Practical Training on the utilization of Himawari-8 Imagery using SATAID

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AOMSUC-10
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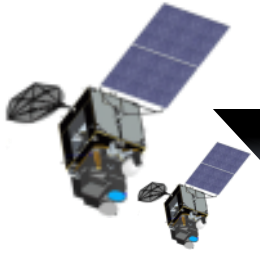
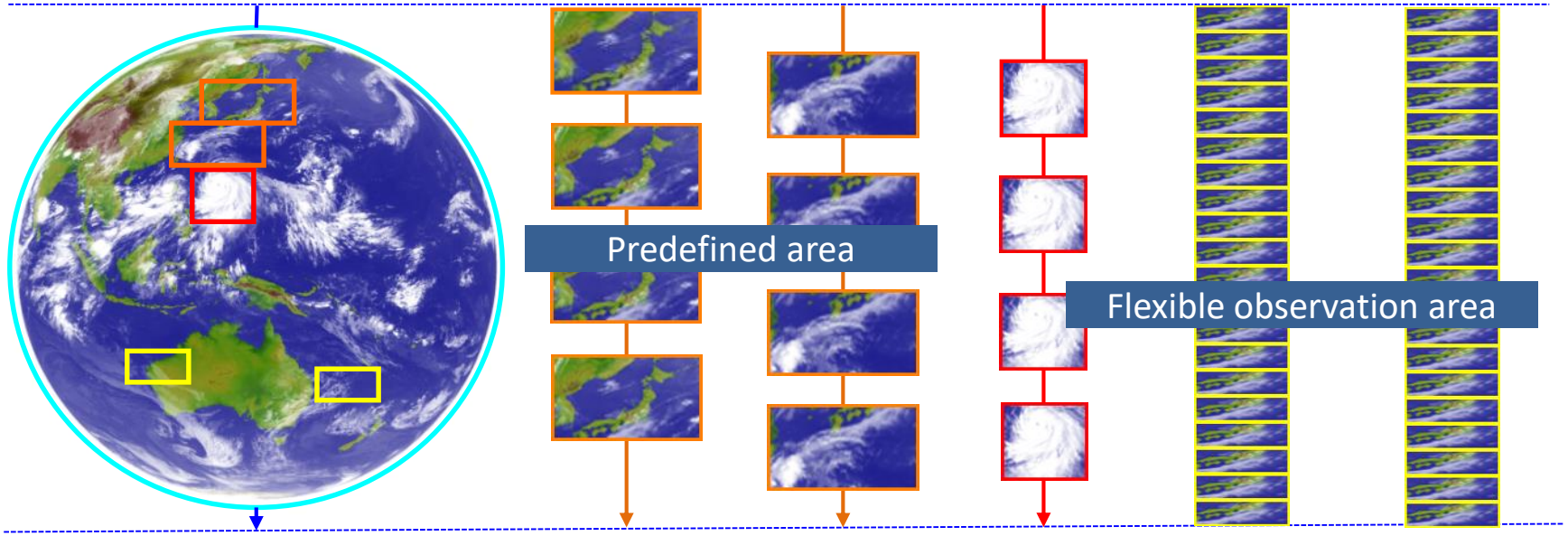


2014 Himawari-8
2016 Himawari-9

Overview of the Himawari-8 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-8 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

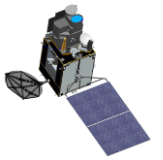
IR4 3.7 μm

IR3 6.8 μm

IR1 10.8 μm

IR2 12.0 μm

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



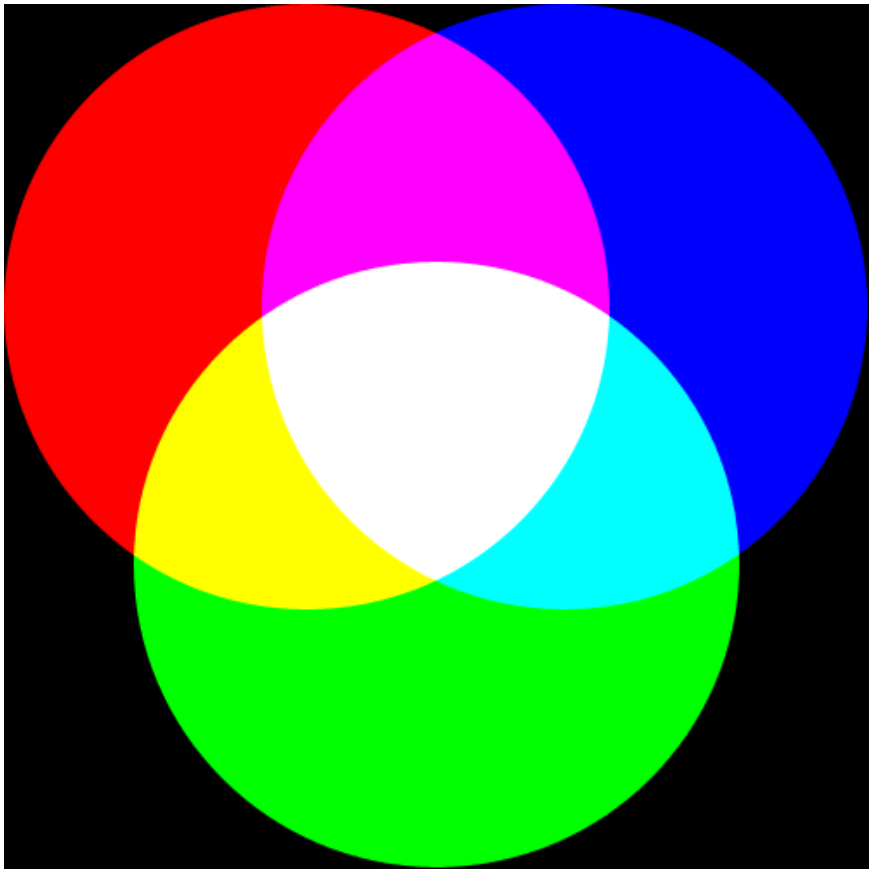
Band		Spatial Resolution	Central Wavelength	Physical Properties	
1	Visible (VIS)	1 km	0.47 μm	vegetation, aerosol	3 Visible Bands
2			0.51 μm	vegetation, aerosol	
3		0.5 km	0.64 μm	Vegetation, low cloud, fog	
4	Near Infrared (NIR)	1 km	0.86 μm	vegetation, aerosol	Addition of NIR Bands
5		2 km	1.6 μm	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	Increase of 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	Increase of 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	

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

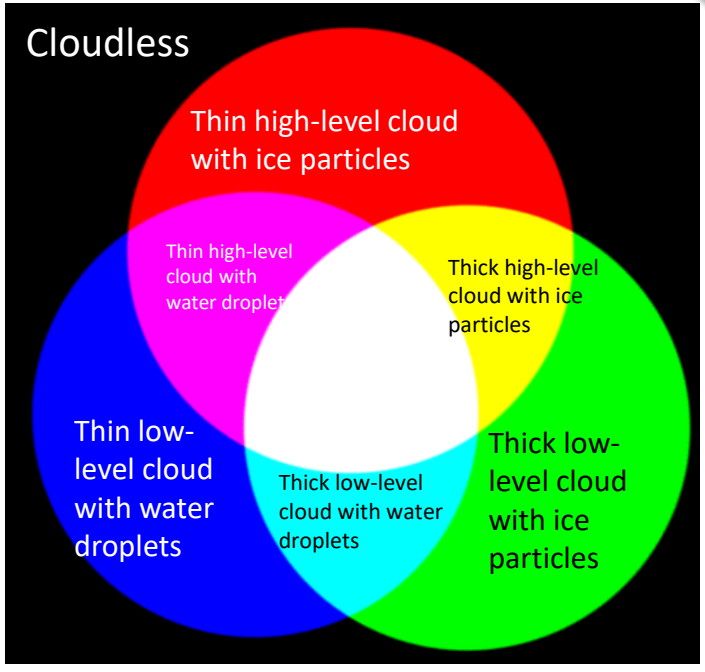


three primary colors RGB

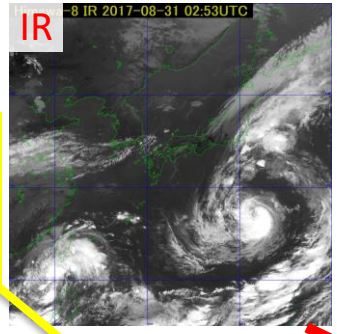
Application to Satellite Imageries

RGB composite

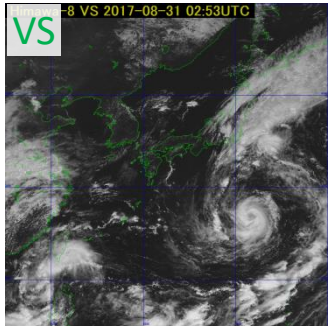
Thick and high cloud (Cb) areas appear yellow!



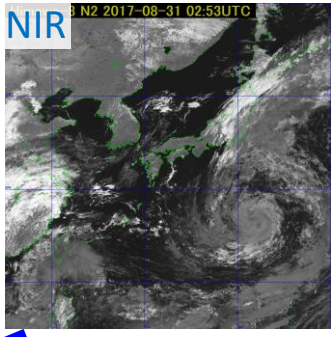
"High" cloud

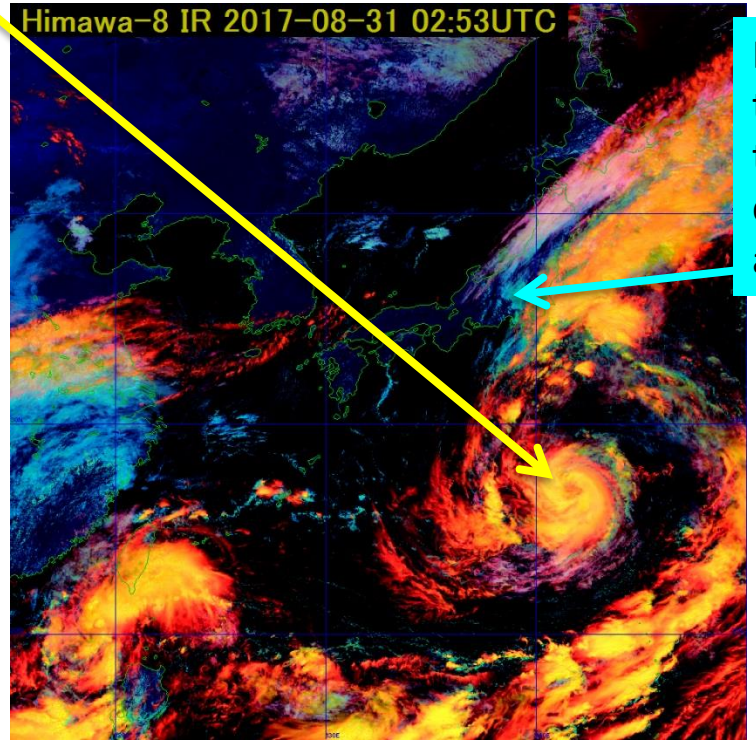


"Thick" cloud



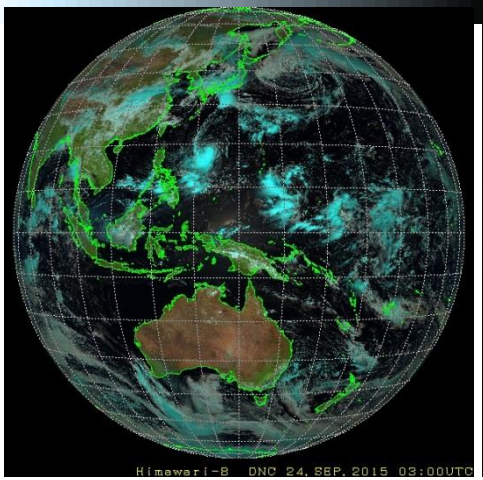
"Ice" cloud



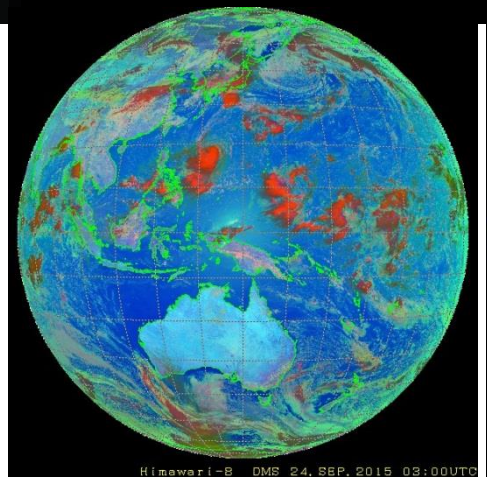


If you want to focus on the low level clouds, look at cyan area.

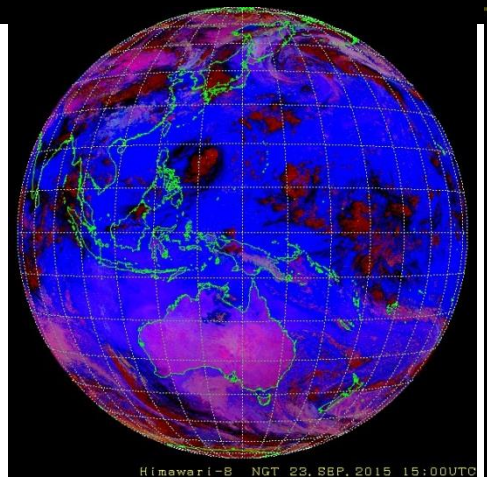
Well-known RGBs from Himawari-8



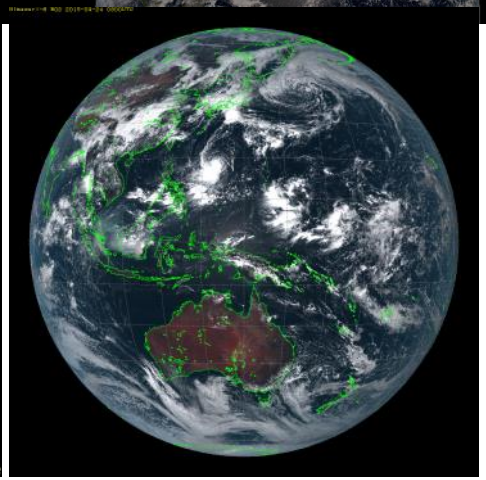
Day Natural Colors



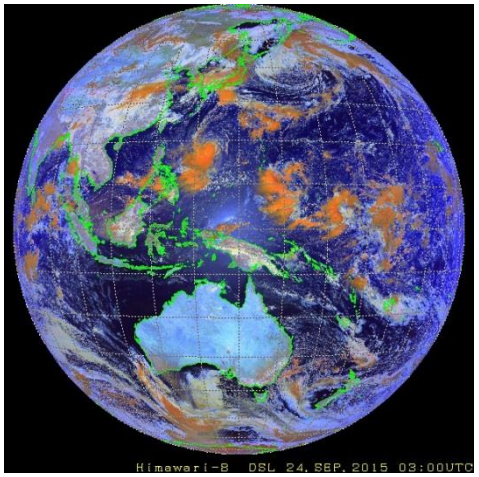
Day Microphysics



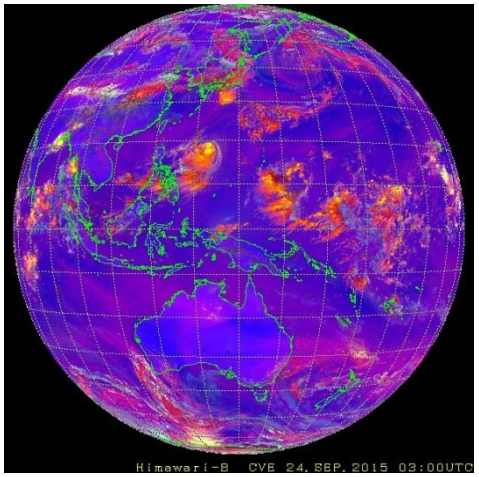
Night Microphysics



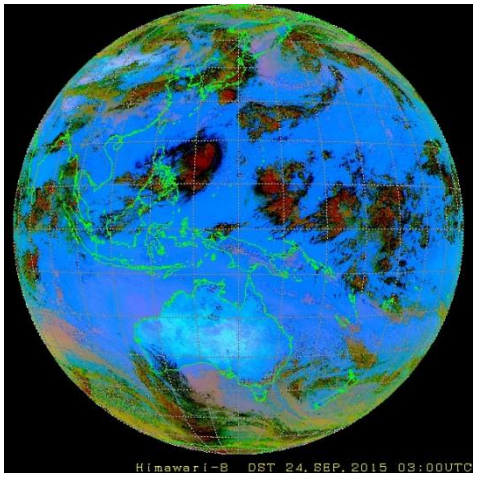
True Color



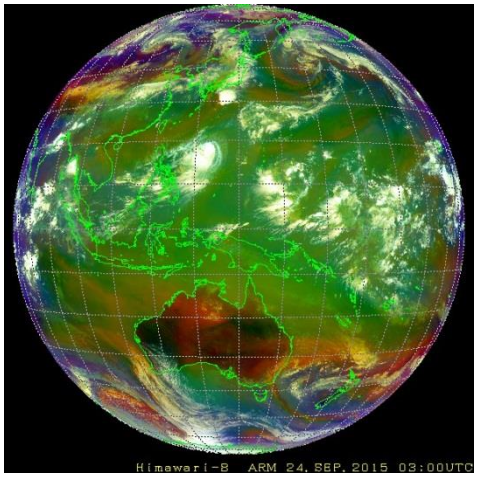
Day Snow-Fog



Day Convective Storm



Dust

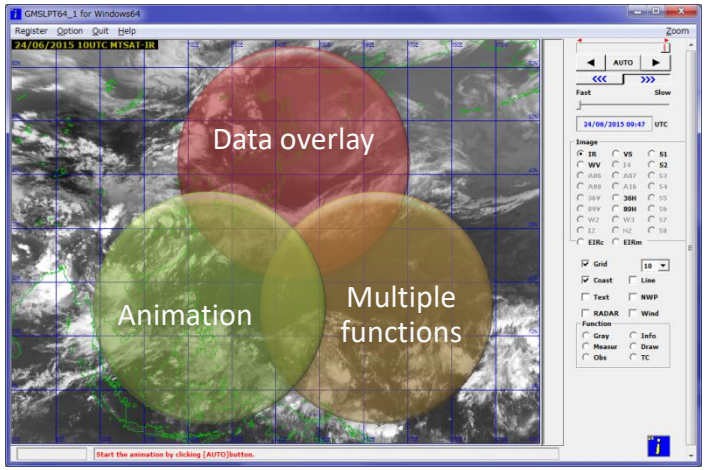


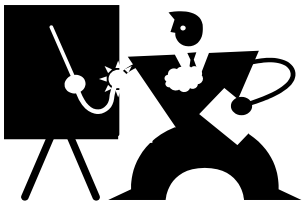
Airmass

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

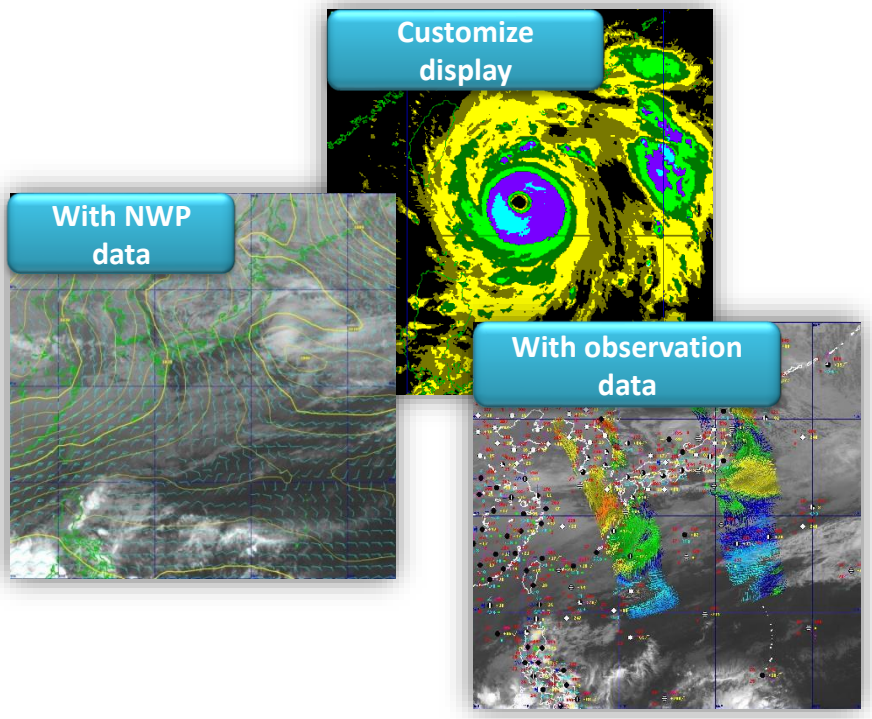
What is SATAID?

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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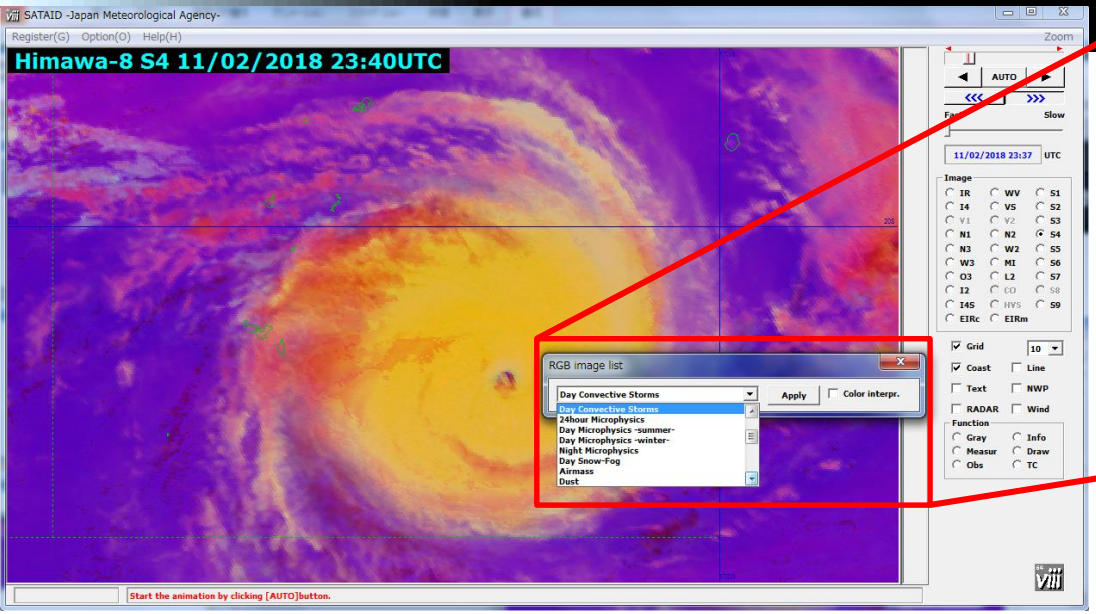
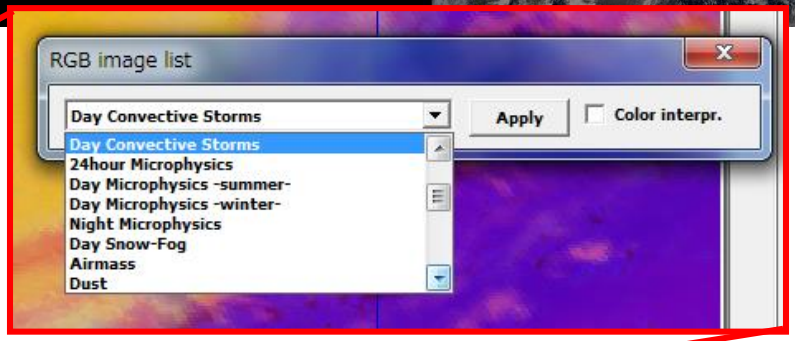
What can we do by using SATAID?

- 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





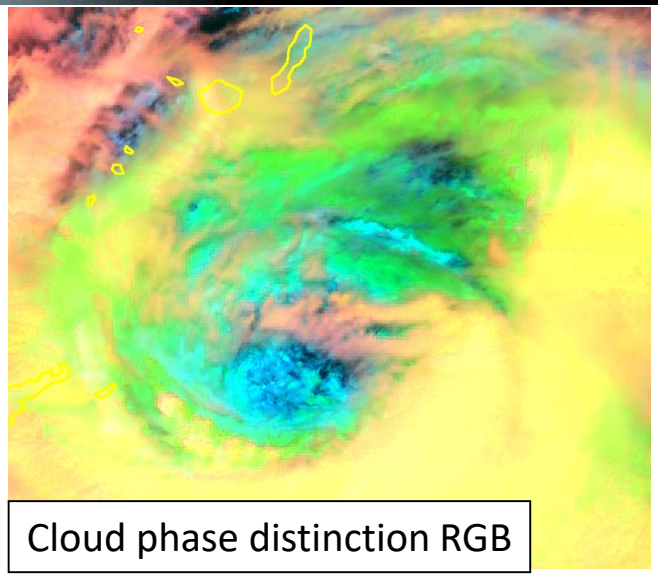
RGB recipe data

Pick | Modify | Insert | Delete | Save | Save As | Regsiter | Close

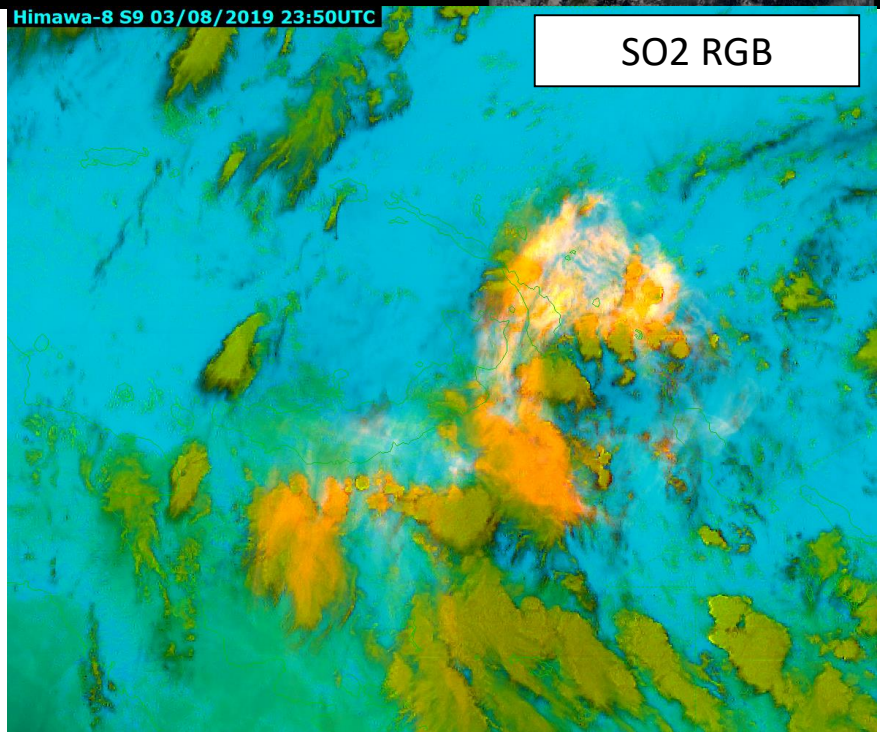
Title	ImageR	ImageG	ImageB	MinR	MaxR	MinG	MaxG	MinB	MaxB	GammaR	GammaG	GammaB
Tropical Day Convecti...	S4(W3-...	S2(I4-I...	S7(N2-...	-5.0	36.0	-1.0	76.0	-0.8	0.25	1.0	0.33	0.95
Tropical Airmass	S3(IR-...	S6(IR-...	WV	-4.7	25.8	-25.5	31.2	190.2	242.6	1.0	0.5	1.0
Tropical Night Microp...	S1(IR-I2)	S2(I4-IR)	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

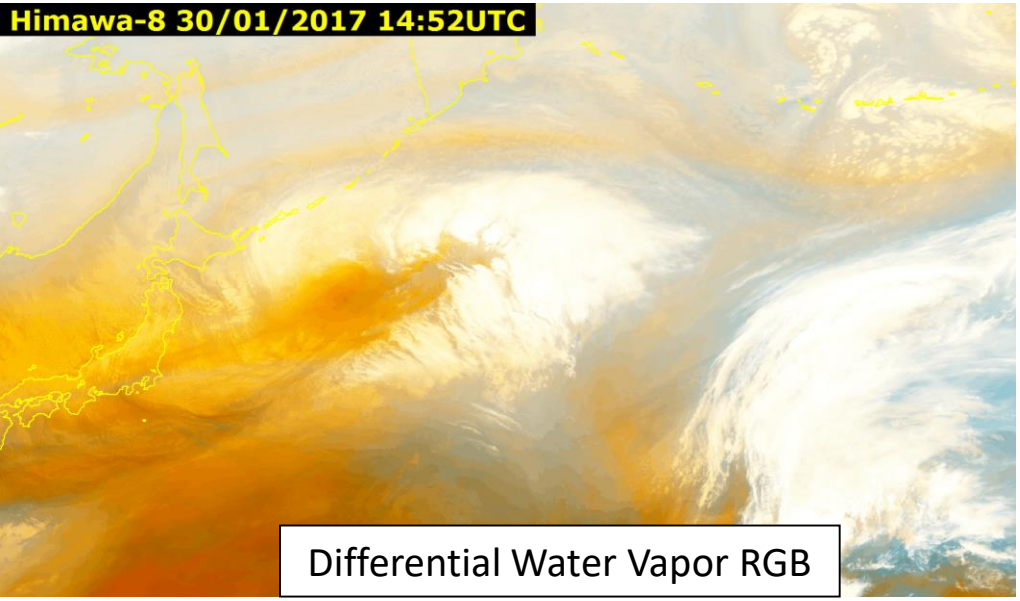
- SATAID can show RGB imagery easily by using RGB image list dropdown menu.
- Select the name of RGB imagery -> Apply
- The RGB list file can edit and you can add new RGB recipe.

JMA original RGB recipes



Cloud phase distinction RGB





Differential Water Vapor RGB

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

How can we get SATAID?

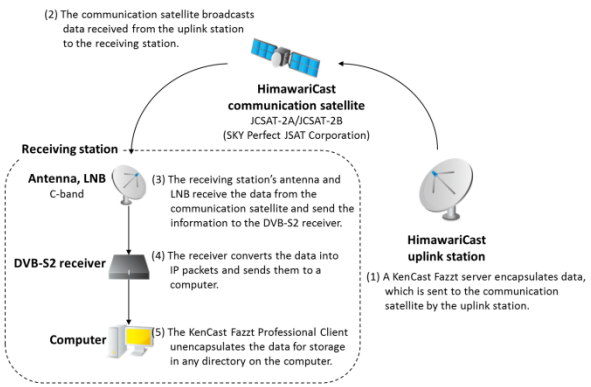
WIS Website

http://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

http://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html



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

Hands-on training on basic SATAID functions and displaying RGBs / ASWind data

It's time to practice using main SATAID functions in order to get used to its basic operations!
Then let's take a look these case studies by SATAID modules.

1. Typhoon Hagibis (T1919) approaching Japan
   - 12 October, 2019 00:00 UTC – 18:30 UTC

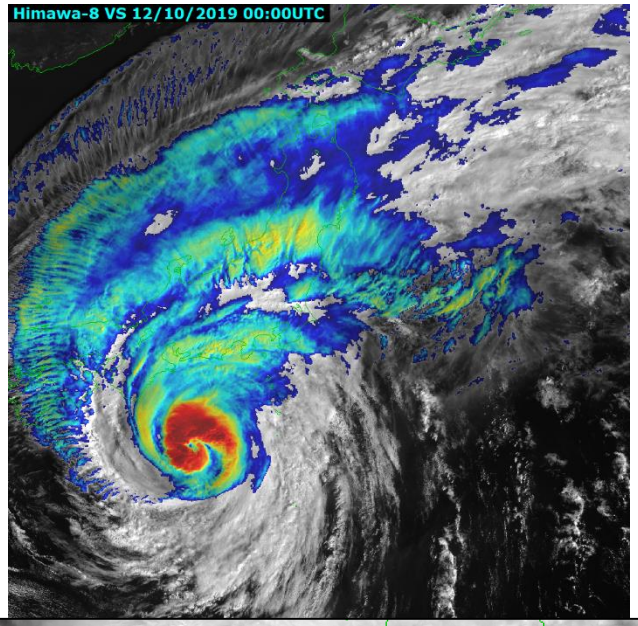
2. Flood in Papua New Guinea
   - 22 September, 2019 00:00 UTC– 23 September, 2019 18:30 UTC

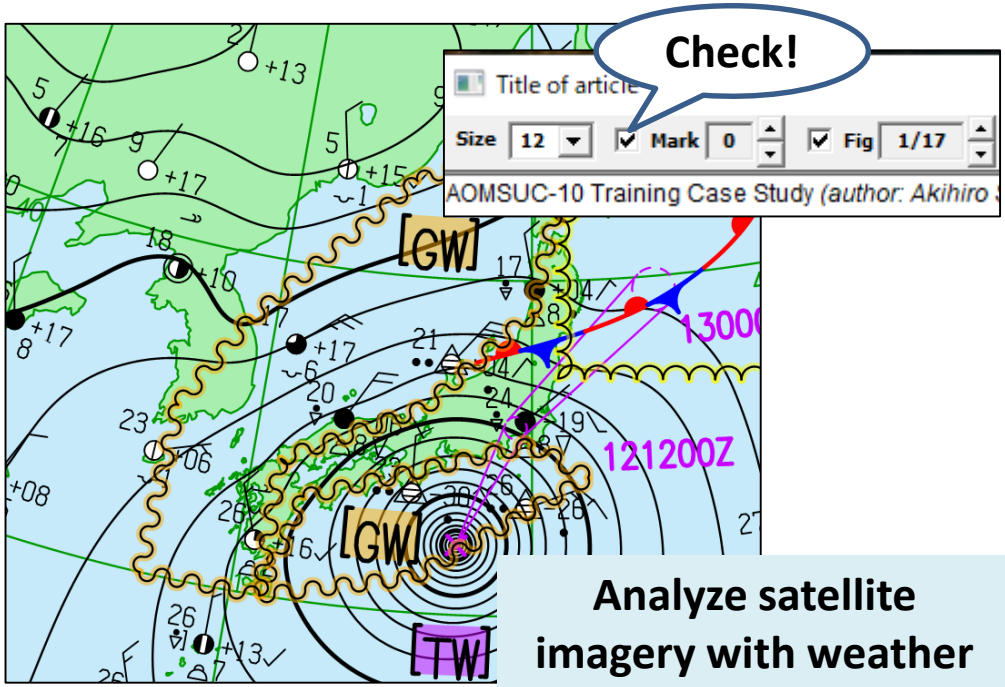
3. Volcanic eruption of Raikoke, Kuril Islands
   - 21 June, 2019 18:00 UTC– 22 June, 2019 06:00 UTC

4. Volcanic eruption of Ulawun, Papua New Guinea
   - 3 August, 2019 00:00 UTC– 4 August, 07:00 UTC

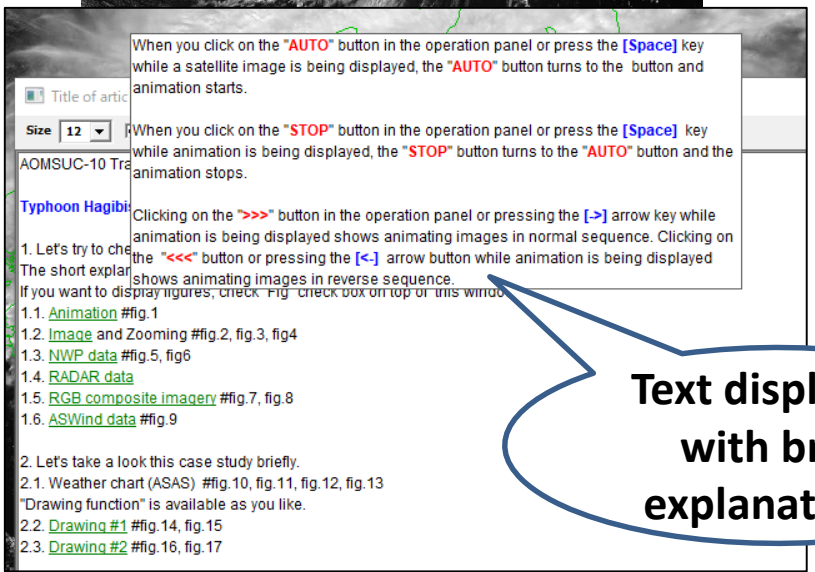
5. Tropical Storm Kajiki (T1914) hitting Hainan and Vietnam
   - 2 September, 2019 00:00 UTC– 23:50 UTC

Overview of SATAID case study modules



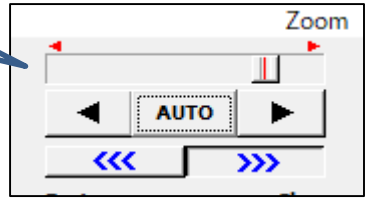


Analyze satellite imagery with weather chart, observation data and so on.

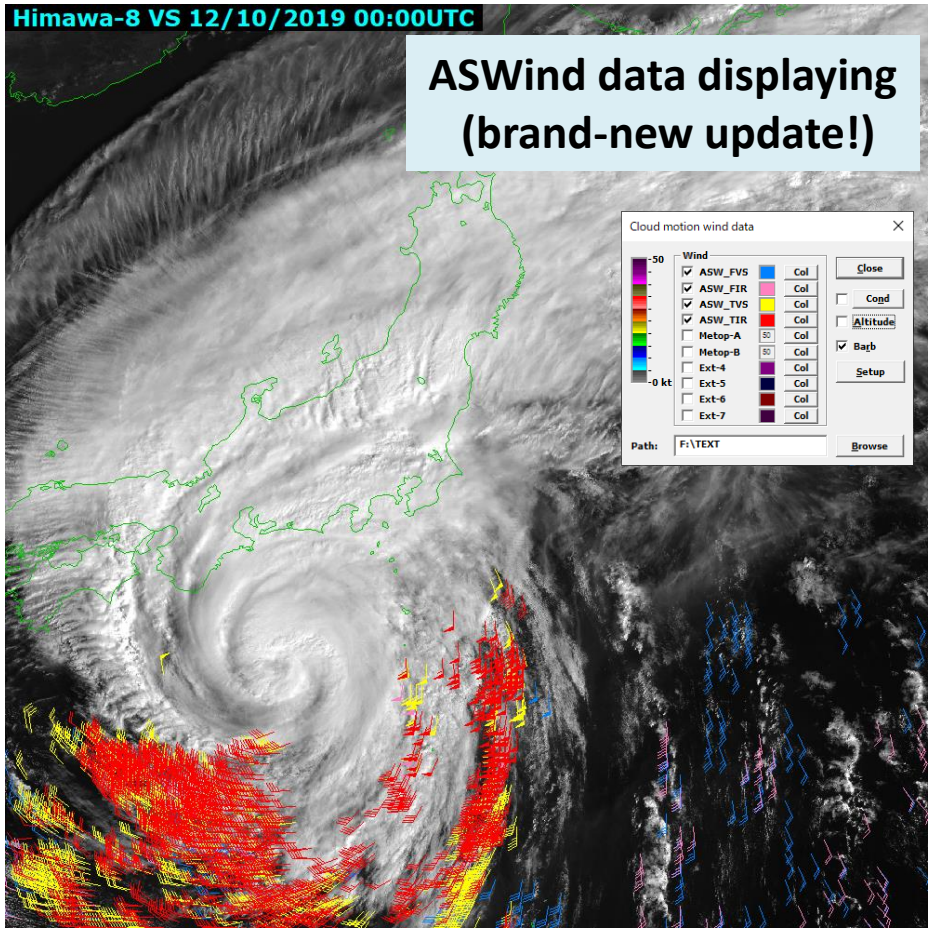


Text displaying with brief explanations.

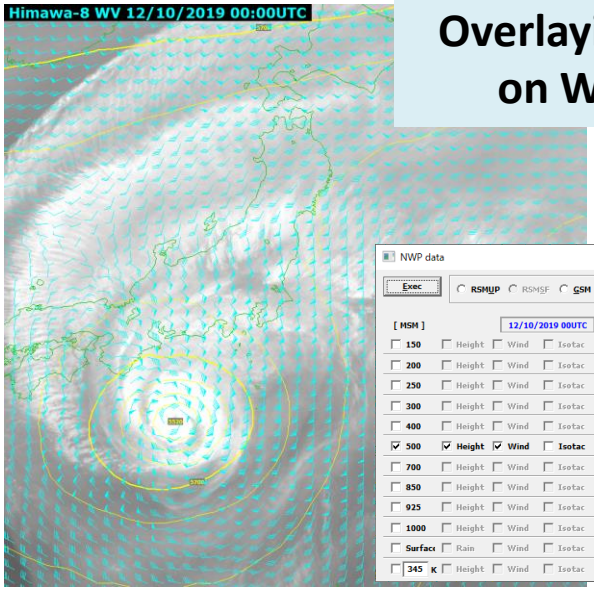
Animation makes easy to analyze satellite imagery.



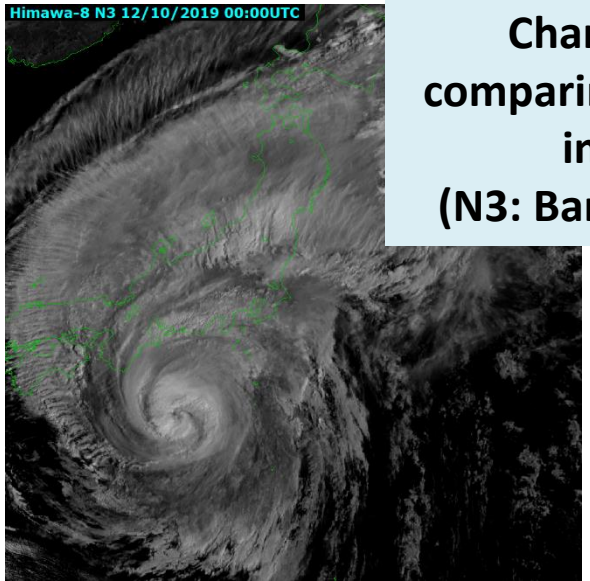
Overview of Case 1
Typhoon Hagibis (T1919) approaching Japan



ASWind data displaying (brand-new update!)



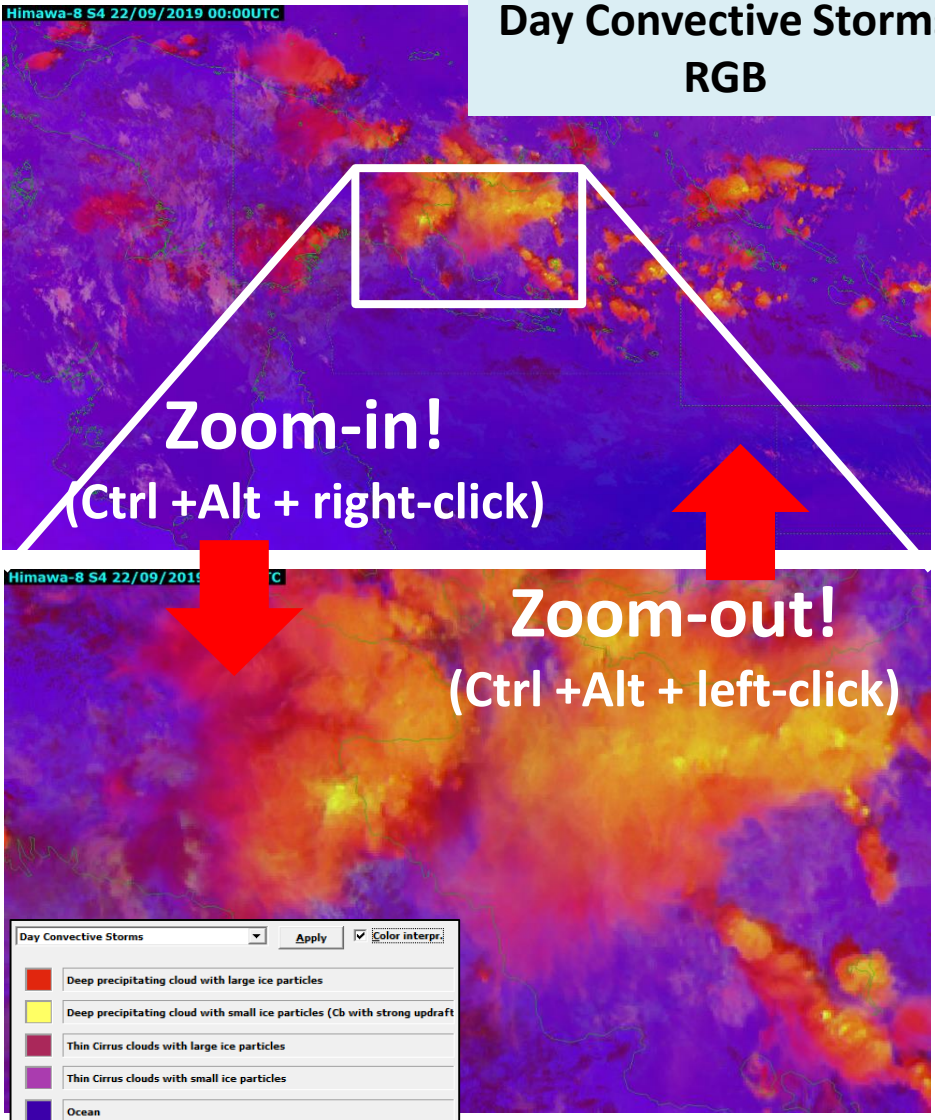
Overlaying NWP data on WV imagery



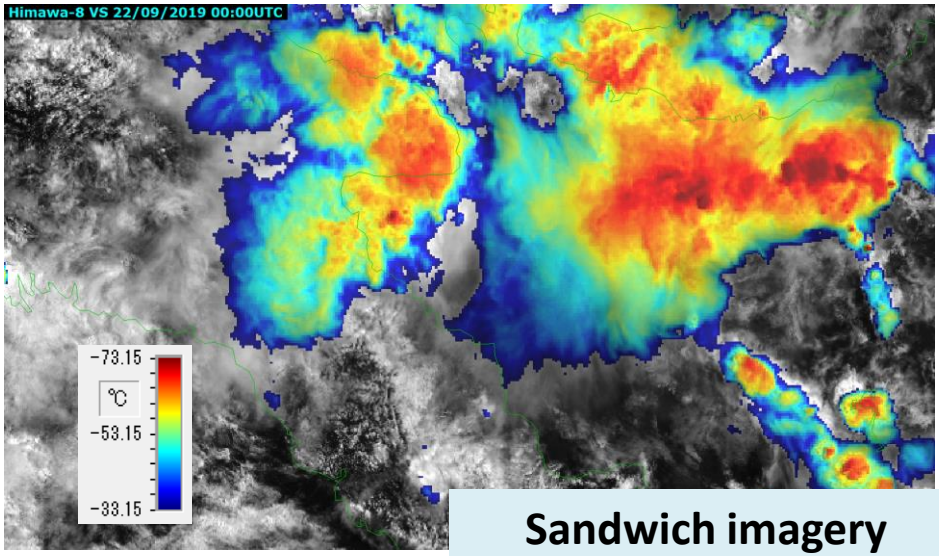
Changing and comparing multi band imagery (N3: Band 6, 2.3 μm)

Let's have a familiarity with the SATAID basic operations!

Overview of Case 2
Flood in Papua New Guinea

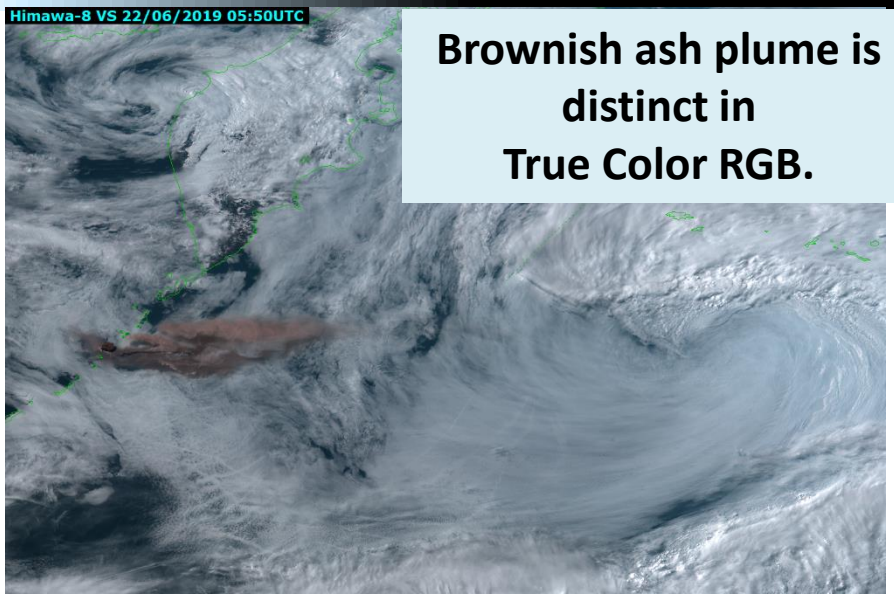


Focus on Cb clouds which brought heavy rain and flood.

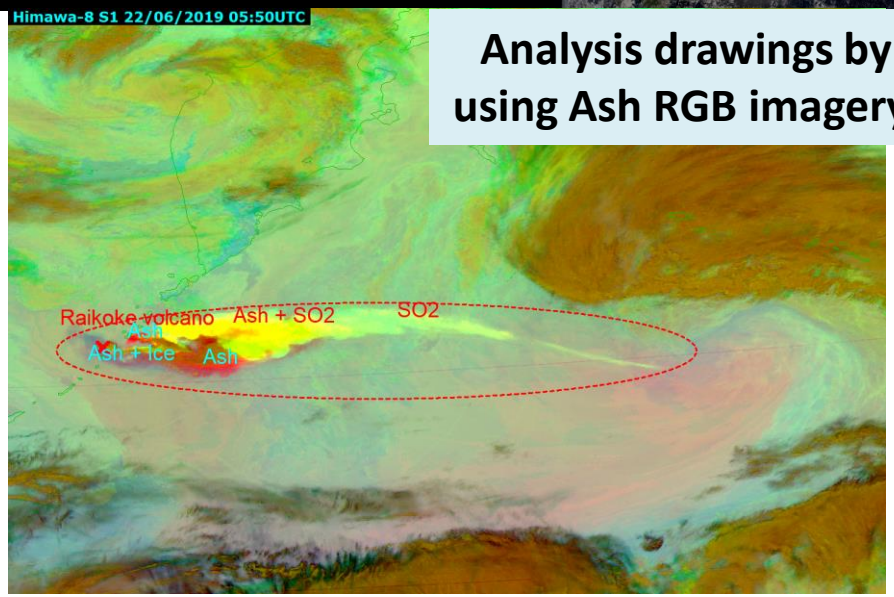


Sandwich imagery

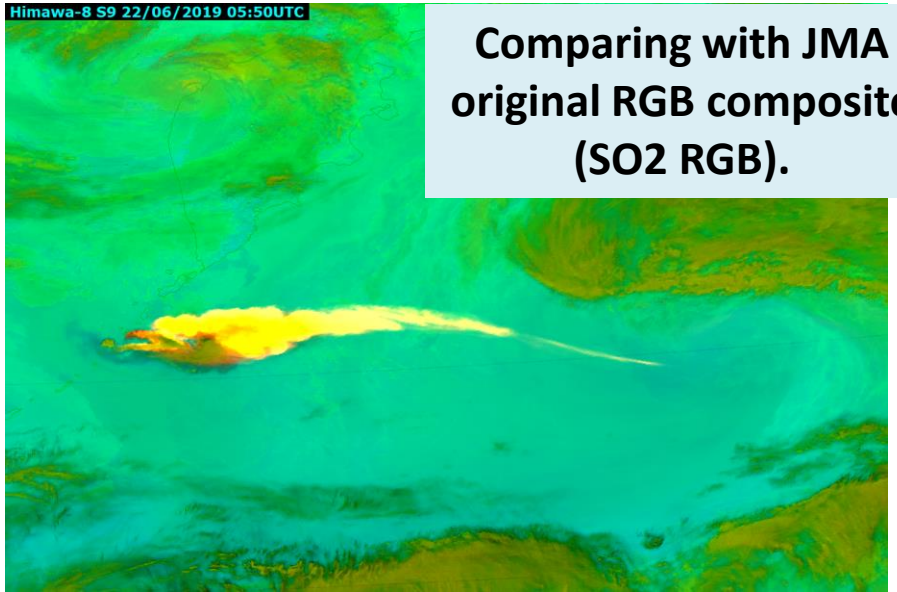
Overview of Case 3
Volcanic eruption of Raikoke, Kuril Islands



Brownish ash plume is distinct in True Color RGB.



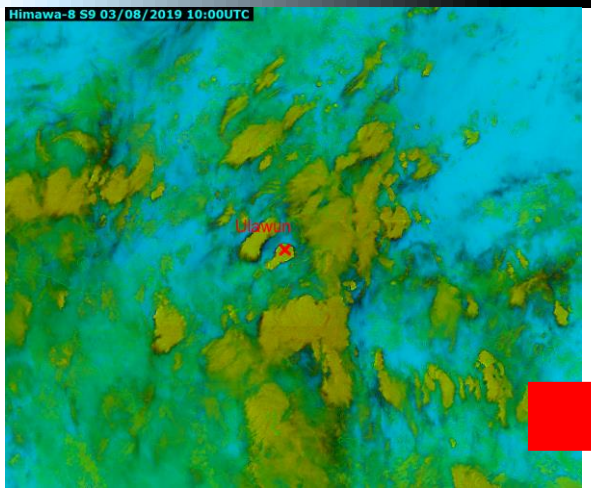
Analysis drawings by using Ash RGB imagery.

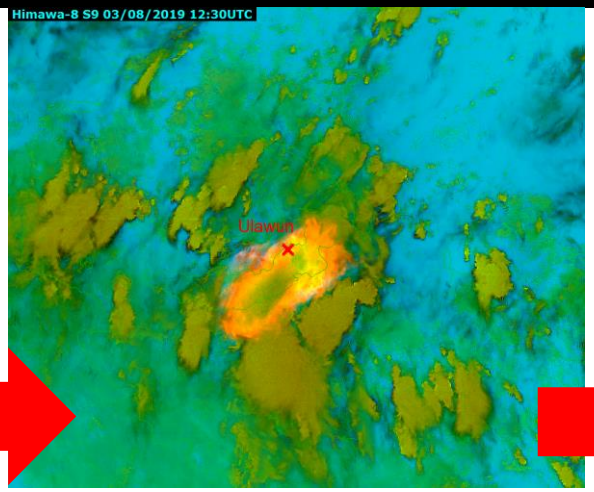


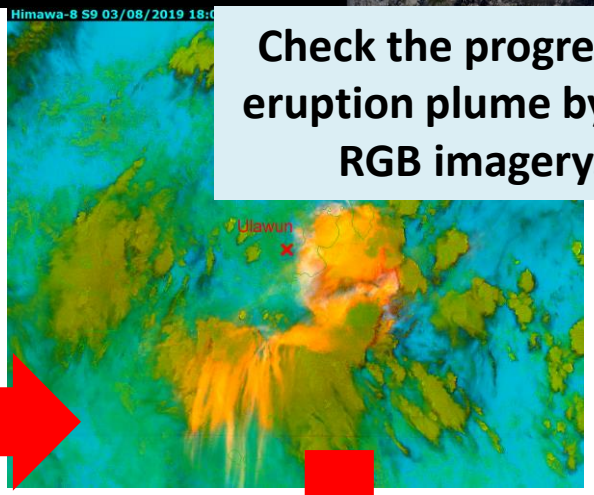
Comparing with JMA original RGB composite (SO2 RGB).

Take full advantage of multiple band imagery and RGB composites according to the purpose.

Overview of Case 4
Volcanic eruption of Ulawun, Papua New Guinea

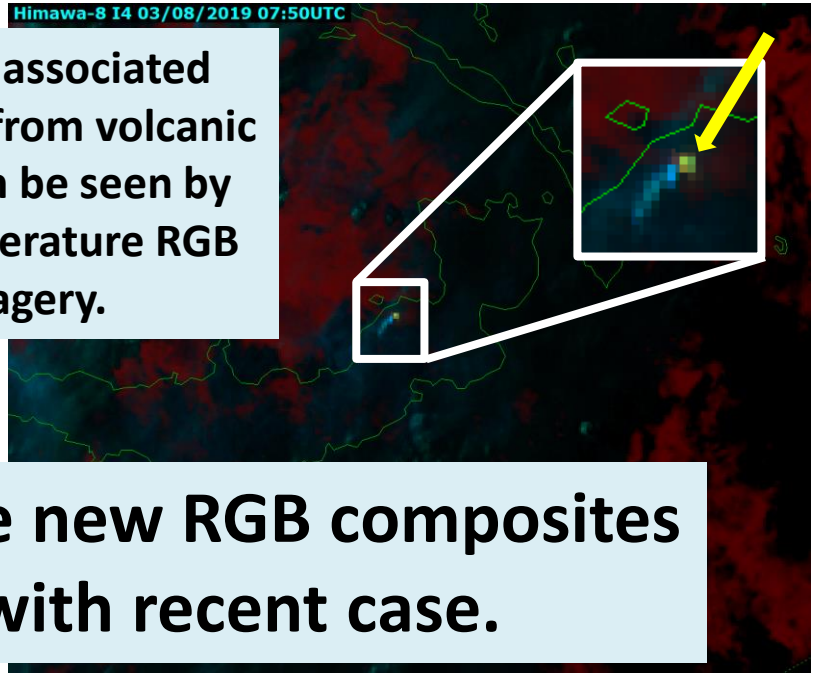


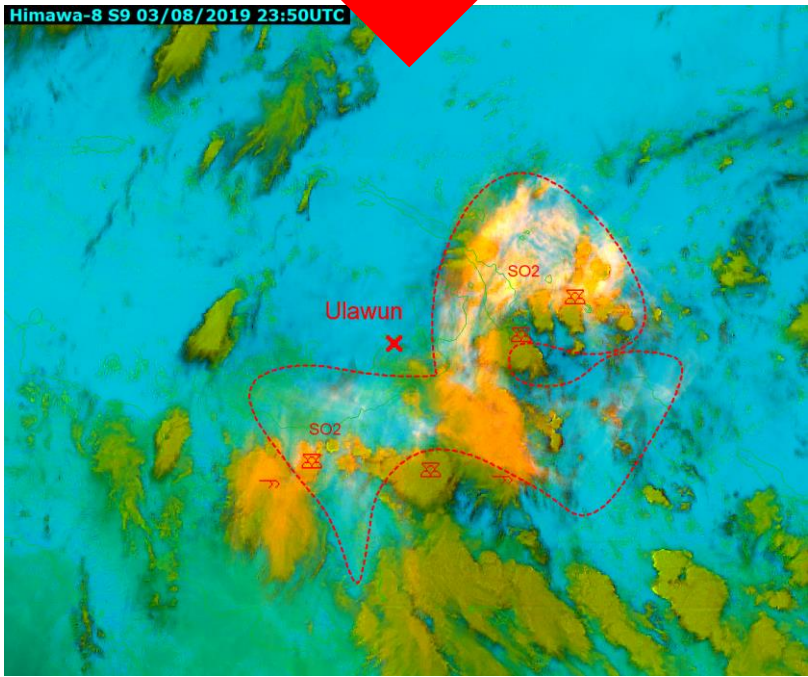




Check the progress of eruption plume by SO2 RGB imagery.

Hotspot associated with heat from volcanic crater can be seen by Fire Temperature RGB imagery.

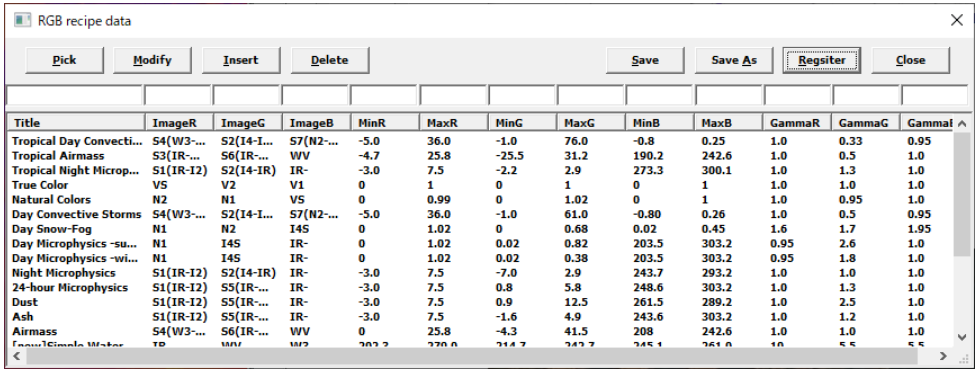




Handle new RGB composites with recent case.

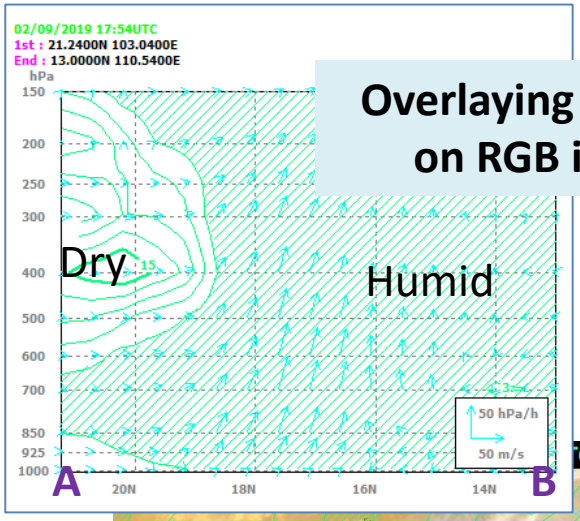
Overview of Case 5
Tropical Storm Kajiki (T1914) hitting Hainan and Vietnam

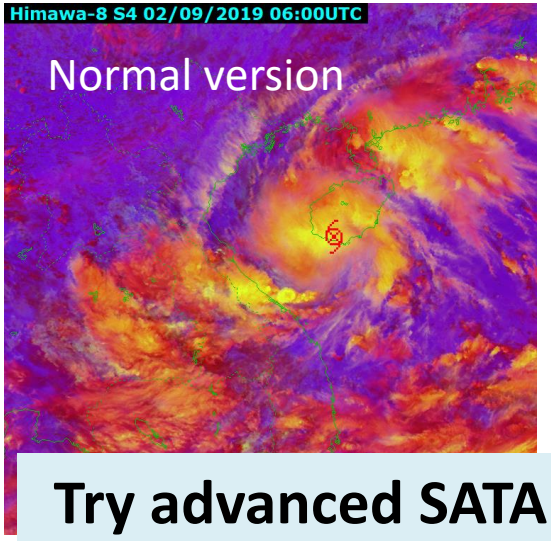
Edit RGB setting and compare carefully

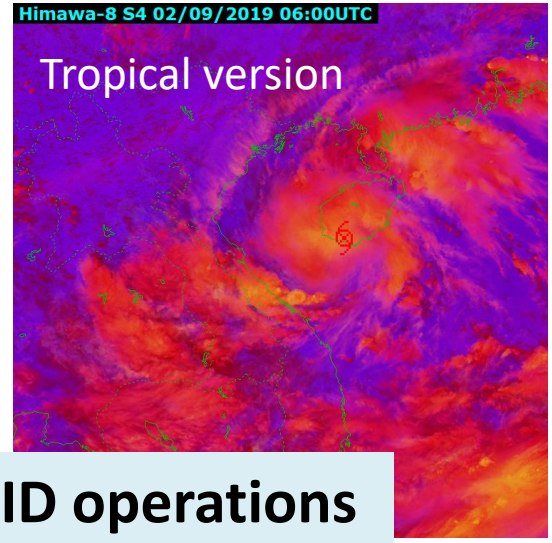


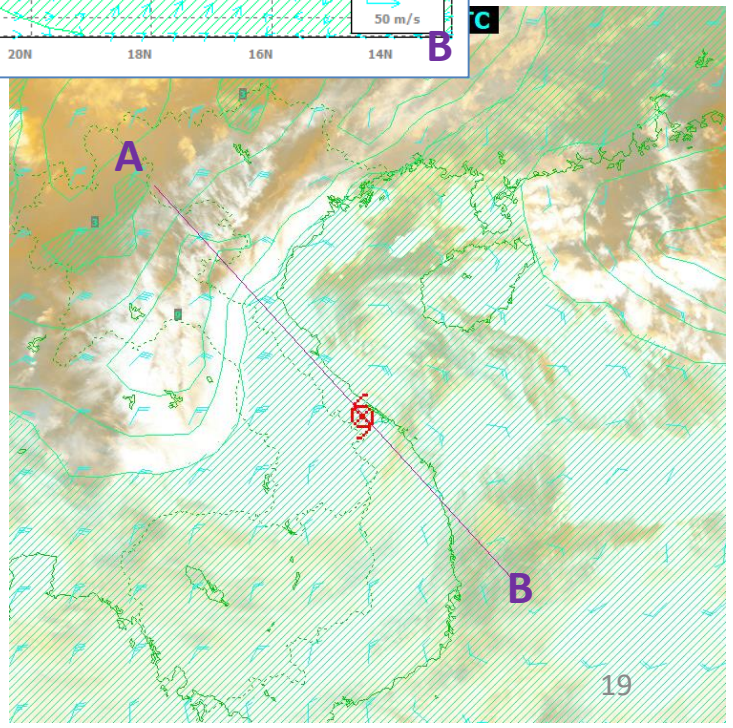
Title	ImageR	ImageG	ImageB	MinR	MaxR	MinG	MaxG	MinB	MaxB	GammaR	GammaG	Gammal
Tropical Day Convecti...	S4(W3-...	S2(I4-I...	S7(N2-...	-5.0	36.0	-1.0	76.0	-0.8	0.25	1.0	0.33	0.95
Tropical Airmass	S3(IR-...	S6(IR-...	WV	-4.7	25.8	-25.5	31.2	190.2	242.6	1.0	0.5	1.0
Tropical Night Microp...	S1(IR-I2)	S2(I4-IR)	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
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	-0.80	0.26	1.0	0.5	0.95
Day Snow-Fog	N1	N2	I4S	0	1.02	0	0.68	0.02	0.45	1.6	1.7	1.95
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
24-hour 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
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
Airmass	S4(W3-...	S6(IR-...	WV	0	25.8	-4.3	41.5	208	242.6	1.0	1.0	1.0

Overlaying NWP data on RGB imagery









Try advanced SATAID operations by using this module!

Summary

- SATAID can display satellite imagery with other observation (ex.in-situ, radar) and NWP datasets.
- SATAID can display RGB composite imagery by simple operation.
- RGB composite imagery is useful tool for using AHI multi bands efficiently.
- SATAID can show WMO standard RGB recipes and JMA original recipes.
- We challenged hands-on practical training of RGB case studies by using SATAID.

Thank you
for your participation!

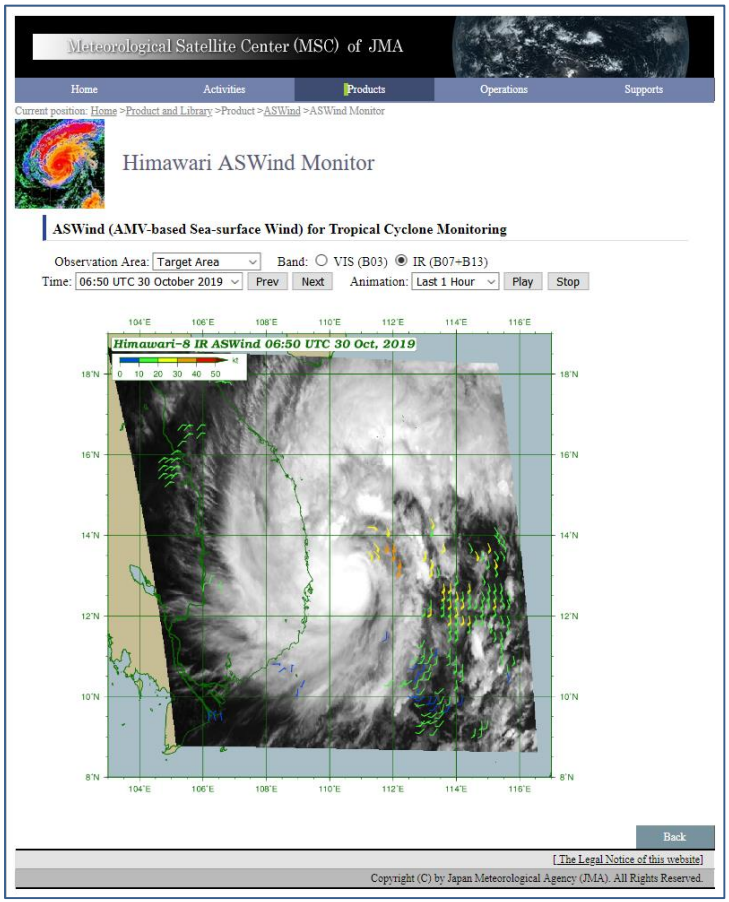
Appendices

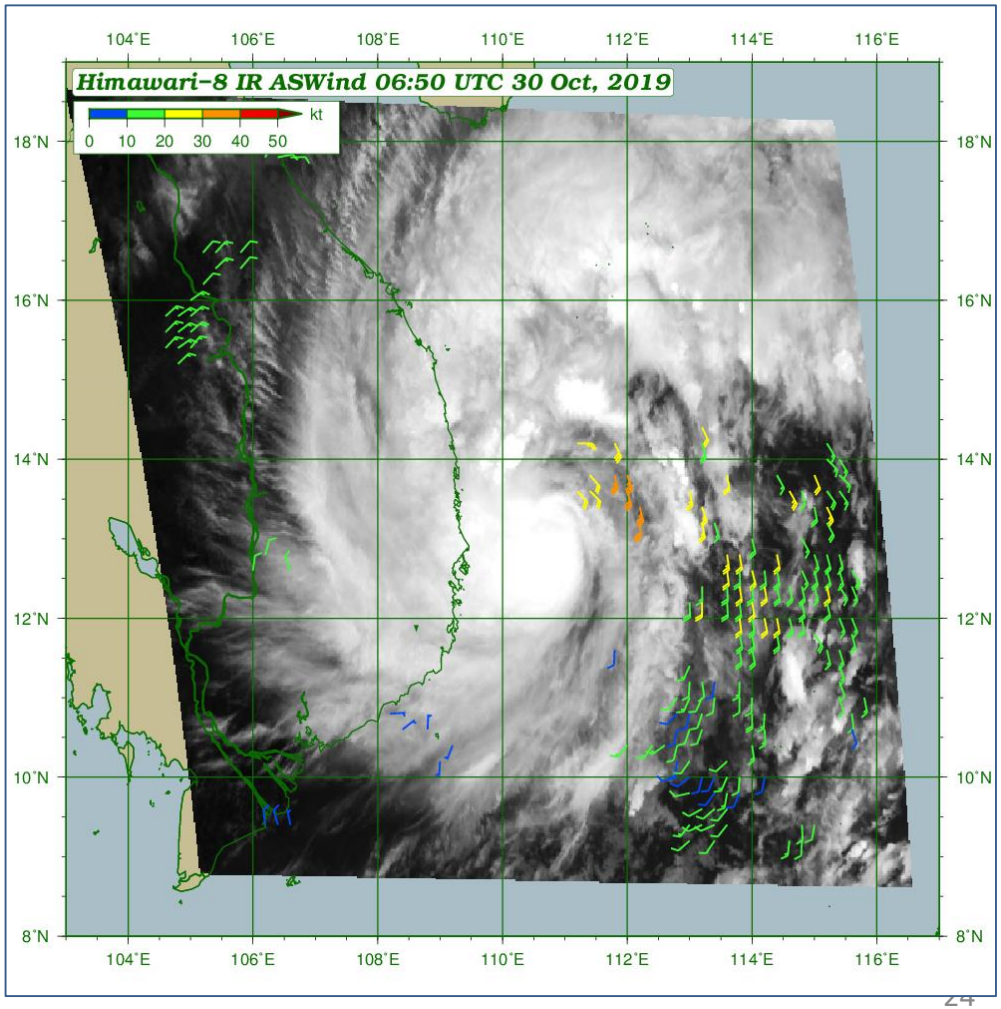
Himawari satellite imagery & products on websites

Himawari ASWind Monitor

ASWind (AMV-based Sea-surface Wind) for Tropical Cyclone Monitoring

https://www.data.jma.go.jp/mscweb/en/product/product/aswind/monitor/aswind.php





Imagery products for Asia-Oceania Region

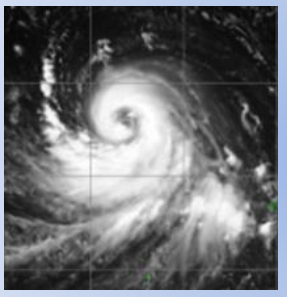
Anyone can get these products by Real-time JPEG imagery service through MSC website for Asia-Oceania region via the Internet.
http://www.data.jma.go.jp/mscweb/data/himawari/index.html

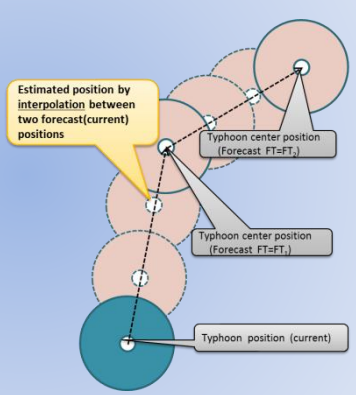
Providing imagery on MSC website

- Easy access to Himawari imagery
- **Processed into sectored images in JPEG format for**
  - Australia
  - Central Asia
  - Pacific Islands
  - Southeast Asia

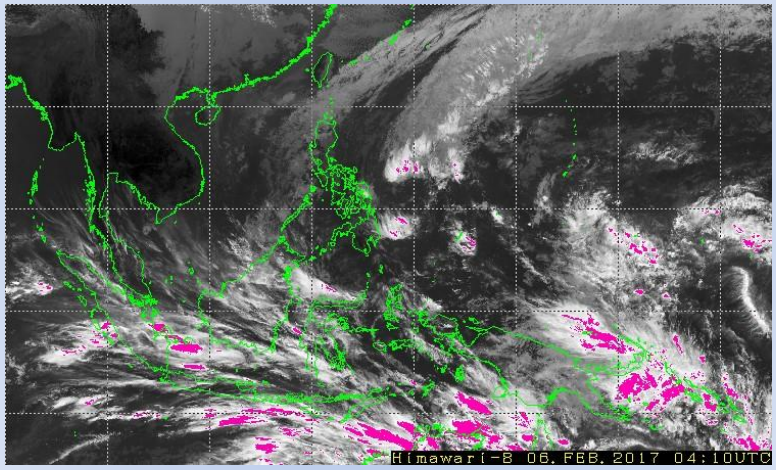
and more....
on real-time basis with animation in the last 23 hours

Target area observation

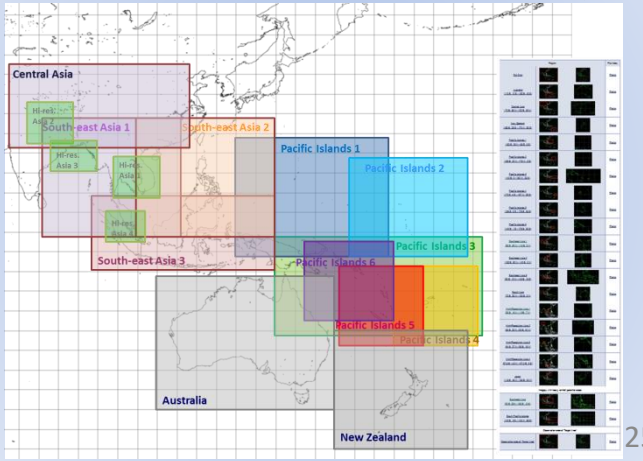




Imagery with heavy rainfall potential areas

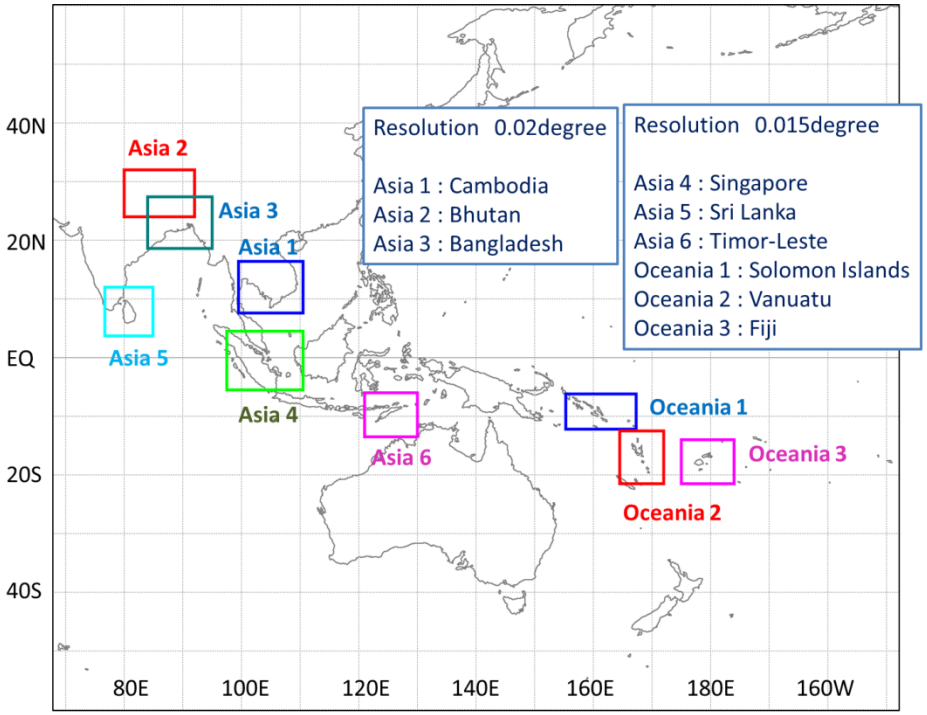


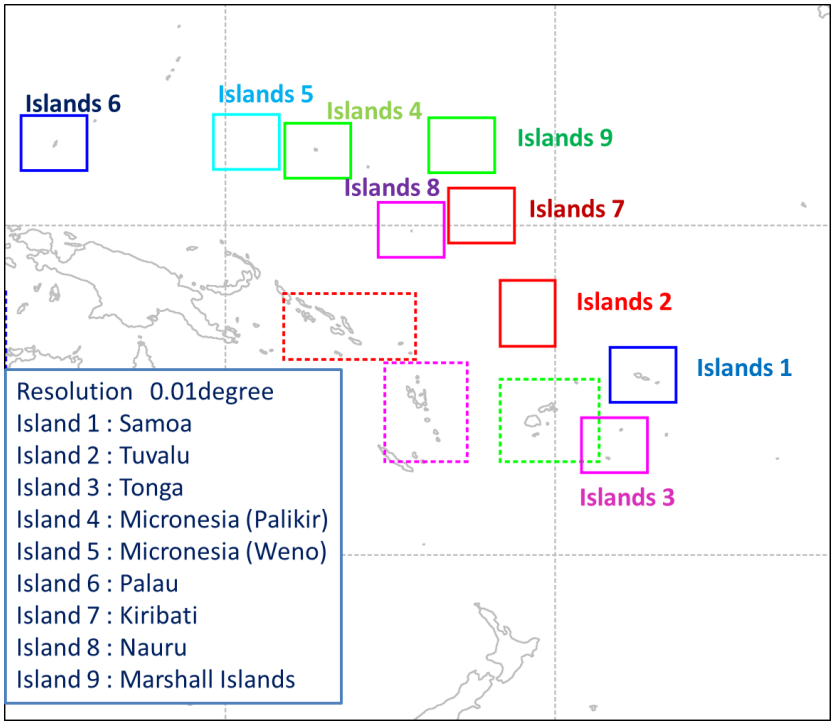
Real-time JPEG Imagery Service through JMA/MSC Website for Asia-Oceania Region



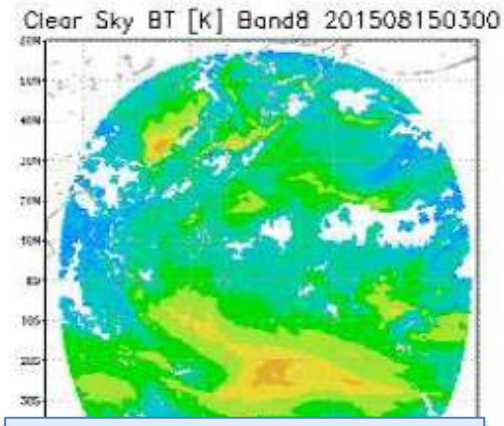
Real-time JPEG Imagery Service on JMA/MSC Website for Oceania Region

JMA/MSC provide high resolution imagery with tiny file size via the Internet to be able to get even under an unstable Internet environment.

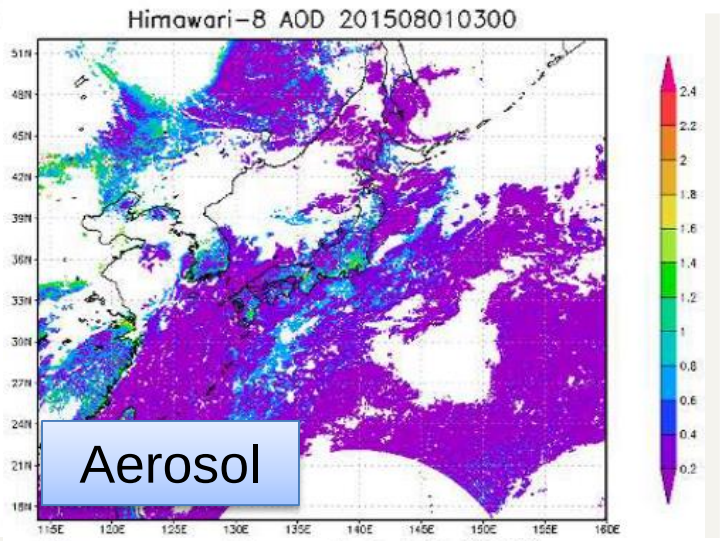




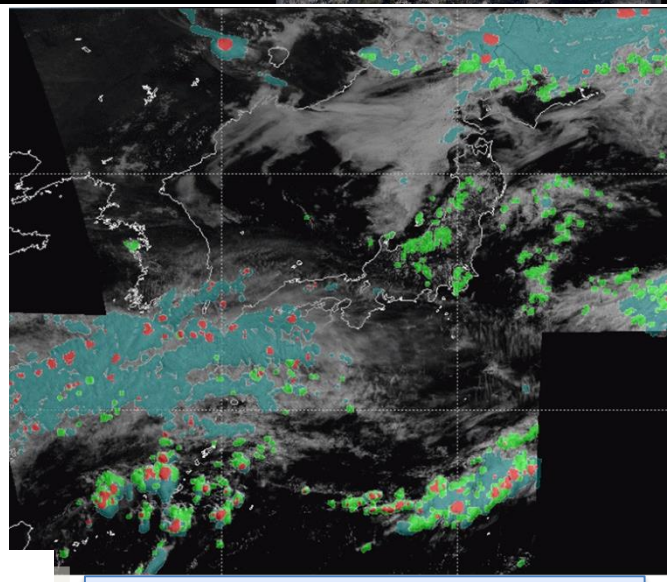
Satellite Products



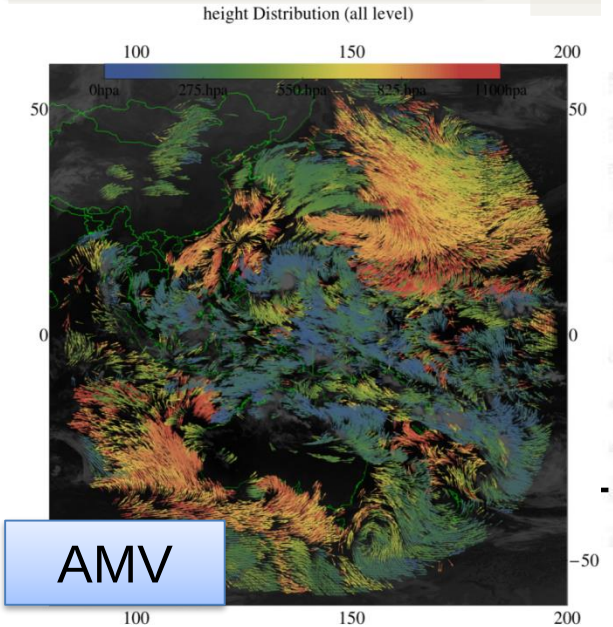
CSR
(Clear Sky Radiance)



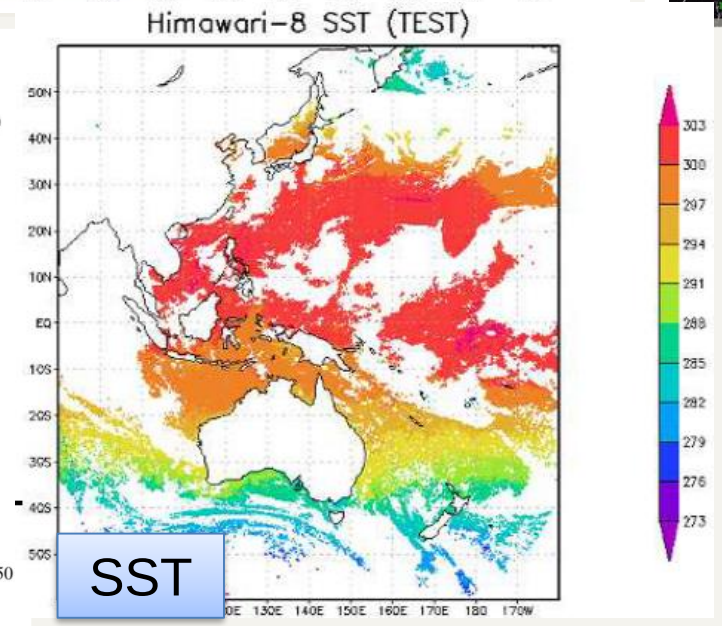
Aerosol



RDCA
(Rapid Developing
Cloud Area)



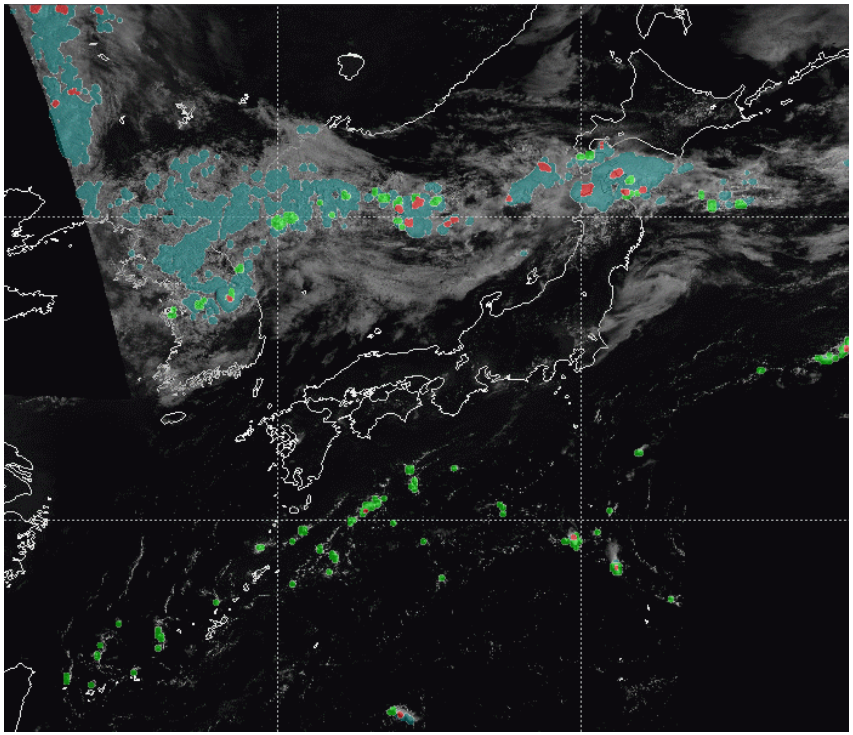
AMV



SST

Rapidly Developing Cumulus Area(RDCA)

- RDCA product detects **rapidly developing cumulus** with thunder and **area of disturbance to occur in near future**.



Rapidly Developing Cumulus Area (RDCA)

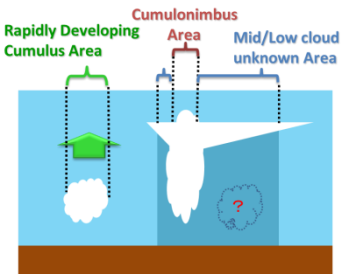
- ✓ Developing cumulus
- ✓ Current/Future disturbance is expected

Cumulonimbus Area

- ✓ A round top, except for anvil cirrus
- ✓ Strong upward flow is expected

Mid/Low Cloud Unknown Area

- ✓ Anvil cirrus
- ✓ Anvil cirrus hides clouds below



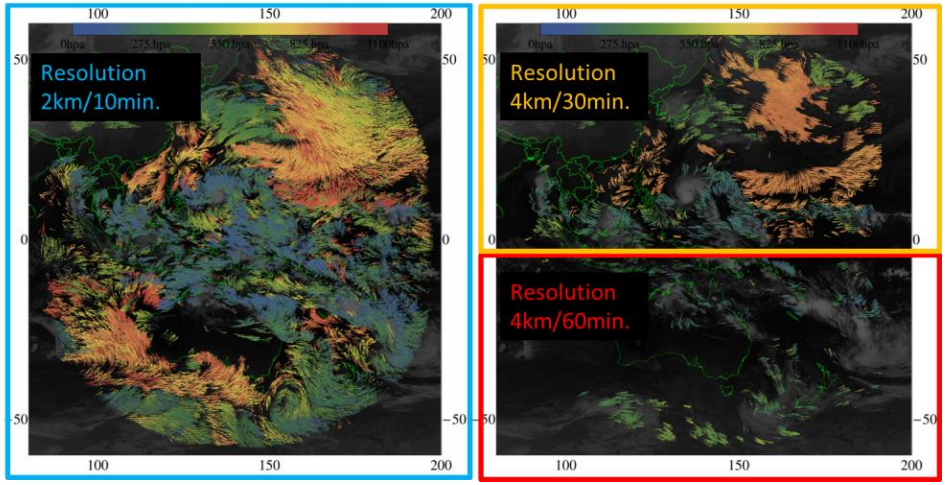
This product is provided to aviation users.

Atmospheric Motion Vectors (AMVs)

AMV is a satellite-derived product that is to estimate the altitude and motion vector of clouds from satellite imagery. It is already used for typhoon analysis , and be used as initial value by numerical forecast.

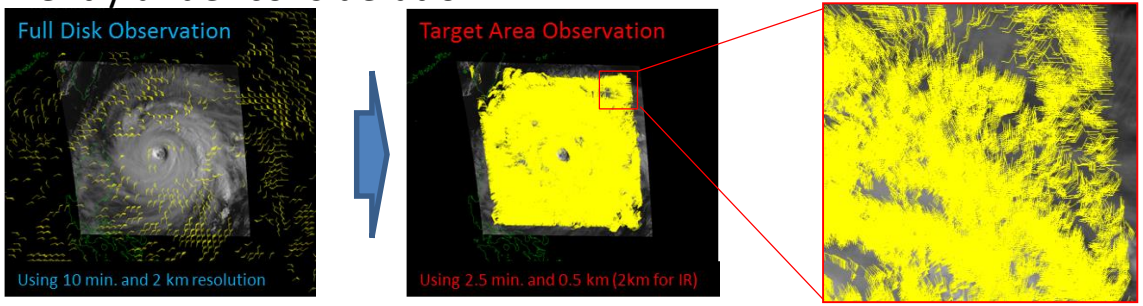
Himawari-8 AMVs derived from Himawari-8 imagery with new algorithm

MTSAT-2 AMVs derived from MTSAT-2 imagery and heritage algorithm



- In the past, AMV was calculated from the difference of images at 30-minute intervals in northern hemisphere using MTSAT-2.
- In southern hemisphere, calculated by images at 60-minute intervals.
- Now, AMV is calculated by using Himawari-8 full disk observation at 10-minute intervals.
- As not only temporal but also spatial resolution is higher than MTSAT-2, detection numbers of AMVs is increasing.

Calculation of AMVs using target area observation is currently under consideration.

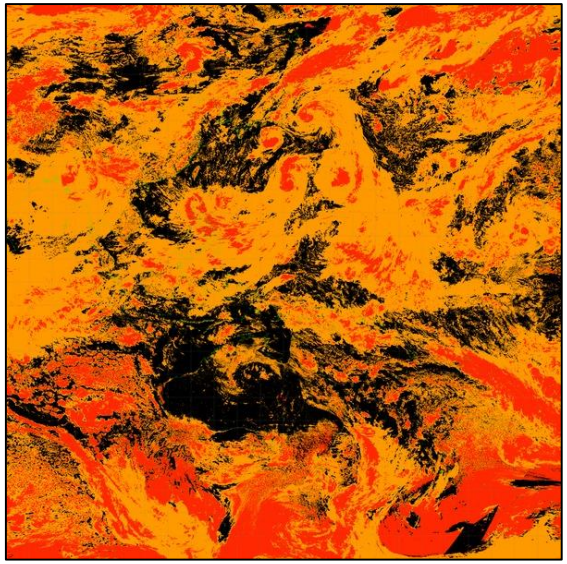


- Improvement to temporal and spatial resolution.
- Detection of low er layer.
- Particularly, the data of the lower layer may be used for estimating the area of windstorm or strong wind.

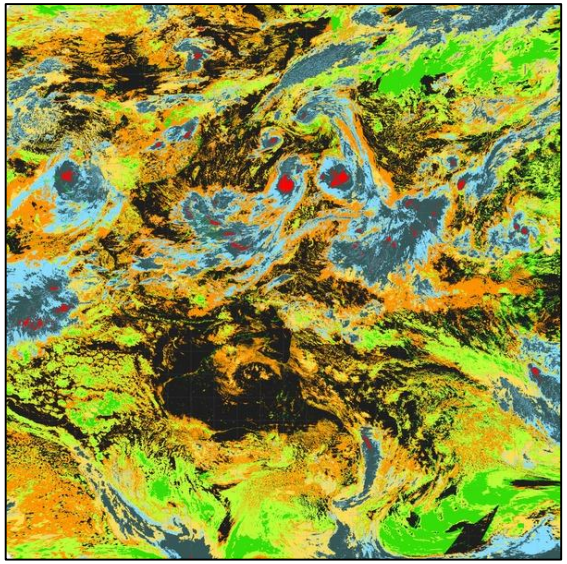
High-resolution Cloud Analysis Information (HCAI)

- Cloud mask, type and top height
  (0.02 degree latitude/longitude grids)
- Currently, MSC provides selected area data to Hong Kong, Indonesia, Kiribati, Malaysia, Mongolia, Myanmar, Singapore, Tonga and Viet Nam via the Internet.

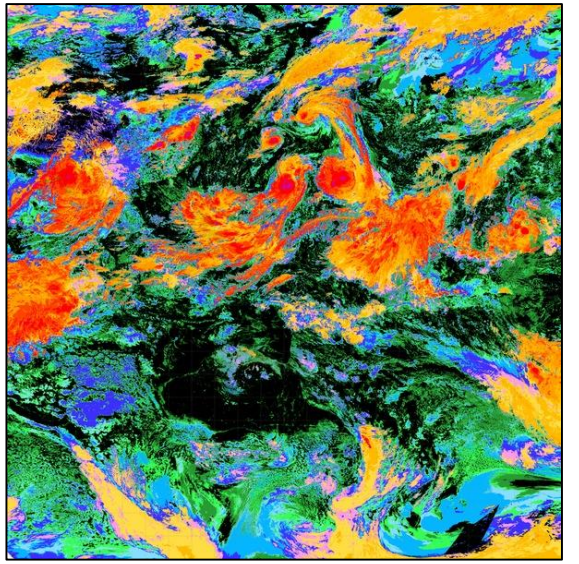
Cloud Mask



Cloud Type



Cloud Top Height

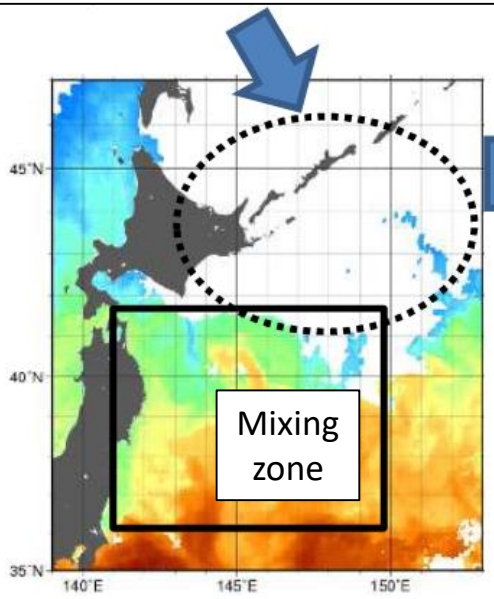


Sea surface temperature

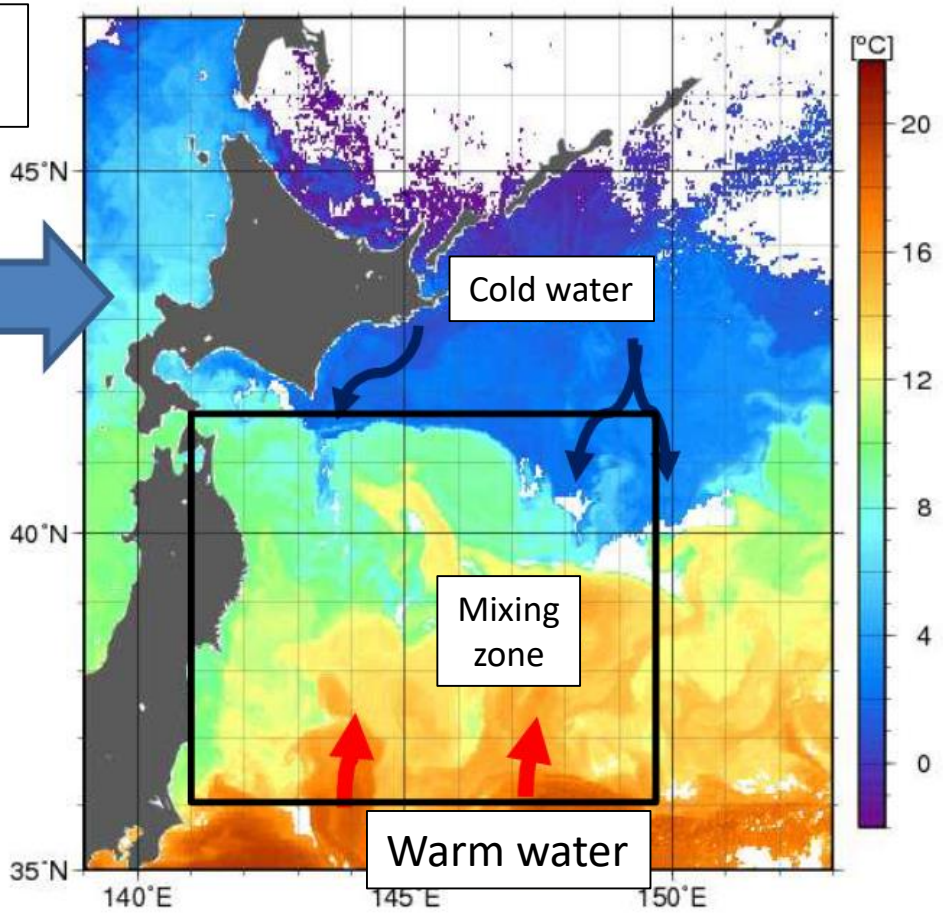
- Use of multi-spectral bands leads to distinguish the cold sea surface and the cloud
- High frequency observation provides more cloud free data

Himawari-7(MTSAT-2)

Can't distinguish the cold sea surface and the cloud



Himawari-8



SATAID

What is SATAID?

- Originally developed by JMA's MSC (Meteorological Satellite Center) as an application software to display satellite imagery and NWP data for training purposes
- Provided to NMHSs as a JMA's contribution to WMO-CGMS Virtual Laboratory for Training in Satellite Meteorology (VL)
- Today, used also as an operational tool for daily weather analysis including tropical cyclone monitoring at JMA's HQ and local offices
- Freely available to NMHSs and easy to install
- Equipped with lots of functions

Introduction to SATAID

For more information on SATAID, please see Introduction Guide for SATAID.

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