Monitoring Sand and Dust Storms from Space

for Expert Consultation on Disaster Information and Knowledge, Session 2

ICC-21 for ESCAP’s RESAP and CDRR-5
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Toshiyuki KURINO
WMO Space Programme Office

Space-based **Qualitative Monitoring** of Sand and Dust Storms
EUMETSAT RGB Imagery Recipe

for extracting meteorological parameters from VIS/IR Multi spectral imager onboard Meteosat Second Generation (MSG) series geostationary meteorological satellites

EUMETSAT MSG Visible 0.6 imagery (23/03/2008 – 12 UTC)

where is the dust?

EUMETRAIN Module on RGB images:
http://www.eumetrain.org/resources/operational_use_rgb.html
EUMETSAT DUST RGB Imagery

**Applications**
Dust, Thin Clouds, Contrails

**Area**
Full MSG Viewing Area

**Time**
Day and Night (every 15 minutes)

**Composition Recipe**

- **Red:** IR12.0μm – IR10.8μm
- **Green:** IR10.8μm – IR8.7μm
- **Blue:** IR10.8μm

Based on the principle of reverse absorption for dust with the IR10.8μm and IR12.0μm channels, as well as the differences in desert emissivity between IR10.8μm and IR8.7μm.

**http://oiswww.eumetsat.int/~idds/html/doc/dust_interpretation.pdf**

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**EUMETSAT RGB Compositing of Multi-Spectral Imagery**

Ash is an RGB composite is designed to detect ash and sulphur dioxide (SO2) from volcanic eruptions which can be used for the provision of warnings to aviation authorities. The Ash RGB is composed from data from a combination of the SEVIRI IR8.7μm, IR10.8μm and IR12.0μm channels.

The advent of true multi-spectral imagers on geostationary satellites has enabled increased insight into cloud and air mass characteristics. On RGB displays some of these characteristics may be easily evidenced with a minimum of processing by attributing a selection of channels and/or channel differences to the individual RGB colour planes.

Dust is an RGB composite is designed to monitor the evolution of dust storms during both day and night. The Dust RGB is composed from data from a combination of the SEVIRI IR8.7μm, IR10.8μm and IR12.0μm channels.

**http://oiswww.eumetsat.org/IPPS/html/MSG/RGB/*
### Himawari RGBs

- Increased information by Himawari-8/AHI’s 16 channels (multi bands) imagery
- EUMETSAT RGB recipes are applicable to Himawari-8 imagery.
- Applying EUMETSAT RGB recipes to Himawari-8
  - Localizing original EUMETSAT RGB recipes for detecting local phenomena in East Asia and Western Pacific regions
  - Developing new RGB products using newly added wavelength bands (0.47, 0.51, 2.3, 6.9μm) for Himawari-8
RGBs from Himawari-8

Very useful imageries to analyze meteorological/non-meteorological phenomenon

- Natural Color
- Day Microphysics
- Night Microphysics
- True Color
- Day Snow-Fog
- Day Convective Storm
- Dust
- Airmass


Dust RGB
Asian Dust (Yellow Sand)

Himawari-8 May 4 2017 12:10 UTC
Sheveluch (56.65N 161.37E)
2017/06/14 1600～2017/06/16 0300 (UTC)
Height of ash: 40,000 feet (12,000m)

(Courtesy of Toshiyuki SAKURAI, Tokyo VAAC)

Ash RGB Imagery

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

JMA real-time RGB Website
RGB Experts and Developers Workshop 2017
Hosted by JMA, EUMETSAT, and WMO
7 - 9 November 2017
JMA Headquarters, Tokyo, Japan

Workshop Objectives:
1. Review of existing RGB composite standards
2. Application of RGBs using new-generation imagers
3. Demonstrating the value of RGBs in context (NWP, products)
4. Compilation of demonstration and training material
5. Exploring new standards for satellite-based composites

All documents and presentation will be available; http://www.wmo.int/pages/prog/sat/meetings/RGB-WS-2017.php

Space-based Quantitative Monitoring of Sand and Dust Storms
for the Assimilation into a global aerosol transport model coupled with global circulation model (GCM)
Aerosol Optical Depth product (Himawari Asian Dust)

- Aerosol Optical Depth and Angstrom Exponent
  (Angstrom Exponent is derived only over the ocean)
- Retrieval algorithm: LUT
  ✓ 0.64, 0.86 μm (ocean), 0.64, 2.3 μm (land)
  ✓ Aerosol type is assumed to be Asian dust
  ✓ NOT optimized for other aerosol types (e.g. haze)
- Internal use (Asian dust monitoring)
  ✓ Plan for introducing a JAXA algorithm in the AOD product on February 2018
- AHI aerosol products for data assimilation
  ✓ Under development in collaboration with JAXA
- Volcanic ash retrieval algorithm would be applied to retrieve aerosol during nighttime

Volcanic Ash (Under-development)

- Installation of NOAA/NESDIS Algorithm
  ✓ Under implementation VOLCAT software developed by NOAA/NESDIS for Himawari-8 volcanic ash product at JMA/MSC
    - Courtesy of NOAA, Dr. Pavolonis and Dr. Sieglaff
- Expected Products
  ✓ Ash top height
  ✓ Mass-loading
  ✓ Optical depth
- Evaluation and Validation
  ✓ Preliminary products will be provided to JMA’s Tokyo VAAC (Volcanic Ash Advisory Center) for testing

Preliminary results of VOLCAT for the eruption of Raung (Indonesia) on 13 July 2015.
Duty for the area of responsibility
- collecting information on eruption/volcanic activity
- monitoring volcanic ash from satellite imagery
- forecasting ash extent
- issuing Volcanic Ash Advisories (VAAs) (Courtesy of Tokyo VAAC, JMA)

Collaboration between Meteorological Satellite Operator and Space Agencies
JAXA Himawari Monitor

- JAXA has been developing Himawari-8 products using the retrieval algorithms which will be consistent with the upcoming Japanese earth observation missions (GCOM-C, GOSAT-2 and EarthCARE), in order to seek synergies between the satellites
- JAXA Himawari Monitor website site was opened in August 2015 to distribute Himawari original (Level 1) and geophysical (Level 2) products
- Over 500 registrations from domestic and international users until today

![Aerosol Optical Thickness](http://www.eorc.jaxa.jp/ptree/index.html)

**Courtesy of Maki Kikuchi, JAXA**

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### JAXA Himawari Products

<table>
<thead>
<tr>
<th>Product name</th>
<th>Grid size</th>
<th>Interval</th>
<th>Format</th>
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<tbody>
<tr>
<td><strong>L1</strong></td>
<td></td>
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<tr>
<td>Reflectance (6 bands)</td>
<td>500m/1km/2km</td>
<td>10min(full) 2.5min(Japan)</td>
<td>HSD NetCDF</td>
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<tr>
<td>Brightness temperature (10 bands)</td>
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<td><strong>Atmosphere</strong></td>
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<tr>
<td>Aerosol properties</td>
<td>5km</td>
<td>10min/1hr</td>
<td>NetCDF</td>
</tr>
<tr>
<td>Cloud properties</td>
<td>5km</td>
<td>10min</td>
<td></td>
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<tr>
<td><strong>Ocean</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sea surface temperature</td>
<td>2km</td>
<td>10min/1hr/1dy</td>
<td></td>
</tr>
<tr>
<td>Ocean color (Chlorophyll-a)</td>
<td>5km(full) 1km(Japan)</td>
<td>1hr</td>
<td></td>
</tr>
<tr>
<td><strong>Land</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wild fire</td>
<td>2km</td>
<td>10min</td>
<td>CSV</td>
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<td><strong>Flux</strong></td>
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<tr>
<td>Photosynthetically active radiation (PAR)</td>
<td>5km(full) 1km(Japan)</td>
<td>1hr</td>
<td>NetCDF</td>
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<tr>
<td>Shortwave radiation (SWR)</td>
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<tr>
<td>Photovoltaic Power (image only)</td>
<td>1km/4km</td>
<td>10min</td>
<td>-</td>
</tr>
</tbody>
</table>

- Retrieval Algorithms are based on those developed for JAXA Earth Observation Satellite Projects. References are available at the web site. (http://www.eorc.jaxa.jp/ptree)

**Courtesy of Maki Kikuchi, JAXA**
Atmospheric Pollutants from Wildfires – an example in Siberia

The Siberian Times, 23 June 2016

Siberia's wildfires seen from 1 million miles away: even the tundra is burning

By The Siberian Times reporter
33 July 2016


Russian volunteers seek a foothold as wildfires rage in Siberia

By Michael Walsh
25 June 2016

Himawari-8 True Color Imagery (16-19 May 2016)

Courtesy of Maki Kikuchi, JAXA
The World Meteorological Organization (WMO) has opened a new office for the Asia-Pacific region in Singapore to improve coordination on hazards ranging from floods to fires and to strengthen meteorological services for rapidly evolving economic sectors such as air and marine transport. The Regional Office is being hosted by the Meteorological Service Singapore (MSS) and will serve as the “nerve” centre for WMO’s programmes in the region.