Ash RGB
Detection of Volcanic Ash

Meteorological Satellite Center, JMA
Volcanic Ash Detection by Infrared and Difference Image, and Basis

B13 (10.4 microns) and B15 (12.3 microns) have opposite characteristics of absorption and scattering for water or quartz particles.

If the difference between B13 and B15 is positive, it would correspond to clouds, which consist of the droplets or ice particles, and if the difference is negative, it would correspond to the particles of quartz.

This characteristics make it possible to detect the dust and volcanic ash.

Hard to detect…

Good for detection!
Volcanic Ash Detection
Difference vs. Ash RGB

This RGB scheme contains the above B13-B15 difference as the “Red” image component, therefore the volcanic ash is displayed on the RGB.

Furthermore, by the difference of 8.6 micron, the volcanic gas (sulfur dioxide, SO2) is viewable on this RGB.

A set of RGB “Ash” scheme
(RGB:B15-B13/B13-B11/B13)

R : IR12.3-IR10.4
   Range: -4～2 [K]  Gamma: 1.0
G : IR10.4-IR8.6
   Range: -4～5 [K]  Gamma: 1.0
B : IR10.4
   Range: 243～208 [K]  Gamma: 1.0

Ash
(RGB:B15-B13/B13-B11/B13)
# Components of “Ash” RGB scheme RGB

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

This scheme is displayed by compositing two differences and IR 10.4 micron images.

The two differences are as follows:
- Difference of B15 (12.0 micron, corresponds to traditional IR2) and B13 (10.4 micron, corresponds to traditional IR)
- Difference of B13 and B11 (8.6 micron, MI: Mid-wavelength infrared)

B11 has a characteristic of absorption by sulfur dioxide (SO2).

A set of RGB “Ash” scheme (RGB:B15-B13/B13-B11/B13)

R : IR12.3-IR10.4  
Range: -4 ~ 2 [K]  
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Range: -4 ~ 5 [K]  
Gamma: 1.0

B : IR10.4  
Range: 243 ~ 208 [K]  
Gamma: 1.0
Example of Ash RGB

Difference vs. Ash RGB, Kamchatka Peninsula

Volcanic ash appears in whitish color.

Volcanic gas appears in bright green-yellowish color!

Ash (RGB:B15-B13/B13-B11/B13)

Volcanic ash appears in pinkish color.
Example of Ash RGB

8.6 micron Difference vs. Ash RGB, Kamchatka Peninsula

Volcanic ash appears in dark
Volcanic gas appears in bright green-yellowish color!

Ash (RGB: B15-B13/B13-B11/B13)

Volcanic ash appears in pinkish color
Volcanic gas appear in bright! Possibly sulfur dioxide
Example of Ash RGB
Volcanic ash with volcanic gas

The green-yellowish part is overlapped by the pinkish volcanic ash.

The volcanic ash appear in whitish area in the 8.6 difference images.
It is considered that the ash would contain sulfur dioxide gas.
Example of Ash RGB
Volcanic ash pursuit by RGB animation

Himawari-8  Ash 2015-02-15 18:05UTC - 2015-02-16 21:35UTC

Ash
(RGB:B15-B13/B13-B11/B13)

By animation display, it will be easy to distinguish and pursue the volcanic ash!
Adjusting of RGB scheme

The RGB “Ash” and “Dust” have same combination of images. Their scheme are adjusted gradations for focusing on respective phenomena.

Sometimes the distinction between ash and (high) clouds is not easy by using “single” RGB. It is effective to choose scheme(s) according to proper appearances.

Volcanic Ash Advisories (Chikurachki, 02:21 UTC 16 Feb 2015)
Ash RGB
Detection of Volcanic Ash
Summary

✓ Ash RGB is adjusted scheme for volcanic ash detection

✓ Useful to distinguish and pursue volcanic ash, in addition to difference images

✓ Especially useful for distinction between “ash-rich” fume and “sulfuric gas-rich”

✓ Available for day and night

✓ Sometimes detection of “Steam-rich” fume is not easy