Introduction of JMA VLab Support Site on RGB Composite Imagery and tentative RGBs

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Contents

• VLab Support Site on RGB composite imagery
• Adjustment RGB recipes (tentative)
• Experimental RGBs by Himawari-8/AHI
VLab Support Site on RGB composite imagery
Background of Opening of VLab Support Site on RGB composite imagery

- RGB composite technique is in the “spotlight” as an effective use of the AHI/Himawari-8 imagery data.

- The Himawari user community is not necessarily familiar with RGB composite imagery.
  → The basic RGB materials are necessary.
Virtual Laboratory for Training and Education in Satellite Meteorology (VLab)

- VLab is a global network of specialized training centres and meteorological satellite operators working together to improve the utilisation of data and products from meteorological and environmental satellites.
- Eight satellite operators are involved: CMA, CONAE, EUMETSAT, INPE, JMA, KMA, NOAA and ROSHYDROMET, and Thirteen training centres – called Centres of Excellence (CoEs) – located in Argentina (Buenos Aires and Cordoba), Australia (Melbourne), Barbados (Bridgetown), Brazil (Cachoeira Paulista), China (Beijing and Nanjing), Costa Rica (San Jose), Kenya (Nairobi), Morocco (Casablanca), Niger (Niamey), Oman (Muscat), Republic of Korea (Gwanghyewon), the Russian Federation (Moscow and St Petersburg) and South Africa (Pretoria). Three CoEs are linked to universities (Buenos Aires, St. Petersburg and Nanjing).

(extract) WMO-CGMS VLab website  http://www.wmo-sat.info/vlab/
Spring and Autumn Equinox Operations of Himawari-8

Observation images of Himawari-8 are affected by the sun avoidance function of the radiometer and the sun stray light in a spring and autumn equinox period. Detailed information: Himawari-8 Operation for Eclipse Periods (10 August 2015)

Important Notice

Direct dissemination service via MTSAT-1R to be terminated on 4 December 2015 (7 October 2015)
Updated top page of JMA VLab site.

Link button to the RGB training page has been added here!

Contributions to the WMO/CGMS-VL

The Virtual Laboratory for Satellite Training and Data Utilization (VL) was established to maximize the use of satellite data around the world. It is a collaborative effort that connects the world's major satellite operators with WMO Centers Of Excellence in satellite meteorology. These centers serve as satellite-focused training resources for WMO Members.

JMA Virtual Laboratory users must note the COPYRIGHT information and DISCLAIMER below.

VL Resources

- Contents

SATAID

- What is SATAID?
- SATAID Operation Manual (PDF: 5,733 KB)

### RGB Training Materials

#### RGB Outline

- **Outline of RGB Composite Imagery** *(PDF version)* *(Approximately 13MB)*

#### WMO recommended schemes

- Natural Color RGB - Detection of snow/ice, vegetation and clouds
  - *PowerPoint version* *(ppx zip, approximately 16MB)*
  - *PDF version* *(Approximately 3MB)*
- Day Microphysics RGB - Nephanalysis in daytime
  - *PowerPoint version* *(ppx zip, approximately 20MB)*
  - *PDF version* *(Approximately 4MB)*
- Day Snow-Fog RGB - Detection of low-level clouds and snow/ice covered area
  - *PowerPoint version* *(ppx zip, approximately 13MB)*
  - *PDF version* *(Approximately 3MB)*
- Night Microphysics RGB - Nephanalysis in night time
  - *PowerPoint version* *(ppx zip, approximately 12MB)*
  - *PDF version* *(Approximately 3MB)*
- Day Convective Storm RGB - Detection of Cumulonimbus Cloud
  - *PowerPoint version* *(ppx zip, approximately 14MB)*
  - *PDF version* *(Approximately 3MB)*
- Dust RGB - Detection of Yellow Sand (Asian Dust)
  - *PowerPoint version* *(ppx zip, approximately 23MB)*
  - *PDF version* *(Approximately 3MB)*
- Airmass RGB - Analysis of air mass and jet stream
  - *PowerPoint version* *(ppx zip, approximately 15MB)*
  - *PDF version* *(Approximately 2MB)*

#### RGB recipes for other applications

- Ash RGB - Detection of Volcanic Ash
  - *PowerPoint version* *(ppx zip, approximately 13MB)*
  - *PDF version* *(Approximately 3MB)*
- True Color RGB by Himawari-8 and -9
  - *PowerPoint version* *(ppx zip, approximately 8MB)*
  - *PDF version* *(Approximately 3MB)*

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- Almost all imagery are derived from Himawari-8.
- Materials for seven WMO recommended schemes
- As for detailed case studies (e.g. Visibility obstruction by fog 2015/XX/XX/XX UTC), they will be prepared and open at the stage when knowledge still more deepened.
- Materials except for WMO recommended schemes
- JMA’s True Color RGB material is here!
Example of materials

Outline of RGB Composite Imagery

Outline material on RGB composite imagery

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

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</table>

There are different properties in each channel, as shown in the left figure.

RGB composite imagery which are possible to create by MTSAT satellites:
- Night Microphysics
- Day Microphysics
- Clouds Convection
- Severe Storms
This material reproduces the EUMETSAT/MSG recipe by using “Himawari8/AHI” imagery.

Natural Color RGB

Detection of snow/ice, vegetation and clouds

Meteorological Satellite Center, JMA

What’s Natural Color RGB?

Example of Natural Color RGB

Sea Ice and Snow/Ice Covered Area

Sea ice and snow/ice covered area appear in cyan color!
This scheme is Himawari's own recipe!
Useful links

- HIMAWARI Real-Time Image
- MTSAT Real-Time Image - MTSAT RGB Composite Imagery -
  - Southeast Asia (90 E, 30N - 120 E, 0 N)
  - Southeast Asia (extended) (90 E, 30N - 165 E, 15 S)
  - South Pacific Islands (140 E, 10N - 145 W, 35 S)
- EUMETSAT Training Library (External link)
  - EUMETSAT RGB Products Explained (External link)
- EUMeTrain ePort (External link)
- GOES-R RGB Products Explained (External link)
- Australian BoM VLab National Himawari-8 Training Campaign (External link)

Links to Himawari real-time image including the RGB composite imagery

Links to MTSAT real-time image including the RGB composite imagery

EUMETSAT Training Library

EUMEeTrain ePort

NOAA GOES-R RGB Products Explained website

Australian BoM VLab National Himawari-8 Training Campaign website

Suitable links will be added here.
Useful links: HIMAWARI Real-Time Image

MSC/JMA website

HIMAWARI Real-Time Image
Useful links: HIMAWARI Real-Time Image

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

Select your favorite RGB!

Click your favorite region!
Future Plan of VLab Support Site on RGB composite imagery

- First phase: materials based on “EUMETSAT” recipe

- Second phase: materials on the imagery specifications of AHI’s sixteen bands

- Third phase: materials of the tuned or optimized (color matching) and “new” RGB recipe

- Continuously: enhance the contents of RGB case studies
Related activities of VLab Support Site on RGB composite imagery

2015

July

- 7 July Start of Himawari-8 operation
- 7 July Opening of VLab RGB website
- BoM: 27-30 July Science Week 2015

August

- September - October JICA Training Course

September

- SWFDP Training Workshop on Severe Weather Forecasting (GDPFS) and Warning Services (PWS)
- 20-22 October BMKG workshop about satellite imagery

October

- 9-13 November The Sixth Asia/Oceania Meteorological Satellite Users’ Conference

November

Investigation of adjustment of existing RGB and development of new RGB scheme

Preparations for page(s) of 16 bands properties

Case study investigation

Outcomes will be applied on the website as needed.
Adjustment RGB recipes (tentative)
Background and method of adjustment RGB recipes

• 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
Assumption of the simulation

• Both of Meteosat-9 and Himawari-8 are on 140 degree east longitude
• Data: 06UTC (FT=0), 28th September 2012
### Bands (channels) and response function

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<th>Himawari-8/ AHI</th>
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Correlation of Bands of Himawari-8/AHI and MSG/SEVIRI

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Difference images

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<td>14-12</td>
<td>11.2-9.6</td>
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</table>
MSG vs H8@Visible and near IR
MSG vs H8@Infrared (3.9 micron)

Nighttime only

Comparison of simulated satellite observation

- MSG
- H8

Slope: 1.05384
Intercept: -10.83889

Num: 364050
Bias: 4.34055
Stdev: 0.89419
Corr: 0.99950

Slope: 1.07051
Intercept: -15.83551

Num: 50136
Bias: 3.26339
Stdev: 1.11920
Corr: 0.99974
MSG vs H8@Infrared (water vapor)
MSG vs H8@Infrared (8~10 micron)
MSG vs H8@Infrared (11~13 micron)

Comparison of simulated satellite observation

Himawari8/11.2μm – METEOSAT9/10.8μm

Himawari8/12.4μm – METEOSAT9/12.0μm

Himawari8/13.3μm – METEOSAT9/13.4μm

Comparison of simulated satellite observation

Comparison of simulated satellite observation

Comparison of simulated satellite observation

Meteosat-8/SEVIRI 10.6 micron TBB[K]

Meteosat-8/SEVIRI 12.0 micron TBB[K]

Meteosat-8/SEVIRI 13.4 micron TBB[K]
### Tentative adjusted recipe by (linear) regression coefficients

#### AIR MASS

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<th>gamma</th>
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<th>max (H8)</th>
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#### DUST

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<td>12.4–10.4</td>
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<tr>
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<td>10</td>
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<td>11.2–3.9</td>
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<th>band (H8)</th>
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#### Natural Colors

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<th>min (H8)</th>
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</table>
Airmass

Original (EUMETSAT) recipe

Interpretation of colors by EUMETSAT

Adjusted recipe
Dust

Adjusted recipe

Original (EUMETSAT) recipe

Himawa-8 S1 13/07/2015 00:06UTC

Interpretation of colors by EUMETSAT

- Cold, thick, high-level clouds
- Thin Cirrus clouds
- Contrails
- Low-level cloud (cold atmosphere, High latitude)
- Low-level cloud (warm atmosphere, Low latitude)
- Dust
- Ocean
Night Microphysics

Either adjustments are better than unadjusted one!

Appearances of low-cloud and surface are improved.
Natural Colors

Original (EUMETSAT) recipe

High-level ice clouds
Low-level water clouds

Ocean  Vegetation  Desert  Snow

Adjusted recipe

Interpretation of colors by EUMETSAT
Summary of the adjustment RGB recipes

• Generally, the adjustments of MSG recipe to Himawari RGB by regression coefficients derived from the investigation seem to be good matching.

• However, the coefficients are linear.
  → Possibility of quadric (or more accurate method) adjustment

• More detail investigation will be required.
Introduction of Experimental RGB by Himawari-8/AHI
### Water Vapors

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

<table>
<thead>
<tr>
<th>Band</th>
<th>Gamma</th>
<th>TBB Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>B13(IR10.4)</td>
<td>10 202.29~278.96[K]</td>
</tr>
<tr>
<td>G</td>
<td>B08(WV6.2)</td>
<td>5.5 214.66~242.67[K]</td>
</tr>
<tr>
<td>B</td>
<td>B10(WV7.3)</td>
<td>5.5 245.12~261.03[K]</td>
</tr>
</tbody>
</table>

- **Interpretation (under investigation)**
  - Cloudless, dry
  - Mid-level cloud, dry
  - Mid and low level: humid
  - High and mid level: humid
  - Cloud with high level top

- **覚え方**
  - Upper level water vapor
  - Mid or lower level water vapor

- **Upper level water vapor**
  - Mid and low level: humid
  - Cloud with high level top

- **Mid or lower level water vapor**
  - Cloudless, dry
  - Mid-level cloud, dry
  - Mid and low level: humid

- **Cloud area**
  - High and mid level: humid
Cloud Phase Distinction

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

**Cloudless**

- Thin high-level cloud with ice particles
- Thin high-level cloud with water droplets
- Thin low-level cloud with water droplets
- Thick low-level cloud with ice particles
- Thick low-level cloud with water droplets
- Thick high-level cloud with ice particles

**Interpretation (under investigation)**

- Cloud thickness
- Cloud phase distinction

<table>
<thead>
<tr>
<th>Band</th>
<th>Gamma</th>
<th>TBB/Reflectivity range</th>
</tr>
</thead>
<tbody>
<tr>
<td>R B13(IR10.4)</td>
<td>1.0</td>
<td>219.619～280.6707[K]</td>
</tr>
<tr>
<td>G B03(VS0.64)</td>
<td>1.0</td>
<td>-0.0346～0.7792</td>
</tr>
<tr>
<td>B B05(N21.6)</td>
<td>1.0</td>
<td>0.0119～0.5932</td>
</tr>
</tbody>
</table>
Fire Detection

<table>
<thead>
<tr>
<th>Band</th>
<th>Gamma</th>
<th>TBB/Reflectivity range</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>B01(V1 0.64)</td>
<td>1.0</td>
</tr>
<tr>
<td>G</td>
<td>B06(N3 2.3)</td>
<td>1.0</td>
</tr>
<tr>
<td>B</td>
<td>B14(L2 11.2)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Application: Fire (hot spot) and smoke detection

- Smoke at daytime
- Hotspot at nighttime

Interpretation (under investigation)

→ Aerosol
→ Cloud phase distinction
→ Cloud top
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)).

<table>
<thead>
<tr>
<th>Band</th>
<th>Gamma</th>
<th>TBB/Reflectivity range</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R B9(WV6.9)-B10(WV7.3)</td>
<td>1.0</td>
<td>-4～2 [K]</td>
<td>SO2, water vapor</td>
</tr>
<tr>
<td>G B13(IR10.4)-B11(IR8.6)</td>
<td>1.0</td>
<td>-4～5 [K]</td>
<td>SO2 (water vapor)</td>
</tr>
<tr>
<td>B B13(IR10.4)</td>
<td>1.0</td>
<td>243～303 [K]</td>
<td>Cloud height</td>
</tr>
</tbody>
</table>
Thank you!