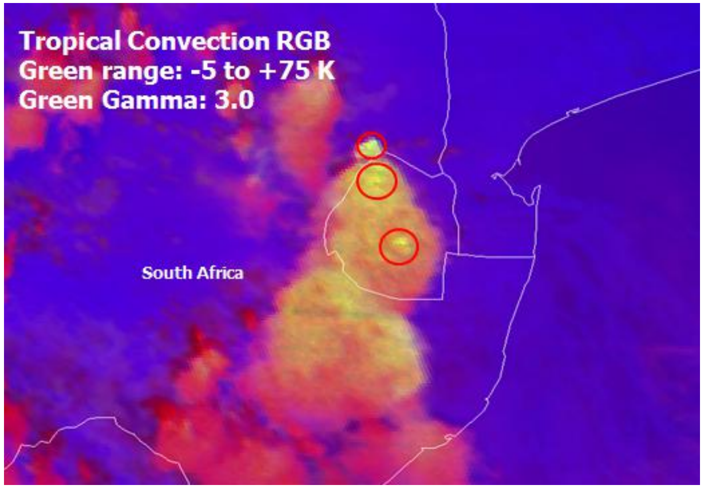
(animation)

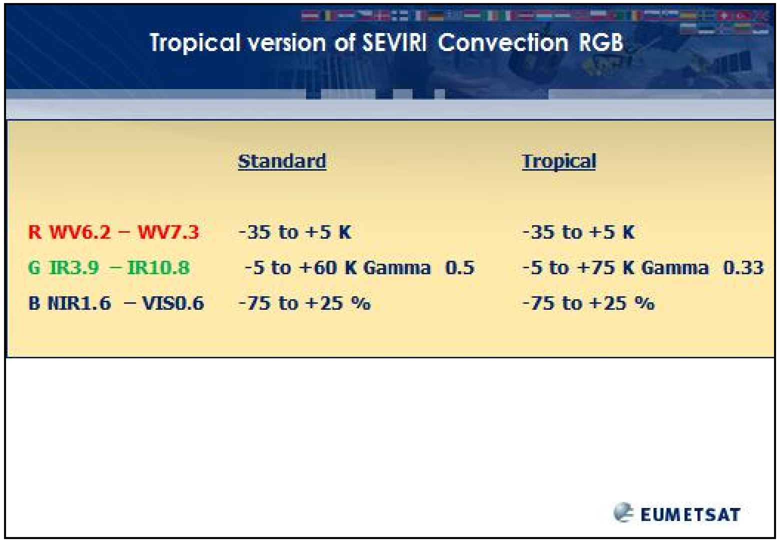


Tropical version of Day Convective Storms RGB (Convection RGB)

Presentation@RGB Experts and Developers Workshop 2017
"Tropical versions of the Airmass, Night Microphysics and Convection RGBs" by Dr. Kerkmann (EUMETSAT)





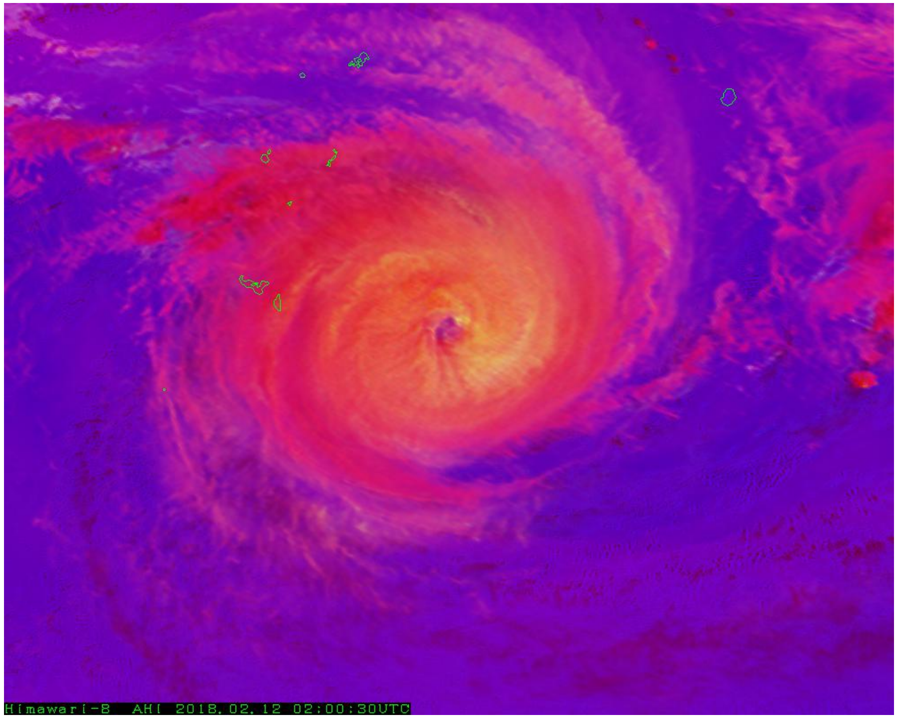


Tropical version of SEVIRI Convection RGB

	Standard	Tropical
R WV6.2 – WV7.3	-35 to +5 K	-35 to +5 K
G IR3.9 – IR10.8	-5 to +60 K Gamma 0.5	-5 to +75 K Gamma 0.33
B NIR1.6 – VIS0.6	-75 to +25 %	-75 to +25 %

Tropical version of Day Convective Storms RGB tuned for Himawari-8

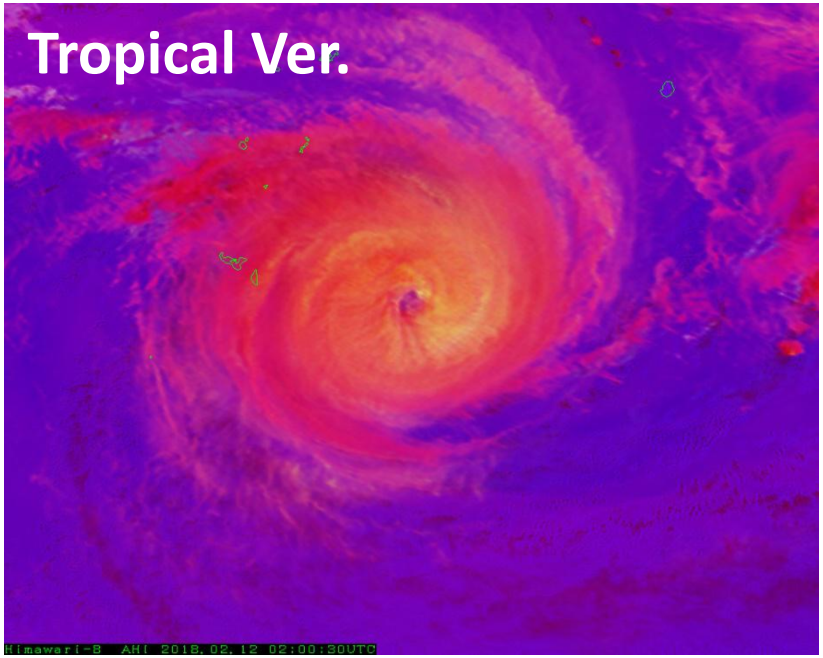
Case study of Cyclone approaching Tonga, February 11, 2018

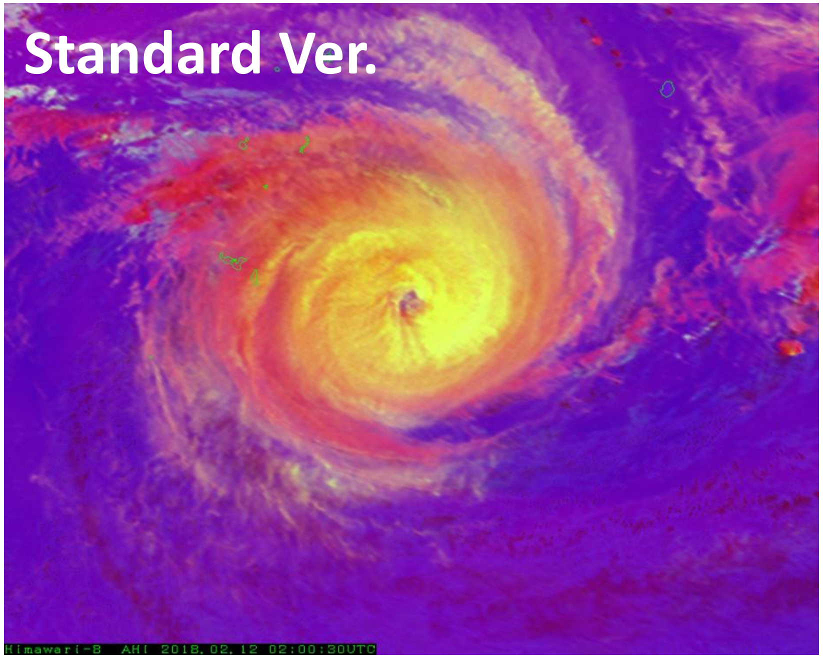


🟥	Deep precipitating cloud with large ice particles
🟨	Deep precipitating cloud with small ice particles
🟥	Thin cirrus clouds with large ice particles
🟪	Thin cirrus clouds with small ice particles
🟦	Ocean
🟪	Land

Tropical Day Convective Storms RGB (JMA tropical version tuned using recent tuning method (2017).)	**Range**	**Gamma**
IR(WV)6.2 – IR(WV)7.3 BTD	**-36 to 5**	**1.0**
IR3.9 –IR10.4 BTD	**-1 to 76**	**0.33**
NIR1.6-VS0.64 REFL	**-80 to 25%**	**0.95**

Comparison of Tropical version vs Normal Day Convective Storms RGB





Appearance of saturated yellowish areas seems to be improved.

Tropical Day Convective Storms RGB (JMA tropical version tuned using recent tuning method (2017).)	**Range**	**Gamma**	**Day Convective Storms RGB** (JMA version tuned using recent tuning method (2017).)	**Range**	**Gamma**
IR(WV)6.2 – IR(WV)7.3 BTD	**-36 to 5**	**1.0**	**IR(WV)6.2 – IR(WV)7.3 BTD**	**-36 to 5**	**1.0**
IR3.9 –IR10.4 BTD	**-1 to 76**	**0.33**	**IR3.9 –IR10.4 BTD**	**-1 to 61**	**0.5**
NIR1.6-VS0.64 REFL	**-80 to 25%**	**0.95**	**NIR1.6-VS0.64 REFL**	**-80 to 25%**	**0.95**

Day Convective Storm RGB
Detection of Cumulonimbus Cloud

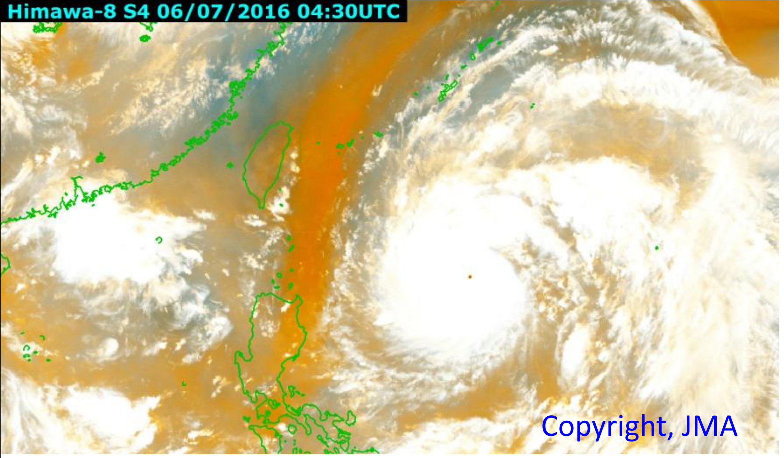
- ✓ Useful to enhance deep convective clouds which have a potential to cause severe phenomena (gust, tornado etc.)

- ✓ Especially useful for identifying Cb with strong updraft

- ✓ Daytime only

4. RGB Imageries

- Introduction to RGB Imagery
- Himawari-8 RGB Imageries
  - ✓ Natural Color RGB
  - ✓ Airmass RGB
  - ✓ Night Microphysics RGB
  - ✓ Day Convective Storms RGB
  - ✓ Differential Water Vapor RGB



Differential Water Vapor RGB

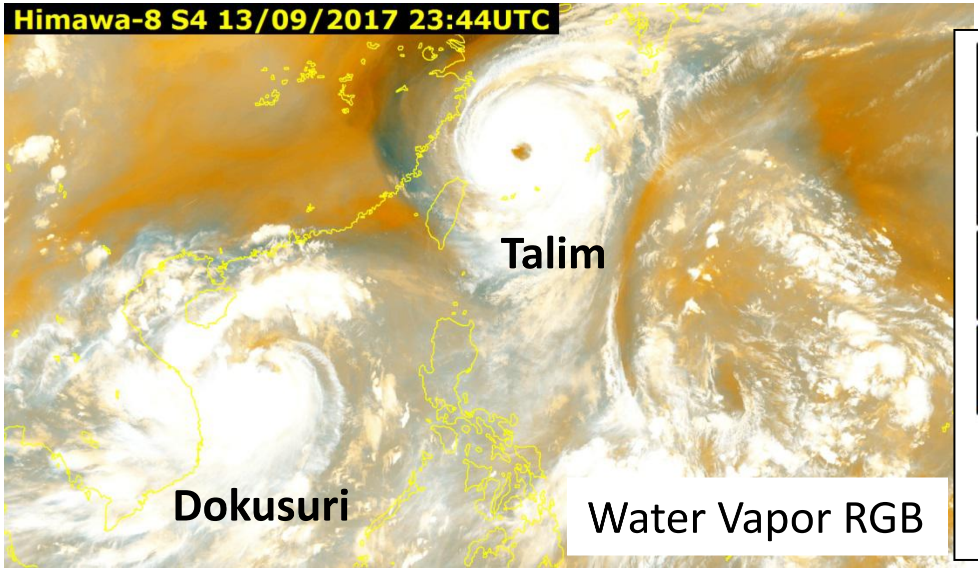
Detection of the water vapor distribution

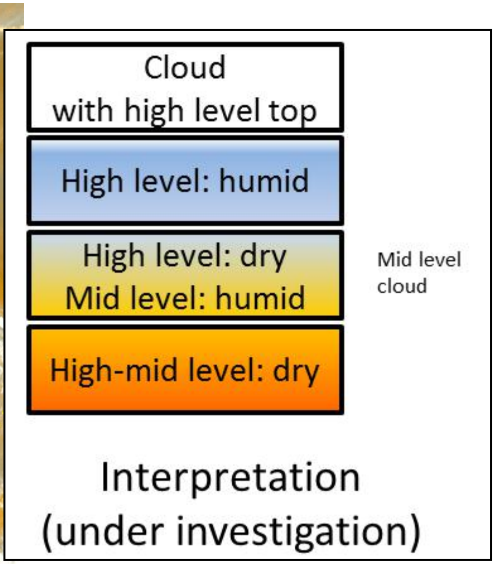
Meteorological Satellite Center, JMA

Differential Water Vapor RGB

- Colorized WV image is useful to grasp the water vapor distribution of upper level. Each WV image is difficult to derive lower level water vapor information.
- Water Vapor RGB has information of lower level water vapor distribution (e.g. different moisture profile).
- JMA employs this RGB image to interpret the environmental condition of typhoon which usually brings negative impact to the development of typhoon.

Ex. Water Vapor RGB product for typhoon monitoring




Cloud with high level top

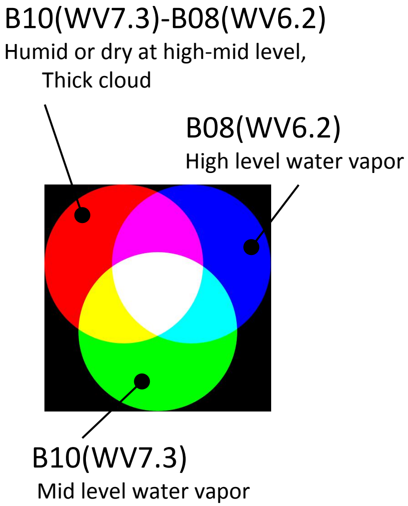
High level: humid

High level: dry
Mid level: humid

High-mid level: dry

Mid level cloud

Interpretation
(under investigation)


B10(WV7.3)-B08(WV6.2)
Humid or dry at high-mid level, Thick cloud

B08(WV6.2)
High level water vapor

B10(WV7.3)
Mid level water vapor

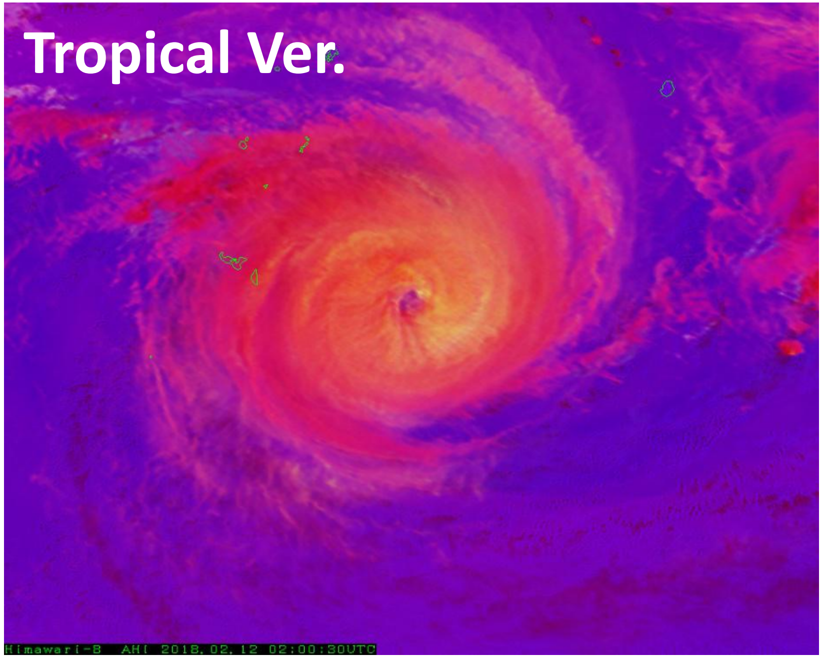
23:44UTC September 13, 2017 Typhoon Talim (1718) and Typhoon Dokusuri (1719)

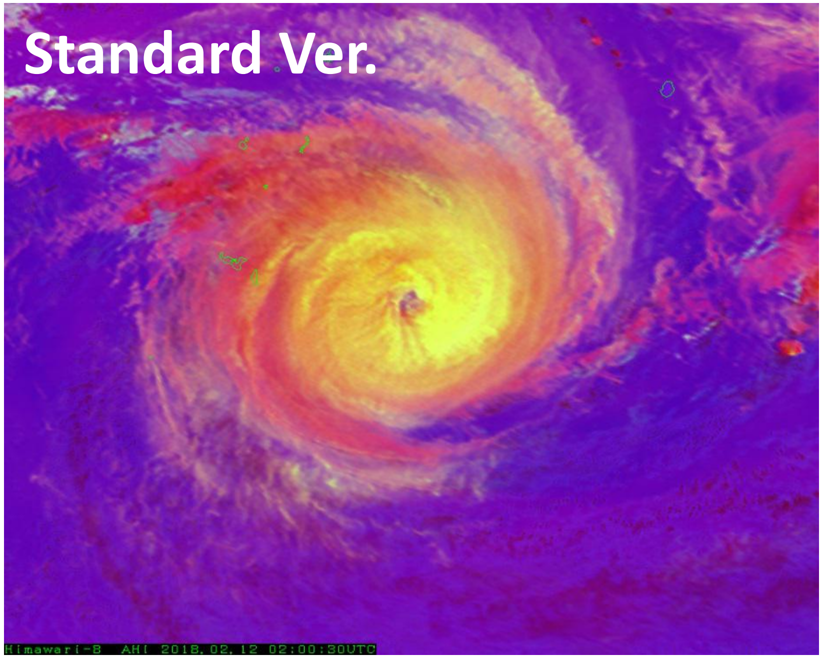
Advantages of RGB

- Advantages
  - Simple process by composition of images enable to create RGB composite imagery.
  - Various information is derivable by an RGB composite imagery.
  - RGB composite imageries are helpful to look for early indications of tropical cyclogenesis or improved organization.
- Drawback
  - A color doesn’t always represent to single phenomenon.
    - Distinction by moving images, etc. is required according to the situation. Skill of image analysis is required.

Comparison of Tropical version vs Normal Day Convective Storms RGB

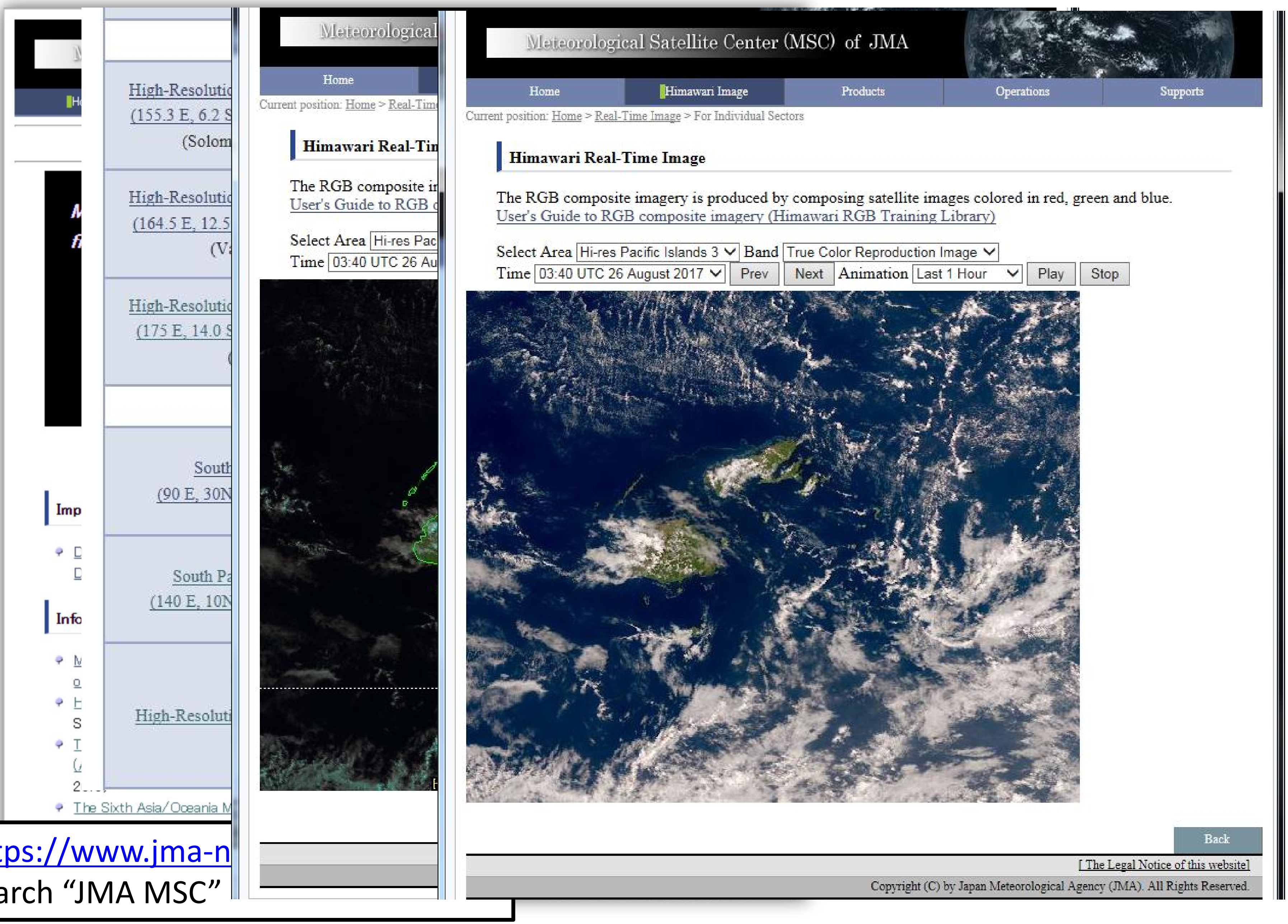
Reshown slide





For example, in case of tropical cyclone, deep convective cloud with strong updrafts is difficult to distinguish unless color adjustment is carried out.

Real-time RGB images on JMA/MSC website



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: Hi-res Pacific Islands 3 Band: True Color Reproduction Image
Time: 03:40 UTC 26 August 2017 Animation: Last 1 Hour

https://www.jma-n
search “JMA MSC”

References

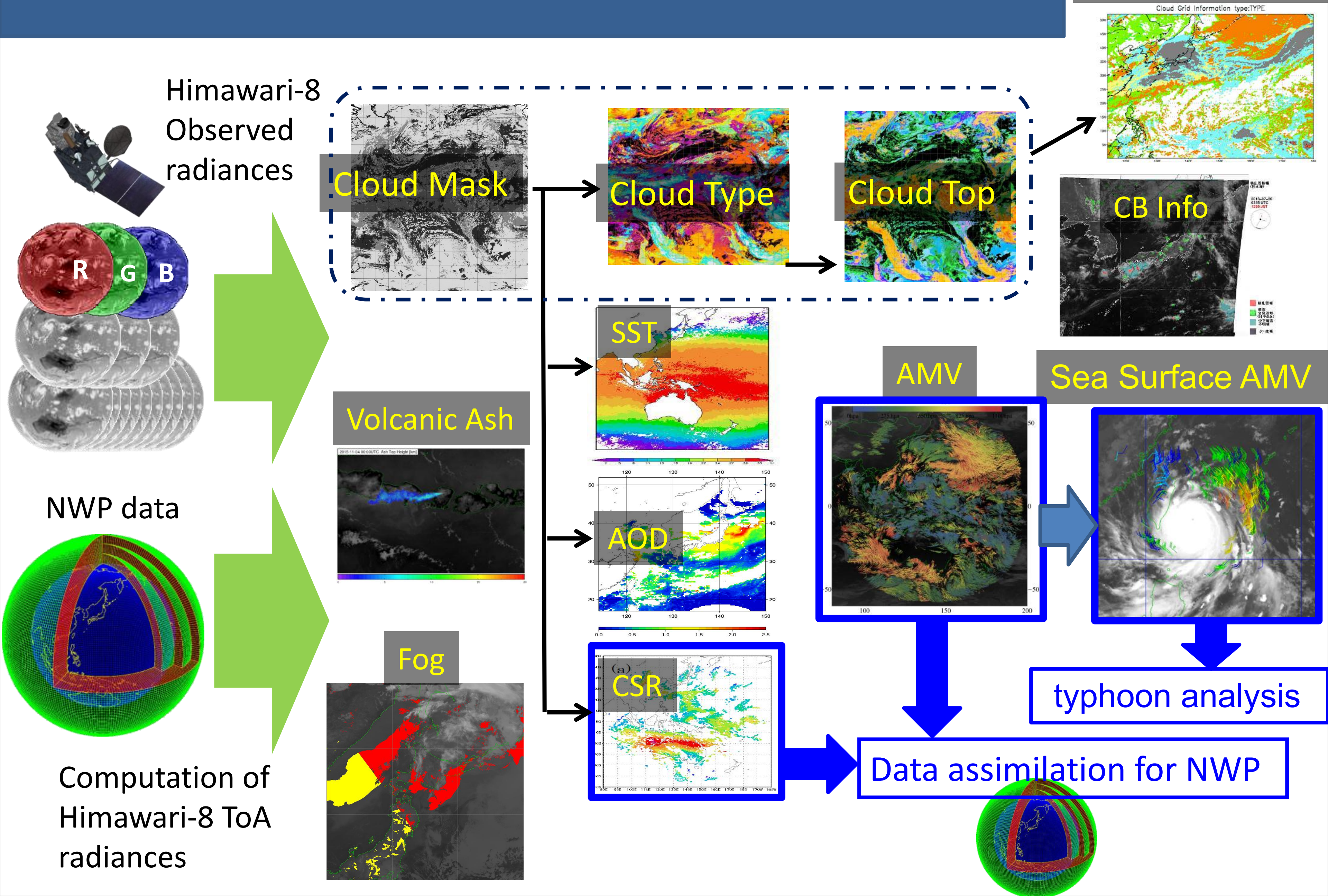
WMO RGB Experts and Developers Workshop 2017

- "Tropical versions of the Airmass, Night Microphysics and Convection RGBs", J. Kerkmann (EUMETSAT)
  http://www.wmo.int/pages/prog/sat/meetings/documents/RGB-WS-2017_Doc_01b_Kerkmann-tropical-rgbs.pdf
- "Adjusting SEVIRI RGB recipes for AHI", H. Murata and A. Shimizu (JMA)
  http://www.wmo.int/pages/prog/sat/meetings/documents/RGB-WS-2017_Doc_01a_Adjusting-SEVIRI-RGB-recipes-for-AHI-share.pdf

Next to
Usage of Himawari-8 and -9 Products for typhoon

Contents

Himawari-8 Geophysical Products



Himawari-8 Observed radiances

R

G

B

NWP data

Computation of Himawari-8 ToA radiances

Cloud Mask

Cloud Type

Cloud Top

Gridded Cloud Info

CB Info

SST

AOD

CSR

Volcanic Ash

Fog

AMV

Sea Surface AMV

typhoon analysis

Data assimilation for NWP

Objective using Himawari-8 and -9 products

1. Improvement of forecasts for NWP systems

- Data assimilation using CSR and AMV products
- Expected to improve on heavy rain forecasts and typhoon track forecasts

2. Improvement of warnings and advisories for typhoon information on a real-time basis

- Usage of Sea Surface AMV product
- Expected to improve for typhoon analysis and forecasting skills

Usage of Himawari-8 and -9 Products for typhoon

1. **CSR**
2. **AMV**
3. **Sea Surface AMV**

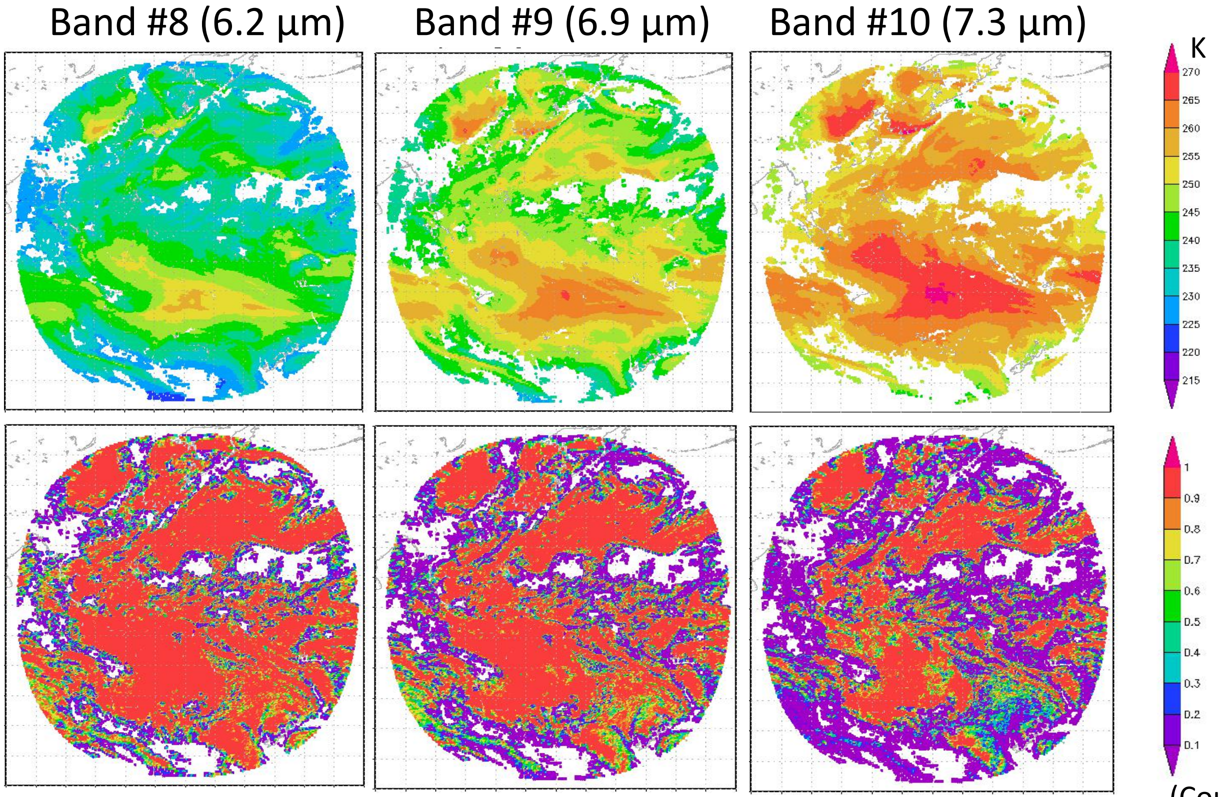
Clear Sky Radiance (CSR)

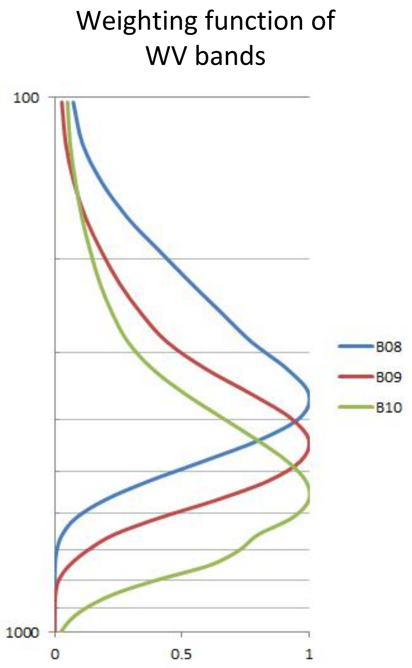
- **Area averaged clear sky brightness temperature**
  - ✓ All IR bands (3.9, 6.2, 6.9, 7.3, 8.6, 9.6, 10.4, 11.2, 12.4, 13.3 μm)
  - ✓ Full disk, **hourly produced** and distributed via GTS mainly for NWP community
  - ✓ Spatial resolution (averaging size): 16 x 16 pixel (IR) (i.e. **32 x 32 km** @SSP)
  - ✓ **Band dependent** clear pixel ratios for clear pixel detection
  - ✓ *Provided to NWP centers via GTS and WIS service*

Brightness Temperature

Clear Pixel Ratio

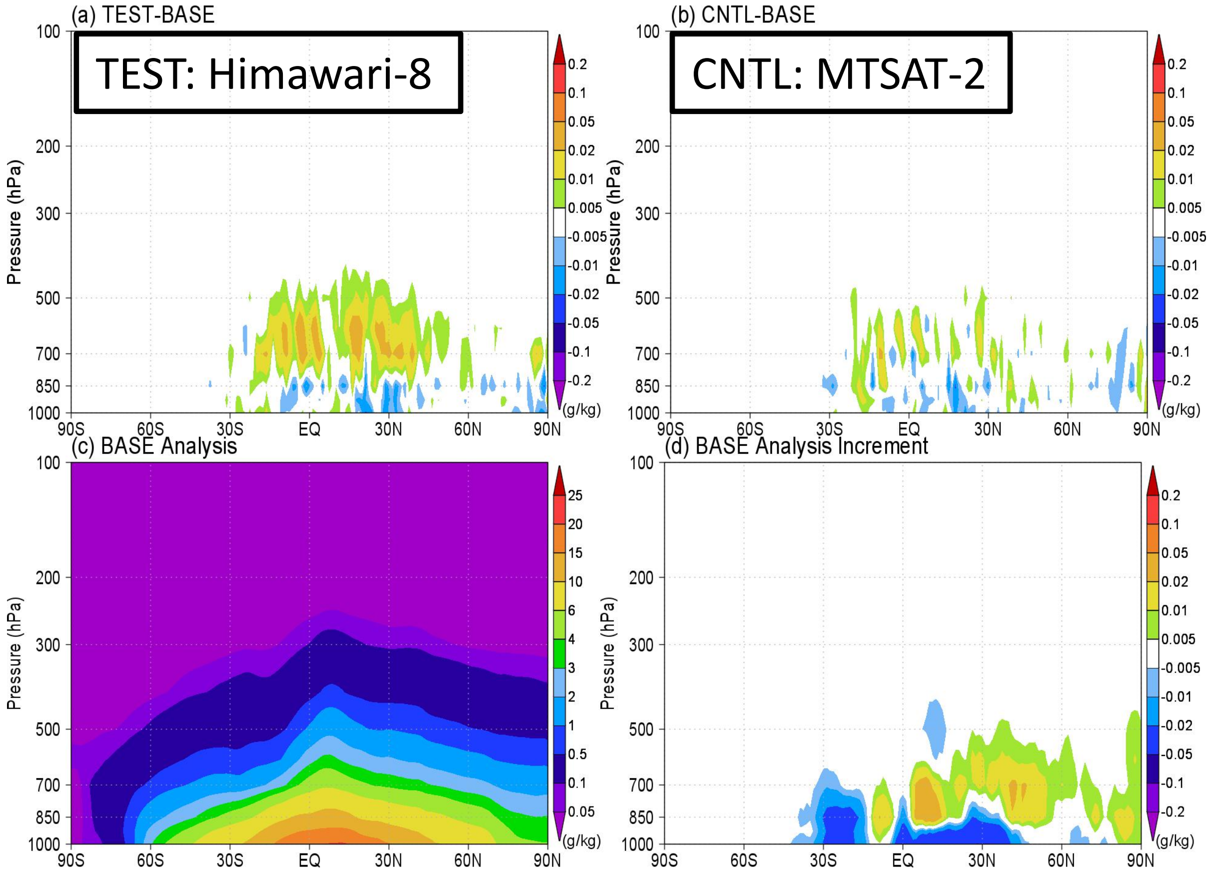
00 UTC on
15 August 2015





(Courtesy of D. Uesawa)

Impact of CSR data assimilation for NWP



TEST: Himawari-8 use

CNTL: MTSAT-2 use

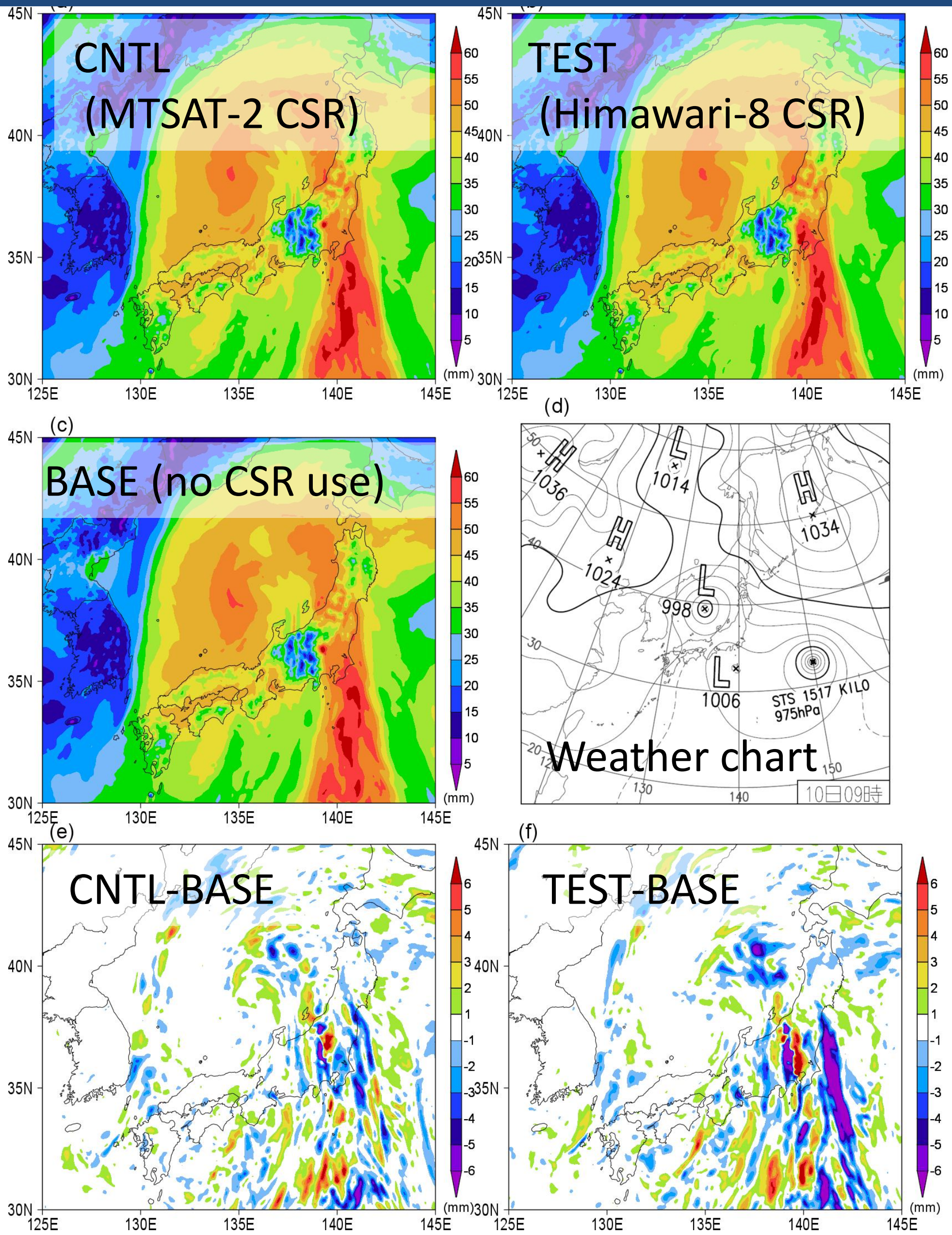
BASE: no CSR observation in Himawari area

The water vapor field changes in analysis.

(Kazumori, M. 2018)

Zonal average monthly mean difference in the specific humidity field for analysis, mean specific humidity field and analysis increment for July 2015.
(a) Mean difference in the specific humidity field between TEST and BASE analysis, (b) as per (a), but for the difference between CNTL and BASE analysis. (c) Mean specific humidity field of BASE analysis, (d) mean analysis increment for specific humidity of BASE. Units are g/kg.

Impact of CSR data assimilation for NWP



Case study of a heavy precipitation event for Japan by typhoon

Comparison of total precipitable water vapor analysis((a) - (c), (e),(f)) on 12 UTC September 9 2015.

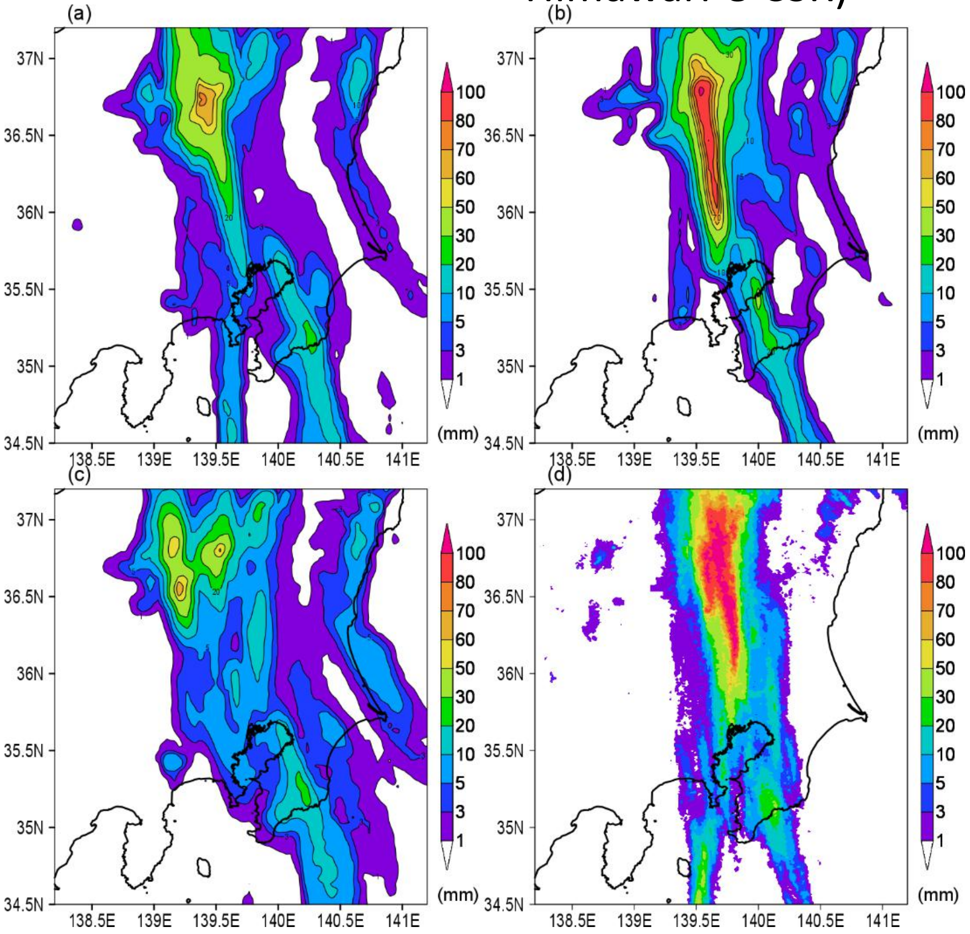
(d) Surface weather chart for 00 UTC on September 10 2015.

The total precipitable water vapor unit is mm.

The contrast of the water vapor field along the moist air flow was remarkable in TEST.

(Kazumori, M. 2018)

Impact of CSR data assimilation for NWP



CNTL (with MTSAT-2 CSR)

TEST (with Himawari-8 CSR)

BASE (no CSR)

observed rainfall distribution

Case study of a heavy precipitation event for Japan by typhoon

Comparison of three-hour cumulative rainfall forecasts for 15 UTC on September 9 2015. The forecast period is three hours and the unit of rainfall is mm/3 hr.

The use of CSR data generally increased the concentration of precipitation. The improvement in TEST was much greater.

(Kazumori, M. 2018)

Usage of Himawari-8 and -9 Products for typhoon

1. **CSR**
2. **AMV**
3. **Sea Surface AMV**

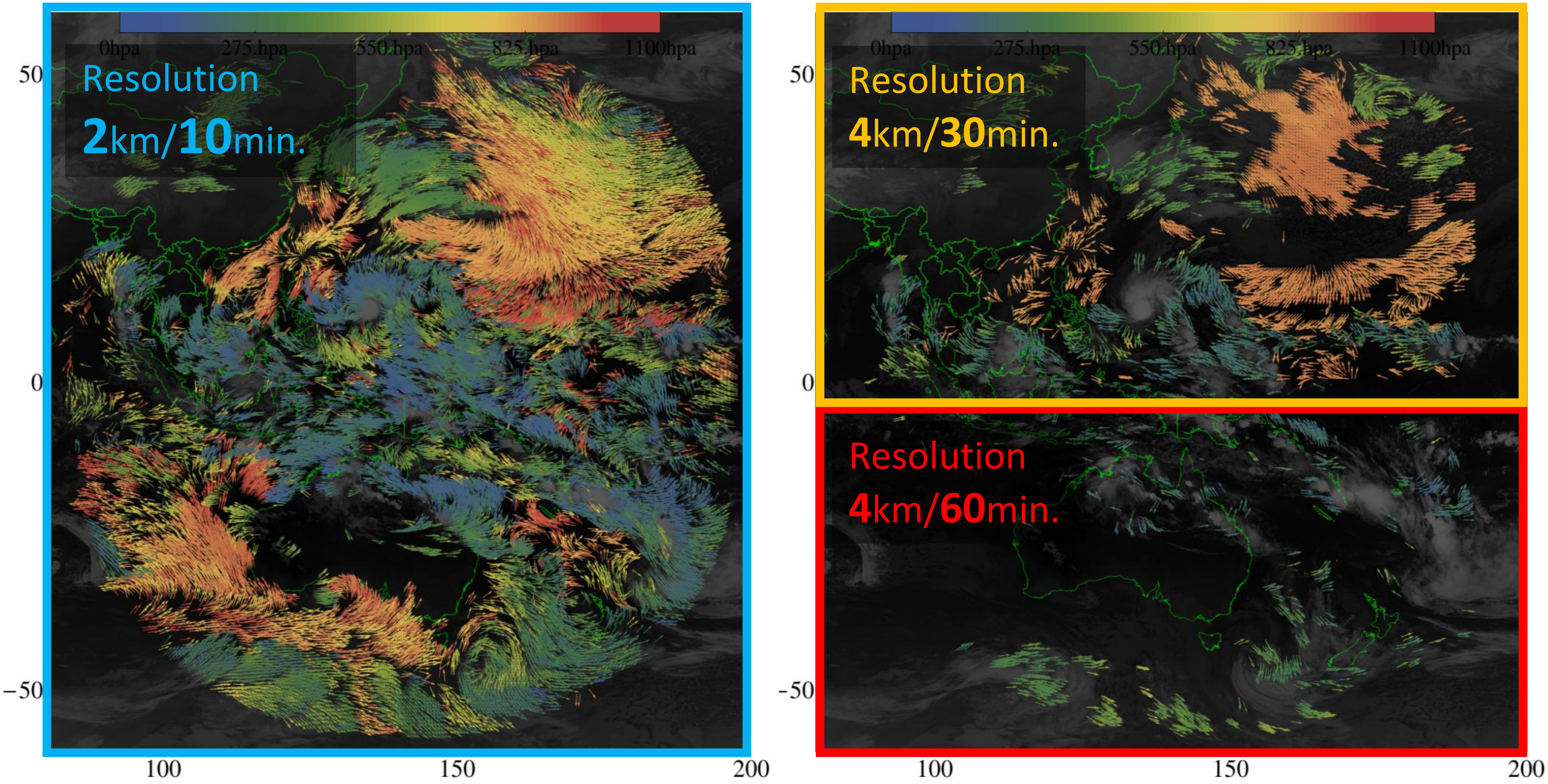
Atmospheric Motion Vector (AMV)

Himawari-8 AMVs

derived from new algorithm
(Shimoji 2014, IWW 12)

MTSAT-2 AMVs

derived from heritage algorithm
(Oyama 2010, MSC technical report)



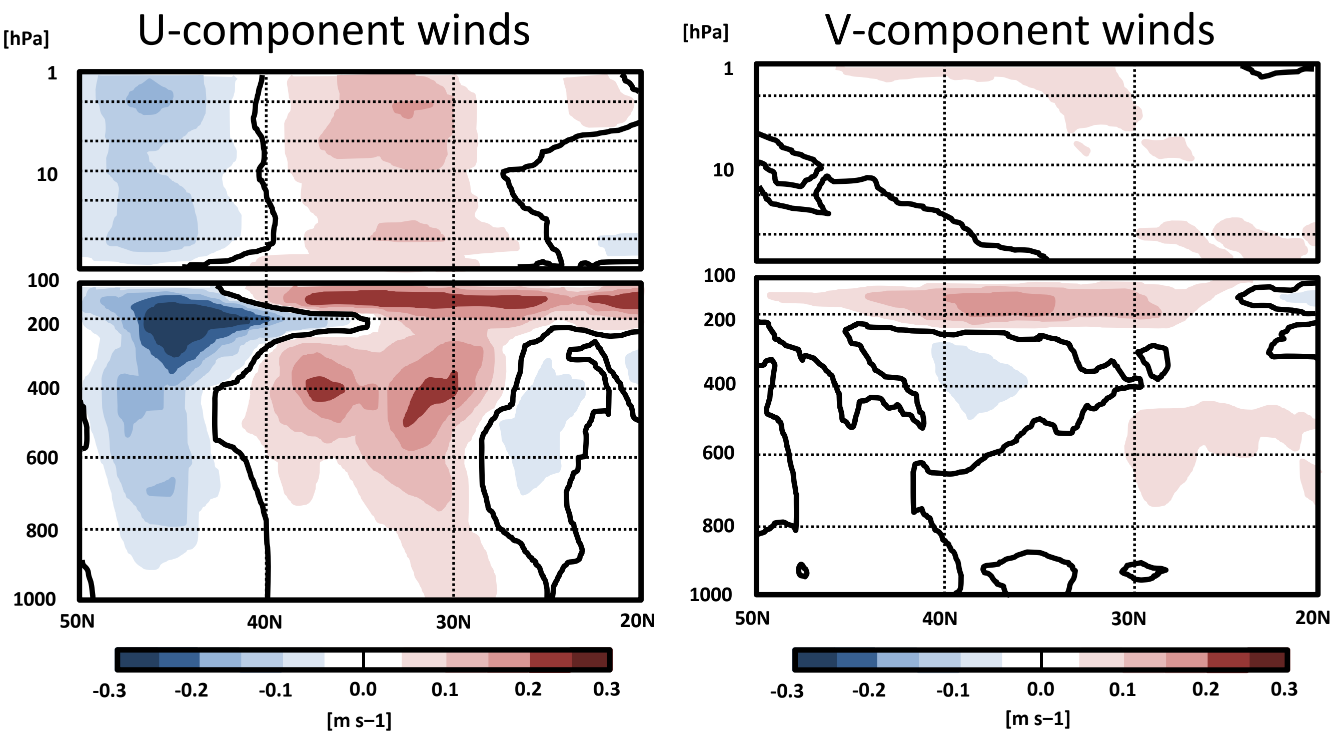
Resolution
2km/**10**min.

Resolution
4km/**30**min.

Resolution
4km/**60**min.

Himawari-8 and MTSAT-2 IR AMV (QI>60, 17 UTC on 14 January 2015)

Impact of AMV data assimilation for NWP

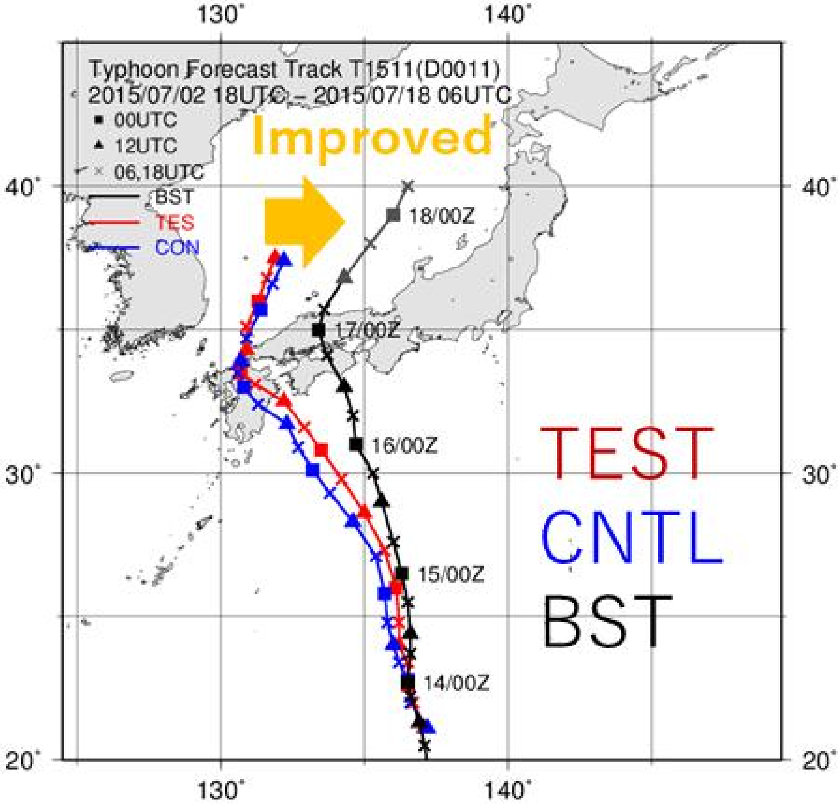


Zonal mean meridional cross sections for analysis field differences of U- and V-component winds around Japan (from 110 to 160° E, 20 to 50° N) between TEST and CNTL for summer 2015.
Positive values (red) indicate TEST (with Himawari-8 usage) numbers larger than CNTL (MTSAT-2 usage) numbers, while negative values (blue) indicate the opposite.

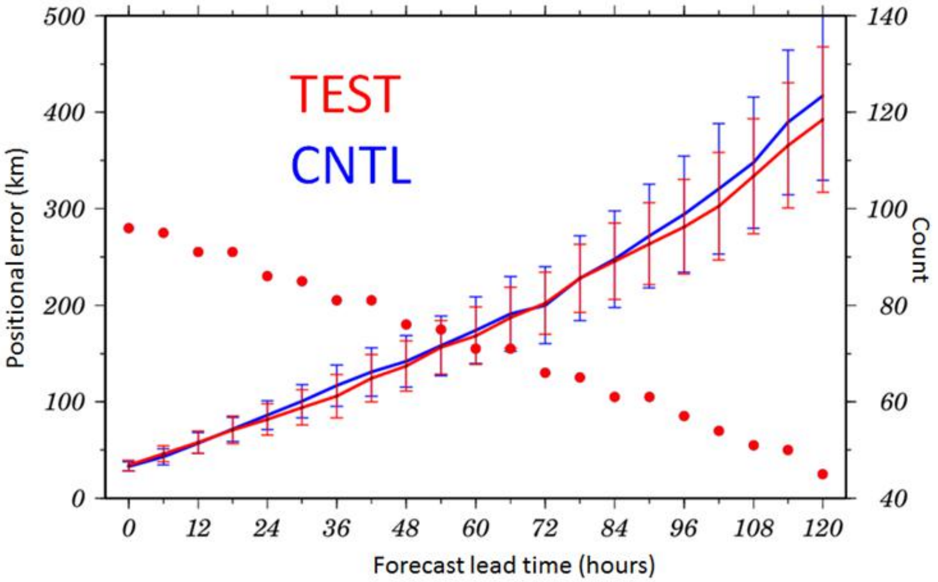
Modification of atmospheric general circulation

(Yamashita, K. 2018)

Impact of AMV data assimilation for NWP



Typhoon track TEST (red), CNTL (blue) and BST (black) forecasts for Nangka (T1511) initialized at 12 UTC on 13 July 2015

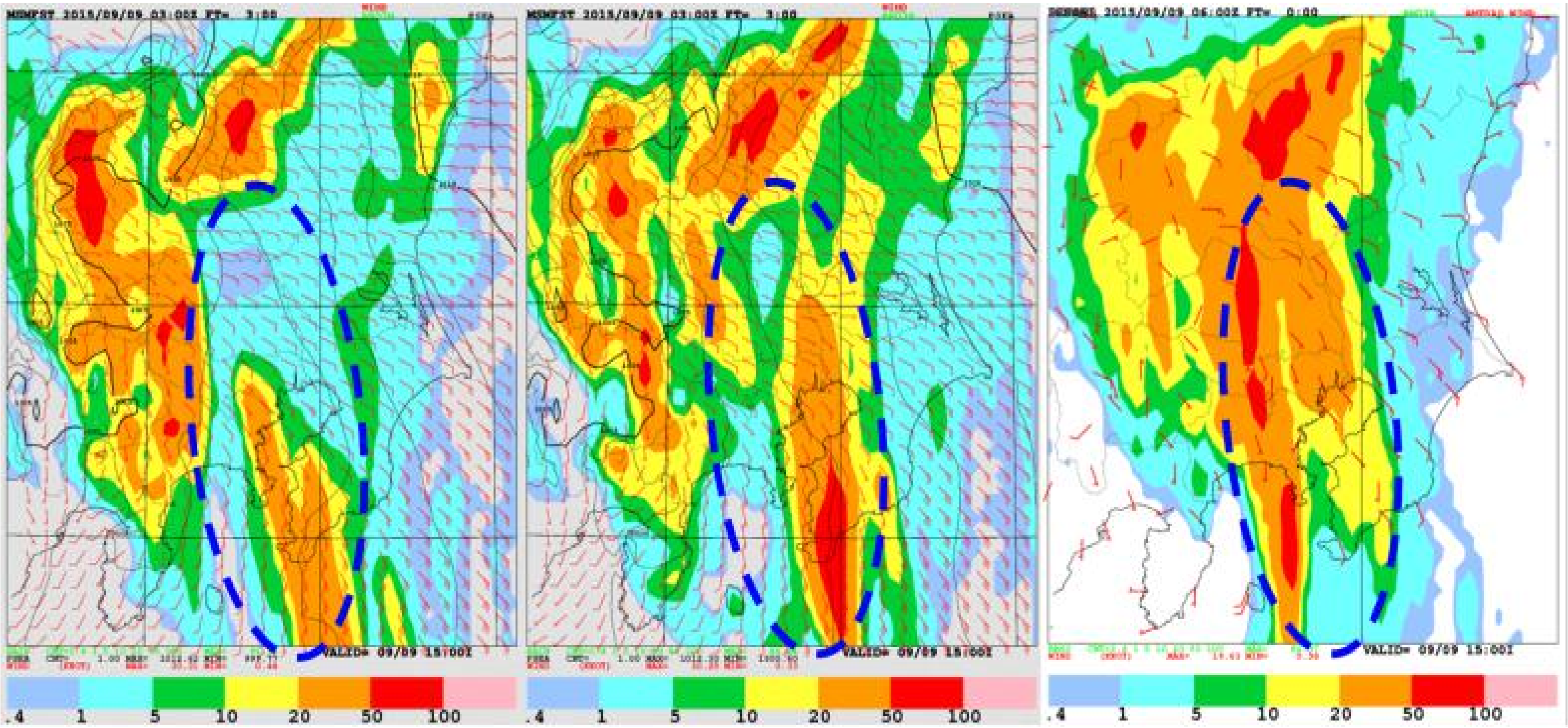


Average typhoon track forecast errors for summer 2015. The red line is for TEST values, the blue line is for CNTL values, and the red dots are sample data numbers. Error bars represent a 95% confidence interval.

(Yamashita, K. 2018)

Impact of AMV data assimilation for NWP

Case study of a heavy precipitation event for Japan by typhoon



CNTL
(with MTSAT-2 usage)

TEST
(with Himawari-8 usage)

OBS

Three-hour forecasts from TEST and CNTL experiments and radar-rainfall composite precipitation (OBS) <u>initialized at 03 UTC on September 9 2015</u> in a case study of Kanto and Tohoku heavy precipitation in eastern Kanto. Blue line areas represent remarkably heavy precipitation.

(Yamashita, K. 2018)

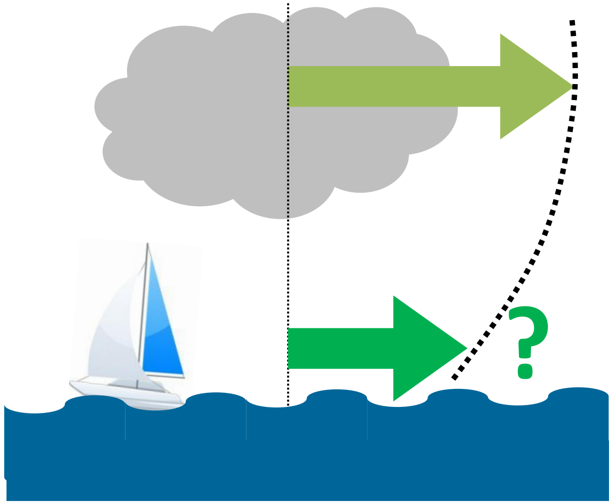
Usage of Himawari-8 and -9 Products for typhoon

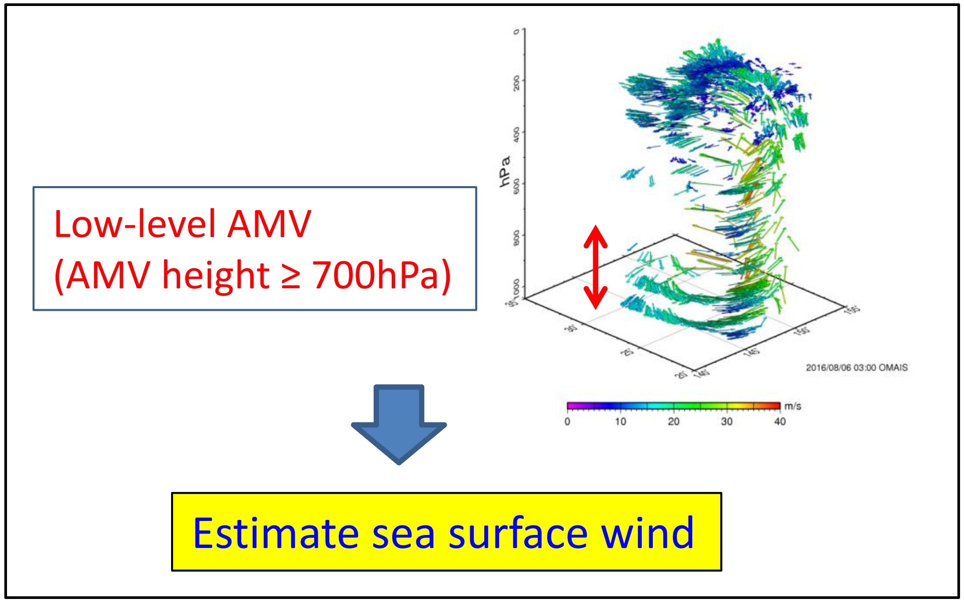
1. **CSR**
2. **AMV**
3. **Sea Surface AMV**

Low level AMV for typhoon analysis

Forecasters estimate intensity of tropical cyclones using surface wind information. In-situ observations such as vessels and buoys are sparse especially on the ocean. ASCAT ocean vector winds are very useful for the analysis, but the number of observations is not sufficient.

If we can estimate sea surface wind from AMV assigned to low altitude, it will be helpful for typhoon analysis.





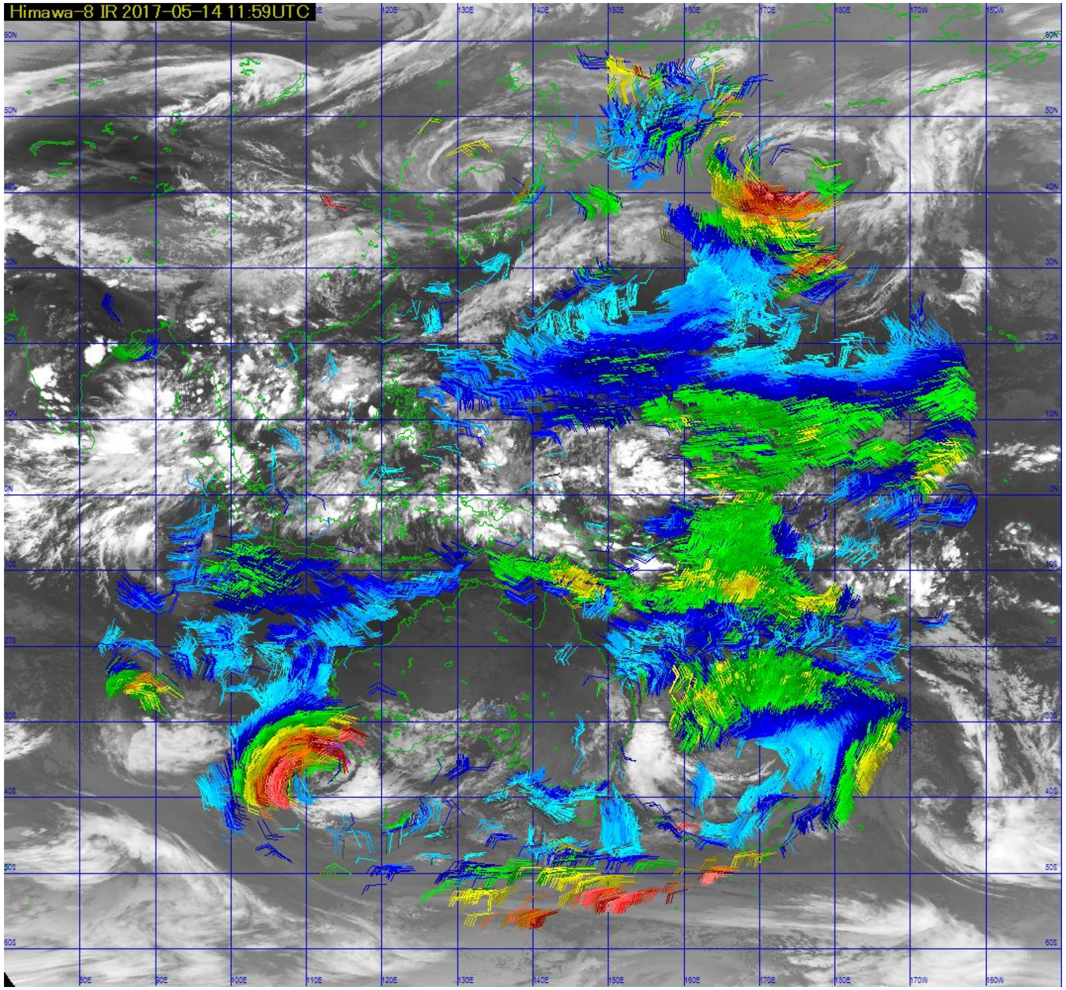
Low-level AMV
(AMV height ≥ 700hPa)

Estimate sea surface wind

Use of Sea Surface AMV at RSMC Tokyo – Typhoon Center

RSMC Tokyo - Typhoon Center
Japan Meteorological Agency

JMA has started the operational use of sea surface AMVs



Since when

Meteorological Satellite Center of JMA has started routine provision of sea level AMVs to the RSMC Tokyo - Typhoon Center from June 2018.

Accordingly, the Center has started using the AMVs operationally.

Product details

The AMVs are for areas ~1,000 km square around each tropical cyclone.

AMVs from full-disk data are available twice/hour, while AMVs from regional scanning are available every 10 min.

Near future plan

JMA is planning to provide the AMVs via Himawari Cast and WIS in the near future.

Achievement with sea surface AMVs

Based on the following findings,

- Low-level AMVs derived from Himawari-8 and sea surface winds are well correlated around tropical cyclones;
  Sea surface wind ≈ 0.76 × low-level AMV, as a result of primary regression

- Himawari-8 provides data for wide area with high frequency that has enough accuracy compared with ASCAT observation data*

  * ASCAT observes a certain fixed area twice a day and it cannot observe right below the satellite.

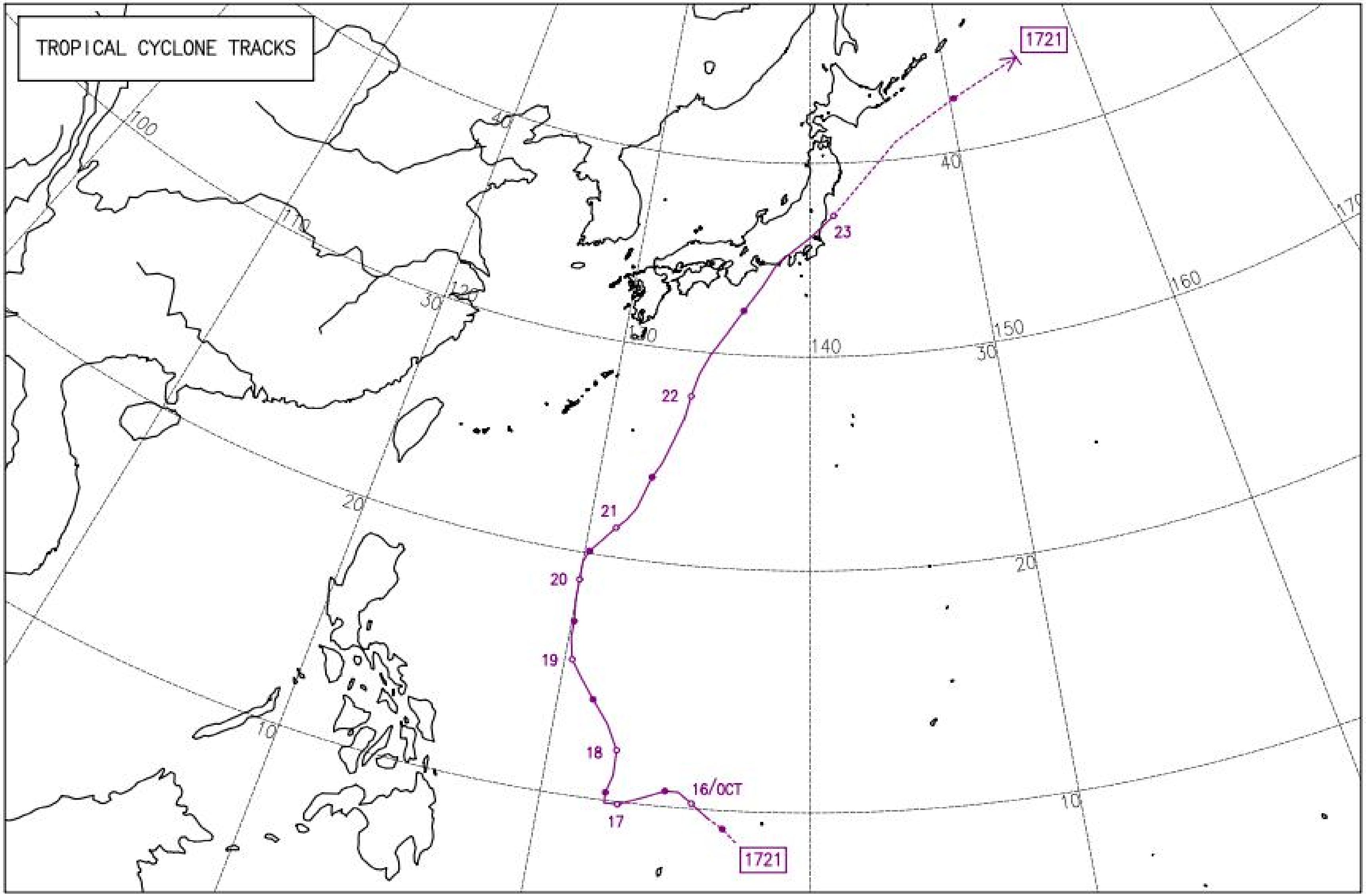
RSMC Tokyo - Typhoon Center has started the operational use of sea surface AMVs in the vicinity of tropical cyclones in June, this year.

The use of sea-surface AMVs is a useful method to estimate strong wind area due to tropical cyclones.

Example of operational use of sea-surface AMVs

~ Sea-surface AMVs estimated from Himawari-8 low-level AMVs ~

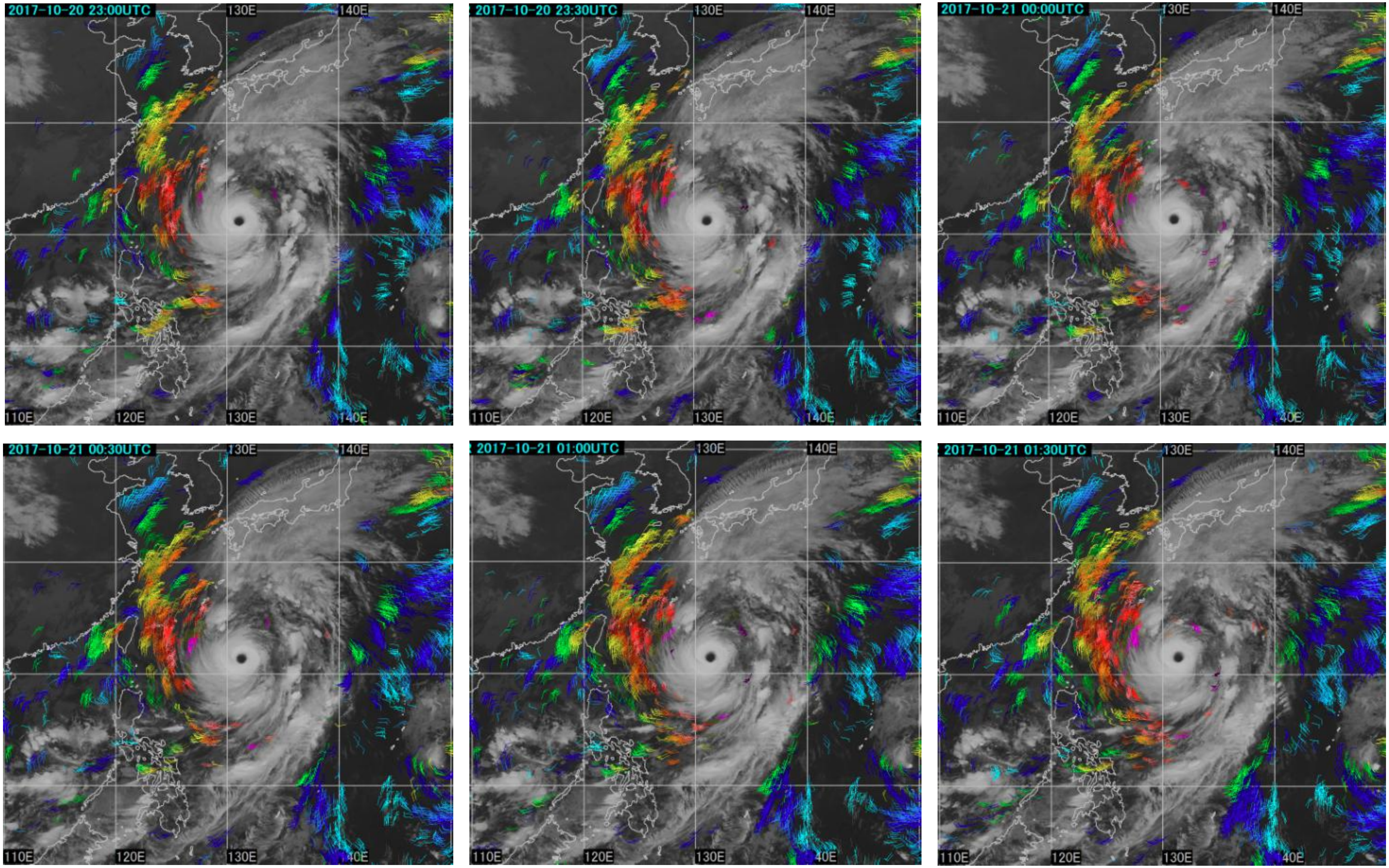
TY1721: LAN



Example of operational use of sea-surface AMVs - #1 -

~ Sea-surface AMVs estimated from Himawari-8 low-level AMVs ~

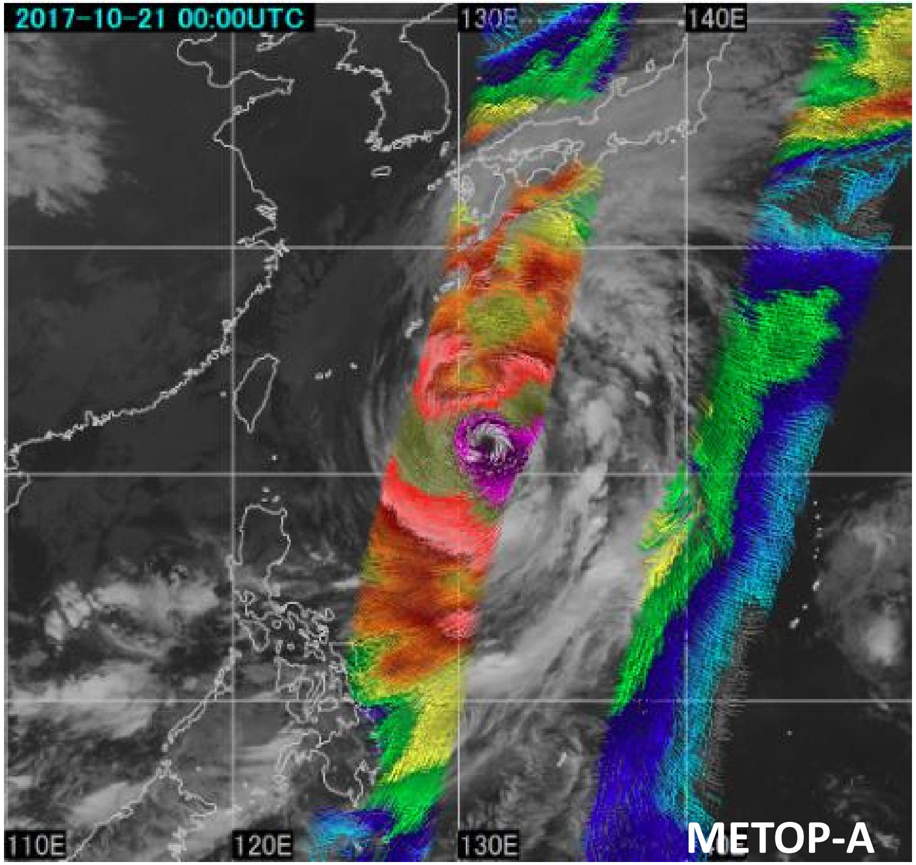
TY1721: LAN

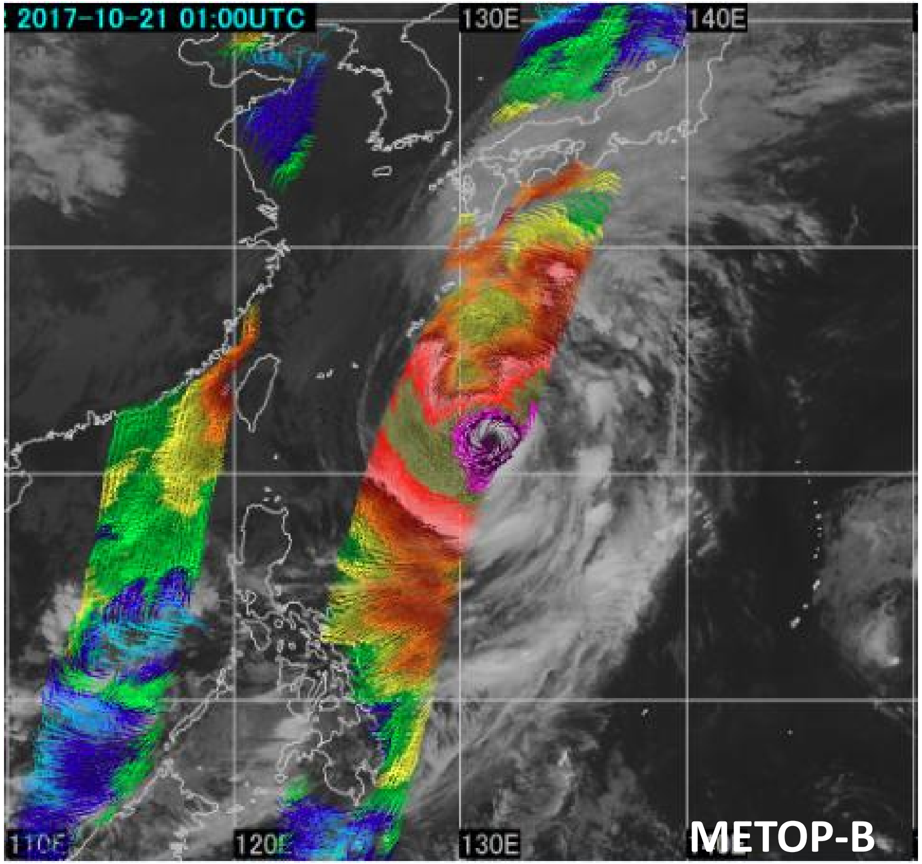


Example of operational use of sea-surface AMVs - #1 -

~ Sea surface winds from ASCAT~

TY1721: LAN

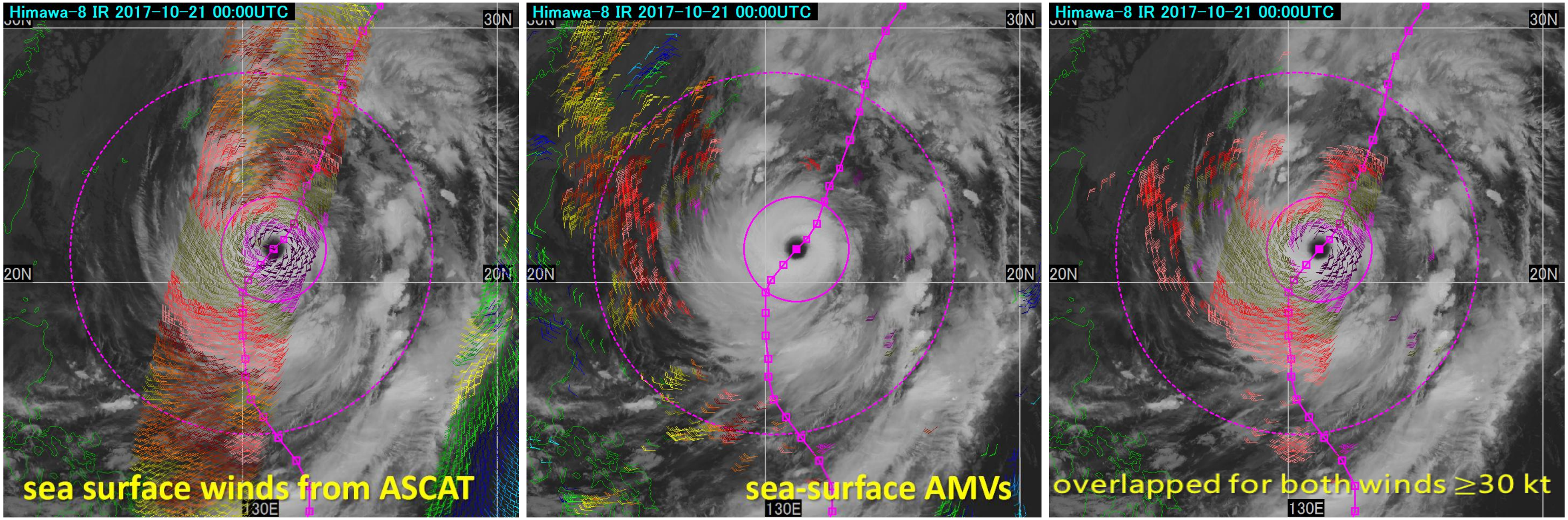




Example of operational use of sea-surface AMVs - #1 -

~ Overlapped sea-surface AMVs and sea surface winds from ASCAT ~

TY1721: LAN



Circle with solid line: area of strong winds at 50 kt or higher
Circle with dashed line: area for winds at 30 kt or higher

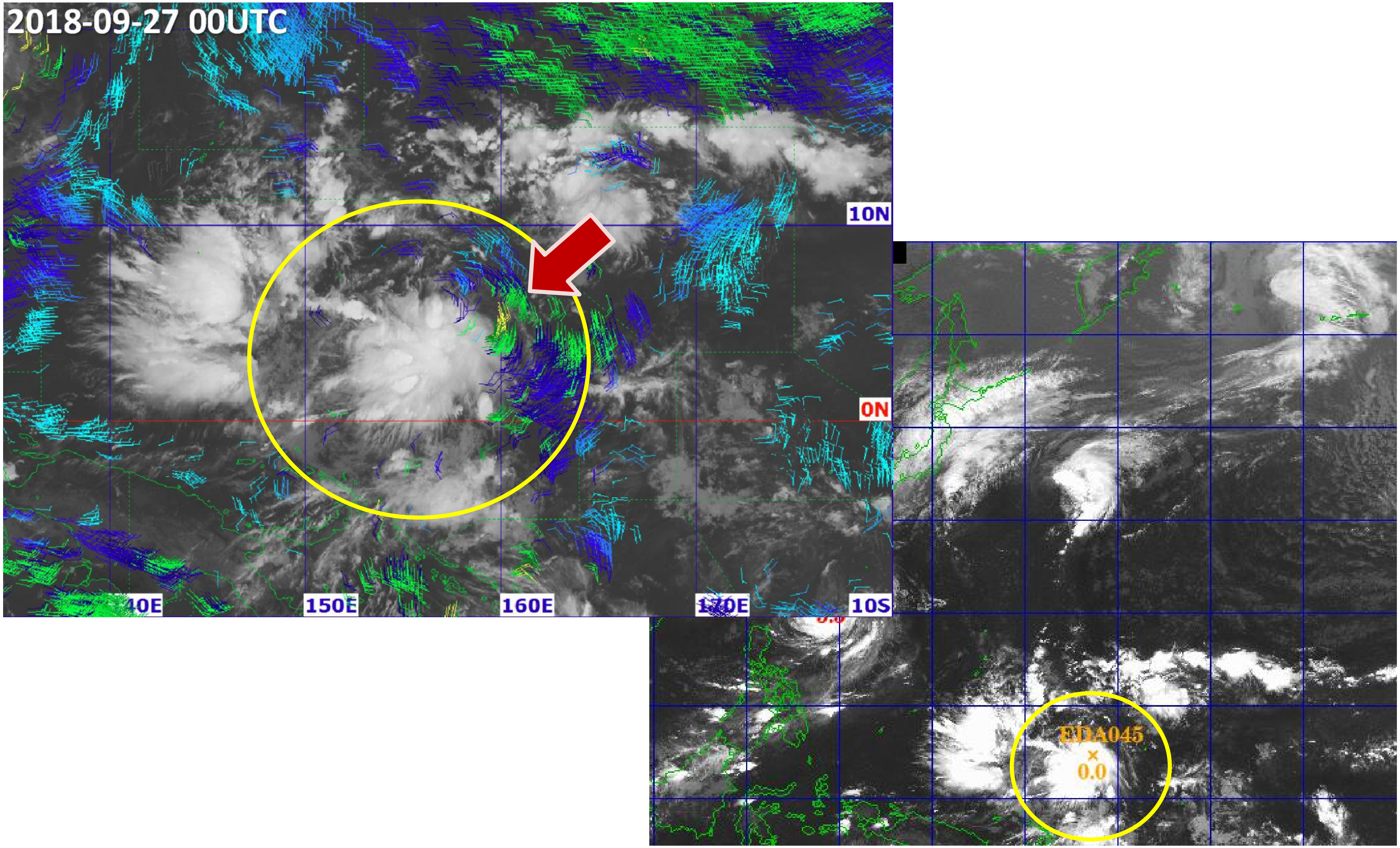
- Sea-surface AMVs estimated from Himawari-8 low-level winds are effective for grasping the wind field in the vicinity of tropical cyclones.
- ASCAT is useful for observing sea surface winds even under dense clouds.

JMA overlaps sea-surface AMVs and ASCAT sea surface winds when available.

Example of operational use of sea-surface AMVs - #2 -

~ Sea-surface AMVs estimated from Himawari-8 low-level AMVs ~

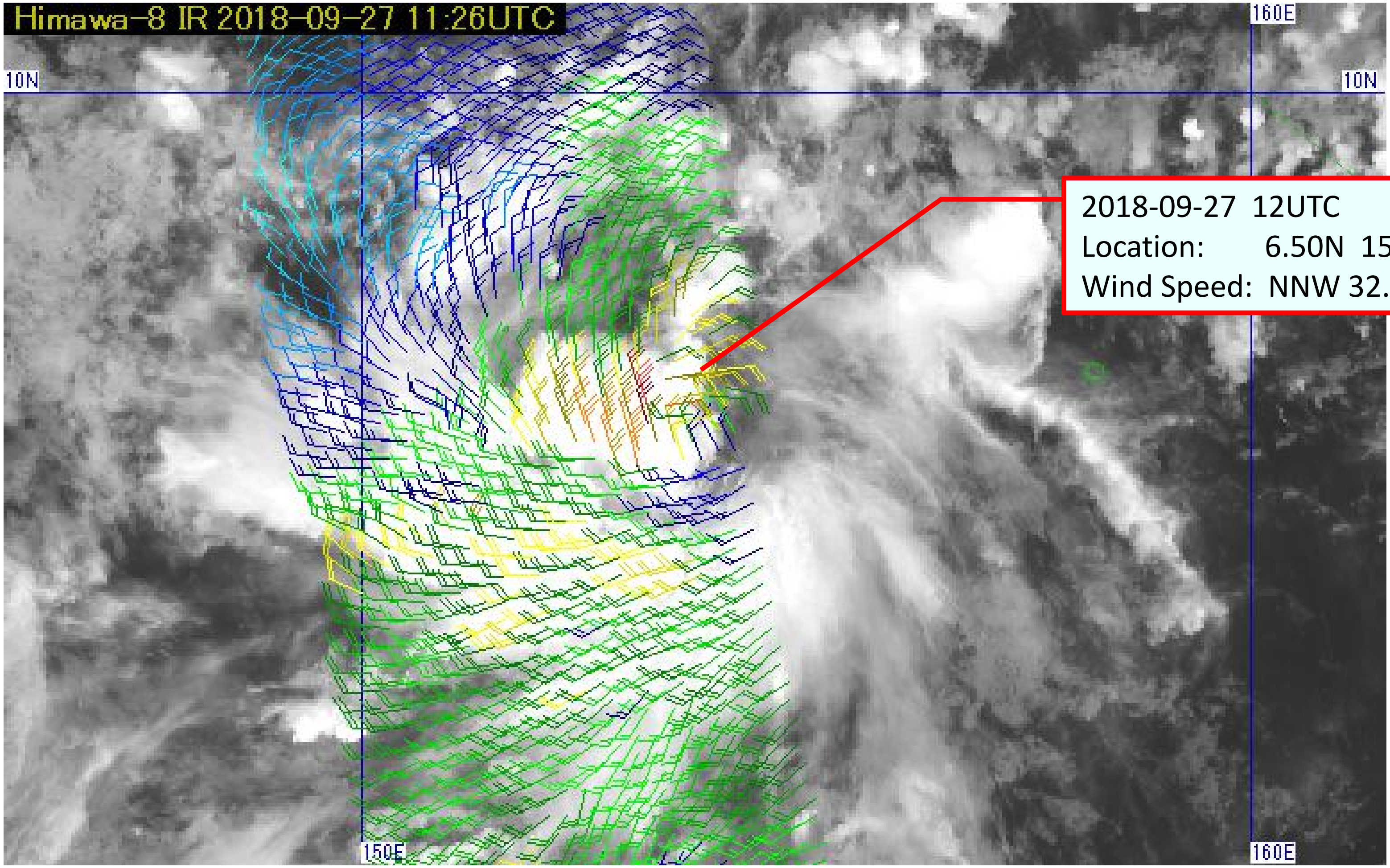
27 September 2018



Example of operational use of sea-surface AMVs - #2 -

~ Sea-surface AMVs estimated from Himawari-8 low-level AMVs ~

27 September 2018

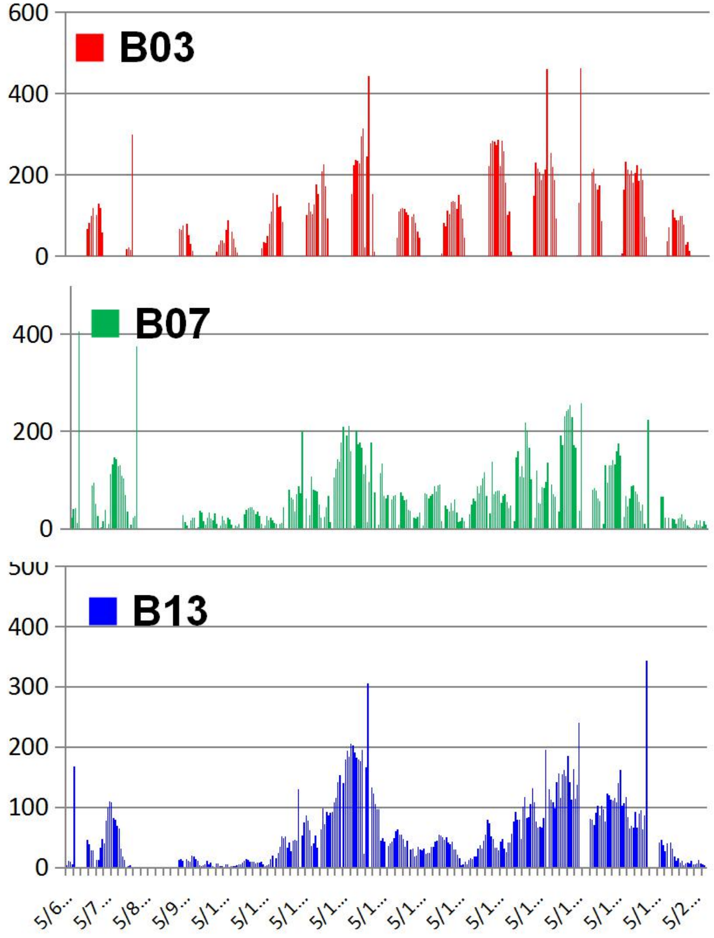


2018-09-27 12UTC
Location: 6.50N 153.20E
Wind Speed: NNW 32.3 kt

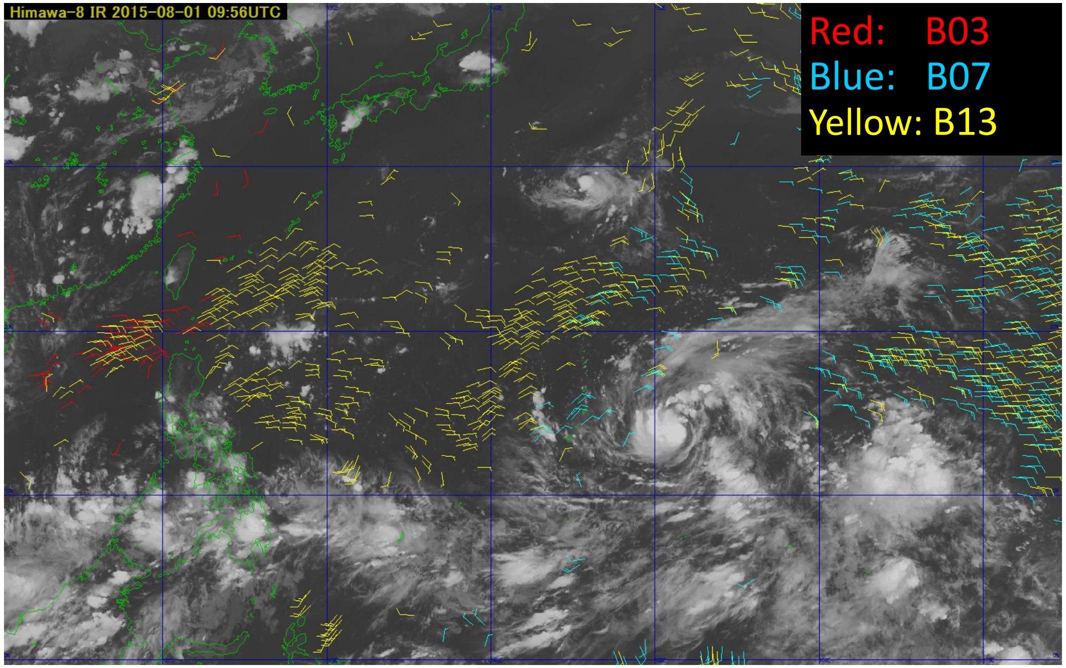
Comparison of accuracy between bands

Sea surface AMVs estimated from B03 (VIS, 0.64μm) have the highest accuracy; however they are available only during daytime.

Sea surface AMVs estimated from B07 (SWIR, 3.9μm) have low accuracy around sunrise and sunset.



Sea surface winds estimated from Himawari-8 low-level AMVs



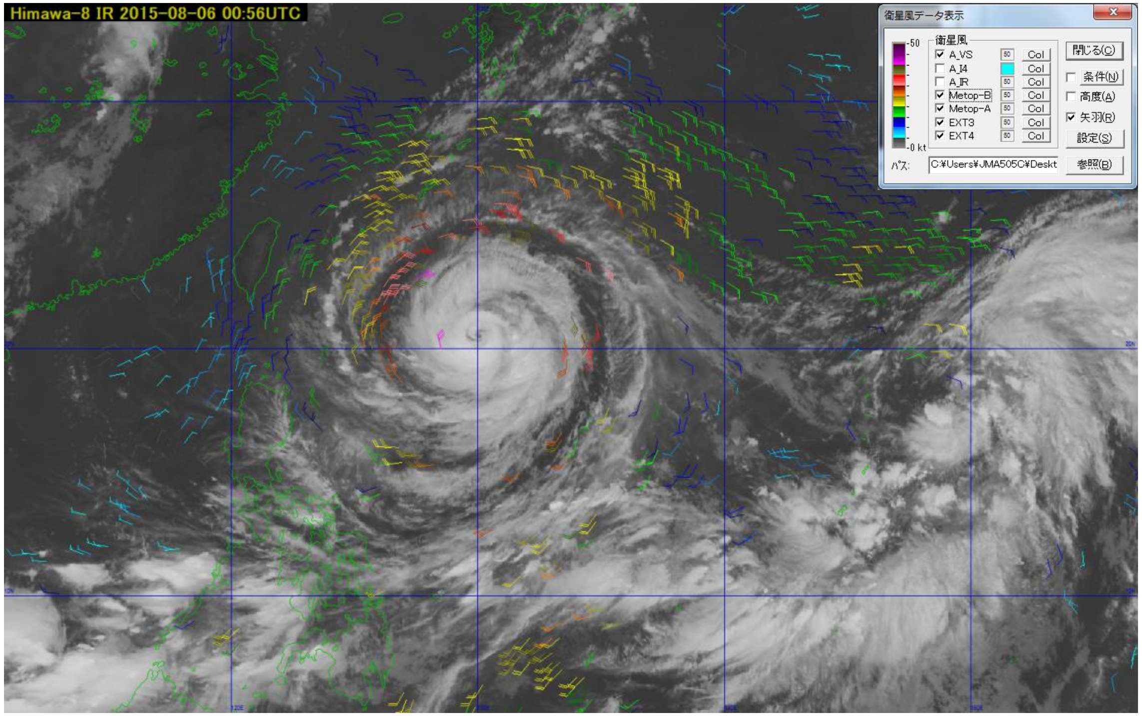
Notes in the use of sea surface AMVs

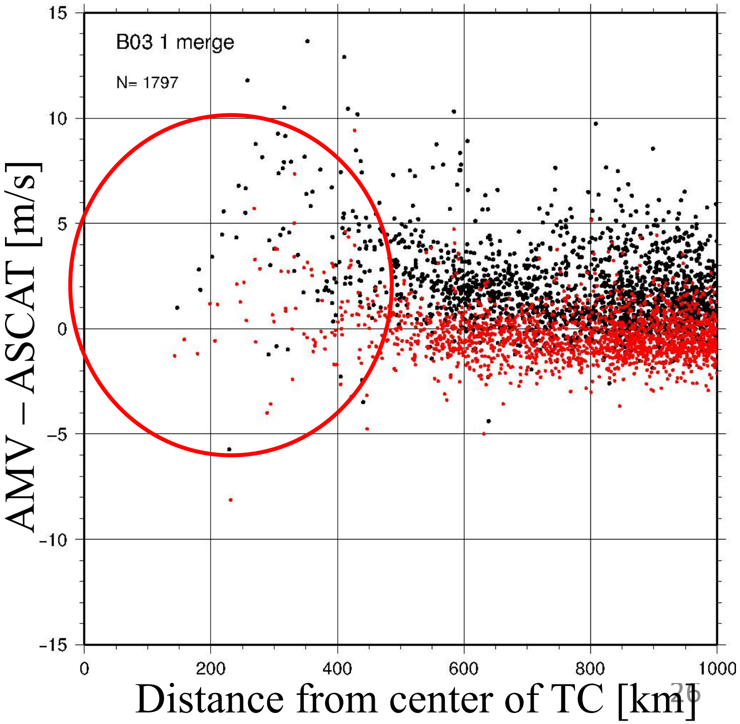
- For areas near the center of TCs, low-level AMVs are not always available as clouds are thick (i.e., due to central dense overcast). Accordingly, sea surface AMVs are not obtained constantly in the areas, either.
- Less data were available for the investigation of wind speed correlation between winds from ASCAT and low-level AMVs at speed ≧ 20 m/s.

→ It is necessary to take into consideration about the uncertainty in accuracy of estimated sea surface AMVs for areas near the center of TCs.

Sea surface winds estimated from Himawari-8 B03 low-level AMVs

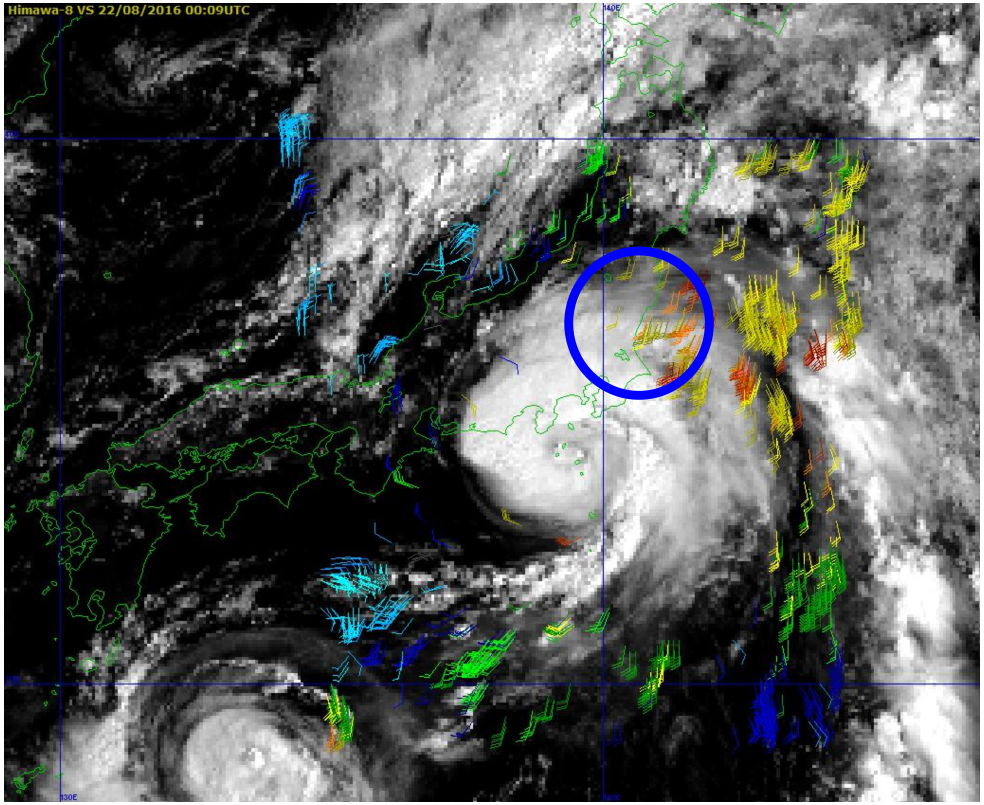
Sea surface winds derived from ASCAT





Notes in the use of sea surface AMVs

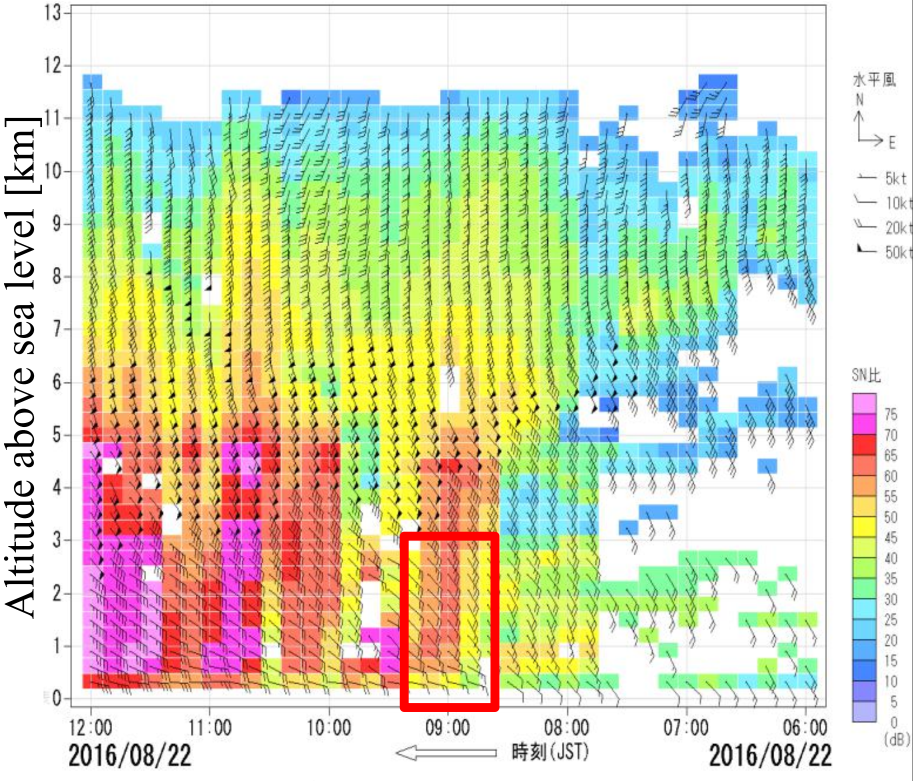
Estimated sea surface AMVs may have gap with the actual winds when inversion layer, with very high wind speed at around 700 hPa and low wind speed on surface, exists.



2016 Aug. 22, 00 UTC

Sea surface AMVs estimated from Himawari-8 B03 low-level AMVs (full disk and rapid scan)

Wind profiler data at Mito



- Sea surface AMVs show SSW winds at around 30 kt in the blue circle.
- Wind profiler data shows SE winds at around 15 kt in red rectangle.

Contents

1. **Overview of Himawari-8 and -9**
2. **Satellite derived products**
3. **RGB Imageries**
4. **Target Area observation for HimawariRequest**
5. **Usage of Himawari-8 and -9 Products for typhoon**

If you have any questions please feel free to contact us.

Contact : jma-msc-contact@ml.kishou.go.jp

References

Kazumori, M., 2018: Assimilation of Himawari-8 Clear Sky Radiance data in JMA's global and mesoscale NWP systems. J. Meteor. Soc. Japan, 96B, https://doi.org/10.2151/jmsj.2018-037.

Yamashita, K., 2018: Operational assimilation of Himawari-8 Atmospheric Motion Vectors into the Numerical Weather Prediction Systems of the Japan Meteorological Agency. J. Meteor. Soc. Japan (submitted).

Thank you