Overview of Himawari-9 and Introduction to SATAID and RGB image

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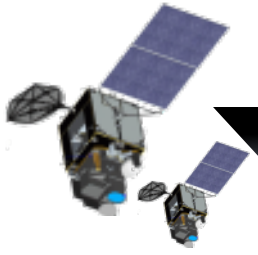


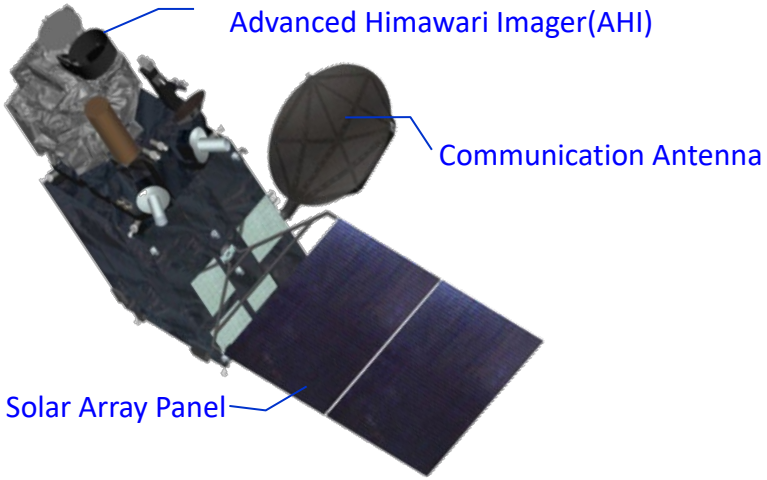
2014 Himawari-8
2016 Himawari-9

Overview of Himawari-8, 9

★Himawari-8, 9 Operation Plan

Satellite \ FY	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Himawari-8			Manufacturing			Launch			Operational						In-orbit standby							
Himawari-9														Launch	In-orbit standby				Operational		

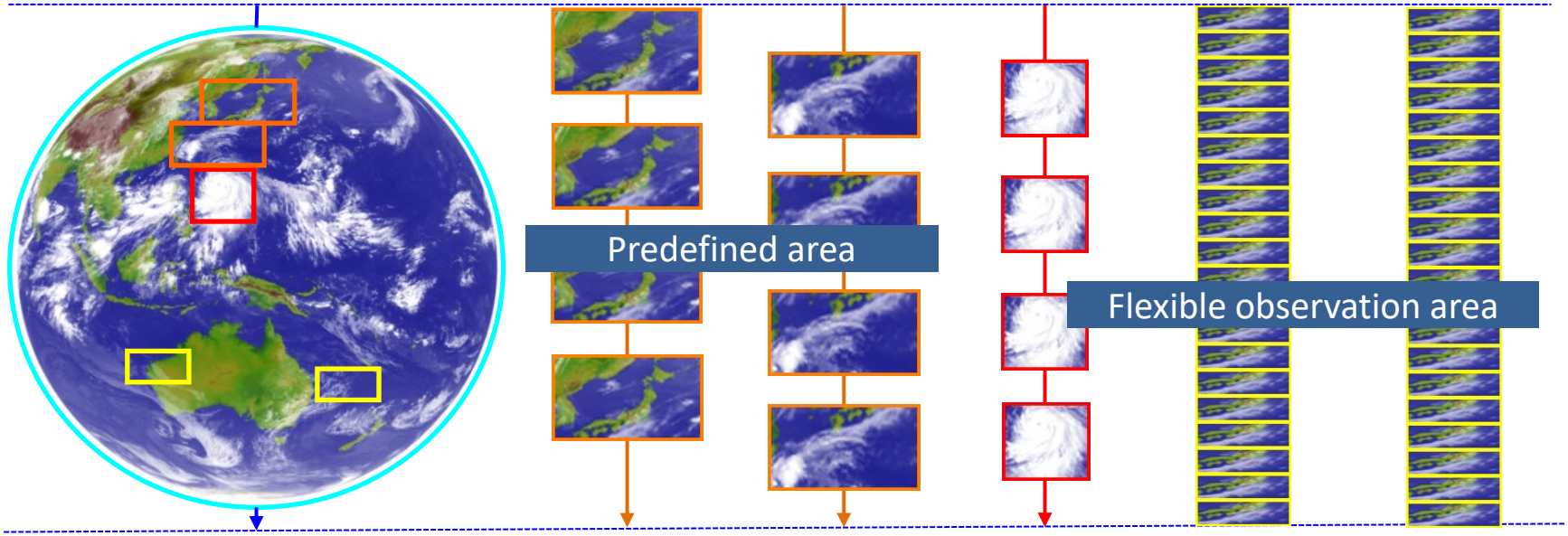
★Satellite conceptual diagram



★Satellite spec

Total length	Approx. 8m
Weight	Approx. 3,500kg (including fuel) Approx. 1,300kg (only main unit)
Initial generated power	Approx. 2.6kW
Design lifetime	Over 15 years (main unit) Over 8 years (observation functions)

Overview of the Himawari-9 observation (10 minutes Repeat Cycle)



Full Disk Observation every 10 min.

Region 1	Region 2	Region 3	Region 4	Region 5
2000 x 1000km (NE Japan)	2000 x 1000km (SW Japan)	1000 x 1000 km (Target Area)	1000 x 500 km (Landmark Area)	1000 x 500 km (Landmark Area)
Every **2.5 min.**	Every **2.5 min.**	Every **2.5 min.**	Every **30 sec.**	Every **30 sec.**

- AHI (Advanced Himawari Imager) on Himawari-9 has the ability of various scans during 10 minutes Full Disk observation.
- AHI can flexibly change the scan range of "Target Area" for observation of phenomena such as **typhoons** and active volcanoes.
- Lunar observation: performed using Landmark Area (Region 5)

AHI Spectral Bands
(5 bands -> 16bands)

cf. MTSAT-2 Bands

VIS 0.68 μm

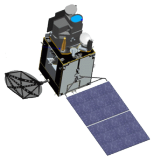
IR4 3.7 μm

IR3 6.8 μm

IR1 10.8 μm

IR2 12.0 μm

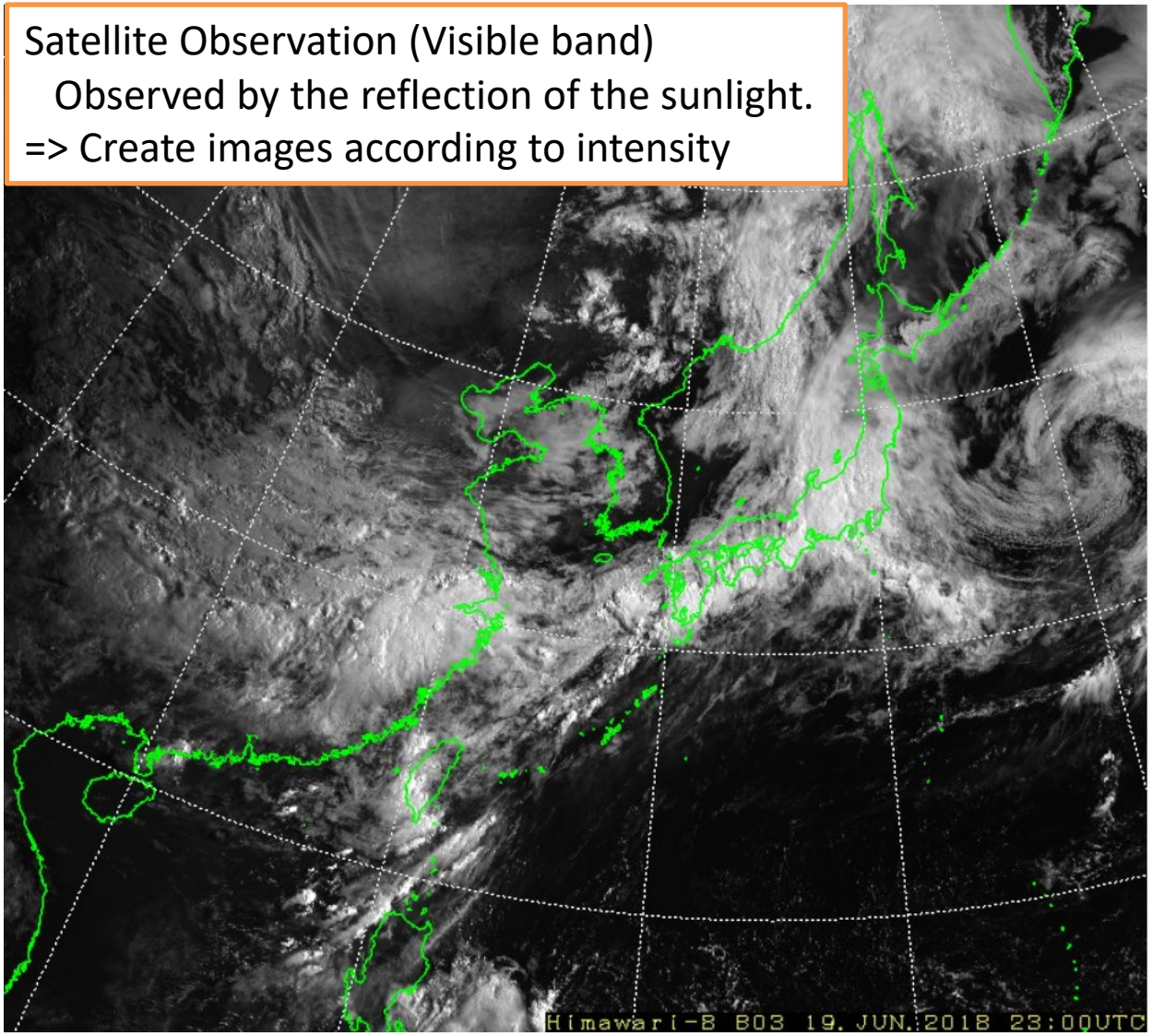
Himawari-8/9 Imager (AHI: Advanced Himawari Imager)



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/particle size	
6			2.3 μm	cloud particle size	
7	Infrared (IR)	2 km	3.9 μm	low cloud, fog, forest fire	
8			6.2 μm	upper-level moisture	WV Bands
9			6.9 μm	mid- and upper-level moisture	
10			7.3 μm	mid-level moisture	
11			8.6 μm	cloud phase, SO_2	TIR Bands
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	

Visible band(B03,0.64μm)

Satellite Observation (Visible band)
Observed by the reflection of the sunlight.
=> Create images according to intensity



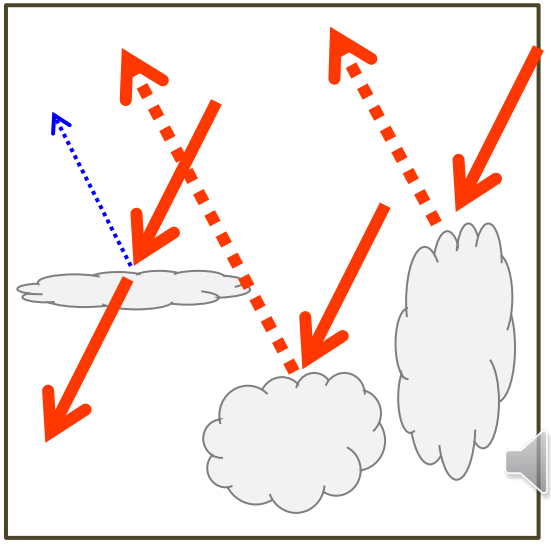
Reflection Strong

Thick cloud

Thin cloud

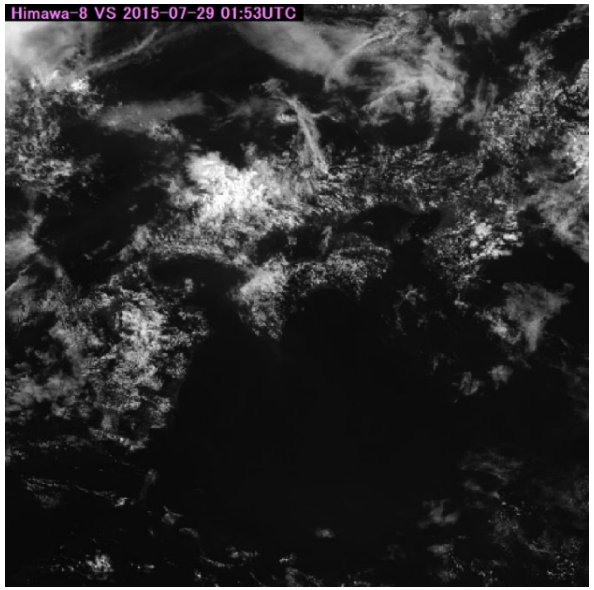
Sea surface

Weak

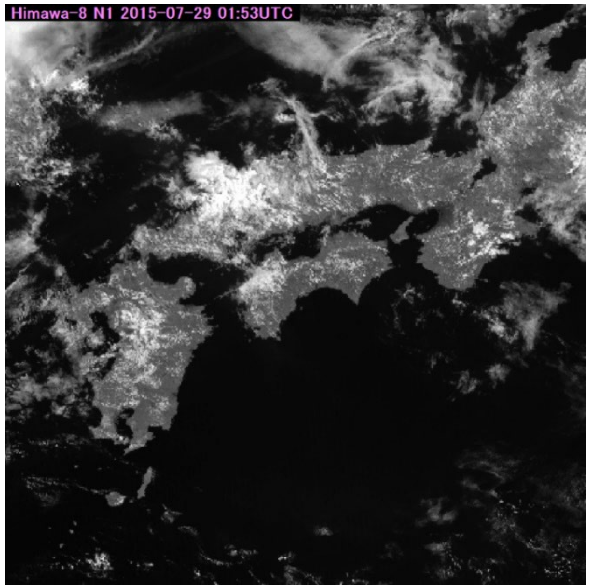


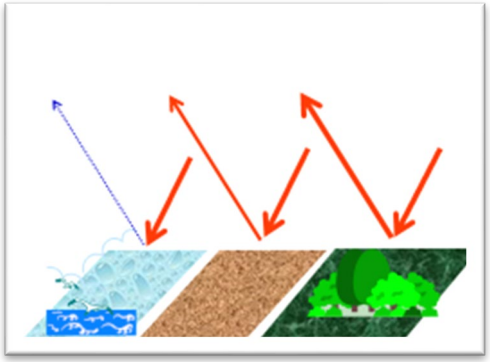
Near-Infrared band(B04,0.86 μm)

Visible band（B03, 0.64μm）



Near-Infrared band(B04, 0.86μm)





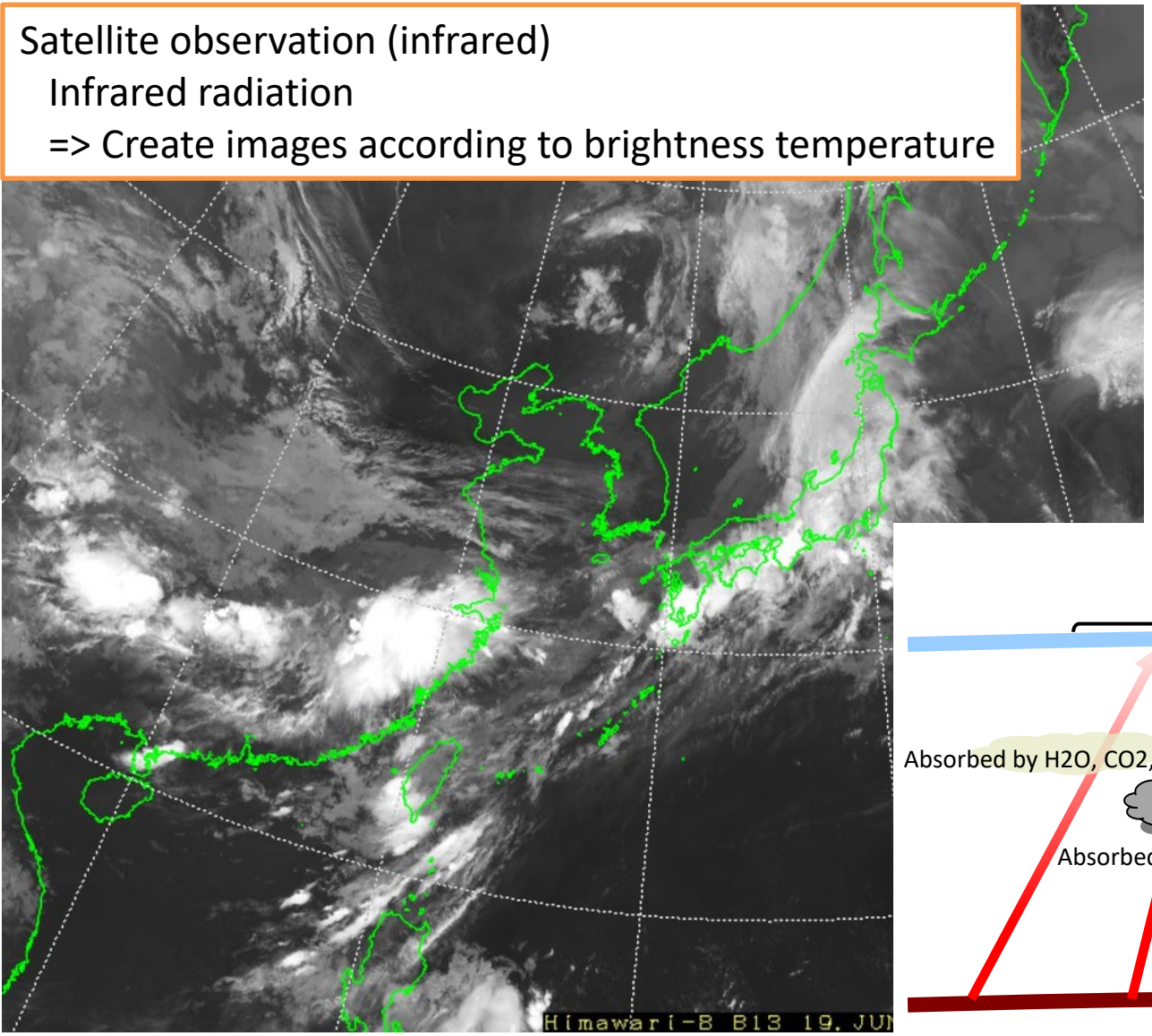
B04(0.86μm) receives strong reflection from vegetation

Difference in reflection due to vegetation

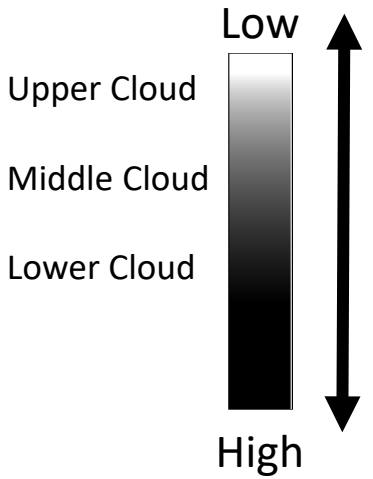
Wavelength near B03 doesn't sense vegetation.
(difficult to distinguish from the sea)
Wavelength near B04 sense vegetation clearly.
(be able to clearly understand the difference from the sea)

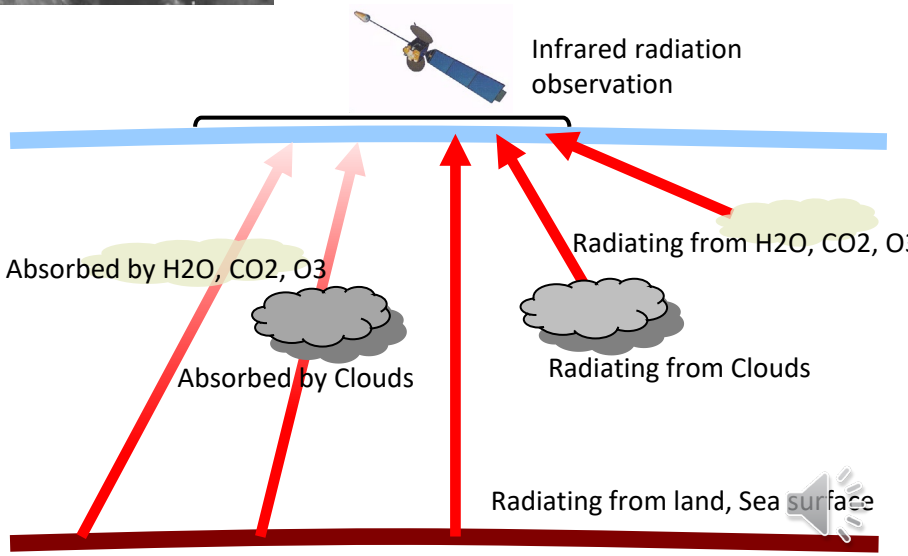
Infrared band(B13,10.4μm)

Satellite observation (infrared)
Infrared radiation
=> Create images according to brightness temperature



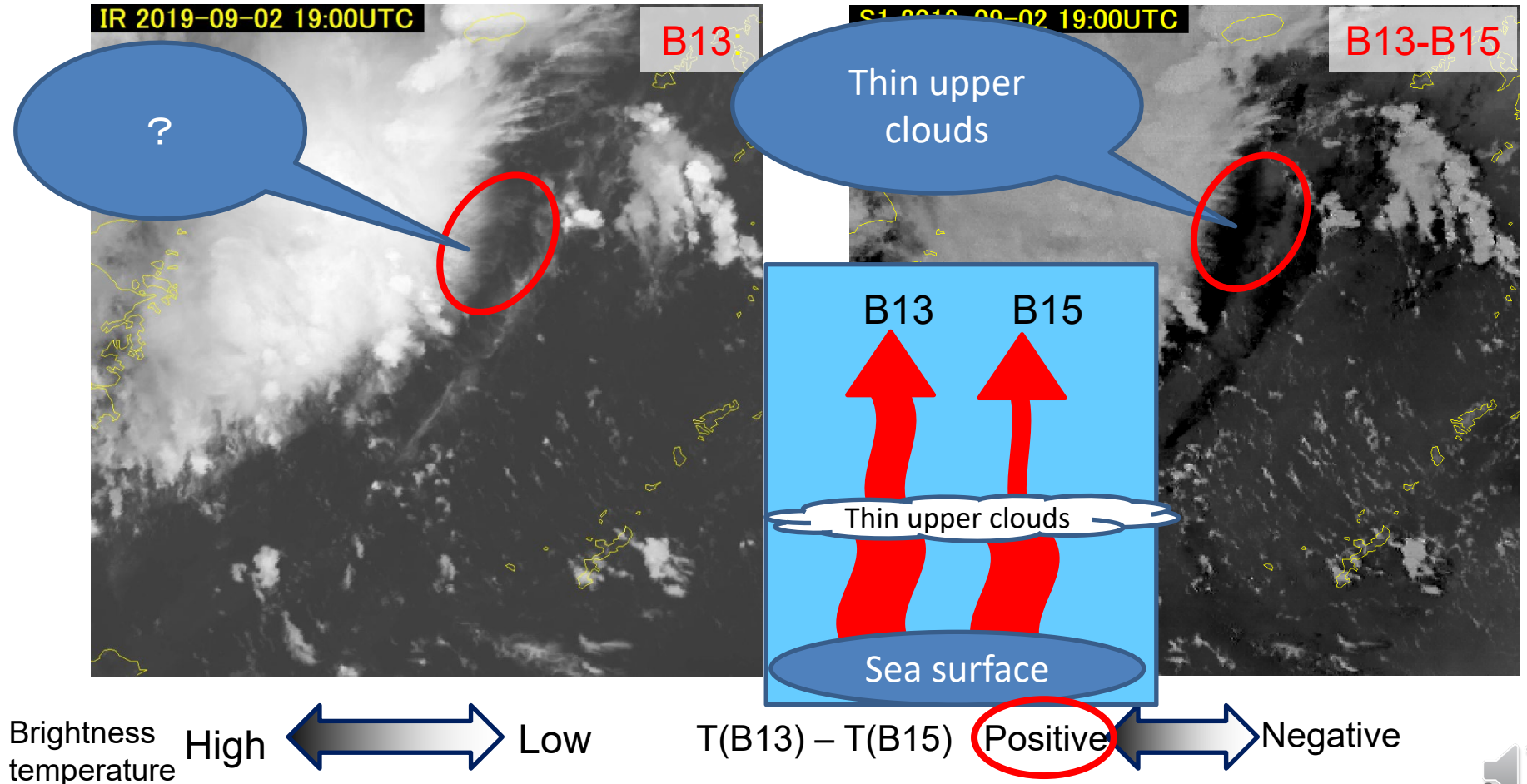
Brightness Temperature





Difference imagery of B13 – B15

- Subtract the brightness temperatures of B15 from B13.

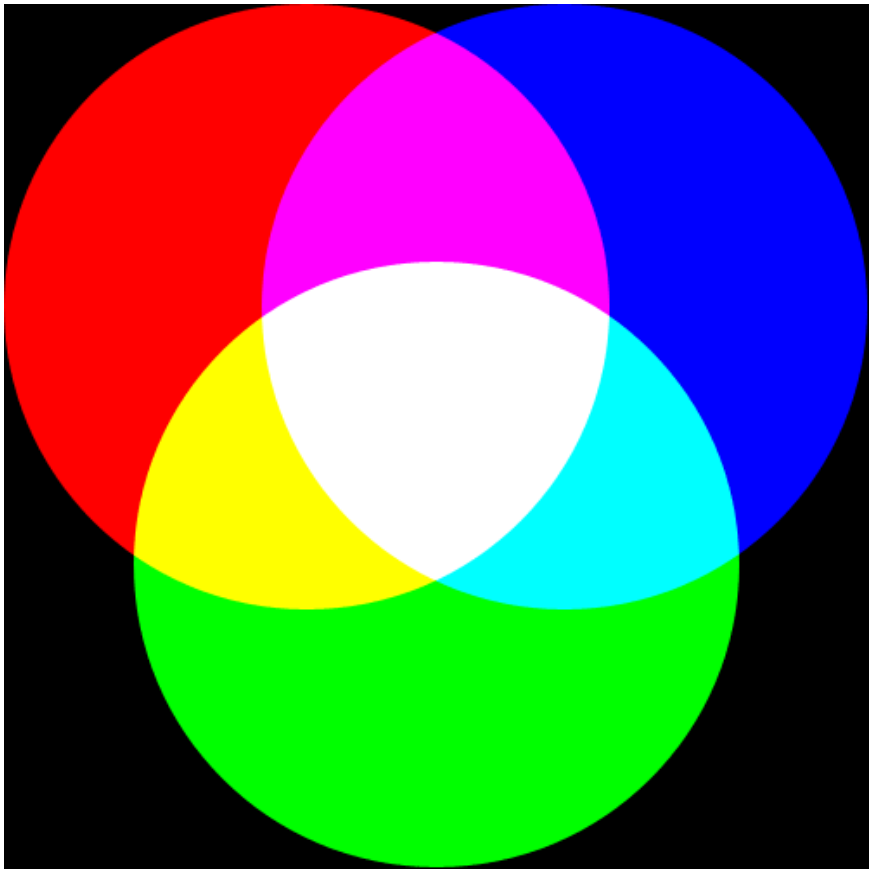


Too many bands!

- 16 bands' images contain a lot of information about
  - Cloud thickness, top temperature
  - Cloud particle size, cloud phase (ice/liquid)
  - Humidity
  - Volcanic ash
  - Vegetation
  - etc.
- **Solution -> RGB image**
  - Can illustrate multiple information on one image.
  - Can be composed by simple process.
  - "SATAID" can compose RGB image easily.

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

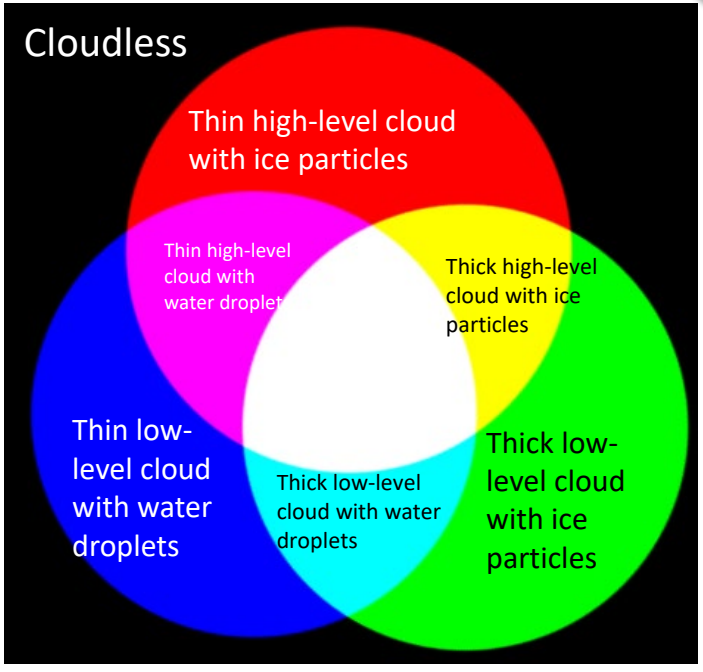


three primary colors RGB

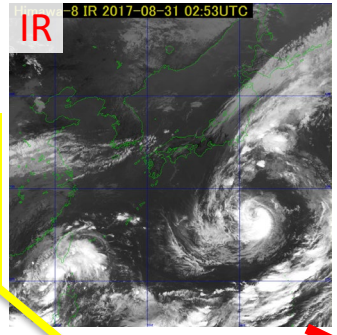
Application to Satellite Imageries

RGB composite

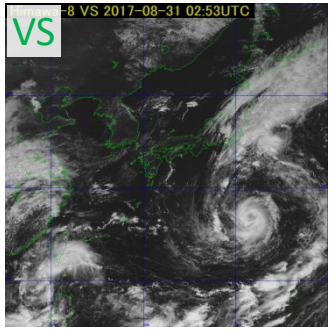
Thick and high cloud (Cb) areas appear yellow!



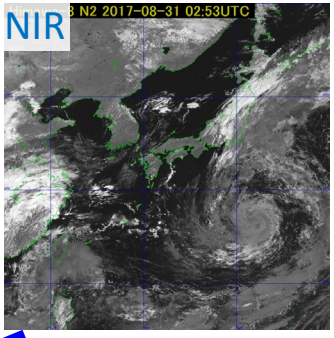
"High" cloud

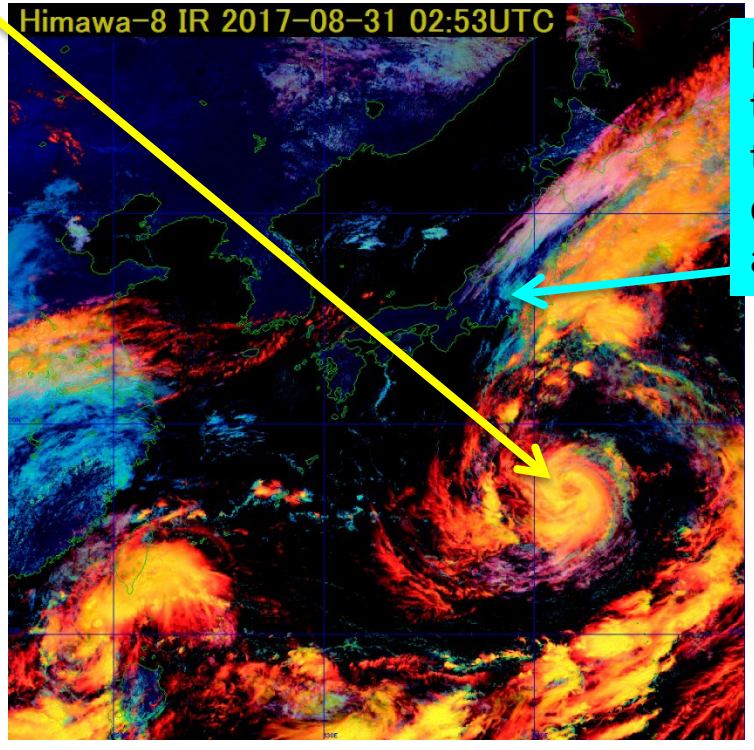


"Thick" cloud



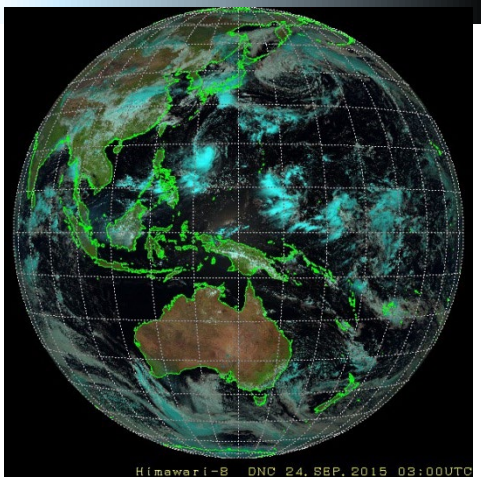
"Ice" cloud



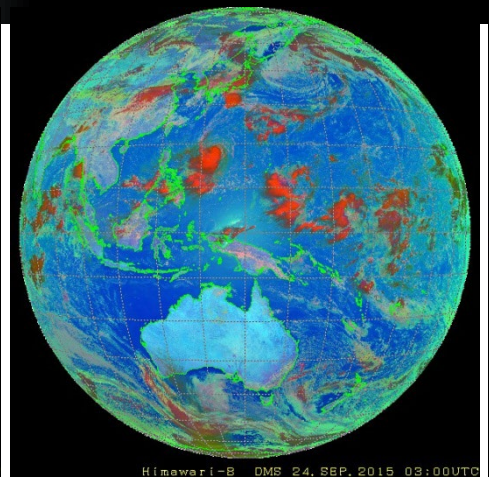


If you want to focus on the low level clouds, look at cyan area.

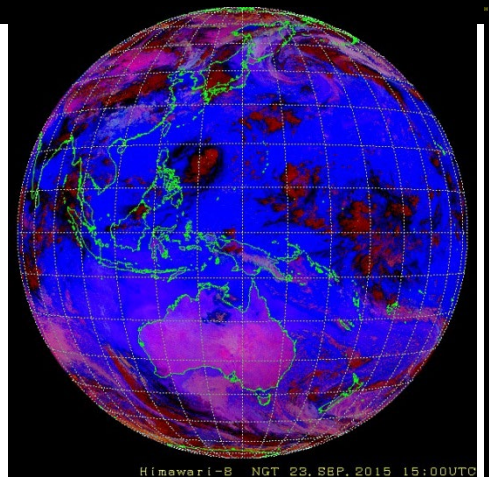
Well-known RGBs from Himawari-9



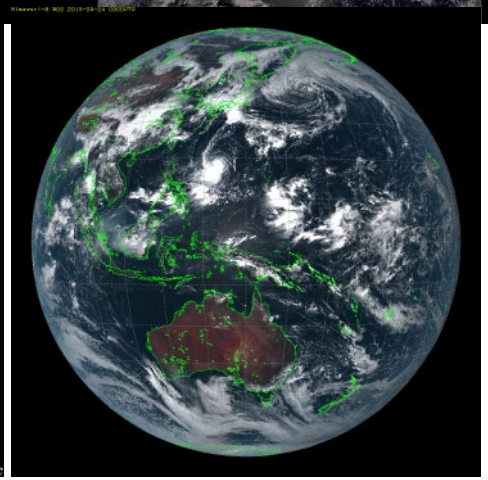
Day Natural Colors



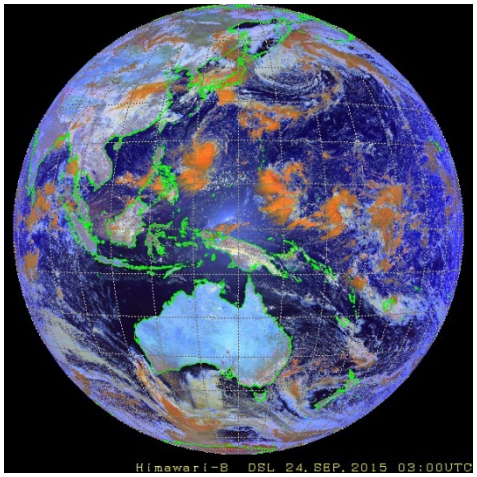
Day Microphysics



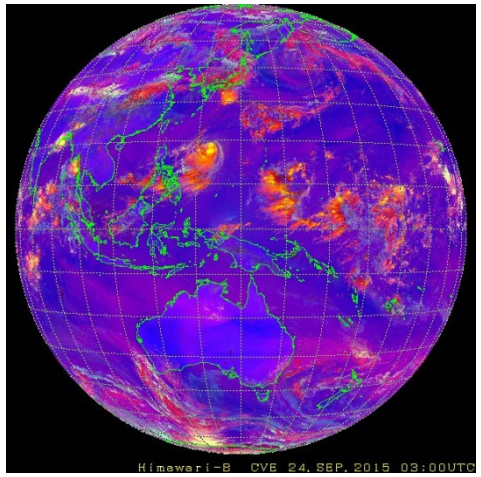
Night Microphysics



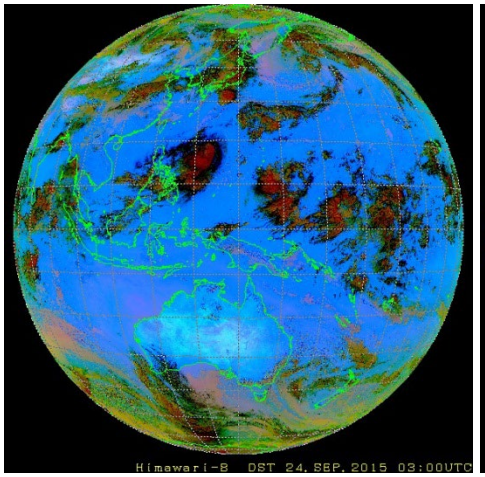
True Color



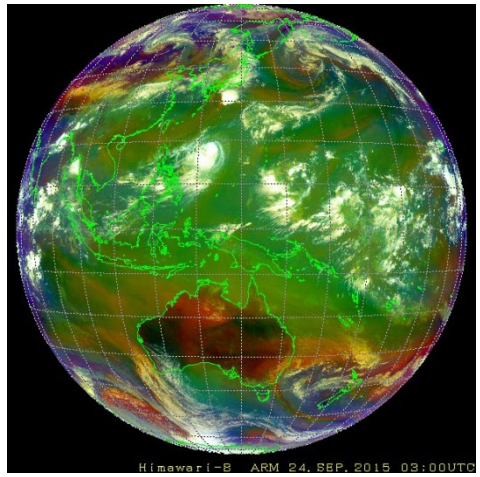
Day Snow-Fog



Day Convective Storm



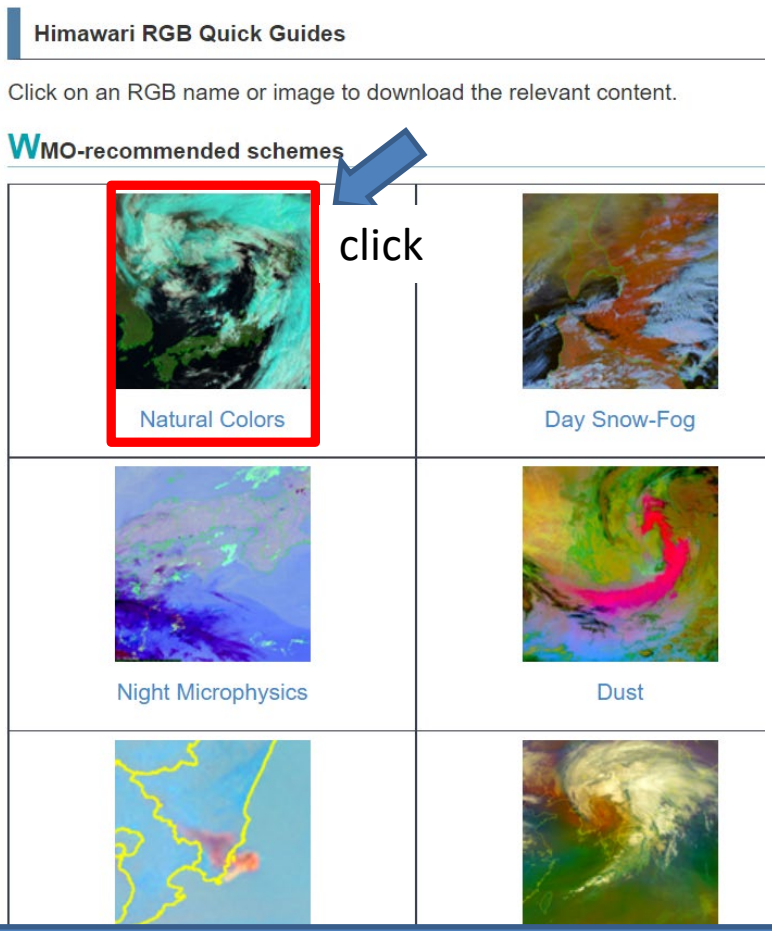
Dust



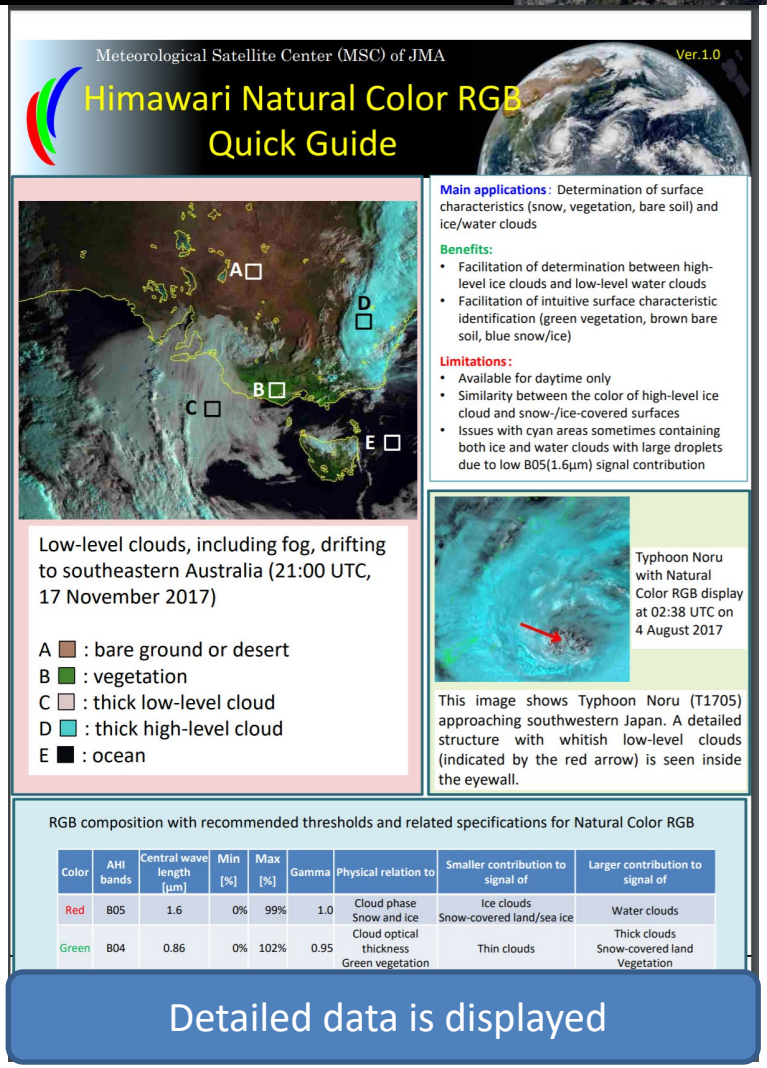
Airmass

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

RGB Quick Guides



RGB Quick Guide Web page in MSC Website

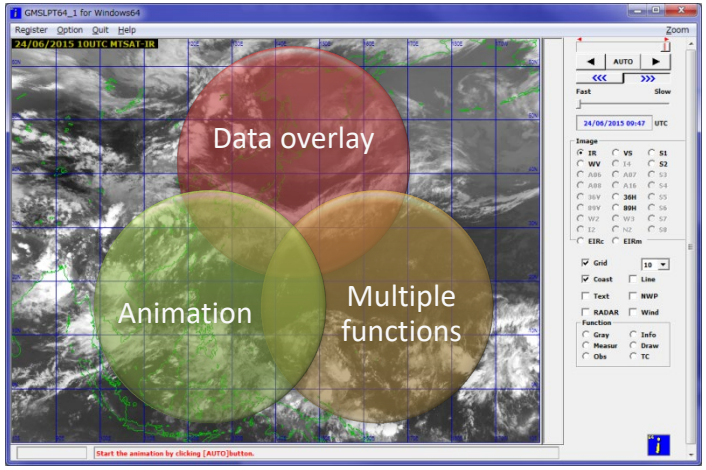


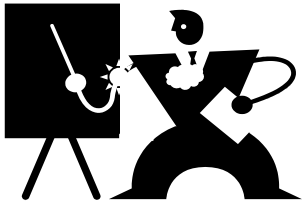
Detailed data is displayed

https://www.jma.go.jp/jma/jma-eng/satellite/VLab/RGB_QG.html

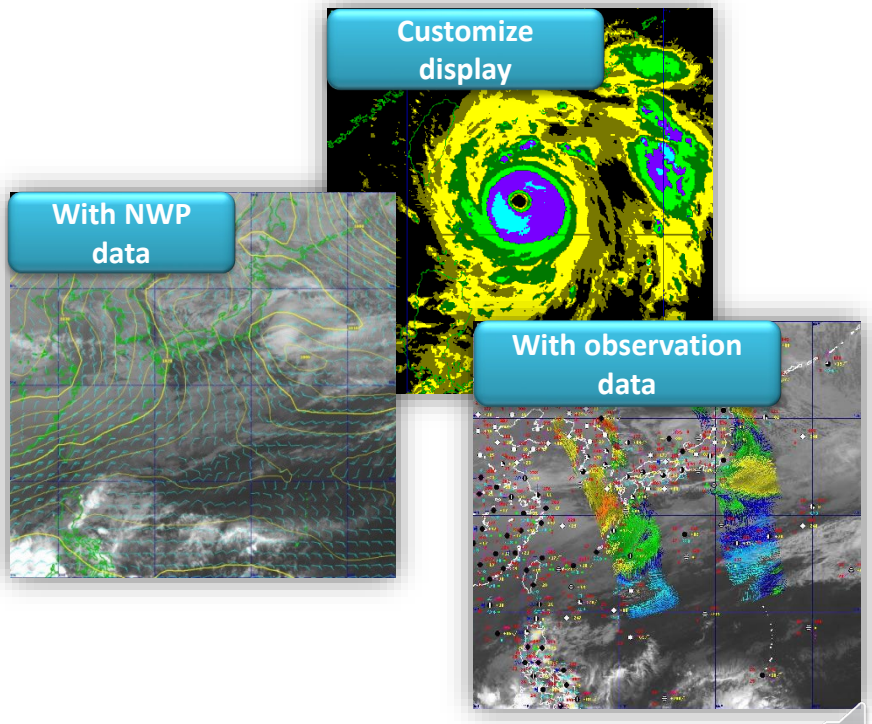
What is SATAID?

SATAID (**SAT**ellite **A**nimation and **I**nteractive **D**iagnosis) 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.





More efficiently and accurately!



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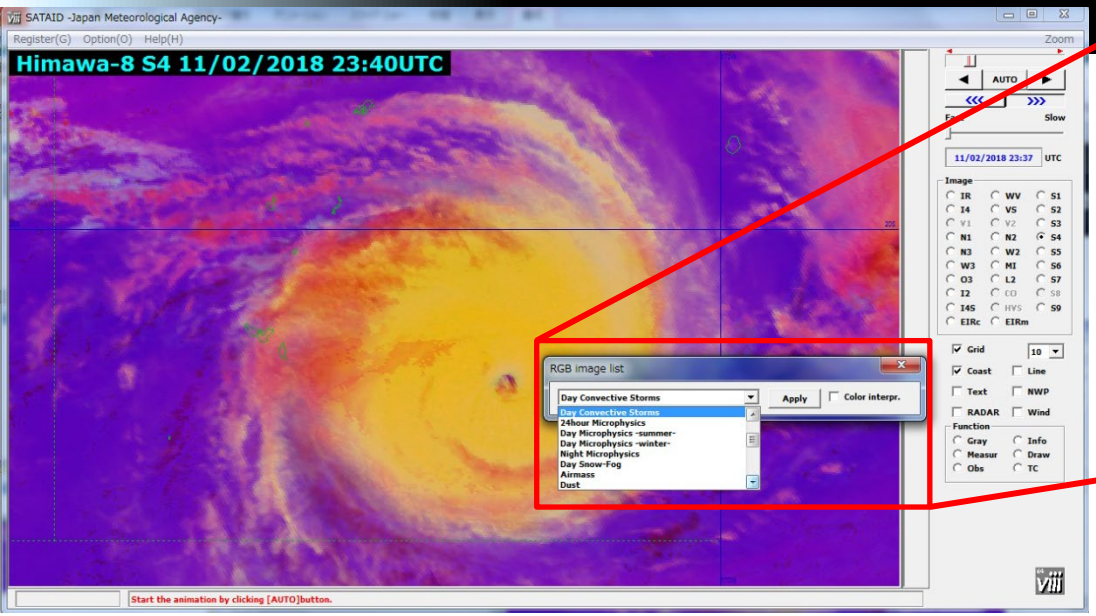
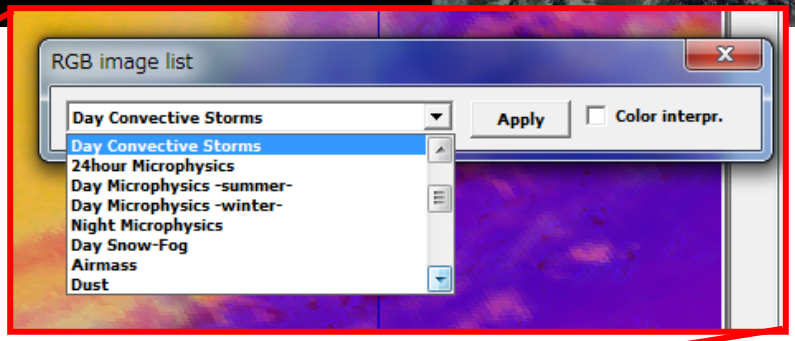
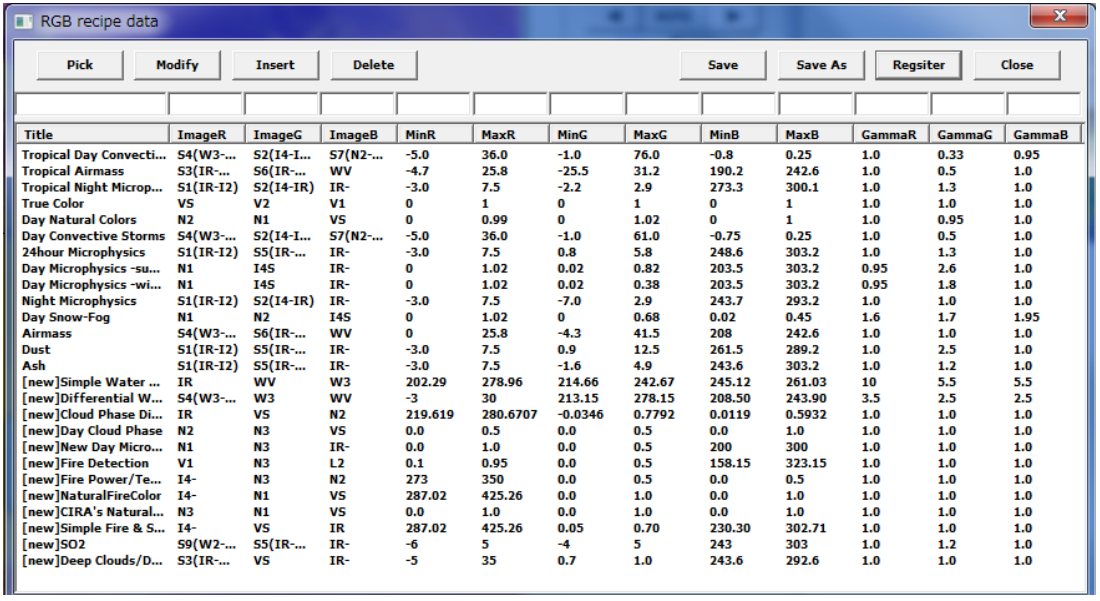
What can we do by using SATAID?

- With SATAID, you can …
  - **Display (and overlay) satellite imagery and NWP data**
    (and various observations i.e. SYNOP, SHIP, TEMP, Radar, Wind Profiler, ASCAT etc. if its format prepared)
  - **Use many functions**
    vertical cross-sectional chart, time-series chart, digital data output to CSV file.....
  - **Save as a file including a package of all data**
    your drawings and comments, which will be useful for trainings and case study archives
  - **Analyze position and intensity of tropical cyclones**

RGB composite imagery on SATAID



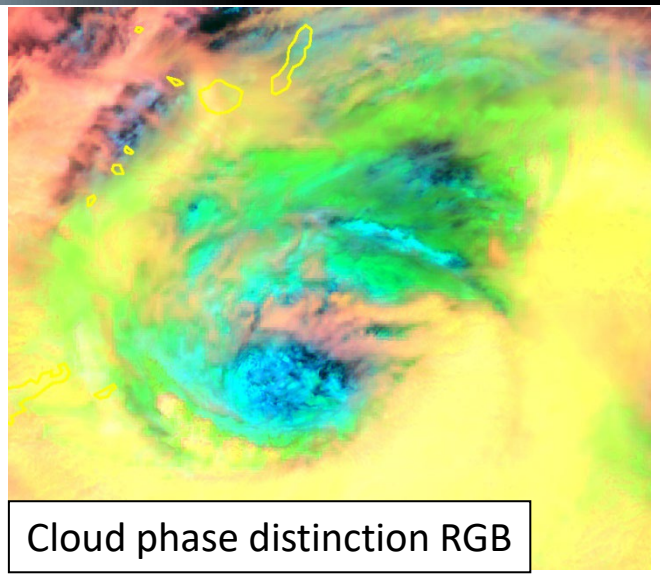




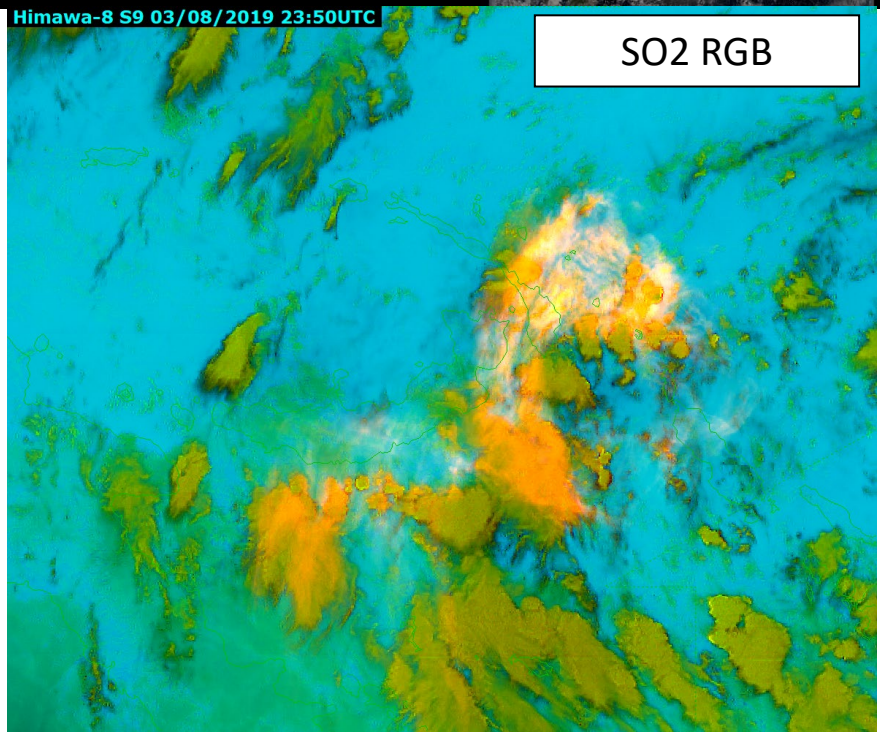
Title	ImageR	ImageG	ImageB	MinR	MaxR	MinG	MaxG	MinB	MaxB	GammaR	GammaG	GammaB
Tropical Day Convecti...	S4(W3-...	S2(I4-I...	S7(N2-...	-5.0	36.0	-1.0	76.0	-0.8	0.25	1.0	0.33	0.95
Tropical Airmass	S3(IR-...	S6(IR-...	WV	-4.7	25.8	-25.5	31.2	190.2	242.6	1.0	0.5	1.0
Tropical Night Microp...	S1(IR-I2)	S2(I4-IR)	IR-	-3.0	7.5	-2.2	2.9	273.3	300.1	1.0	1.3	1.0
True Color	VS	V2	V1	0	1	0	1	0	1	1.0	1.0	1.0
Day Natural Colors	N2	N1	VS	0	0.99	0	1.02	0	1	1.0	0.95	1.0
Day Convective Storms	S4(W3-...	S2(I4-I...	S7(N2-...	-5.0	36.0	-1.0	61.0	-0.75	0.25	1.0	0.5	1.0
24hour Microphysics	S1(IR-I2)	S5(IR-...	IR-	-3.0	7.5	0.8	5.8	248.6	303.2	1.0	1.3	1.0
Day Microphysics -su...	N1	I4S	IR-	0	1.02	0.02	0.82	203.5	303.2	0.95	2.6	1.0
Day Microphysics -wi...	N1	I4S	IR-	0	1.02	0.02	0.38	203.5	303.2	0.95	1.8	1.0
Night Microphysics	S1(IR-I2)	S2(I4-IR)	IR-	-3.0	7.5	-7.0	2.9	243.7	293.2	1.0	1.0	1.0
Day Snow-Fog	N1	N2	I4S	0	1.02	0	0.68	0.02	0.45	1.6	1.7	1.95
Airmass	S4(W3-...	S6(IR-...	WV	0	25.8	-4.3	41.5	208	242.6	1.0	1.0	1.0
Dust	S1(IR-I2)	S5(IR-...	IR-	-3.0	7.5	0.9	12.5	261.5	289.2	1.0	2.5	1.0
Ash	S1(IR-I2)	S5(IR-...	IR-	-3.0	7.5	-1.6	4.9	243.6	303.2	1.0	1.2	1.0
[new]Simple Water ...	IR	WV	W3	202.29	278.96	214.66	242.67	245.12	261.03	10	5.5	5.5
[new]Differential W...	S4(W3-...	W3	WV	-3	30	213.15	278.15	208.50	243.90	3.5	2.5	2.5
[new]Cloud Phase Di...	IR	VS	N2	219.619	280.6707	-0.0346	0.7792	0.0119	0.5932	1.0	1.0	1.0
[new]Day Cloud Phase	N2	N3	VS	0.0	0.5	0.0	0.5	0.0	1.0	1.0	1.0	1.0
[new]New Day Micro...	N1	N3	IR-	0.0	1.0	0.0	0.5	200	300	1.0	1.0	1.0
[new]Fire Detection	V1	N3	L2	0.1	0.95	0.0	0.5	158.15	323.15	1.0	1.0	1.0
[new]Fire Power/Te...	I4-	N3	N2	273	350	0.0	0.5	0.0	0.5	1.0	1.0	1.0
[new]NaturalFireColor	I4-	N1	VS	287.02	425.26	0.0	1.0	0.0	1.0	1.0	1.0	1.0
[new]CIRA's Natural...	N3	N1	VS	0.0	1.0	0.0	1.0	0.0	1.0	1.0	1.0	1.0
[new]Simple Fire & S...	I4-	VS	IR	287.02	425.26	0.05	0.70	230.30	302.71	1.0	1.0	1.0
[new]SO2	S9(W2-...	S5(IR-...	IR-	-6	5	-4	5	243	303	1.0	1.2	1.0
[new]Deep Clouds/D...	S3(IR-...	VS	IR-	-5	35	0.7	1.0	243.6	292.6	1.0	1.0	1.0

- SATAID can show RGB imagery easily by using RGB image list dropdown menu.
- Select the name of RGB imagery -> Apply
- You can edit the RGB list file and add new RGB recipe.

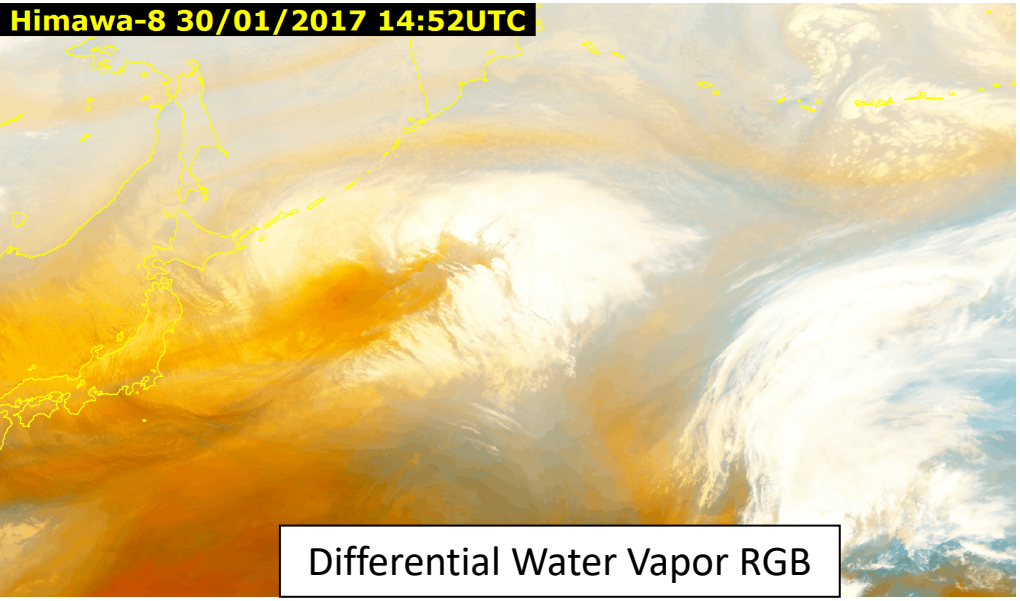
JMA original RGB recipes



Cloud phase distinction RGB



SO2 RGB



Differential Water Vapor RGB

- RGB list file for SATAID includes some JMA original RGB recipes

How can we get SATAID?

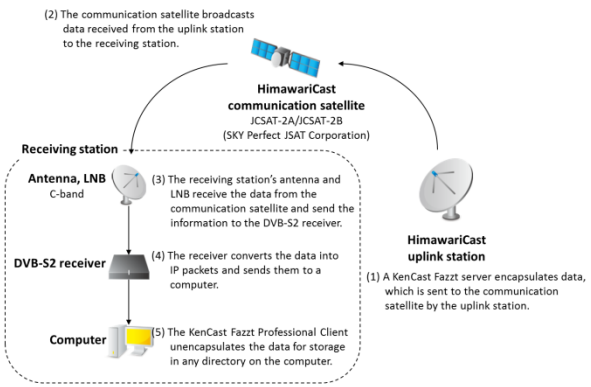
WIS Website

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

- Internet Environment is required
- 5 channels are available every 10 minutes
- ID and Password are required
  (*wis-jma at met.kishou.go.jp*)

Himawari-Cast

https://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.php



- Dedicated antenna and computers are required
- 14 channels are available every 10 minutes

Summary so far

- Himawari-8, 9 Overview

Himawari-8, 9 make Full Disk observation every 10 minutes and Region observation every 2 and a half minutes. The number of observed bands are 16, and a variety of information can be obtained. These are useful for disaster prevention and so on.

- RGB Composite

To get important information efficiently, RGB composites were developed. RGB images can be created by a simple process of image compositing. Various information is derivable by one RGB image.

- SATAID

SATAID has a variety of functions and easily displays satellite images, RGB composites and other meteorological data.