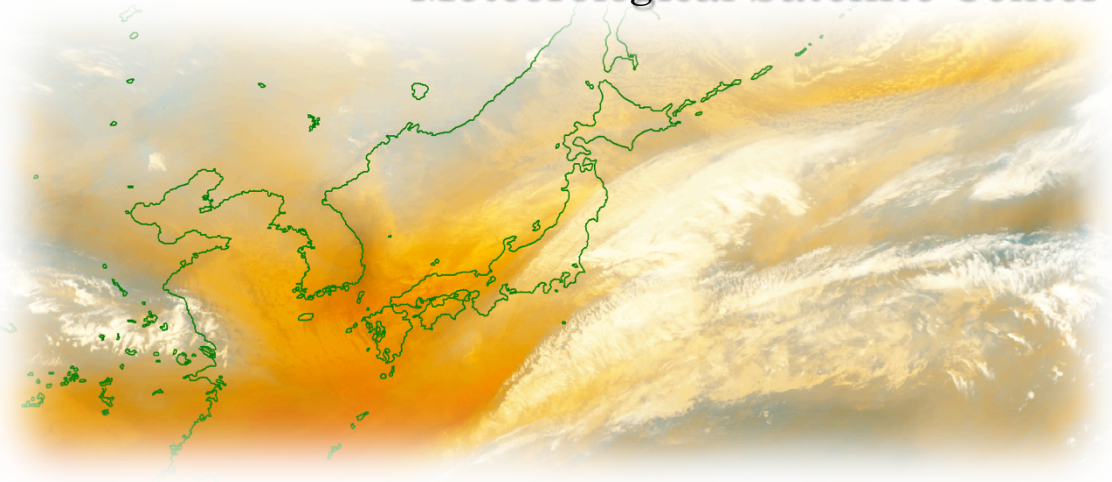

New recipes of RGB composite images by Himawari-8

-Introduction of Experimental New RGBs by Himawari-8/AHI-

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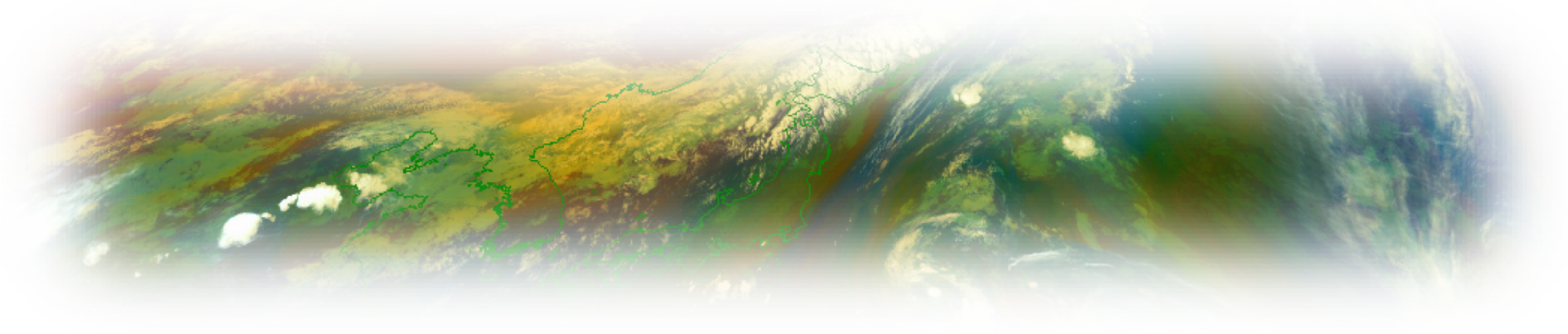
Japan Meteorological Agency
Akihiro SHIMIZU
aki-shimizu@met.kishou.go.jp

2016 NOAA-Australian Bureau-JMA Virtual Session on RGBs
28 November 2016



Contents

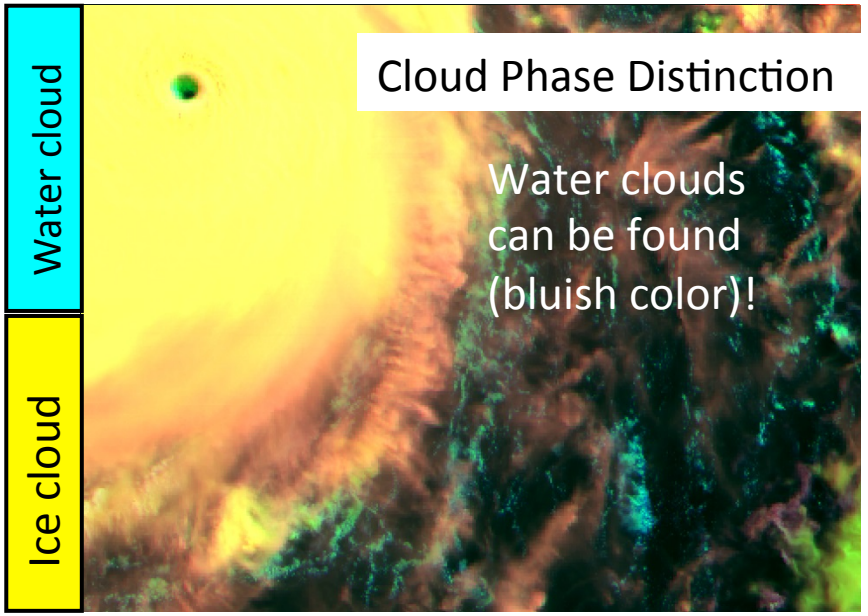
- Background
- Tentative ideas for new RGB recipes
  - Cloud phase
  - Water vapor
  - Fire/smoke detection
  - Convection
  - SO2
- Adjusting RGB recipes
- Summary

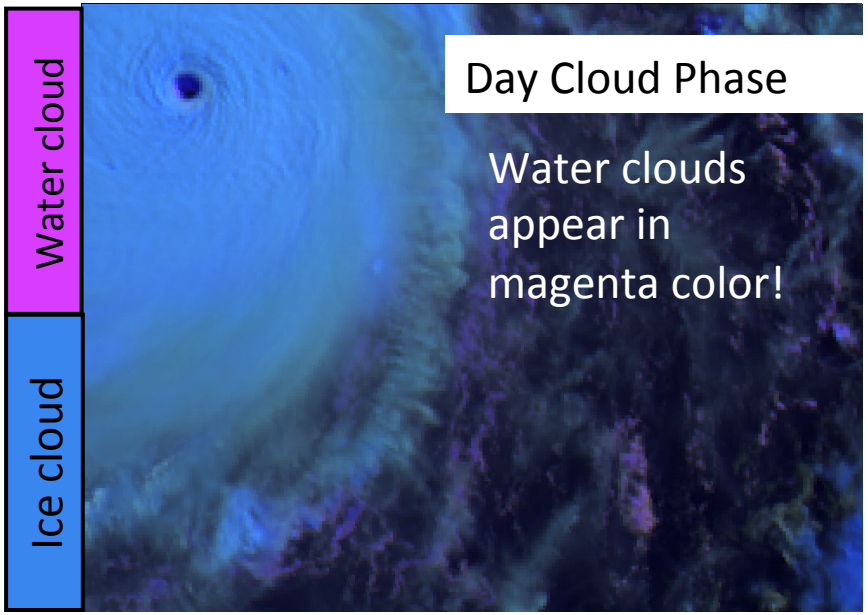
Background

- Drastic increase of information by Himawari-8/AHI's multi bands
  - The RGB technique is one of good solutions.
  - MSG/EUMETSAT recipes are useful to Himawari-8 imagery users.

- Seeking Himawari-8 own recipes
  - Effective use of newly wavelength bands by GEO (0.47, 0.51, 2.3, 6.9μm)
  - Recipes containing only five (traditional) bands (0.64, 3.9, 6.2, 10.4, 12.4μm) data for users whose communication environments are limited
  - Tuning of recipes for local features

Water or Ice?



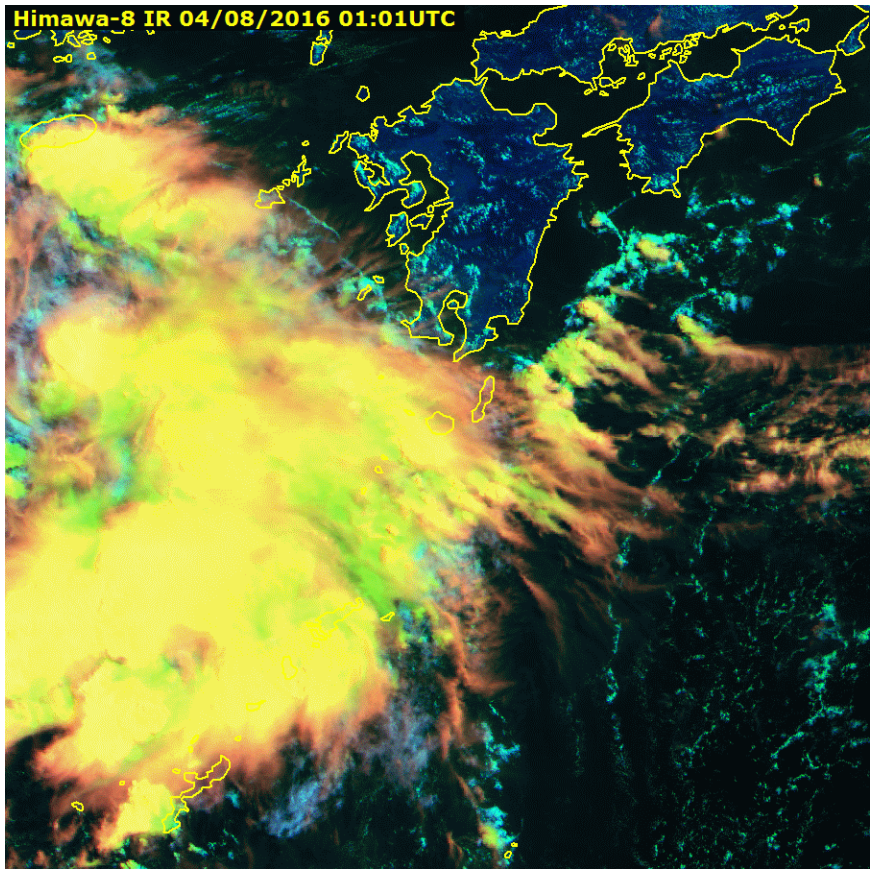


Day natural color RGB is useful for the separation of “ice” and “water” clouds.
But the separation is not perfect…

Day Cloud Phase looks better to separate water clouds from ice clouds.
2.3µm band of Himawari-8 have a potential to improve the phase identification.

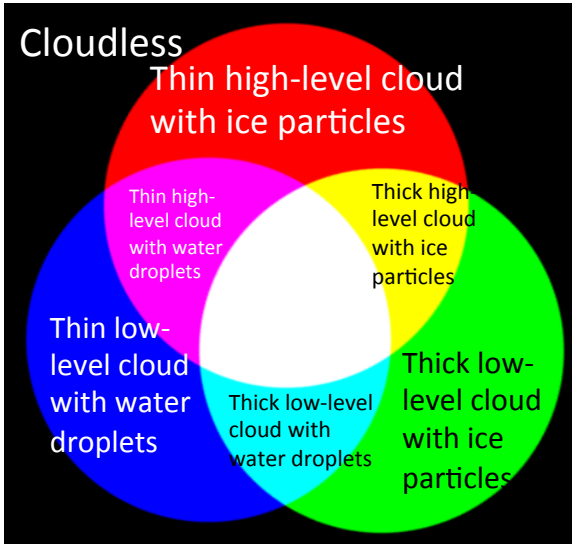
* “Day Cloud Phase” RGB is based on an article by Dr. Kerkmann (EUMETSAT).
http://www.eumetsat.int/website/home/Images/ImageLibrary/DAT_2861499.html

Cloud Phase Distinction



4th August, 2016 Vicinity of Western Japan

Application:
Analysis cloud thickness, height of cloud top and cloud phase at one time.



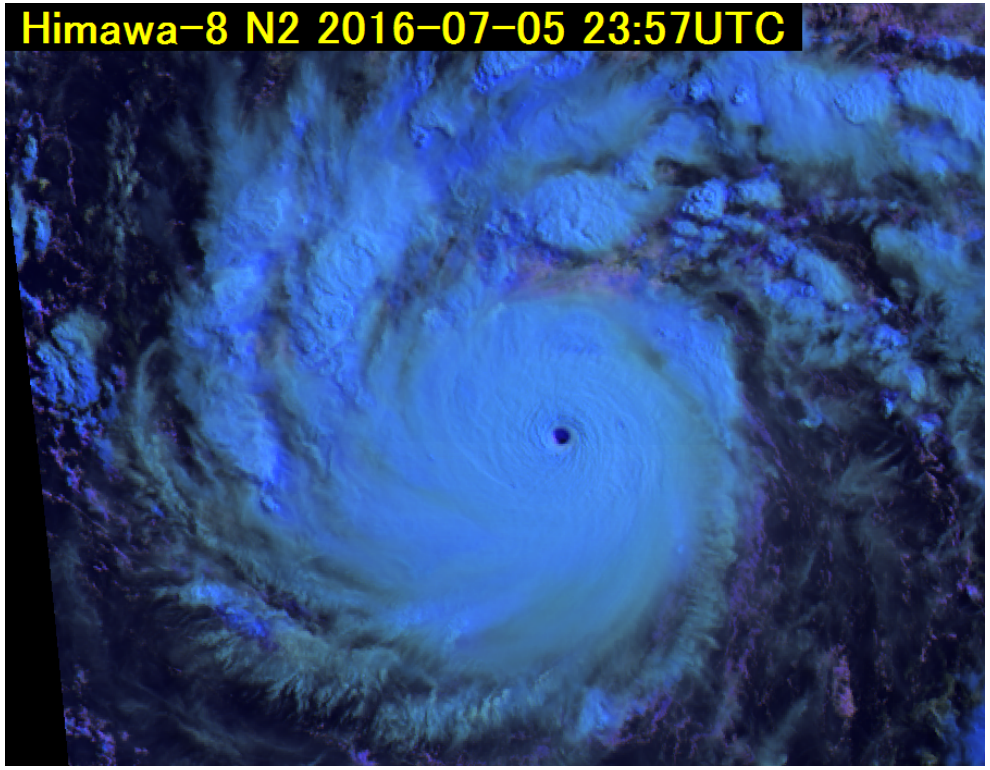
Interpretation (under investigation)

	Band	Gamma	TBB/Reflectivity range	
R	B13(IR 10.4)	1.0	219.62～280.67[K]	→ Cloud height
G	B03(VS 0.64)	1.0	0.00～0.78	→ Cloud thickness
B	B05(N2 1.6)	1.0	0.01～0.59	→ Cloud phase

Day Cloud Phase

Application for AHI/Himawari-8 (based on Dr. Kerkmann's article)

http://www.eumetsat.int/website/home/Images/ImageLibrary/DAT_2861499.html



Application:
Analysis cloud thickness, cloud phase by using 2.3 μm band

Ice cloud (small ice)

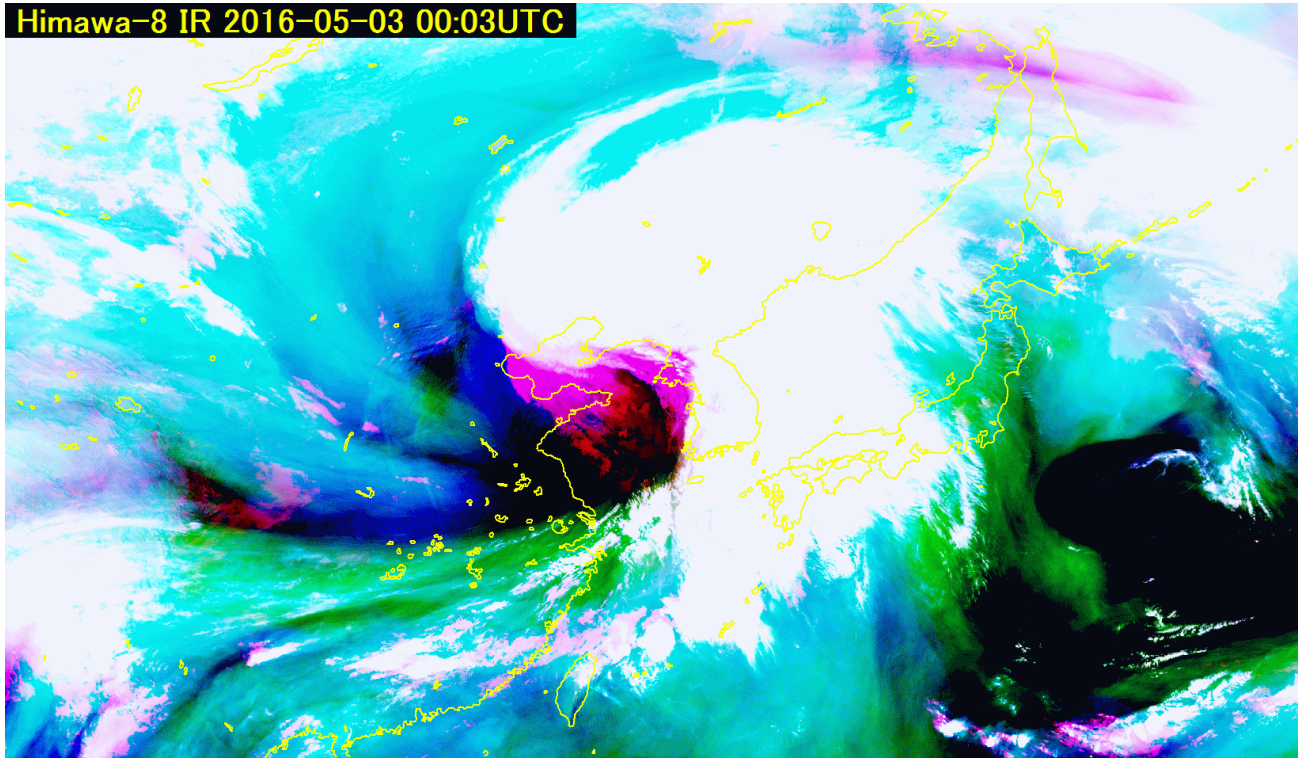
Ice cloud (large ice)

Water cloud

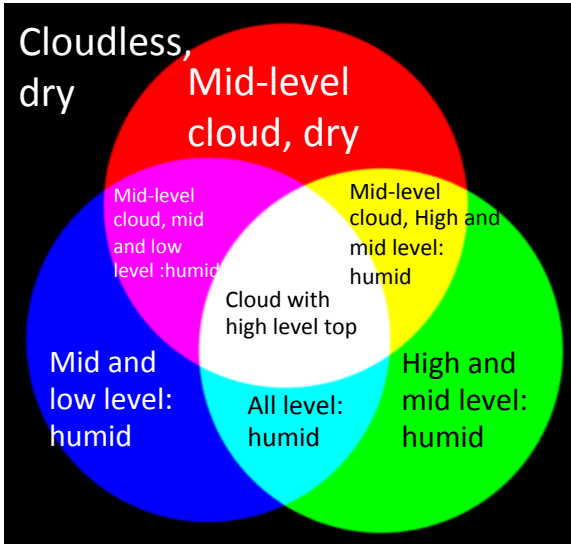
A part of Interpretation
(under investigation)

	Band	Gamma	TBB/Reflectivity range	
R	B05(N2 1.6)	1.0	0.0～1.0	→ Cloud phase
G	B06(N3 2.3)	1.0	0.0～0.7	→ Cloud phase
B	B01(V1 0.46)	1.0	0.0～1.0	→Cloud thickness

Water Vapors



Application:
Analysis of water vapor distribution for each level excluding cloud area



	Band	Gamma	TBB Range
R	B13(IR10.4)	10	202.29～278.96[K]
G	B08(WV6.2)	5.5	214.66～242.67[K]
B	B10(WV7.3)	5.5	245.12～261.03[K]

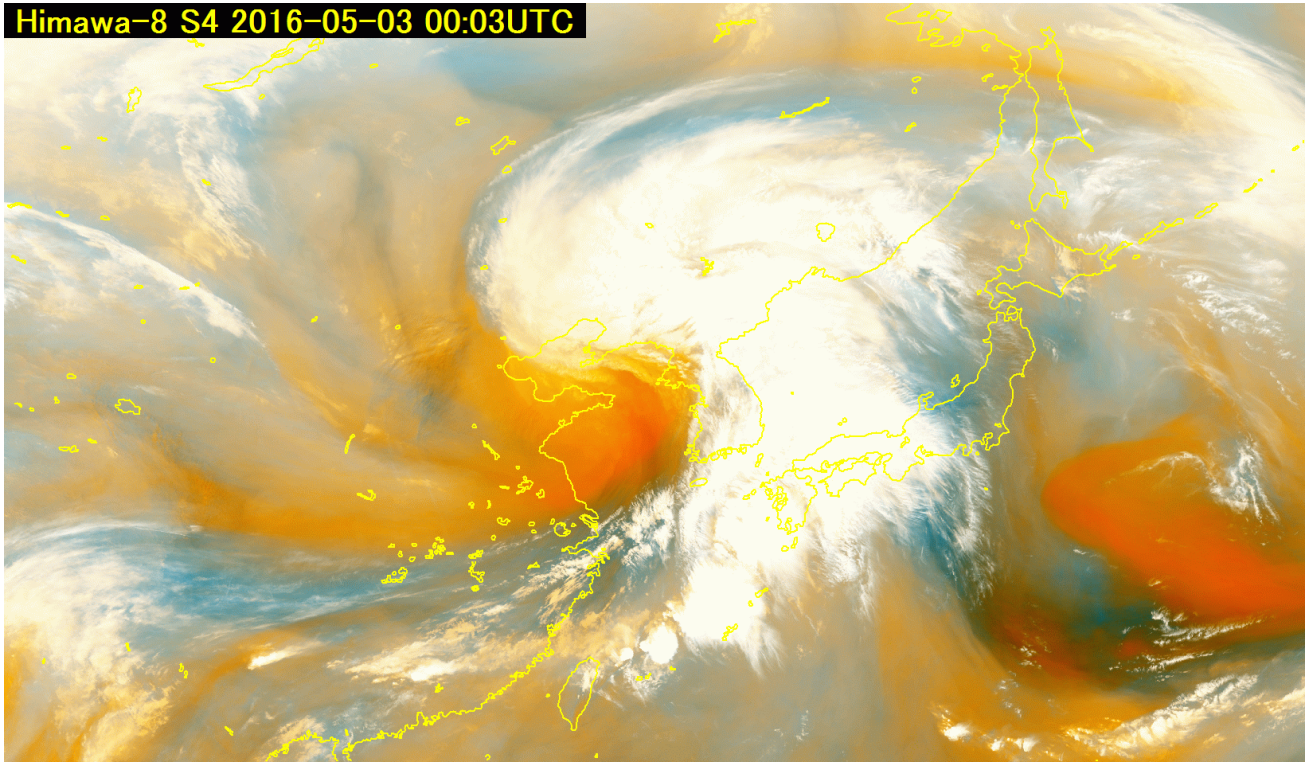
Interpretation
(under investigation)

→ Cloud area

→ Upper level water vapor

→ Mid or lower level water vapor

Water Vapors (other version)



Application:
Analysis of water vapor distribution for high-mid level such as trough, ridge and darkening etc.

Cloud with high level top
High level: humid
High level: dry Mid level: humid
High-mid level: dry

Mid level cloud

Interpretation
(under investigation)

	Band	Gamma	TBB Range
R	B10(WV7.3)-B08(WV6.2)	3.5	-3～30 [K]
G	B10(WV7.3)	2.5	213.15～278.15 [K]
B	B08(WV6.2)	2.5	208.50～243.90 [K]

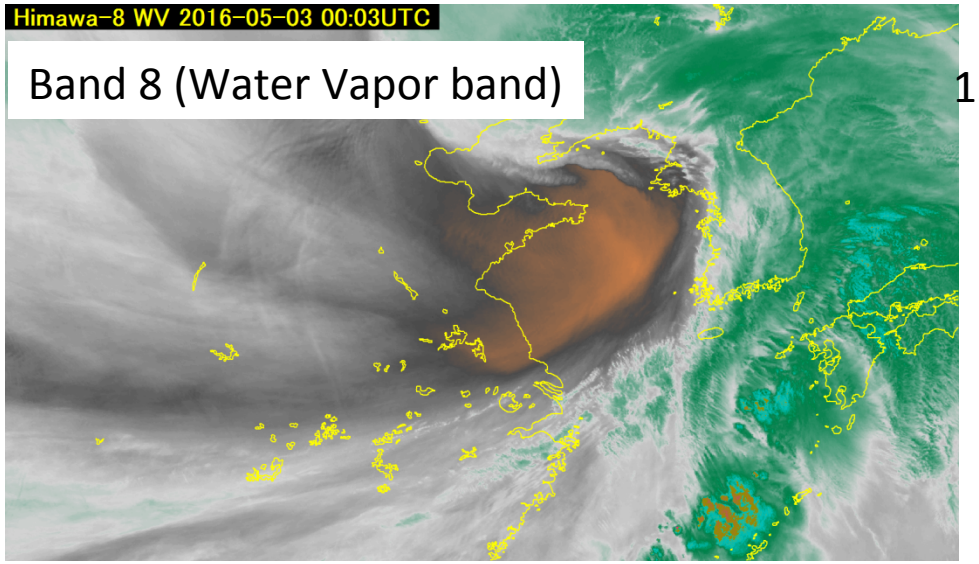
→ Humid or dry at high-mid level, Thick cloud

→ Mid level water vapor

→ High level water vapor

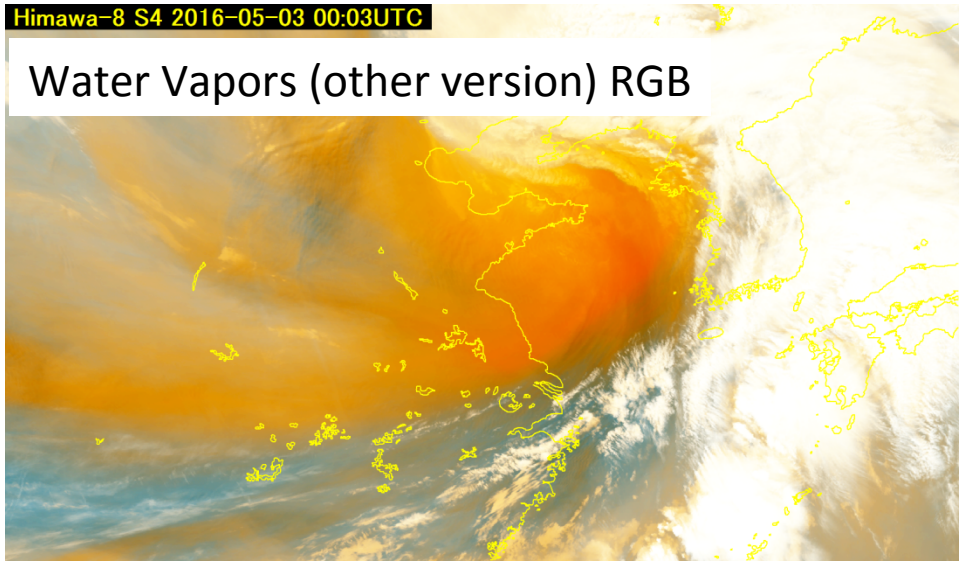
Water vapor

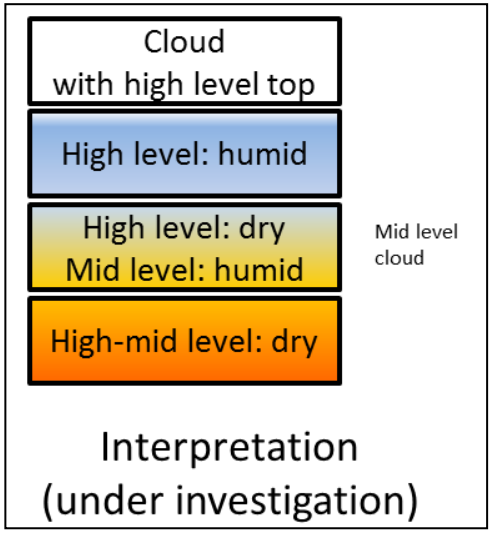
Comparison with (single) WV band image



Colorized WV image is useful to grasp the water vapor distribution of upper level.

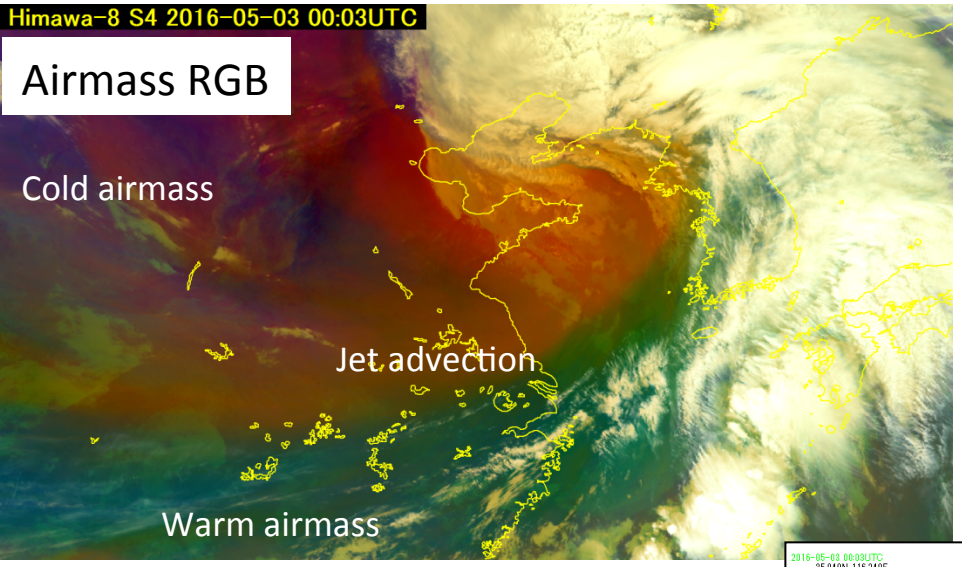
While Water Vapor RGB has information of lower level water vapor distribution (e.g. different moisture profile).

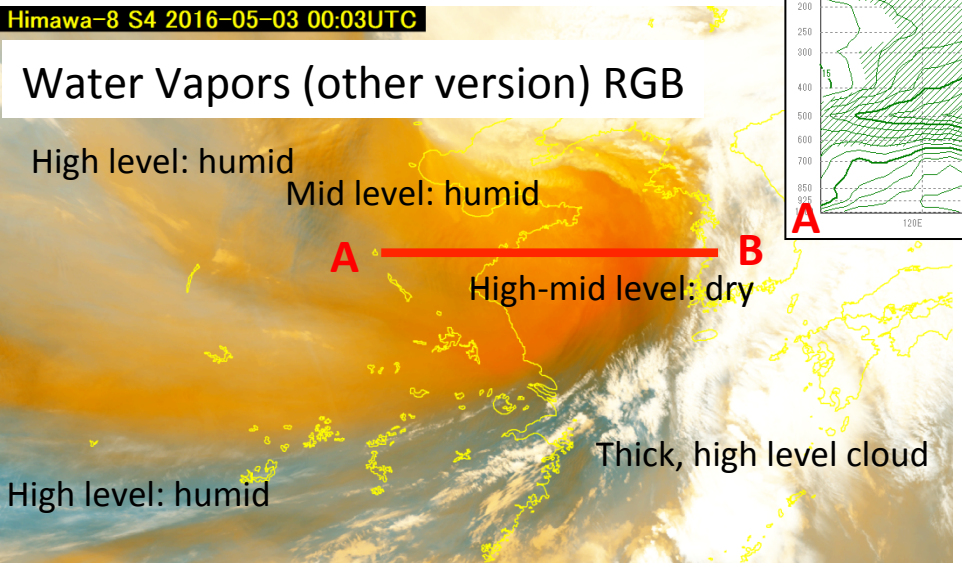


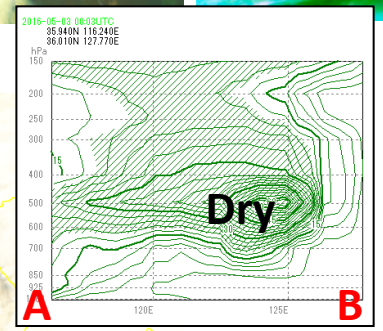


Water vapor

Water Vapor RGBs Comparison





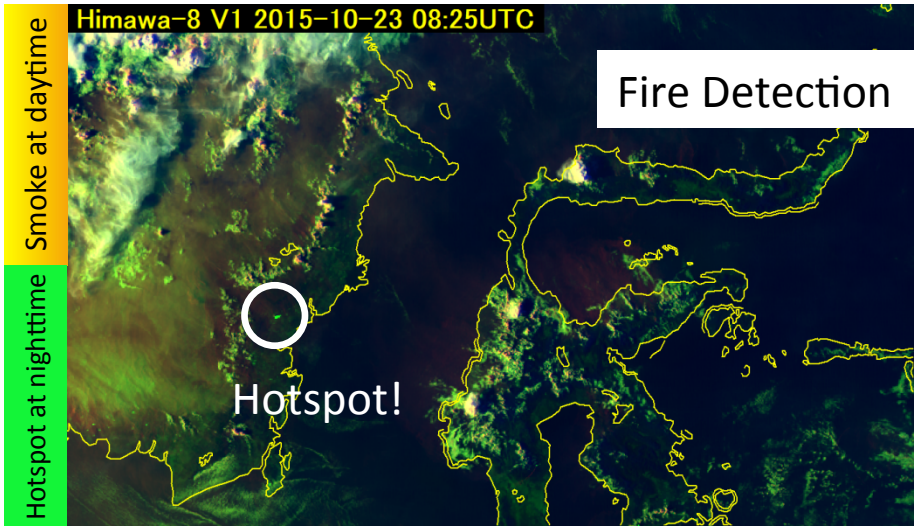


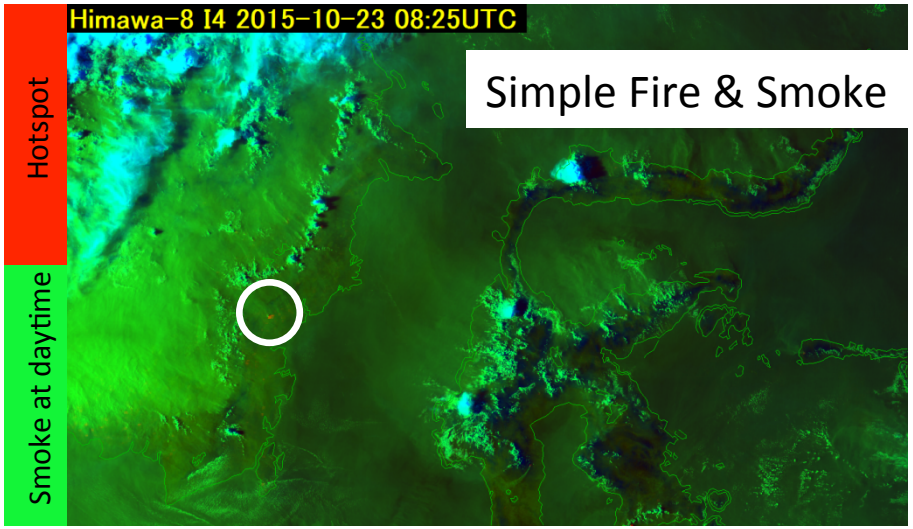
Airmass RGB is useful to grasp the distribution of air masses and the flow of air currents.

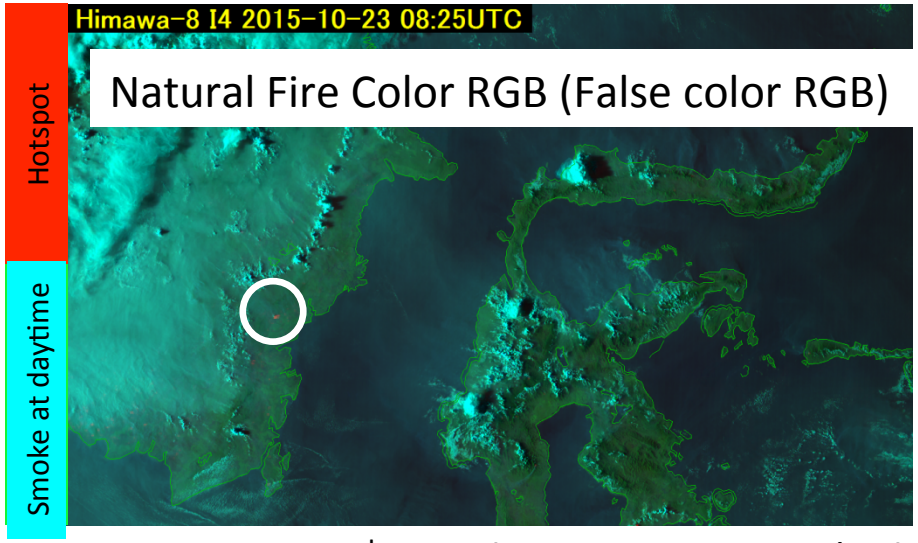
But it is difficult to see the water vapor distribution for each vertical level by using Airmass RGB.

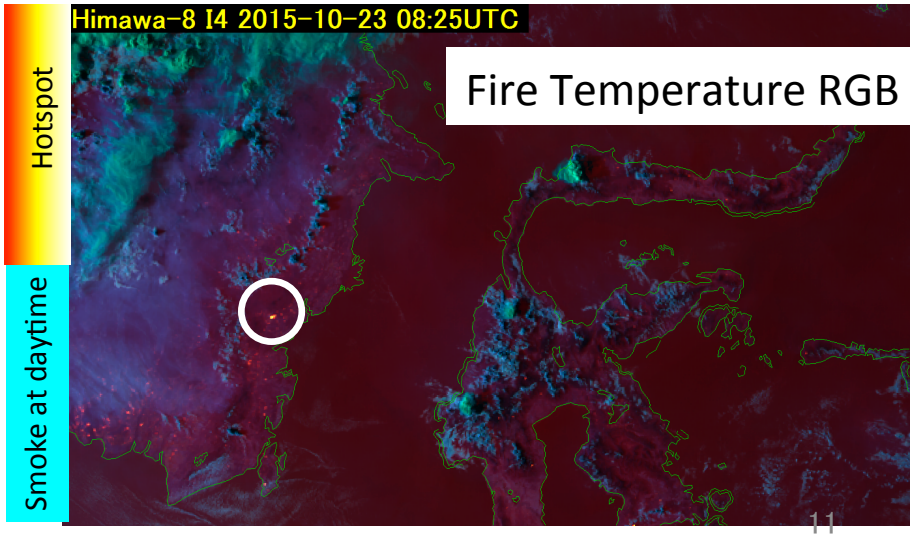
JMA/MSC is going to develop the water vapor RGBs.

Fire/smoke RGBs



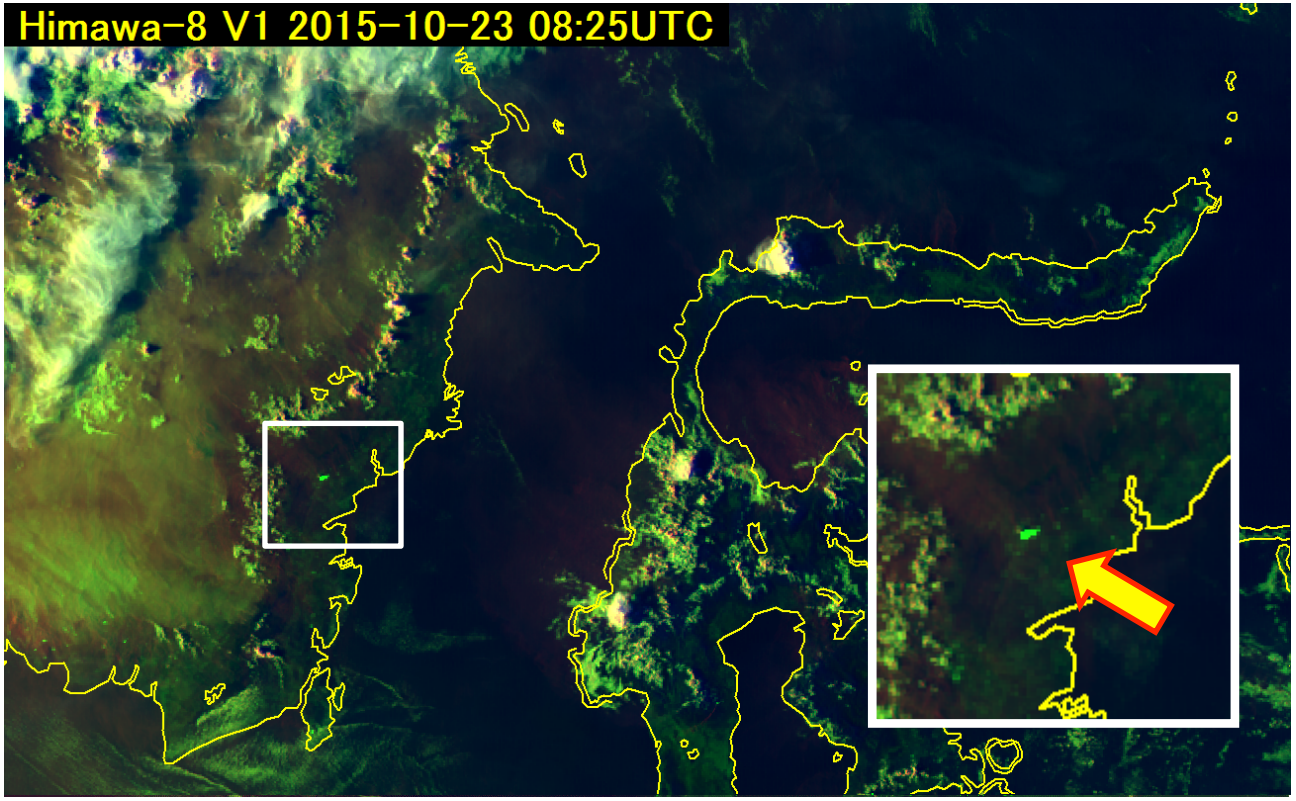






23rd October, 2015 Borneo(Kalimantan) and Sulawesi Isl. Indonesia

Fire Detection



Application: Fire (hot spot) and smoke detection

Smoke at daytime

Hotspot at day/ nighttime

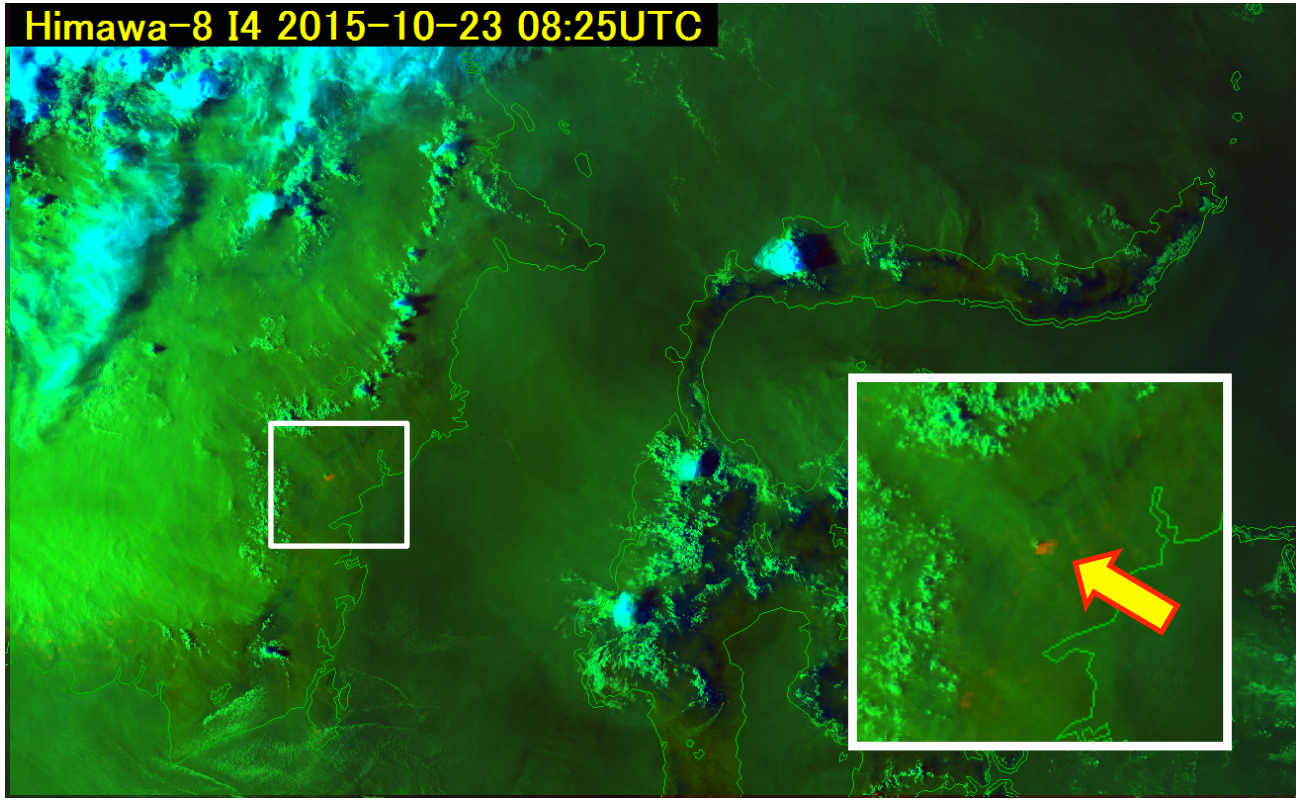
Interpretation (under investigation)

	Band	Gamma	TBB/Reflectivity range	
R	B01(V1 0.46)	1.0	0.3～0.95	→ Aerosol
G	B06(N3 2.3)	1.0	0.0～0.5	→ Hotspot
B	B14(L2 11.2)	1.0	158.15～323.15 [K]	→ Cloud

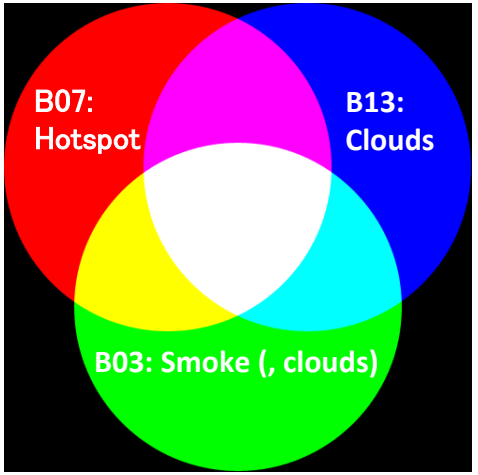
Fire/smoke detection

Simple Fire & Smoke RGB

by traditional bands (for WIS users)



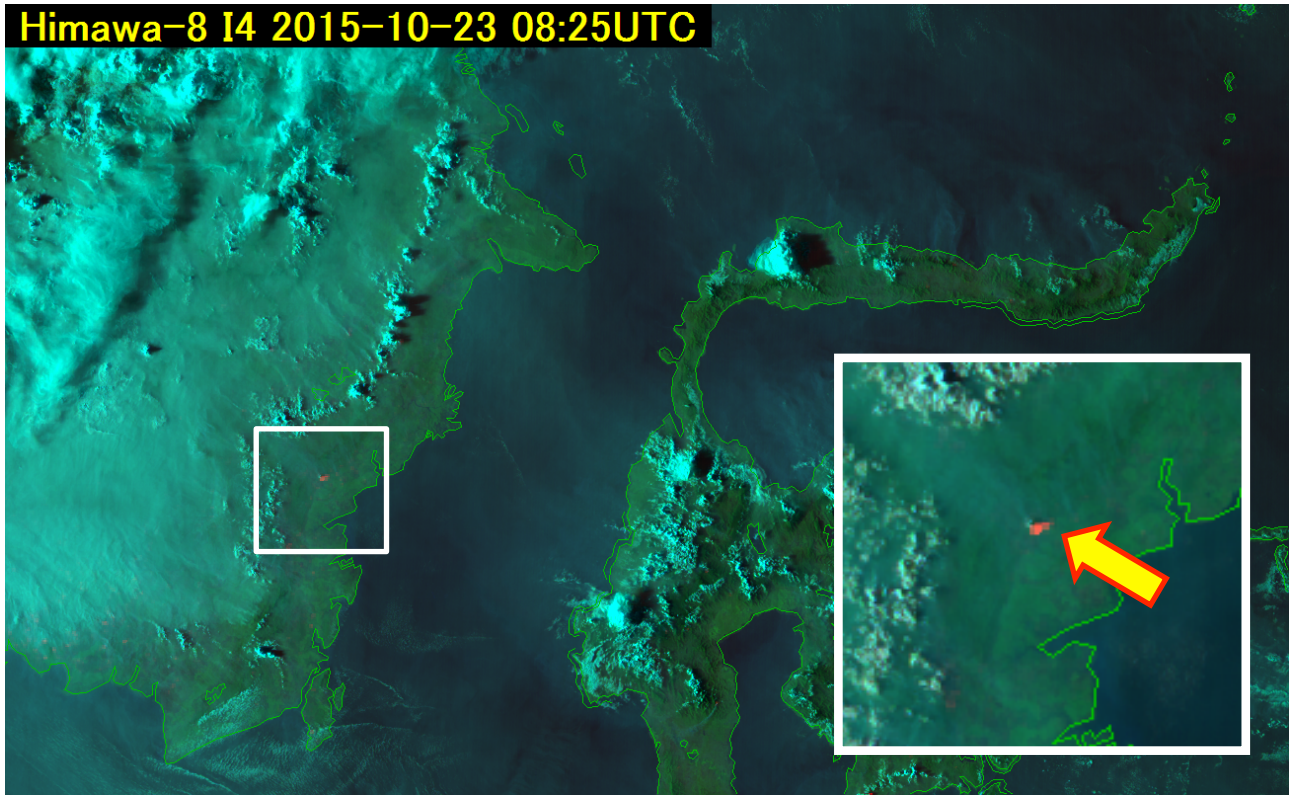
Contribution to RGB Colors



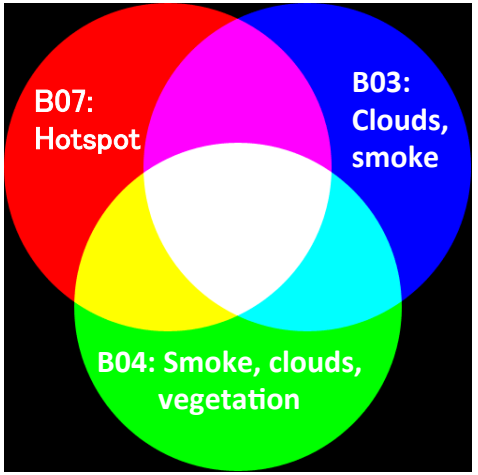
	Band	Gamma	TBB/Reflectivity range	
R	B07(I4 3.9)	1.0	287.02～425.26 [K]	→ Hotspot
G	B03(VS 0.64)	1.0	0.05～0.70	→ Aerosol
B	B13(IR 10.4)	1.0	230.30～302.71 [K]	→ Cloud top

Natural Fire Color RGB (False color RGB)

Tuned by MSC/JMA (based on CIRA's material)



Contribution to RGB Colors

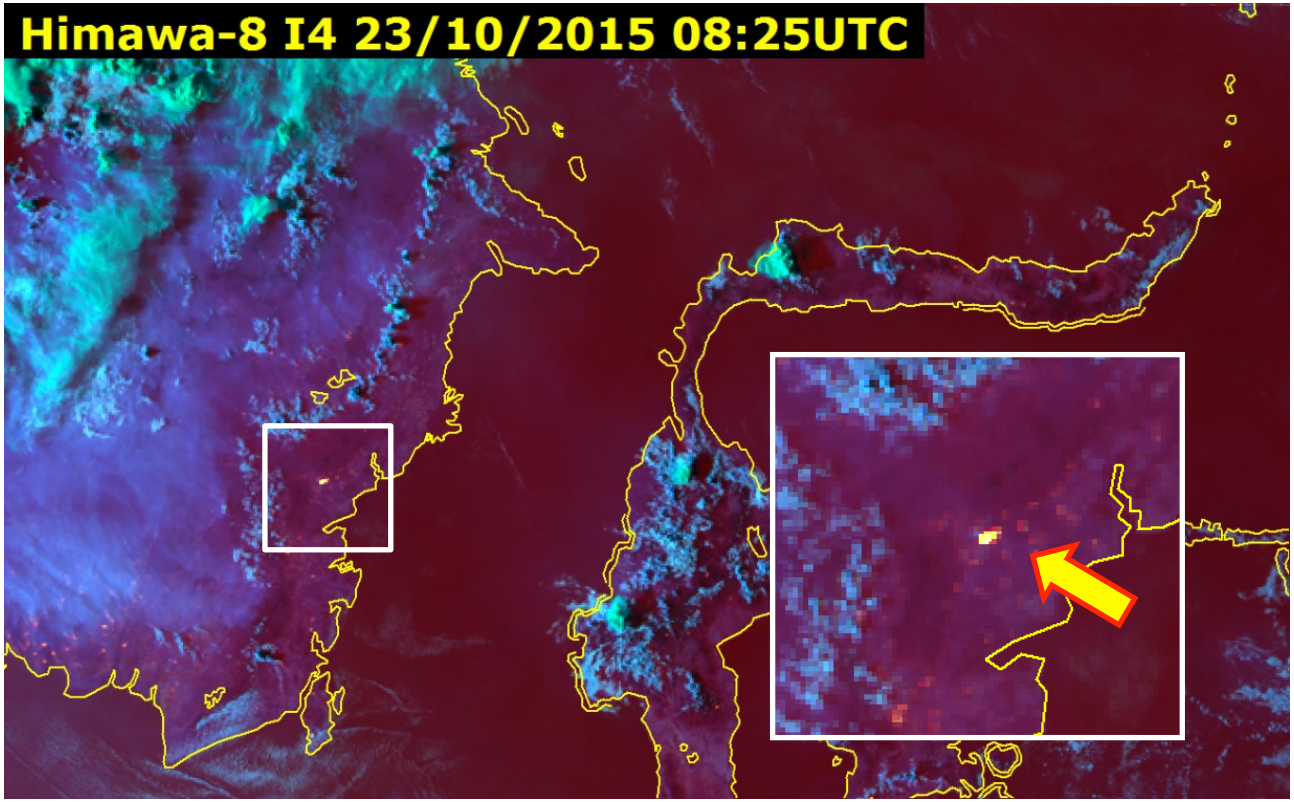


	Band	Gamma	TBB/Reflectivity range	
R	B07(I4 3.9)	1.0	287.02～400.00 [K]	→ Hotspot
G	B04(N1 0.86)	1.0	0.0～1.0	→ Burned area, Aerosol
B	B03(VS 0.64)	1.0	0.0～1.0	→ Aerosol

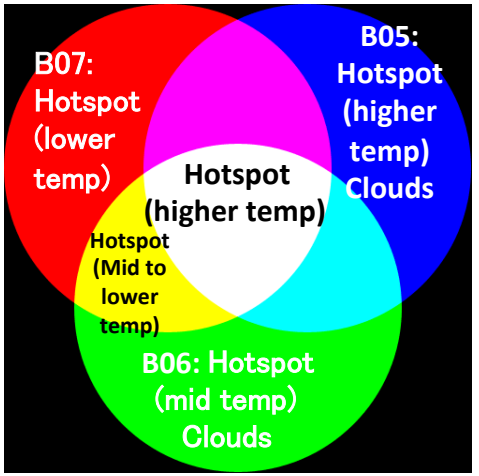
Fire/smoke detection

Fire Temperature RGB

Application for AHI/Himawari-8 (based on CIRA's material and Dr. Kerkmann's comment)



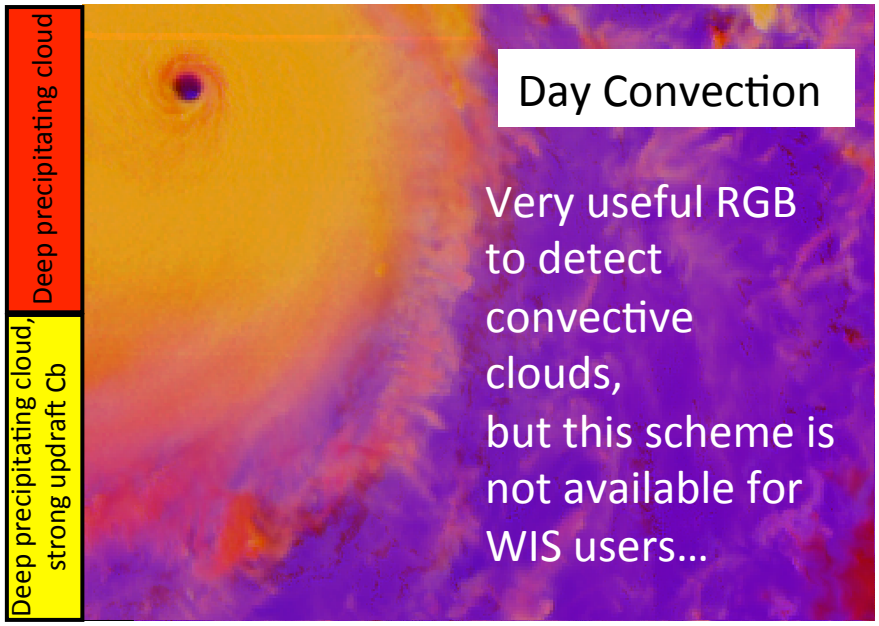
Contribution to RGB Colors

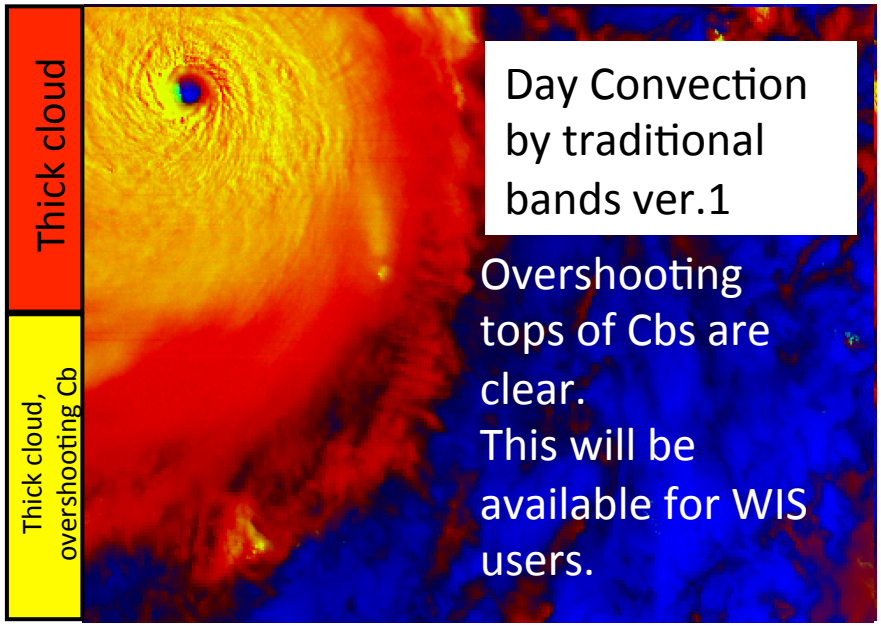


*under investigation

	Band	Gamma	TBB/Reflectivity range
R	B07(I4 3.9)	1.0	273.00～350.00 [K]
G	B06(N3 2.3)	1.0	0.0～0.6
B	B05(N2 1.6)	1.0	0.0～0.6

Convections by traditional bands



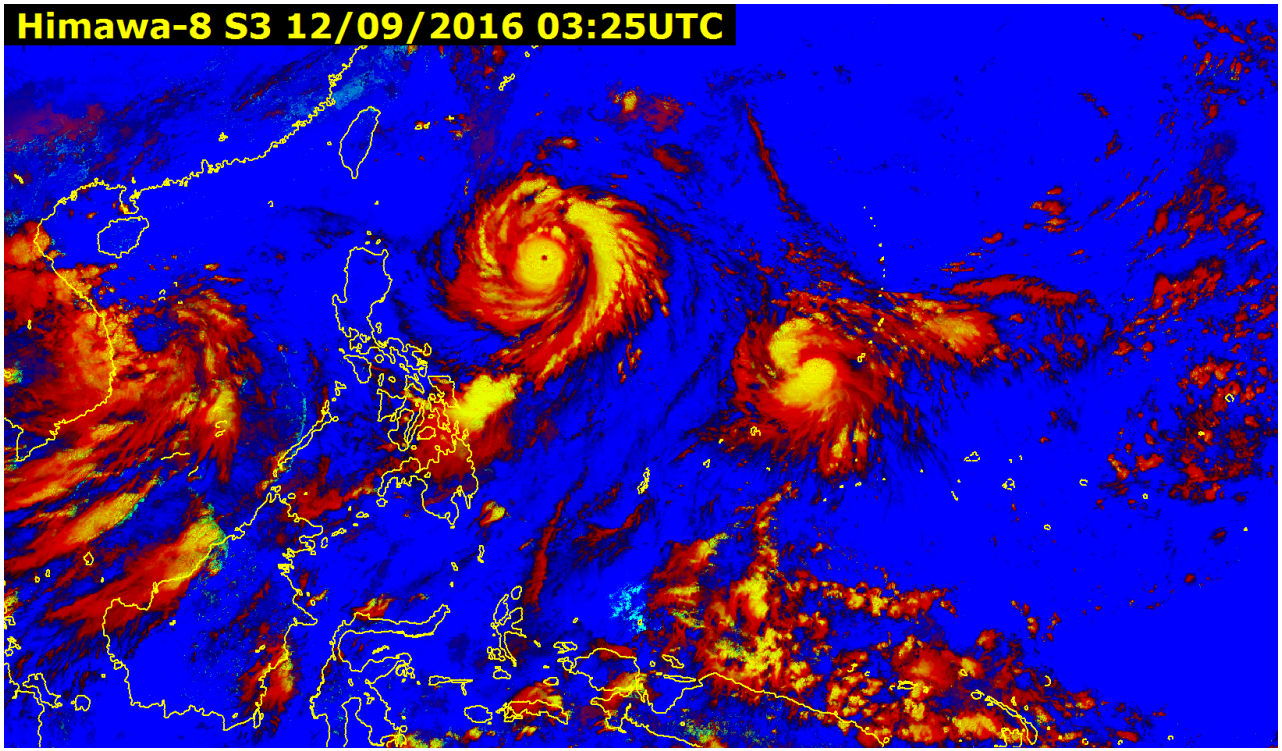


JMA's WIS (WMO Information System) SATAID Service users can access only five (traditional) bands (0.64, 3.9, 6.2,10.4, 12.4μm) data (SATAID format).

For the JMA's WIS users and other users whose communication environments are limited, the RGB recipes by the five bands have been developed.

Day Convection ver.1

by traditional bands (for WIS users)



Thick cloud, overshooting Cb

Thick cloud

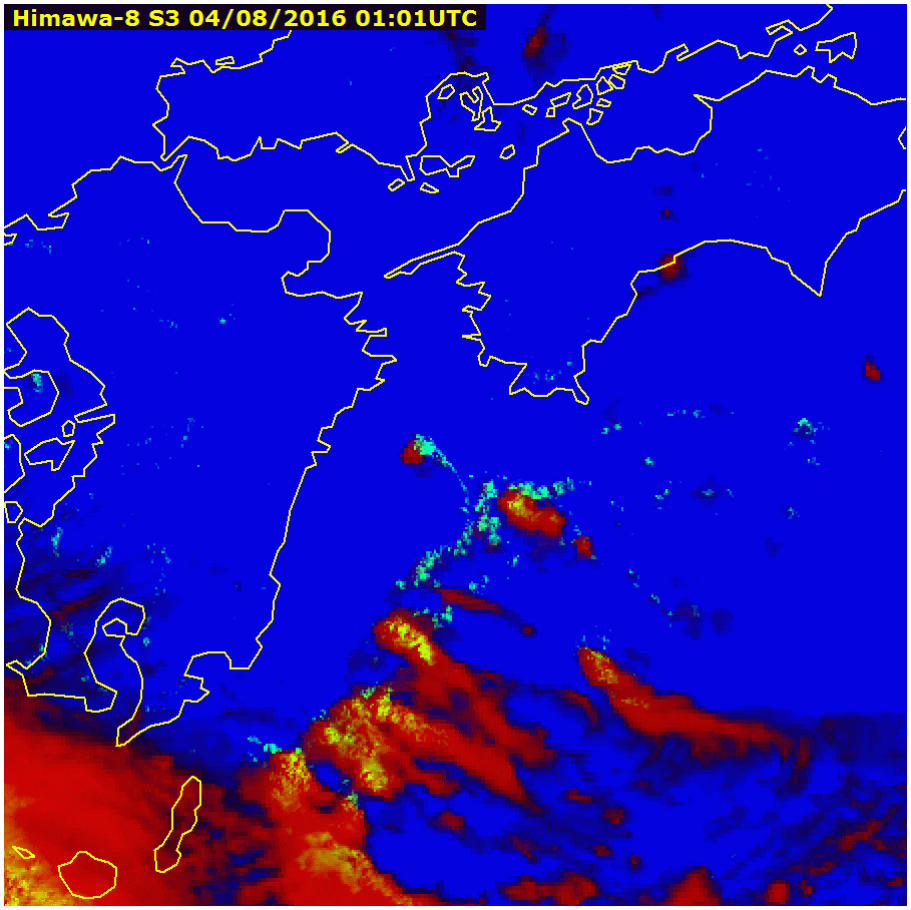
Thin high cloud

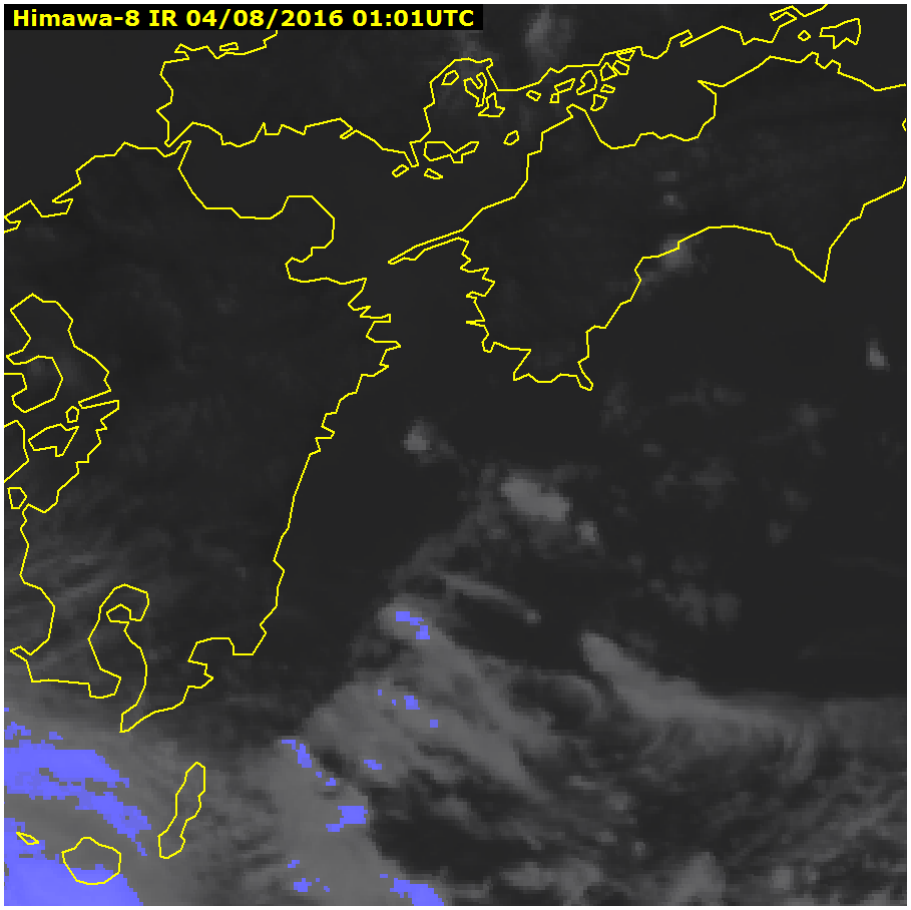
Ocean

Interpretation
(under investigation)

	Band	Gamma	TBB/Reflectivity range
R	B13(IR 10.4)-B08(WV6.2)	1.0	-5.0～35.0 [K]
G	B03(VS 0.64)	1.0	0.7～1.0
B	B13(IR 10.4)	1.0	243.6～292.6 [K]

Focus on convective clouds
Day Convection ver.1 vs. Low TBB Area (< -50 ℃)

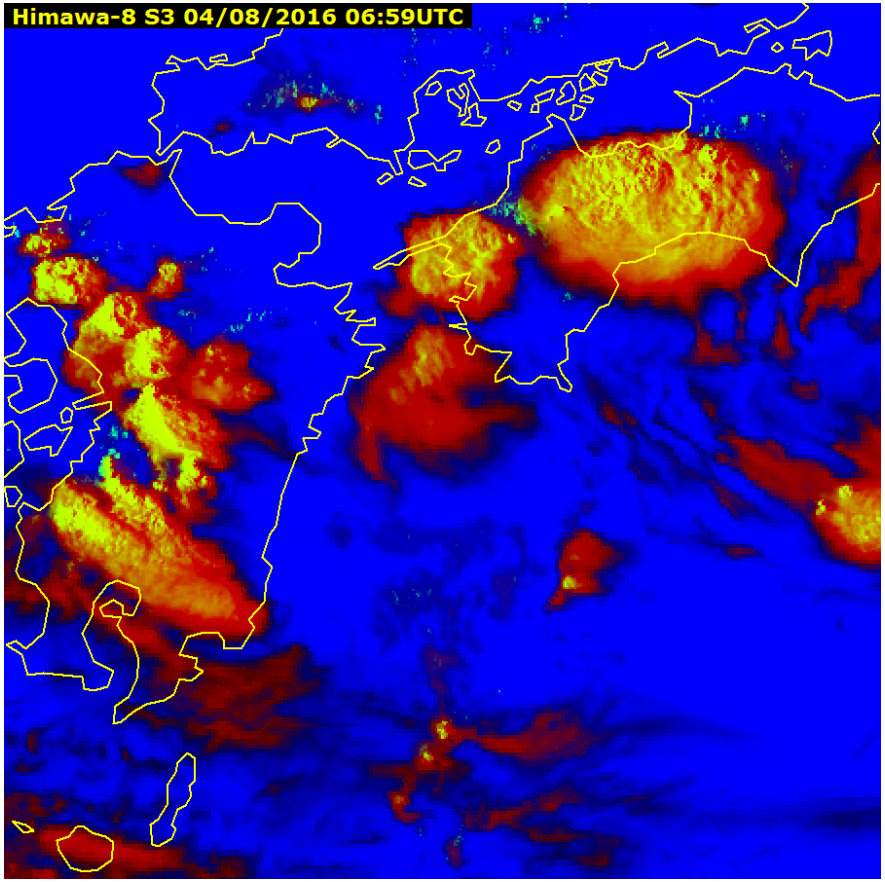


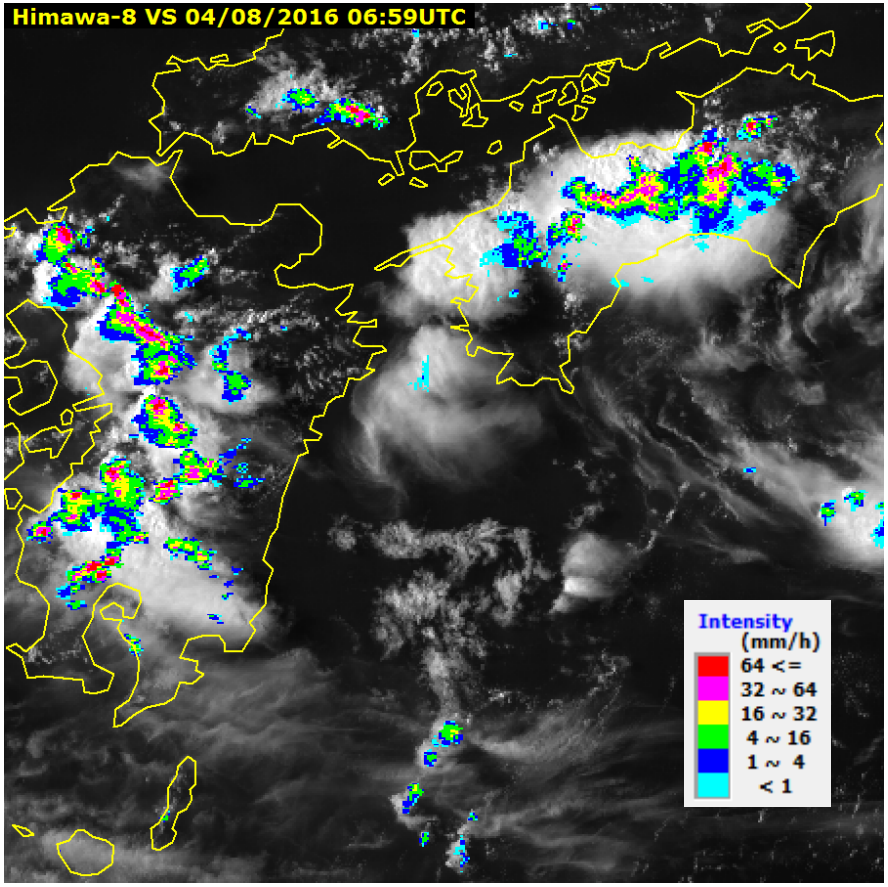


Blue area: TBB(B13)< -50 ℃

4th August, 2016 Vicinity of Western Japan

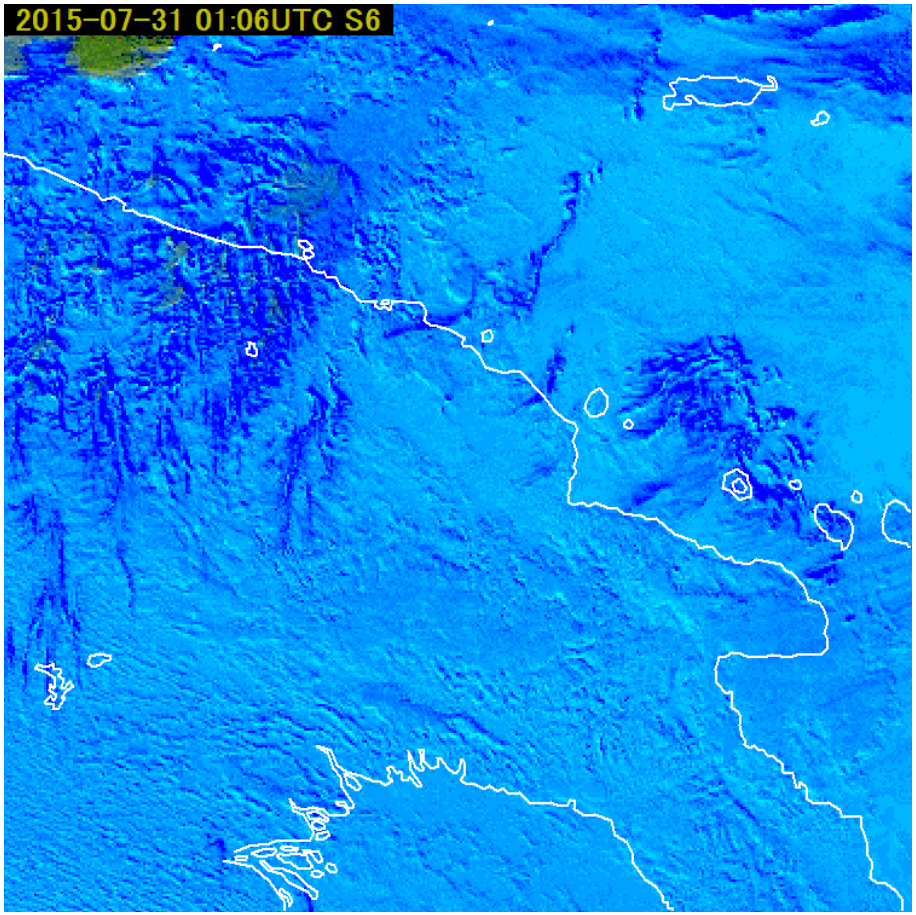
Comparison with Radar





4th August, 2016 Vicinity of Western Japan

SO2



Application: Detection of volcanic gas (sulfur dioxide)

This scheme is modified Ash RGB (Red beam: originally, difference (12.0-10.8), modified difference (6.9-7.3)).

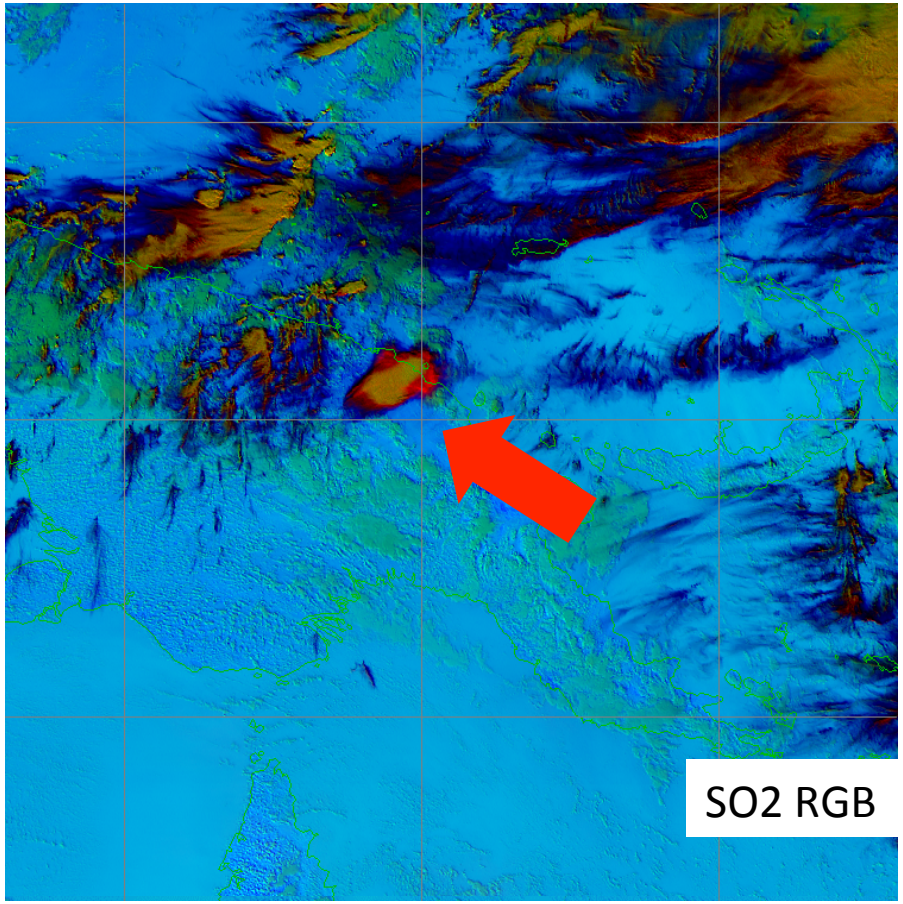
Volcanic gas (SO2> Water vapor?)

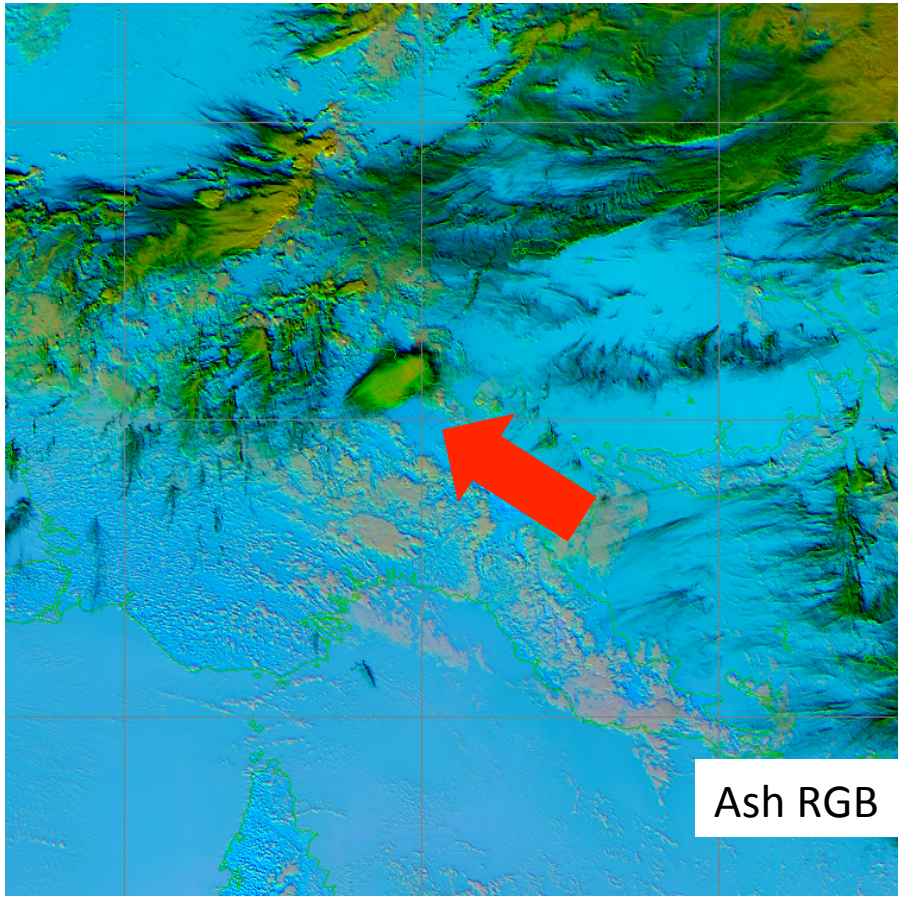
Volcanic gas (SO2 < Water vapor?)

Interpretation (under investigation)

	Band	Gamma	TBB/Reflectivity range	
R	B09(WV6.9)-B10(WV7.3)	1.0	-4～2 [K]	→ SO2, water vapor
G	B13(IR10.4)-B11(IR8.6)	1.0	-4～5 [K]	→ SO2
B	B13(IR10.4)	1.0	243～303 [K]	→ Cloud height

SO2 RGB VS. Ash RGB





31th July, 2015 Mt. Manam, Papua New Guinea

In this case, the SO2 RGB is suitable to separate sulfuric gas (sulfur dioxide) from volcanic ash.

Background and method of adjustment RGB recipes

(from material of AOMSUC-6, 2015)

- Imager difference between Himawari and Meteosat (MSG)
- Basic RGB recipes are based on MSG data

→ Necessity of proper enhancements or adjustments of individual color beams

→ Investigation of correlation between Himawari-8 and MSG-2, by simulated data (by H. Murata)

→ Possibility to adjust MSG recipe to Himawari RGB by regression coefficient derived from the investigation

Tentative adjusted recipe by (linear) regression coefficients

AIR MASS

RGB	band(MSG)	min(MSG)	max(MSG)	gamma	band(H8)	min(H8)	max(H8)	gamma
R	6.2-7.3	-25	0	1.0	6.2-7.3	-26.2	0.6	1.0
G	9.7-10.8	-40	5	1.0	11.2-9.6	-43.2	6.7	1.0
B	6.2(inv)	243	208	1.0	6.2(inv)	243.9	208.5	1.0

DUST

RGB	band(MSG)	min(MSG)	max(MSG)	gamma	band(H8)	min(H8)	max(H8)	gamma
R	12.0-10.8	-4	2	1.0	12.4-10.4	-6.7	2.6	1.0
G	10.8-8.7	0	15	2.5	11.2-8.6	-0.5	20.0	2.5
B	10.8	261	289	1.0	10.4	261.2	288.7	1.0

Night Microphysics #1

RGB	band(MSG)	min(MSG)	max(MSG)	gamma	band(H8)	min(H8)	max(H8)	gamma
R	12.0-10.8	-4	2	1.0	12.4-10.4	-6.7	2.6	1.0
G	10.8-3.9	0	10	1.0	11.2-3.9	-3.5	6.9	1.0
B	10.8	243	293	1.0	10.4	243.6	292.6	1.0

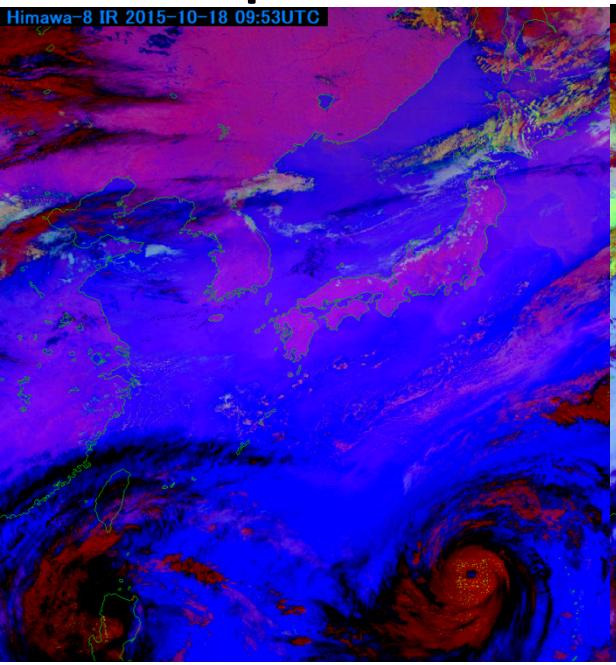
Night Microphysics #2

RGB	band(MSG)	min(MSG)	max(MSG)	gamma	band(H8)	min(H8)	max(H8)	gamma
R	12.0-10.8	-4	2	1.0	12.4-10.4	-6.7	2.6	1.0
G	10.8-3.9	0	10	1.0	10.4-3.9	-3.1	5.2	1.0
B	10.8	243	293	1.0	10.4	243.6	292.6	1.0

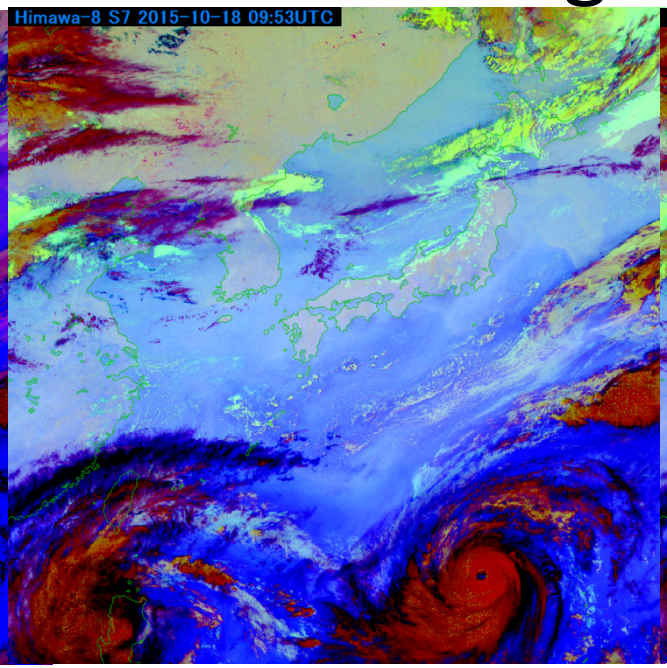
NaturalColors

RGB	band(MSG)	min(MSG)	max(MSG)	gamma	band(H8)	min(H8)	max(H8)	gamma
R	1.6	0	100	1.0	1.6	0.0	97.5	1.0
G	0.8	0	100	1.0	0.86	0.0	108.6	1.0
B	0.6	0	100	1.0	0.64	0.0	100.0	1.0

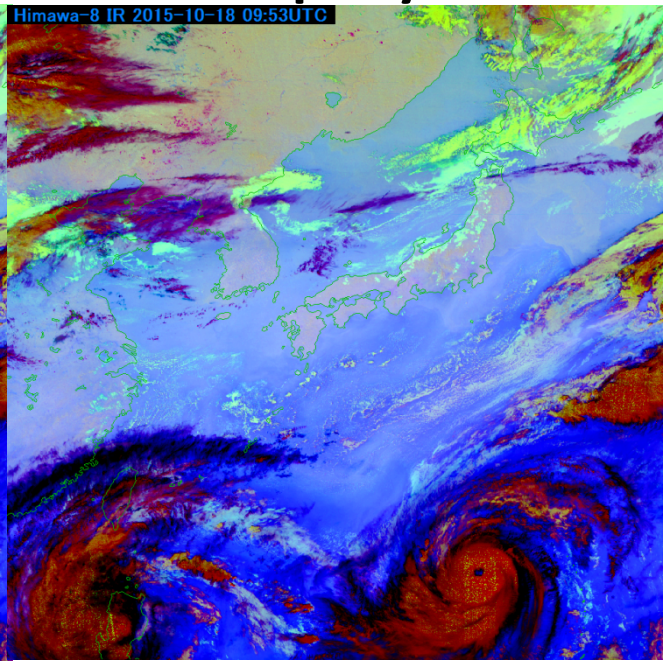
Comparison with “tuned” Night Microphysics



Original (EUMETSAT)recipe

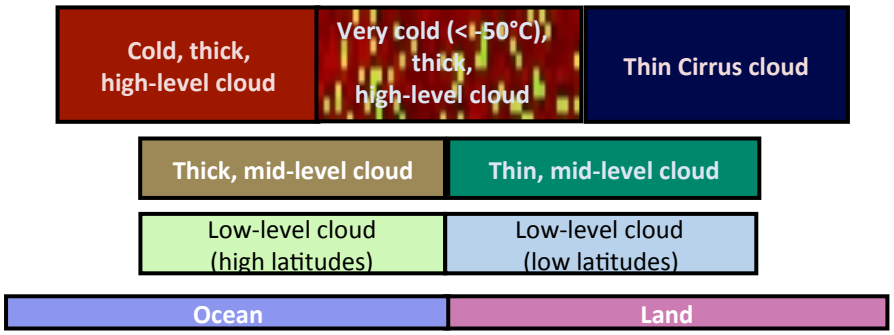


Adjusted recipe #1



Adjusted recipe #2

Interpretation of colors by EUMETSAT



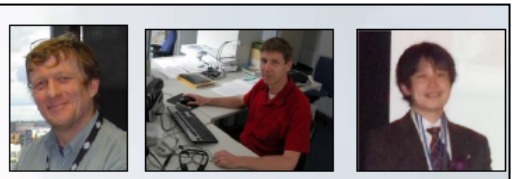
Either adjustments are better than unadjusted one!

Appearances of low-cloud and surface are improved.

Adjustment RGB recipes (tentative)

Collaboration with Australian Bureau

Images courtesy B. Zeschke, Bureau of Meteorology



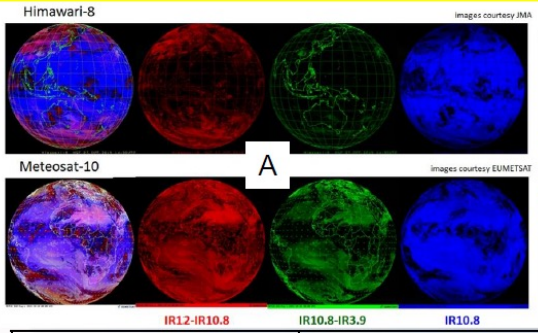
Liaison with:

- Principal Sponsoring Satellite Operator
- VLab Contacts
- EUMETSAT experts
- Researchers (CAWCR etc.)
- Other stakeholders

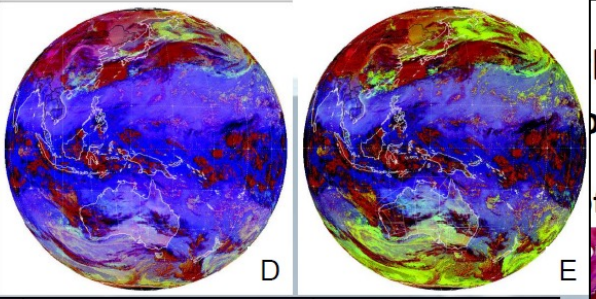
Tuning the Night Microphysics RGB products by Forecasters and stakeholders to suit local conditions

Thick high cloud | Thick mid-level cloud | Low cloud/fog (warm) | Ocean
Thin Cirrus | Thin mid-level cloud | Low cloud/fog (cold) | Land

Most tuning required in the Red and Green beams



Night-time Microphysics RGB
Valid Sun, 10 Apr 2016 14:00 UTC

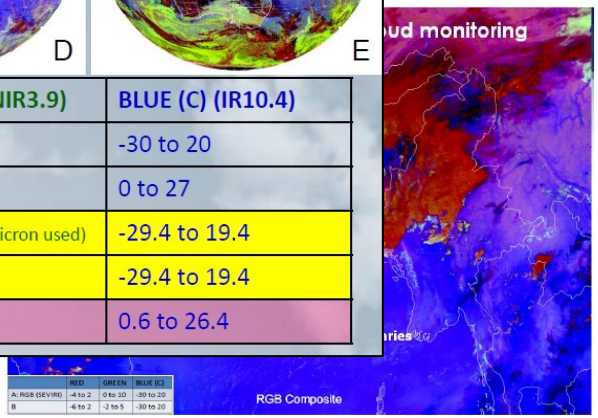


	RED (IR12.0 – IR10.4)	GREEN (IR10.4-NIR3.9)	BLUE (C) (IR10.4)
A: SEVIRI RECIPE	-4 to 2	0 to 10	-30 to 20
B: NCMP-TROP	-4 to 2	0 to 5	0 to 27
C: JMA version 1	-6.7 to 2.6	-3.5 to 6.9 (11.2 micron used)	-29.4 to 19.4
D: JMA version 2	-6.7 to 2.6	-3.1 to 5.2	-29.4 to 19.4
E: TROP Hybrid (scaled)	-6.7 to 2.6	-3.1 to 2.6	0.6 to 26.4

he Night

ow boundaries from storms at night.

f Bengal)

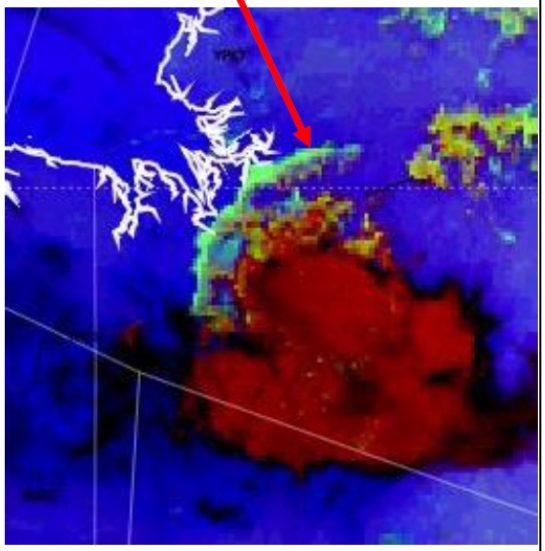


2 May 2016, 16:00UTC
Himawari-8 RGB recipe B.

	RED	GREEN	BLUE (C)
A: RGB (SEVIRI)	-4 to 2	0 to 10	-30 to 20
B	-6 to 2	-2 to 5	-30 to 20

image courtesy J.Kerkmann, EUMETSAT

Storm outflow (Northern Territory)



21 March 2016, 18:20 UTC
Himawari-8 Tropically tuned RGB product

image courtesy JMA/BOM

Active studies related to tuning RGB Products have been done by Mr. Zeschke of Australian Bureau.

Summary

- Tentative ideas for new RGB recipes
  - Cloud phase
    - 2.3 μm (B06) will be a “Key” component.
  - Water vapor
    - Challenge to the visualization of the water vapor distribution for each vertical level is in progress.
  - Fire/smoke detection, Convection
    - Simple RGBs by traditional five bands will be useful for WIS users.
  - SO2
    - The RGB shows good results of the sulfur dioxide detection in some cases.
- Adjusting RGB schemes
  - Generally, the adjustments of MSG recipe to Himawari RGB by regression coefficients derived from the investigation seem to be good matching.
  - Collaborative effort with Himawari-8 users such as Australian Bureau is ongoing.

- More detail investigation will be required!

Thank you!

“Sunflower” is origin of the name “Himawari”.
This photo was taken near Meteorological Satellite Center.