Australian Government
Bureau of Meteorology

Himawari-8 derived RGB products applied to the Australasia-Pacific region

AOMSUC-6 Training Event

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Australian VLab Centre of Excellence

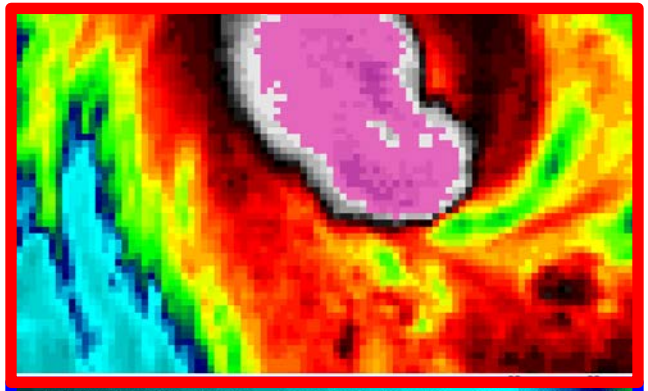
Content

- During this session the WMO/EUMETSAT endorsed RGB products will be briefly introduced.
- We will compare RGB products generated from Himawari-8 data with equivalent METEOSAT RGB products.
- We will examine the suitability and limitations of Himawari-8 RGB products across the Australasia-Pacific region utilising a number of case studies.
- To give attendees a better understanding of this topic there will be some practical exercises during the session.
- Useful resources and references will also be presented.

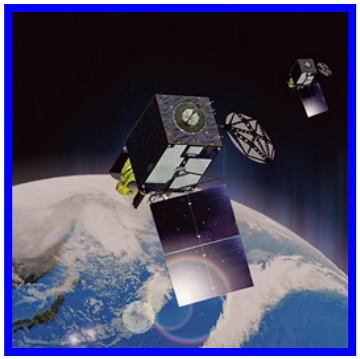
animation courtesy JMA/CIMSS

Comparing Himawari 8/9 with MTSAT-2

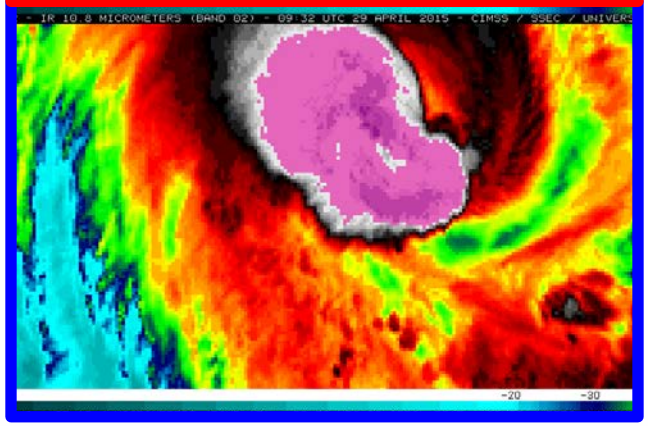
MTSAT 2



Band	Central Wavelength [μm]	Spatial Resolution
1	0.43 - 0.48	1Km
2	0.50 - 0.52	1Km
3	0.63 - 0.66	0.5Km
4	0.85 - 0.87	1Km
5	1.60 - 1.62	2Km
6	2.25 - 2.27	2Km
7	3.74 - 3.96	2Km
8	6.06 - 6.43	2Km
9	6.89 - 7.01	2Km
10	7.26 - 7.43	2Km
11	8.44 - 8.76	2Km
12	9.54 - 9.72	2Km
13	10.3 - 10.6	2Km
14	11.1- 11.3	2Km
15	12.2 - 12.5	2Km
16	13.2 - 13.4	2Km



Himawari 8



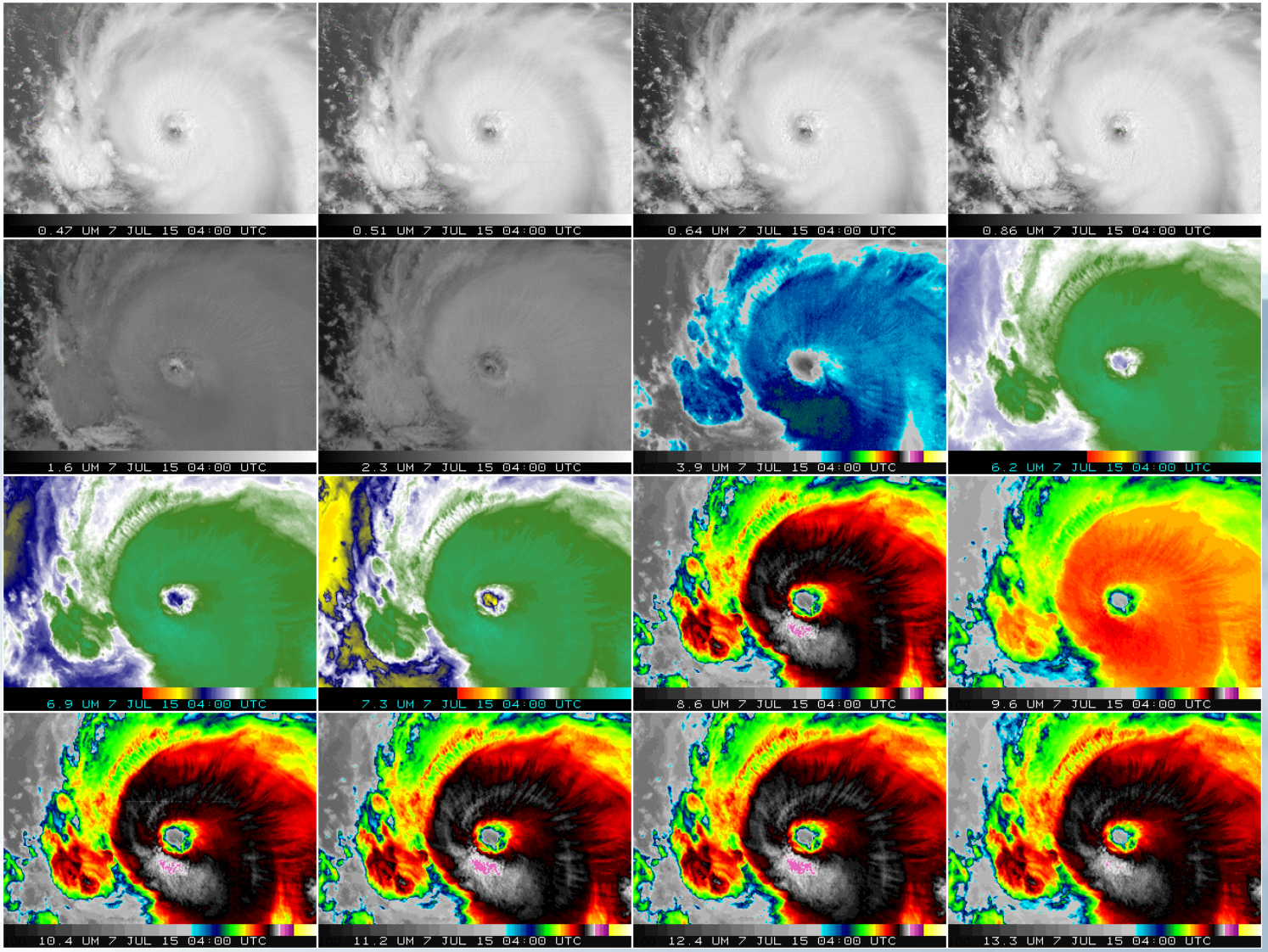
Band	Central Wavelength [μm]	Spatial Resolution
1	0.55 – 0.90	1Km
2	3.50 – 4.00	4Km
3	6.50- 7.00	4Km
4	10.3 – 11.3	4Km
5	11.5 – 12.5	4Km

MTSAT-2 image courtesy JMA, Himawari-8 image courtesy NASA

The 16 channels of Himawari-8: Typhoon Nangka

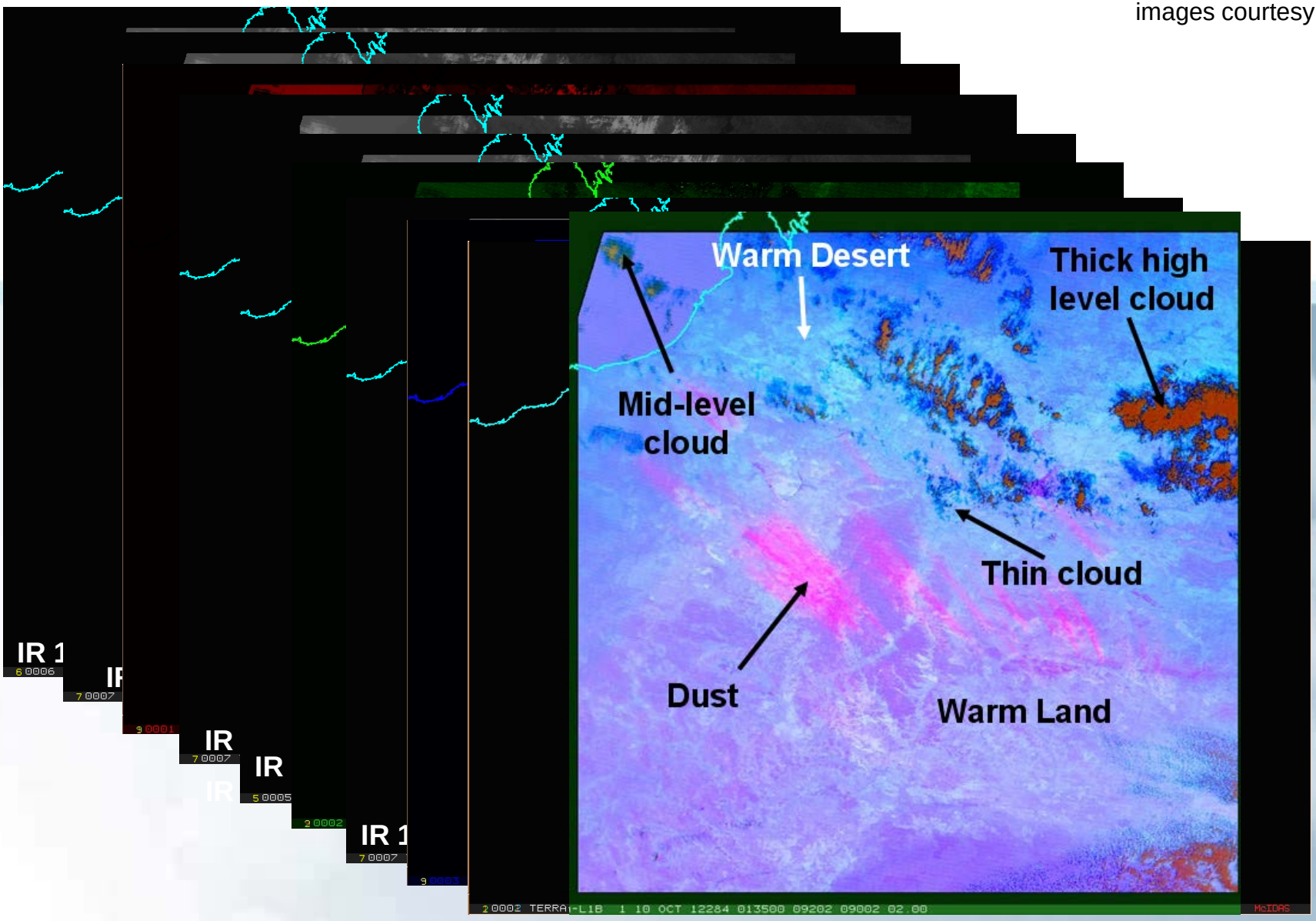
7 July 2015 0400 – 0810UTC

animations courtesy JMA, from the CIMSS Himawari-8 Blog web page



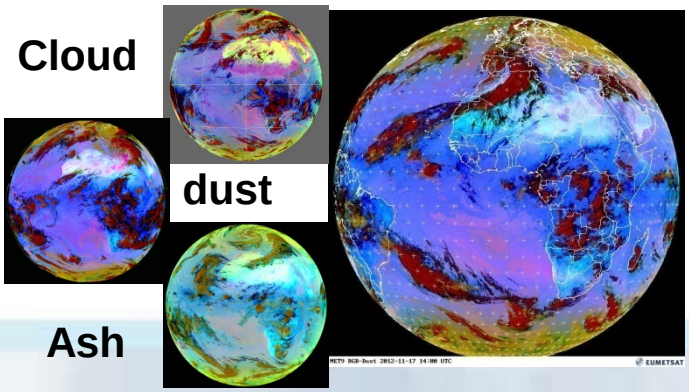
Combining channels into RGB products – the Dust RGB product (NW Australia, 10 October 2012, MODIS data)

images courtesy JMA/BOM

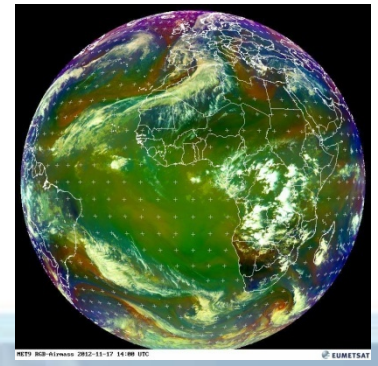


RGB products for Operational Forecasting – EUMETSAT / WMO recommendation

Two RGB composites which complement each other



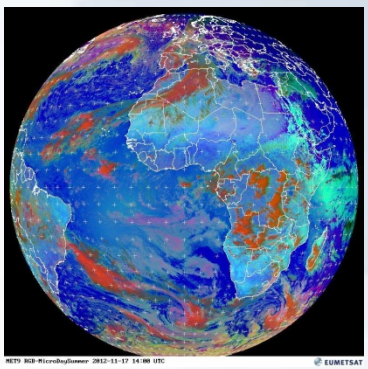
24 hour Microphysical RGB



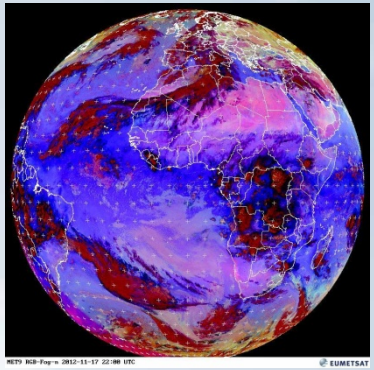
Airmass RGB

from RGB Products Overview (RGB Tutorial) J. Kerkmann EUMETSAT

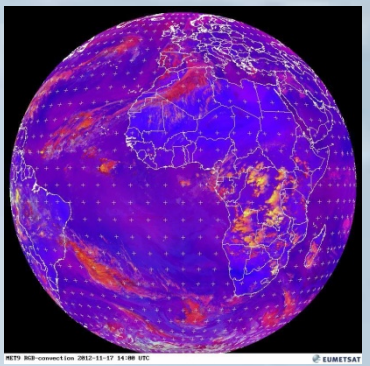
Five application specific RGBs



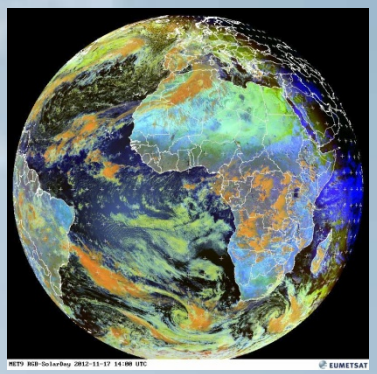
Day Microphysical RGB



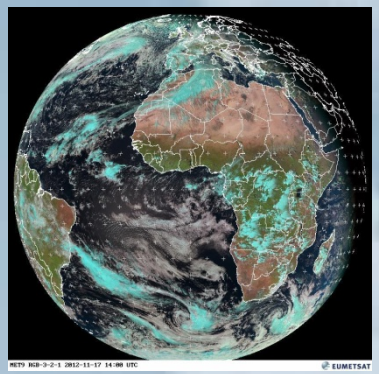
Night Microphysical RGB



Day Convection RGB



Snow / fog RGB

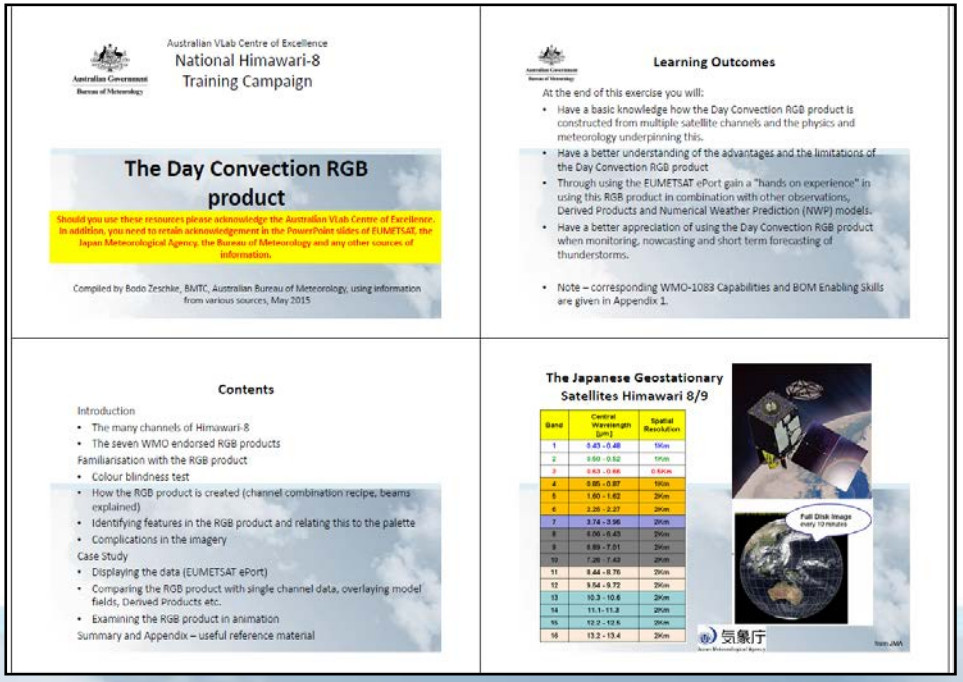


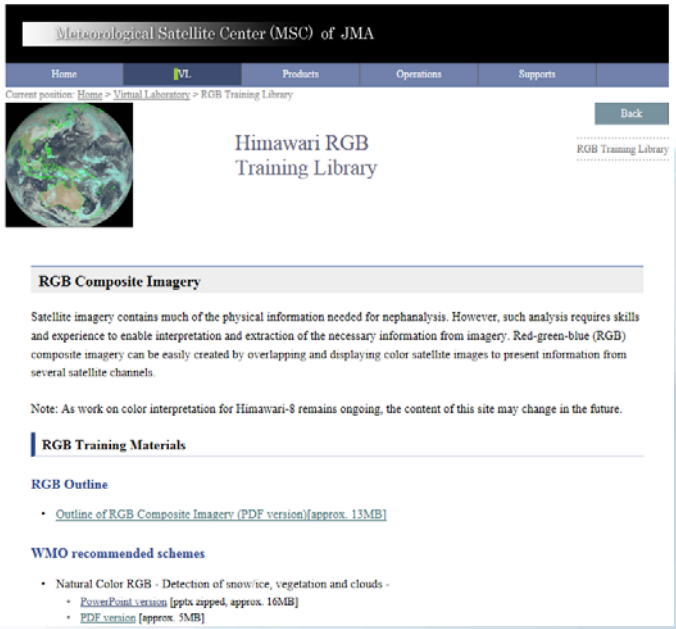
Natural Colours RGB

Accessing RGB resources

Australian Vlab Centre of Excellence web page

http://www.virtuallab.bom.gov.au/training/hw-8-training/introduction-resources-and-case-studies/



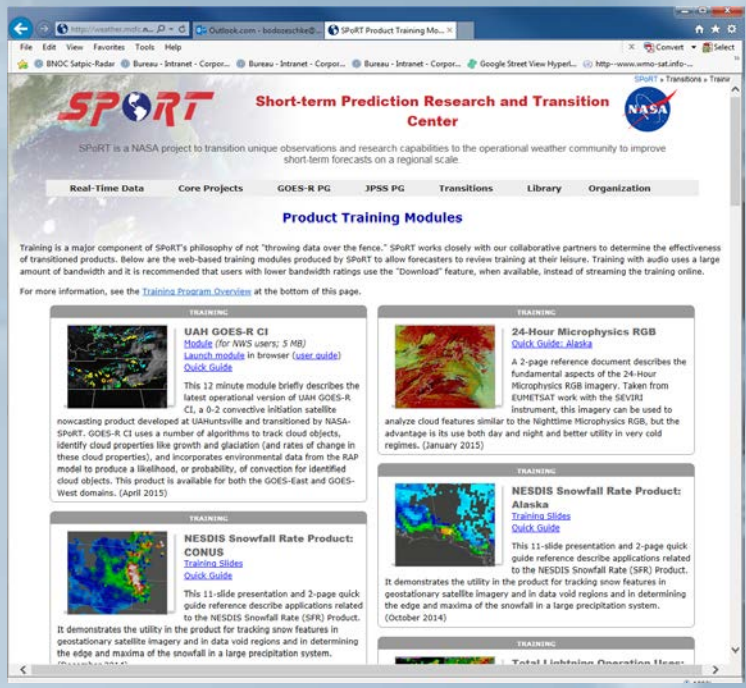


JMA User's Guide to RGB composite imagery (Himawari RGB Training Library)

http://www.data.jma.go.jp/mscweb/en/VRL/VLab_RGB/RGBimage.html

NASA Short-term Prediction Research and Transition Center (SPORT) Training

http://weather.msfc.nasa.gov/sport/training/



Accessing RGB resources on the Australian Vlab Centre of Excellence Web page

http://www.virtuallab.bom.gov.au/training/hw-8-training/introduction-resources-and-case-studies/

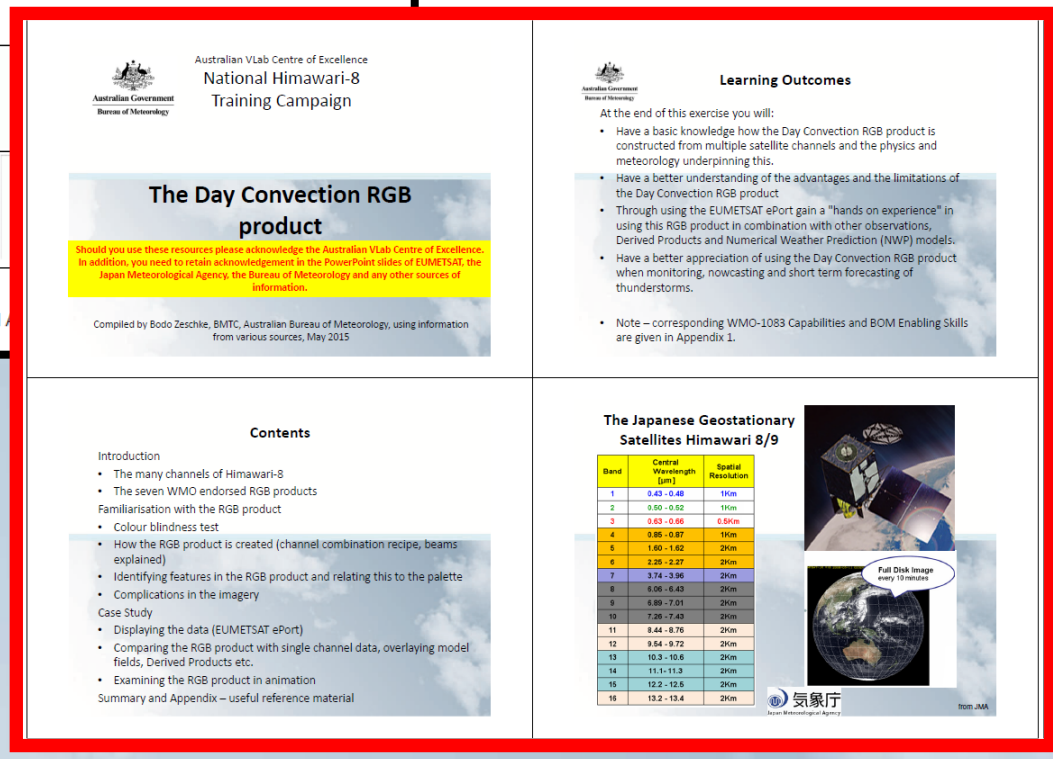
Red-Green-Blue (RGB) Product reference information.

In response to the stakeholder feedback during Phase 1 of the Campaign, below are easy-to-use resources pertaining to the RGB products. These .pdf files include:

- How the RGB products are constructed
- Uses and limitations of the products.
- EUMETSAT ePort exercises for you to try in order to gain familiarisation with the products.

Dust RGB	Ash RGB	Airmass RGB
Additional RGB (to be added)	Night Microphysics RGB	Day Convection RGB

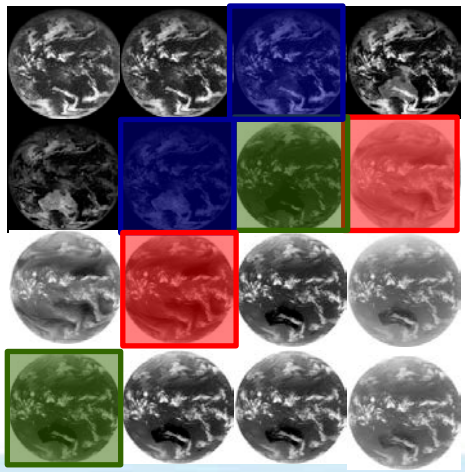
A very useful and relevant Himawari-8 RGB Composite Imagery resource from the Japan Meteorological A



- **RGB product reference .pdf files for easy Forecaster reference.**
- **Most include EUMETSAT ePort exercise.**

Note: JMA and NASA SPORT also has these RGB reference resources

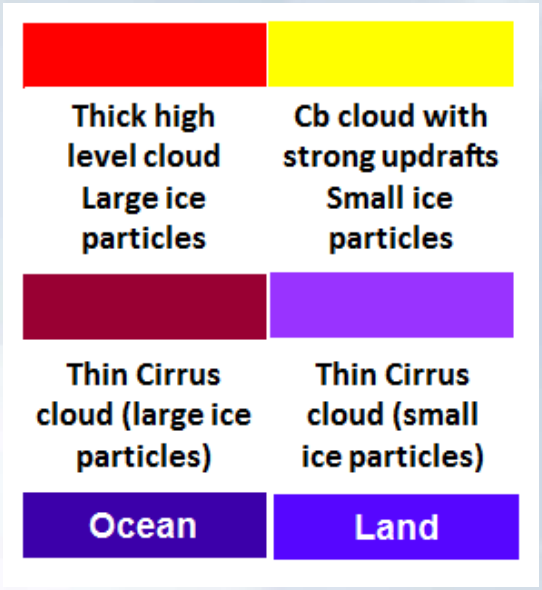
Processing of Himawari-8 data – Day Convection RGB



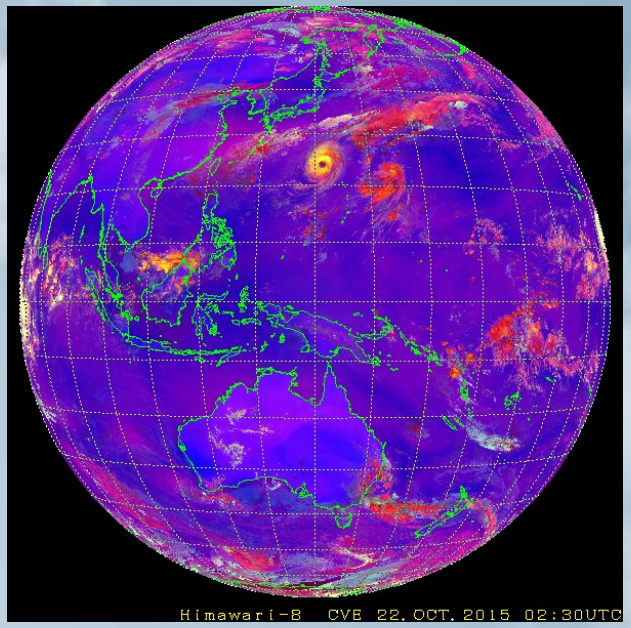
Himawari-8 channels

Recommended Range and Enhancement				
Beam	Channel	Range	Gamma	Gamma 2
Red	WV6.2 – WV7.3	-35 … +5	1.0	1.0
Green	IR3.9 – IR10.8	-5 … +60	0.5	1.0
Blue	NIR1.6 – VIS0.6	-75 … +25	1.0	1.0

Channel combination "recipe" (from EUMETSAT)



Colour interpretation palette

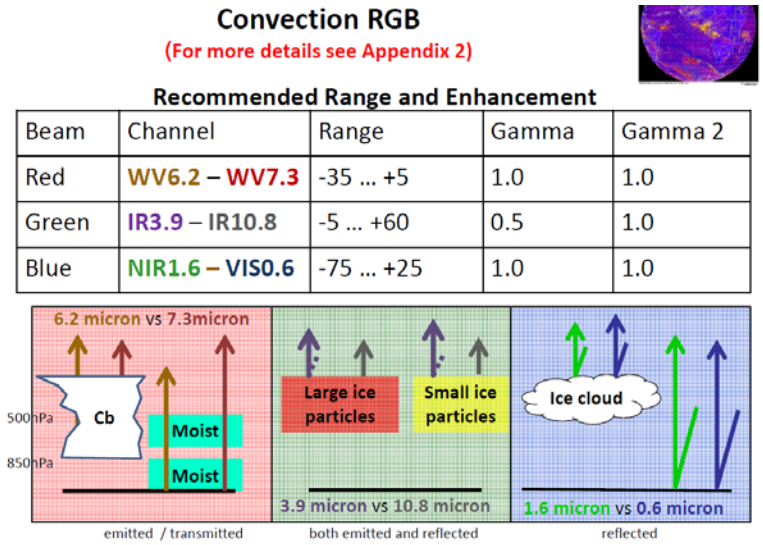


Day Microphysics RGB product

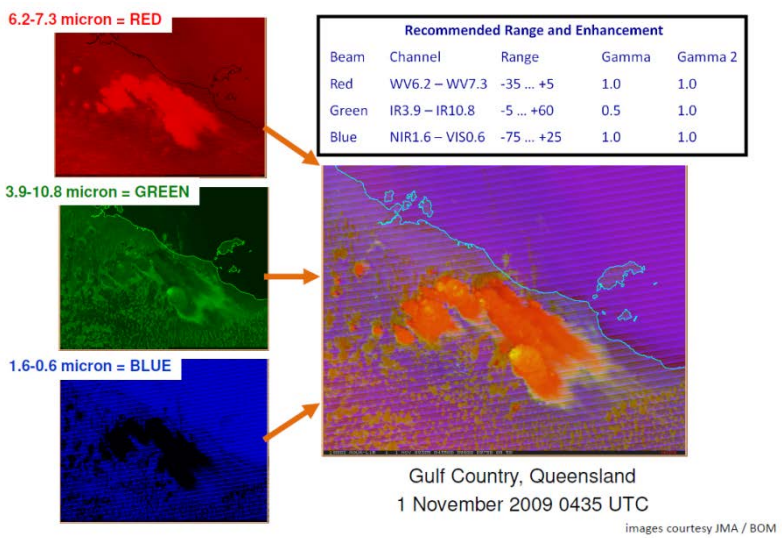
Image courtesy JMA

Other information on each RGB web resource page

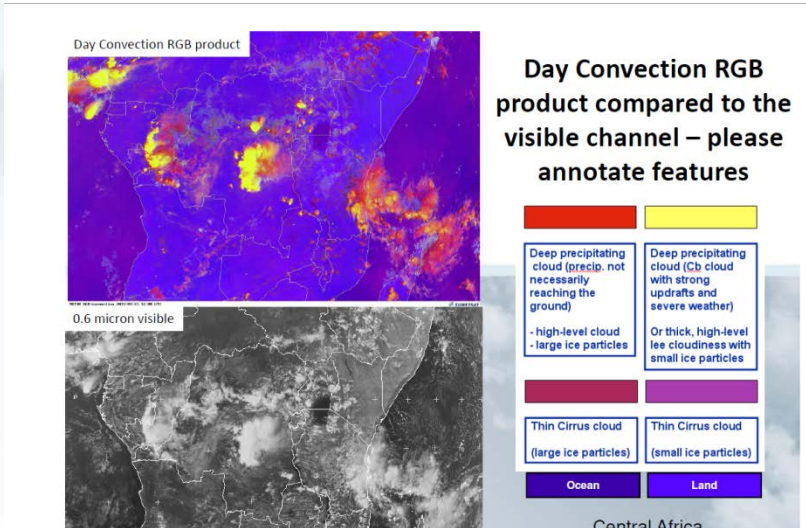
Physics of the RGB product



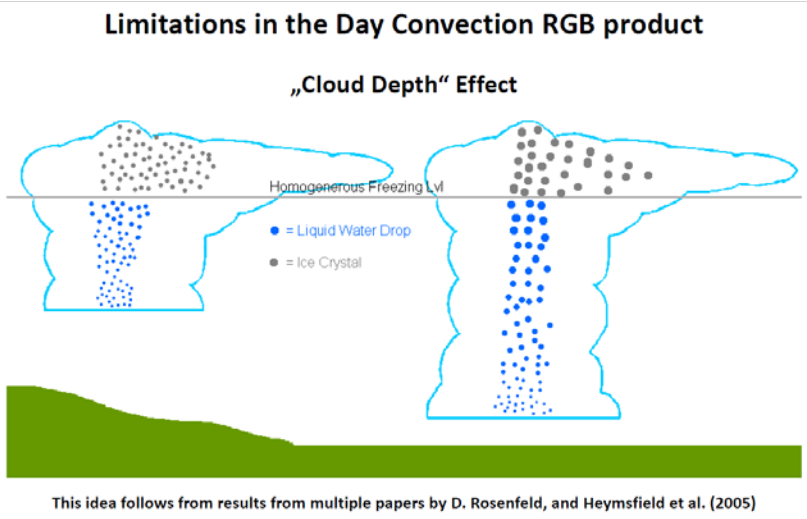
The beams composing the RGB product



Comparison with other satellite data

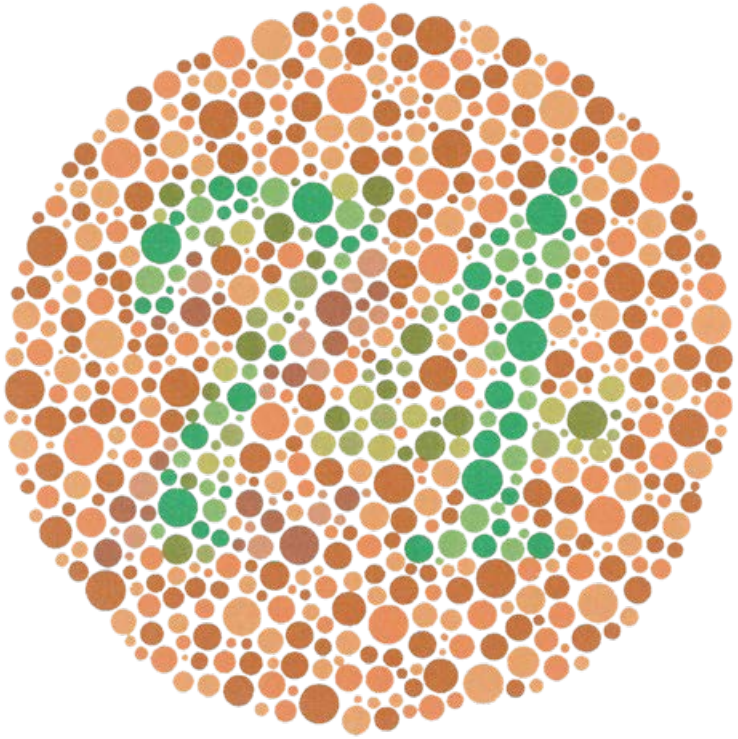


Limitations in the RGB product



Limitations – people who cannot sense colour

image courtesy Wikipedia



Question: What number can you see within the above pattern?

A:21 B:74 C: 47

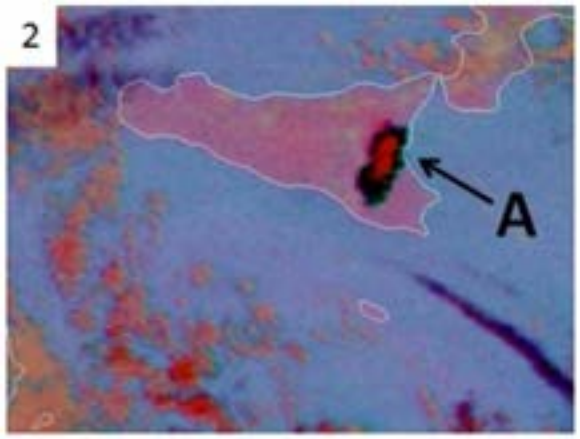


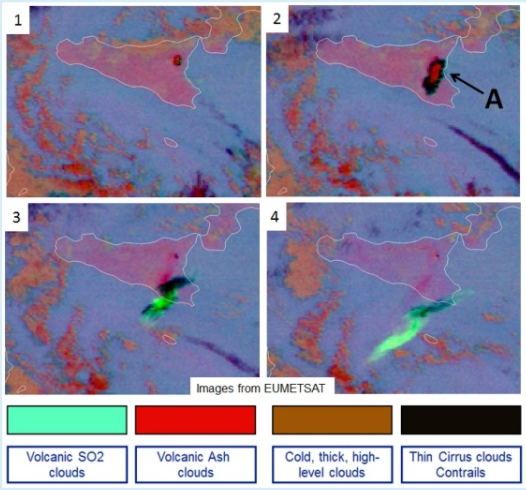
image courtesy BOM/JMA

Question 10

Incorrect

Mark 0.00 out of 1.00

Remove flag



Examine the following scenes in the Ash RGB product showing the eruption of Etna volcano in Sicily, Italy on the 5th January 2012. What does the red signal annotated by (A) correspond to? (select one)

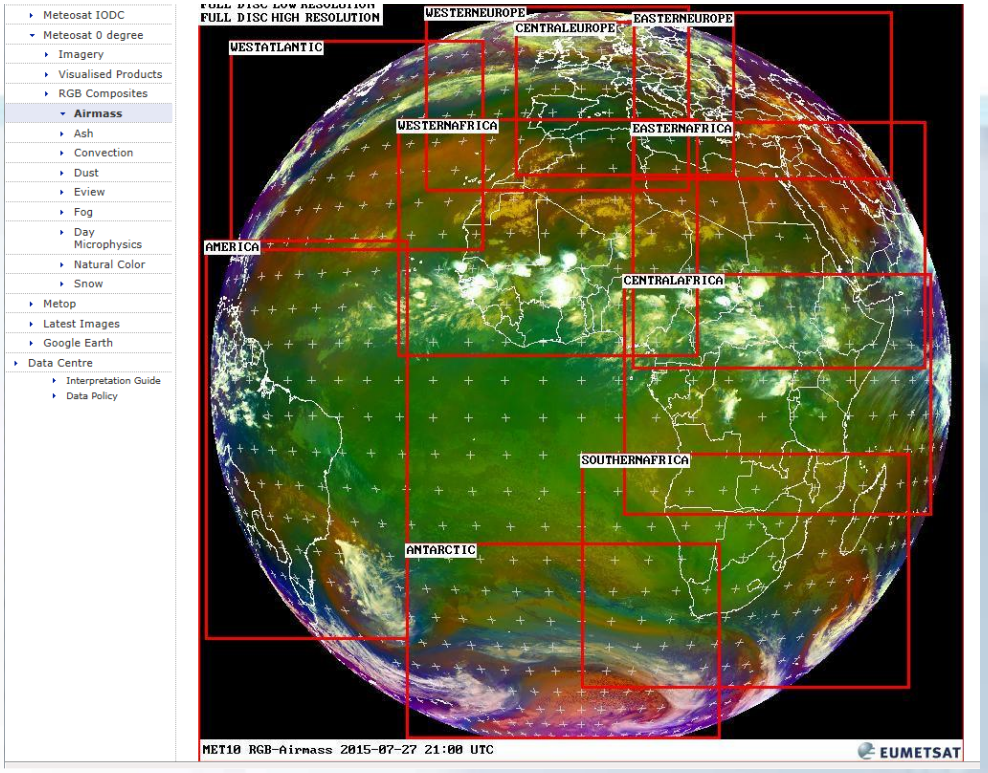
Select one:

- a. This is not the volcanic eruption at all, it is actually a Cb cloud generated by topography. The main volcanic eruption occurred later that day.
- b. It is most likely the thick volcanic ash cloud possibly coated with ice.
- c. According to the colour palette it is clearly thin cirrus cloud with the surface of the earth showing through in red in the centre of this cloud.
- d. The volcanic ash cloud as shown in the Ash RGB product palette ✗ Please check the notes pertaining to the Ash RGB product in the "Red-Green-Blue (RGB) Product reference information" section on the National Himawari-8 Training Campaign web page.

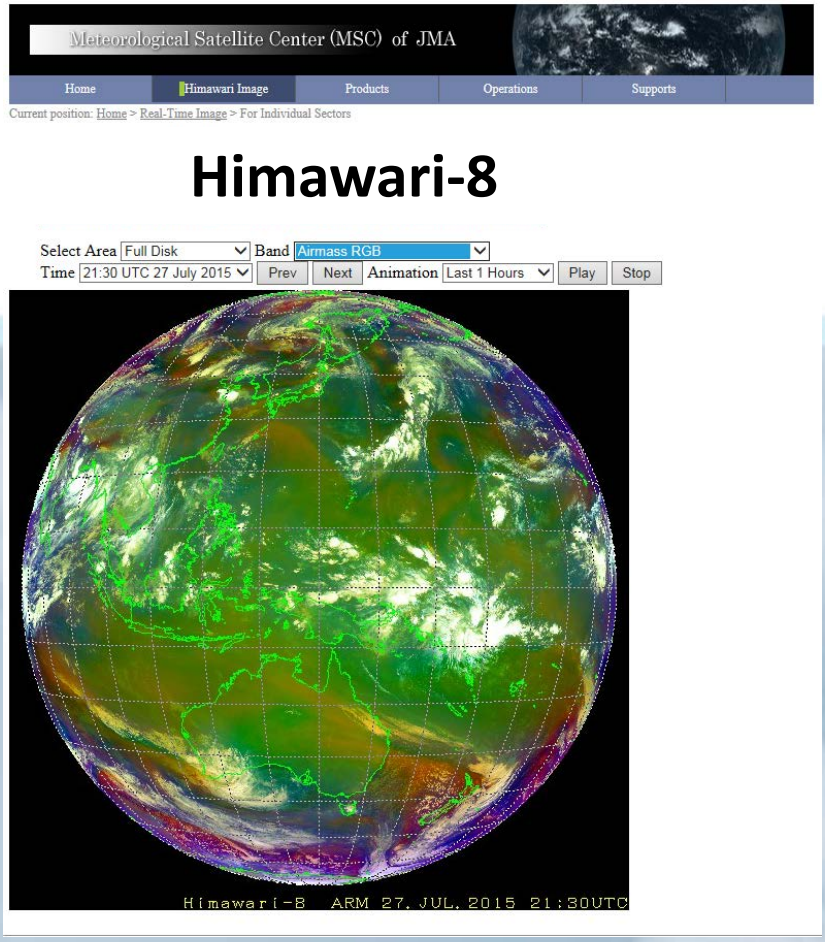
Particular web pages for comparing Himawari-8 with METEOSAT-10 RGB products

Eumetsat RGB Composites

http://oiswww.eumetsat.org/IPPS/html/MSG/RGB/



METEOSAT-10



Himawari-8

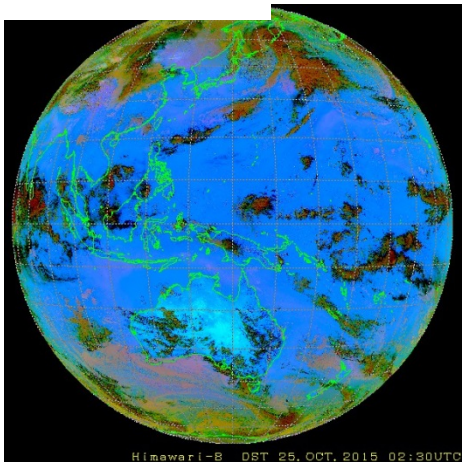
JMA RGB Composites

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

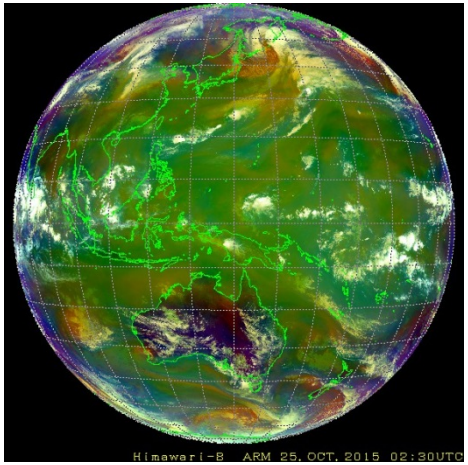
Exercise 1: RGB products from Himawari-8 and Meteosat-10

Himawari-8

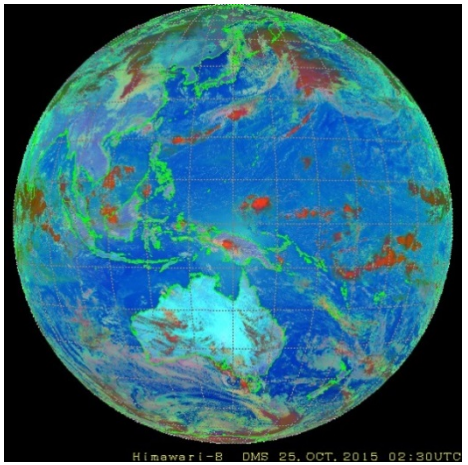
images courtesy JMA



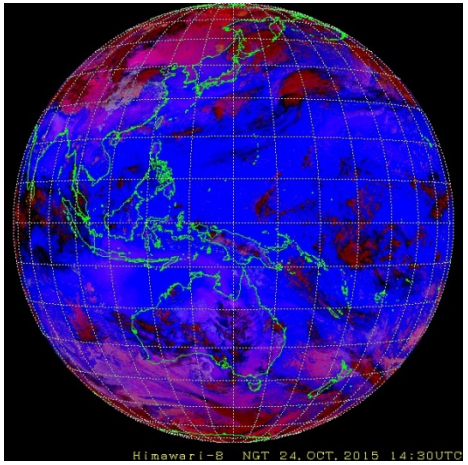
A: Dust RGB



B: Airmass RGB

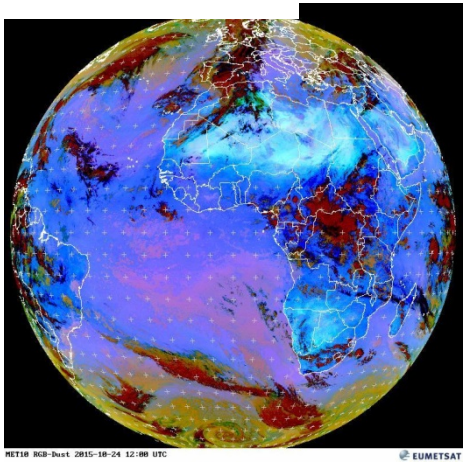


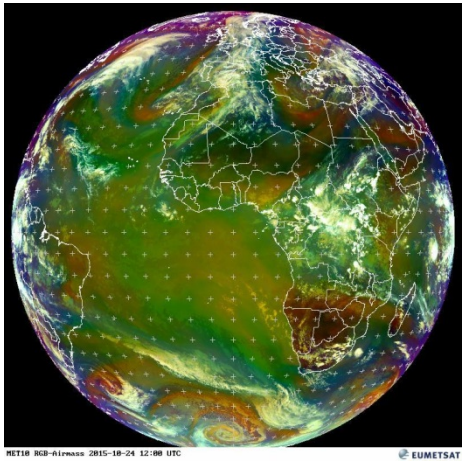
C: Day Microphysics RGB

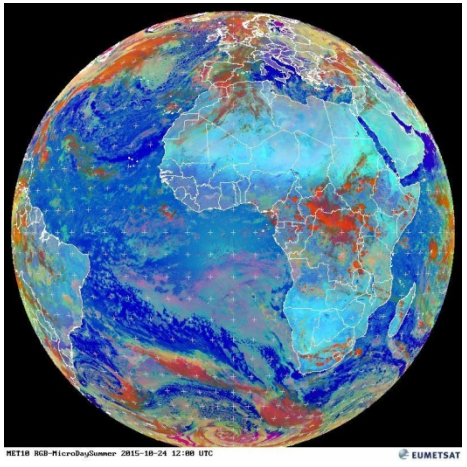


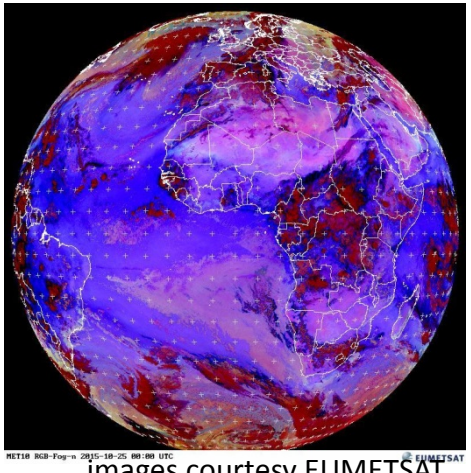
D: Night Microphysics RGB

METEOSAT-10









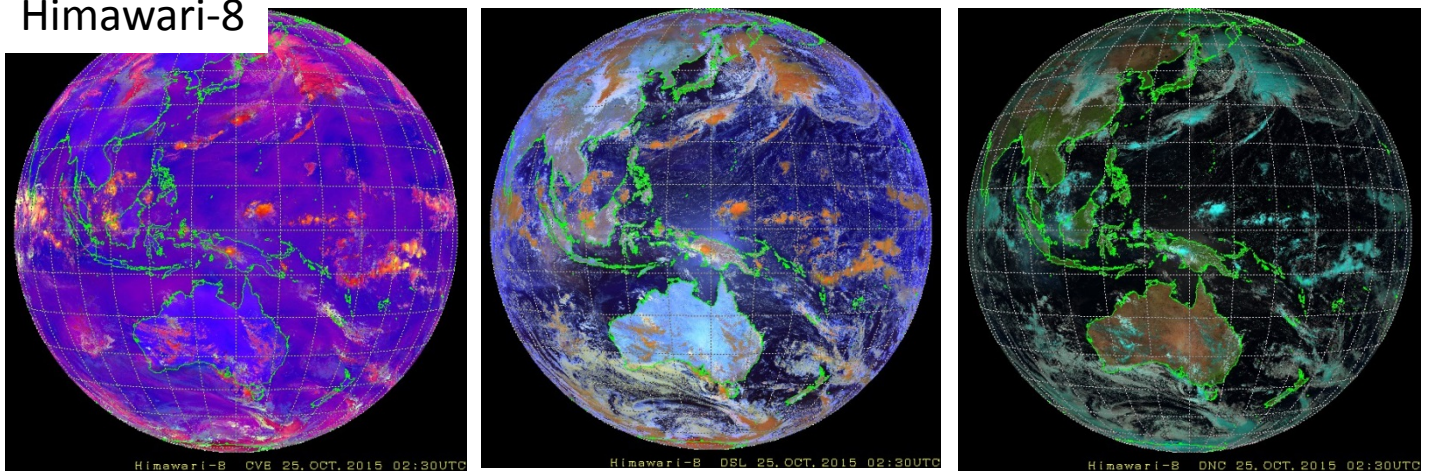
images courtesy EUMETSAT

Question: which of these Himawari-8 RGB products require the greatest adjustment?
Rank from 1 (most adjustment) to 4 (least adjustment)

Exercise 2: RGB products from Himawari-8 and Meteosat-10

images courtesy JMA

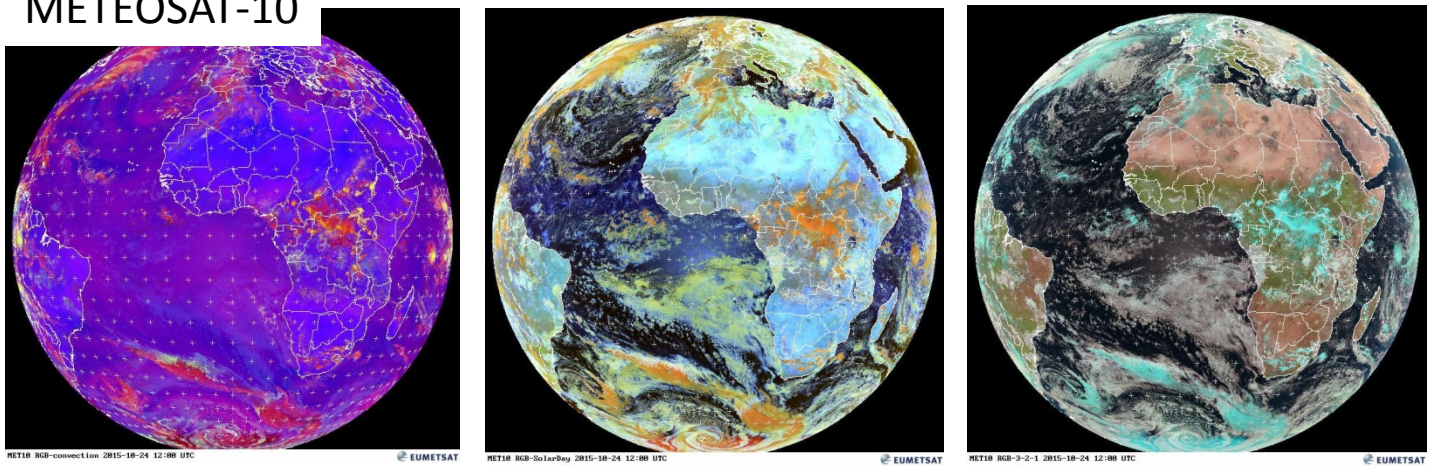
Himawari-8



E: Day Convection RGB F: Snow/Fog RGB G: Natural Colour RGB

images courtesy EUMETSAT

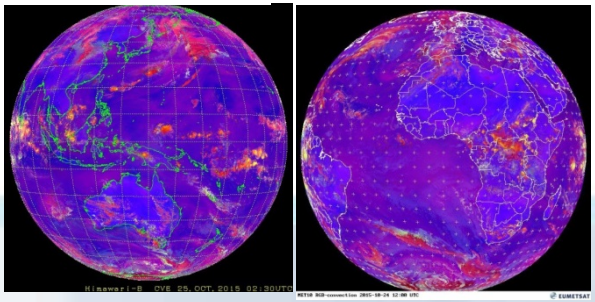
METEOSAT-10



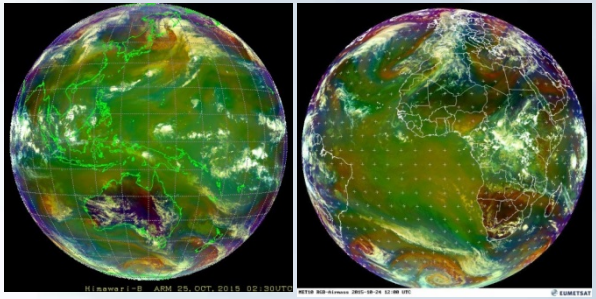
Question: which of these Himawari-8 RGB products require the greatest adjustment?
Rank from 1 (most adjustment) to 3 (least adjustment)

Summary: Which RGB products need most adjustment?

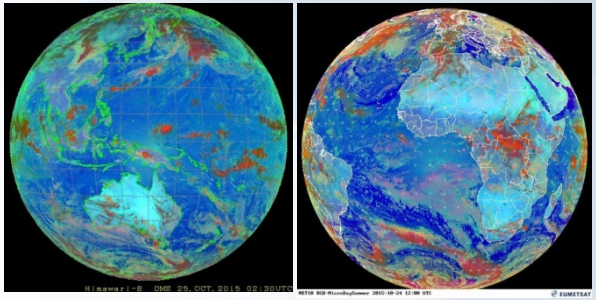
Himawari-8 METEOSAT-10



Day Convection RGB

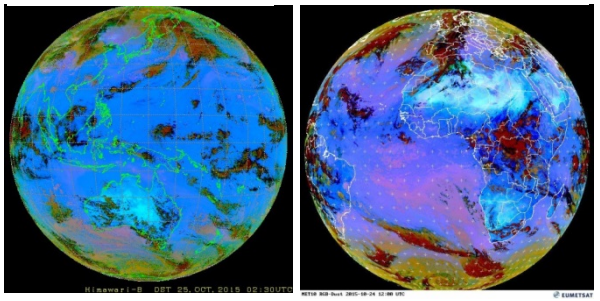


Airmass RGB

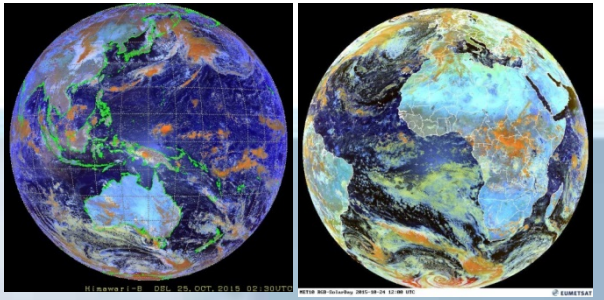


Day Microphysics RGB

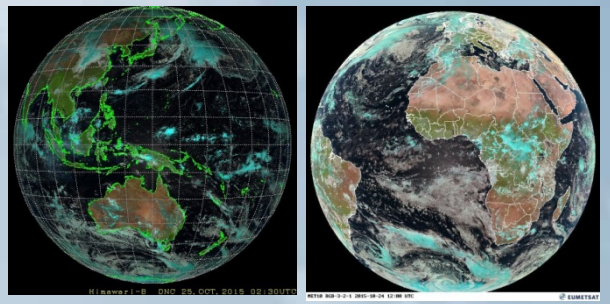
Himawari-8 METEOSAT-10



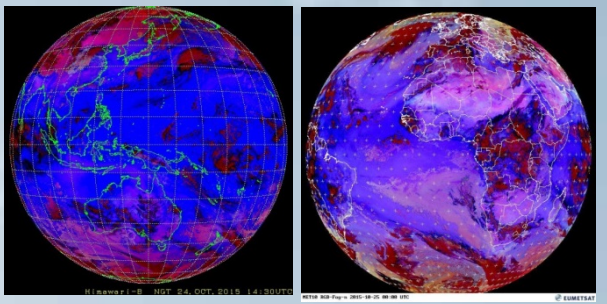
Dust RGB



Snow/Fog RGB



Natural Colour RGB



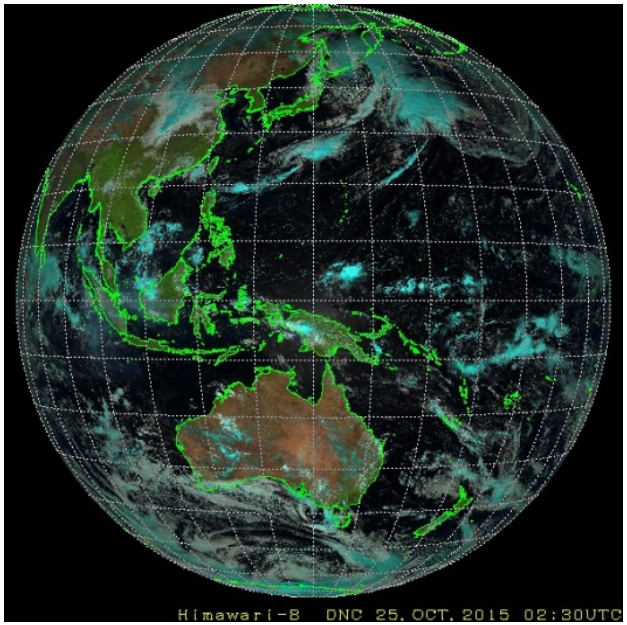
Night Microphysics RGB

images courtesy JMA images courtesy EUMETSAT

Correction: Adjusting for solar zenith angle (24/25 October)

Natural Colour RGB

image courtesy JMA



Himawari-8
JMA web page

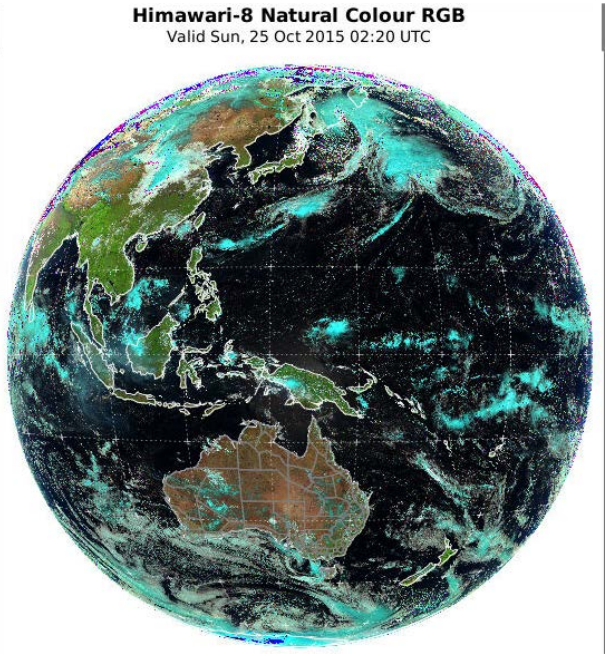
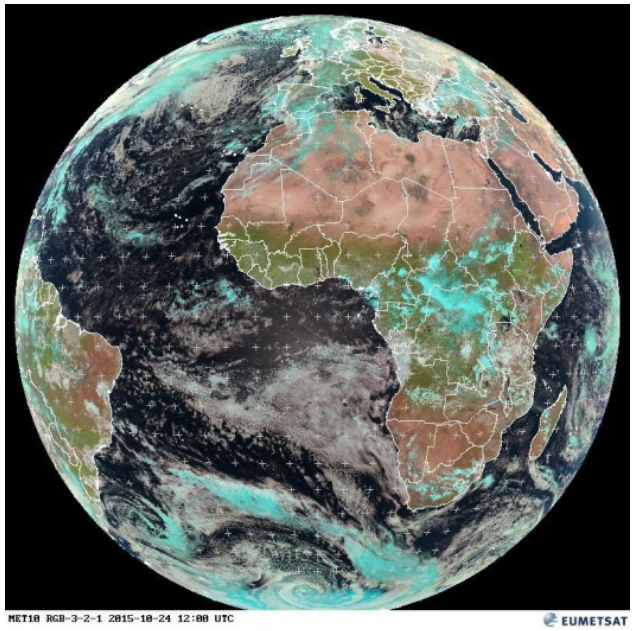


image courtesy BOM/JMA

Himawari-8
Visual Weather
(VICRO RFC)

image courtesy EUMETSAT

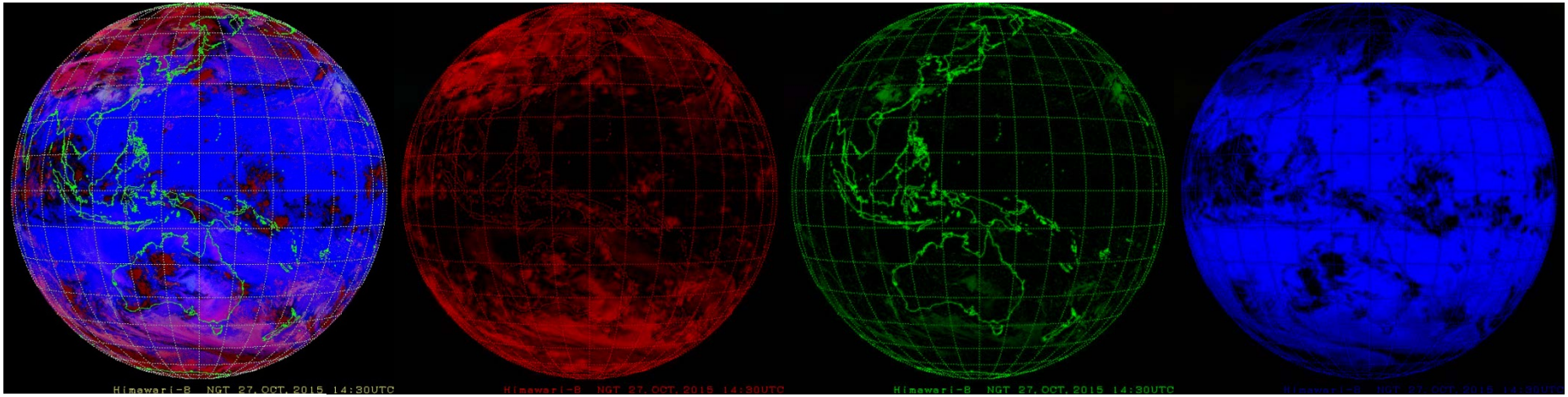


Meteosat-10,
EUMETSAT web page

Correction: Comparing the Beams – the Night Microphysics RGB product (27/28 October)

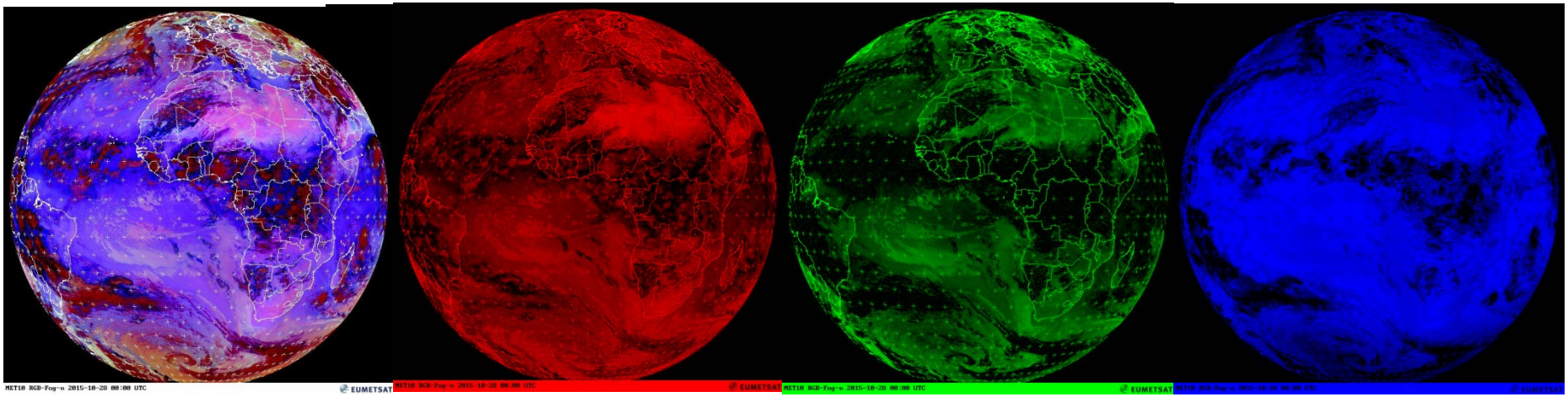
Himawari-8

images courtesy JMA



Meteosat-10

images courtesy EUMETSAT



IR12-IR10.8 IR10.8-IR3.9 IR10.8

Correction: Tuning the Night Microphysics RGB (27/28 October)

image courtesy JMA

Himawari-8 JMA web site

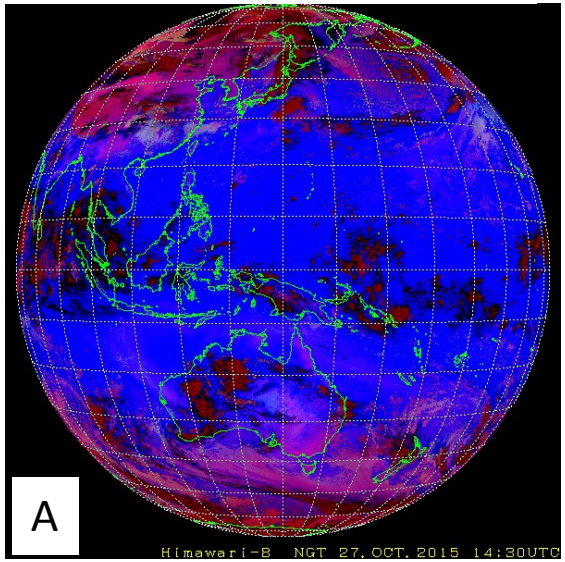
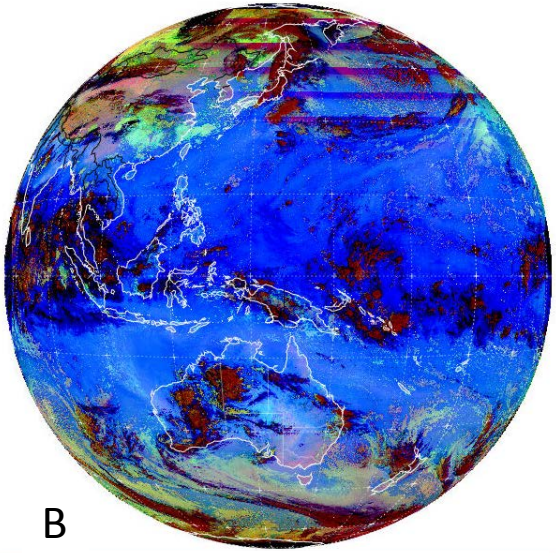


image courtesy BOM/JMA

Himawari-8 Kerkmann modification



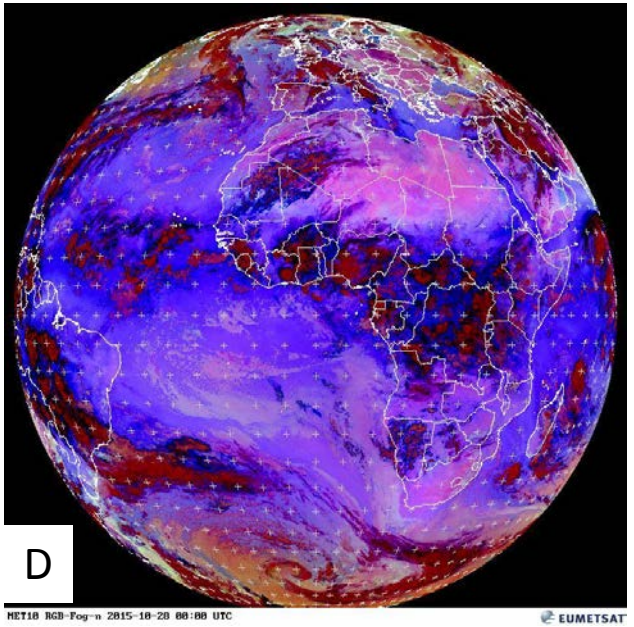
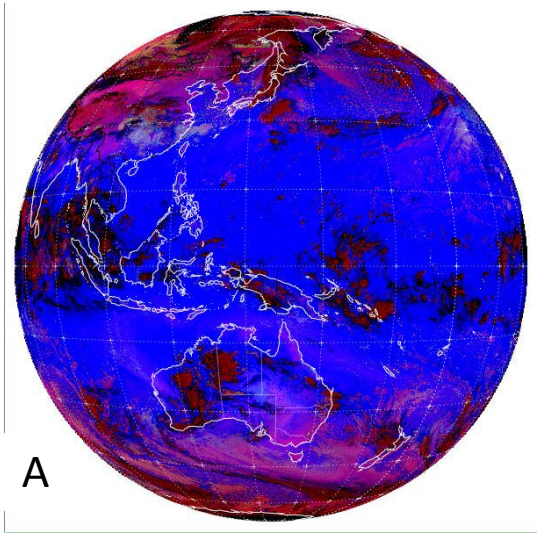
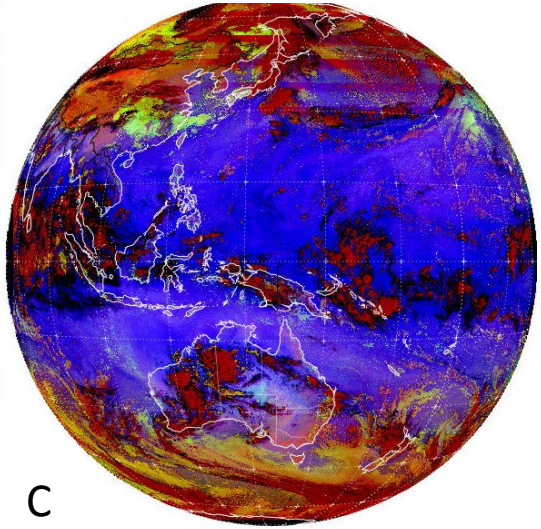


image courtesy EUMETSAT

Himawari-8 Bureau Visual Weather



Himawari-8 BOM modification

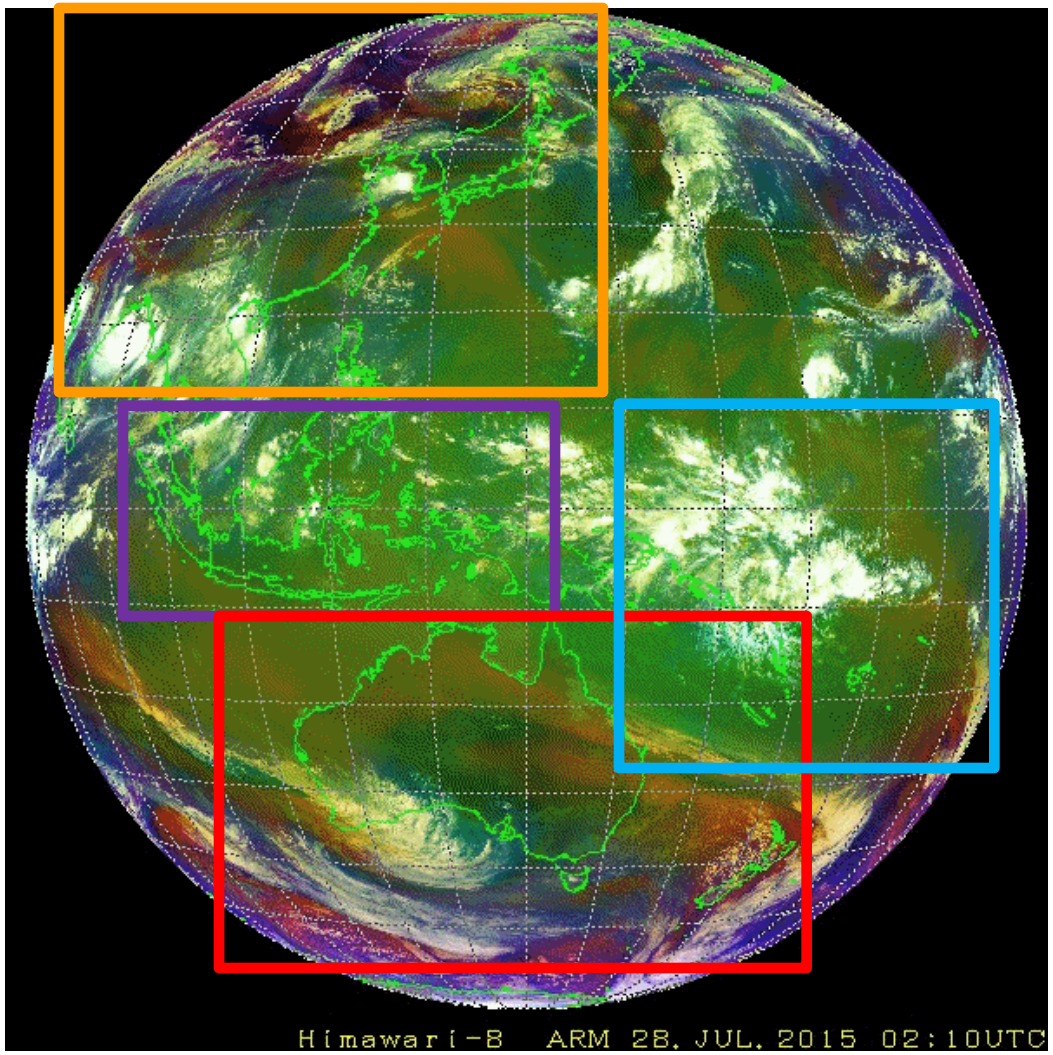


	RED	GREEN	BLUE (C)
A	-4 to 2	0 to 10	-30 to 20
B	-4 to 2	-5 to 5	-30 to 20
C	-6 to 2	-2 to 5	-5 to 25
D	-4 to 2	0 to 10	-30 to 20

image courtesy JMA/BOM

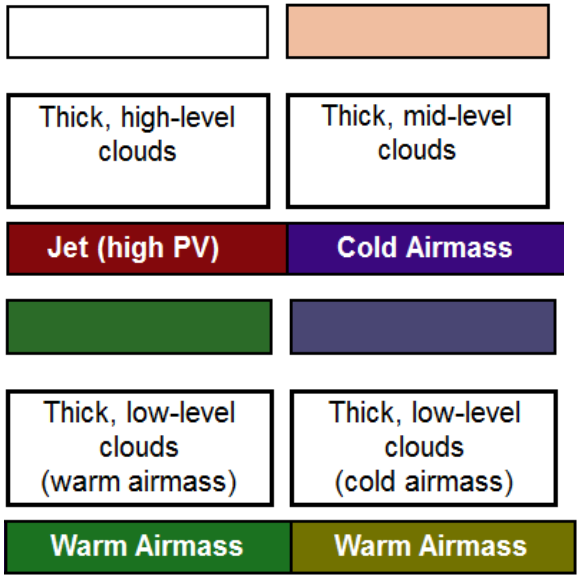
Exercise 3: Assess the information content of the Airmass RGB product for the following domains (annotate by ✓or x)

animations courtesy JMA



28th July 2015

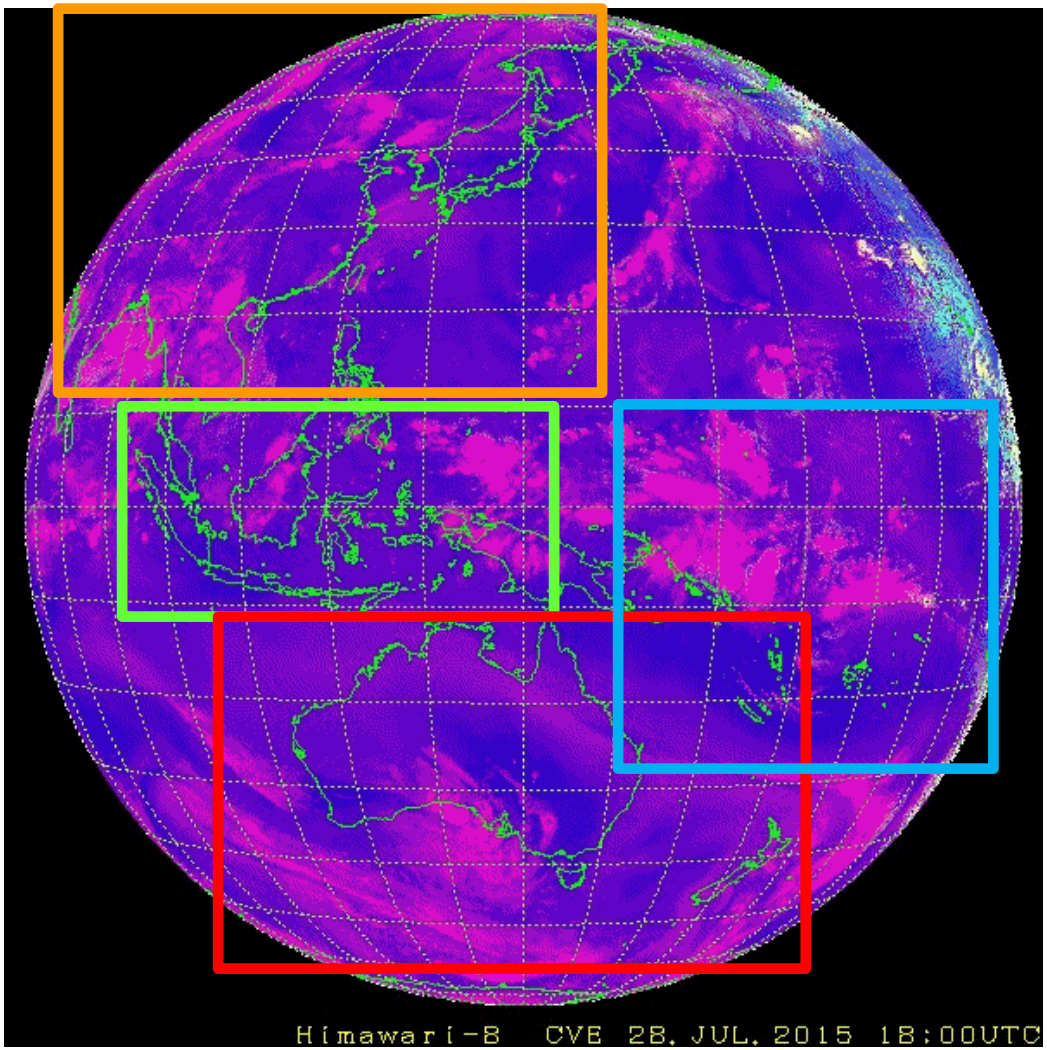
- Australia-New Zealand Region
- Indonesian region
- Southwest Pacific
- East Asia



Exercise 4: Assess the information content of the Day Convection RGB product for the following domains

(annotate by ✓or x)

animations courtesy JMA



28th July 2015

- Australia-New Zealand Region (winter)
- Indonesian region
- Southwest Pacific
- East Asia (summer)

Thick high level cloud Large ice particles	Cb cloud with strong updrafts Small ice particles
Thin Cirrus cloud (large ice particles)	Thin Cirrus cloud (small ice particles)
Ocean	Land

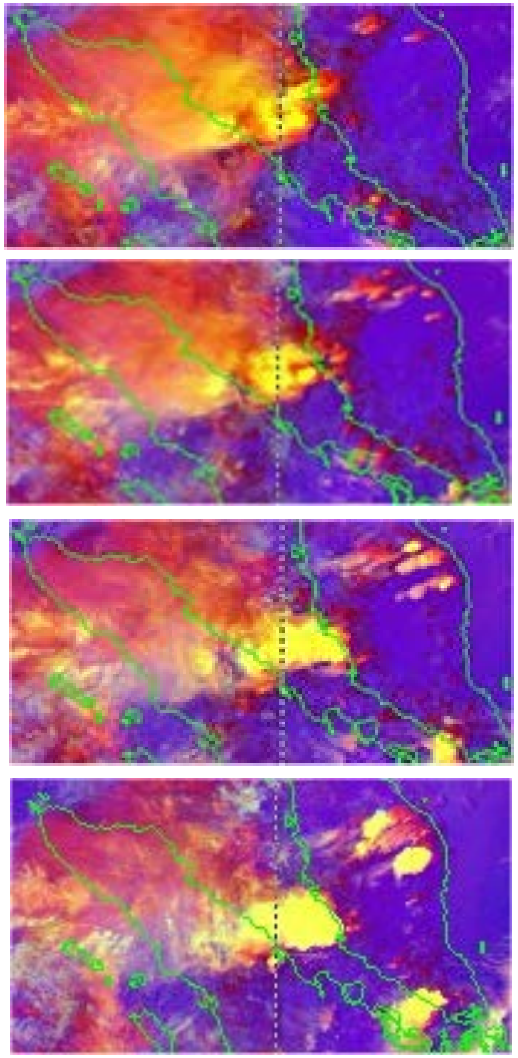
images courtesy JMA

Investigating the Day Convection RGB product

Exercise 5: where is the Day Convection giving more information?

Thick high level cloud Large ice particles	Cb cloud with strong updrafts Small ice particles
Thin Cirrus cloud (large ice particles)	Thin Cirrus cloud (small ice particles)
Ocean	Land

Sumatra / Malaysia convection
11th August 2015



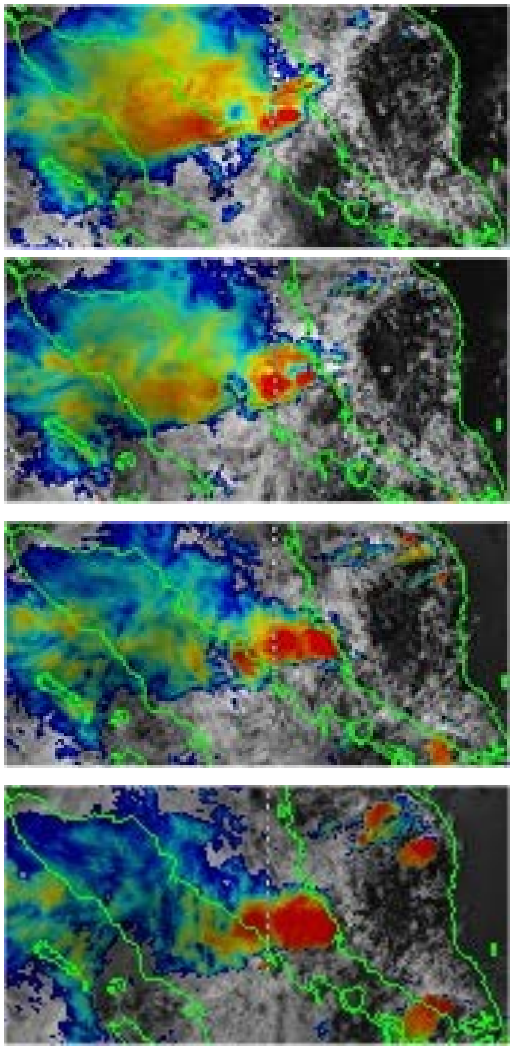
0530UTC

0630UTC

0730UTC

0830UTC

Himawari-8 Day convection RGB



Himawari-8 Sandwich product

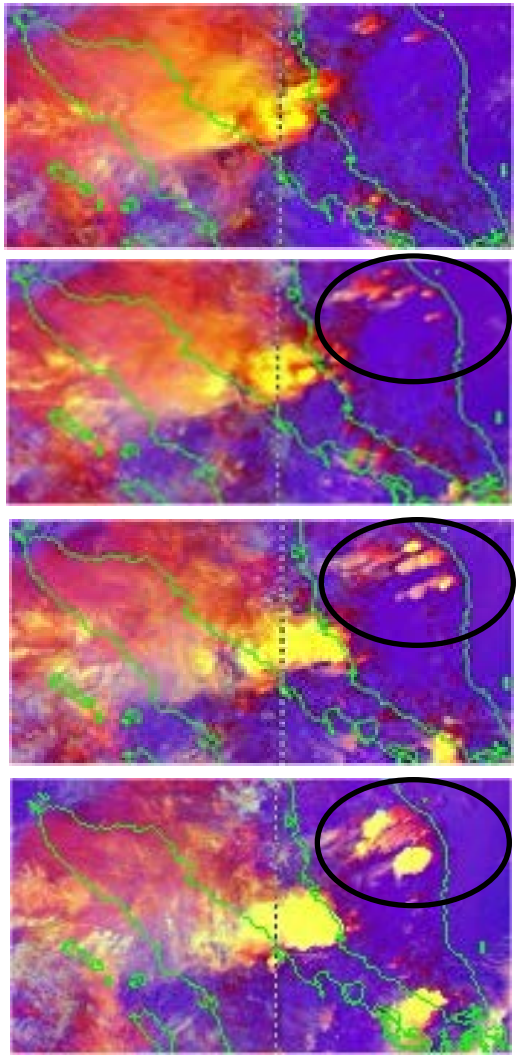
images courtesy JMA

Investigating the Day Convection RGB product

Advantage in the method – detection of new convection

Thick high level cloud Large ice particles	Cb cloud with strong updrafts Small ice particles
Thin Cirrus cloud (large ice particles)	Thin Cirrus cloud (small ice particles)
Ocean	Land

Sumatra / Malaysia convection
11th August 2015



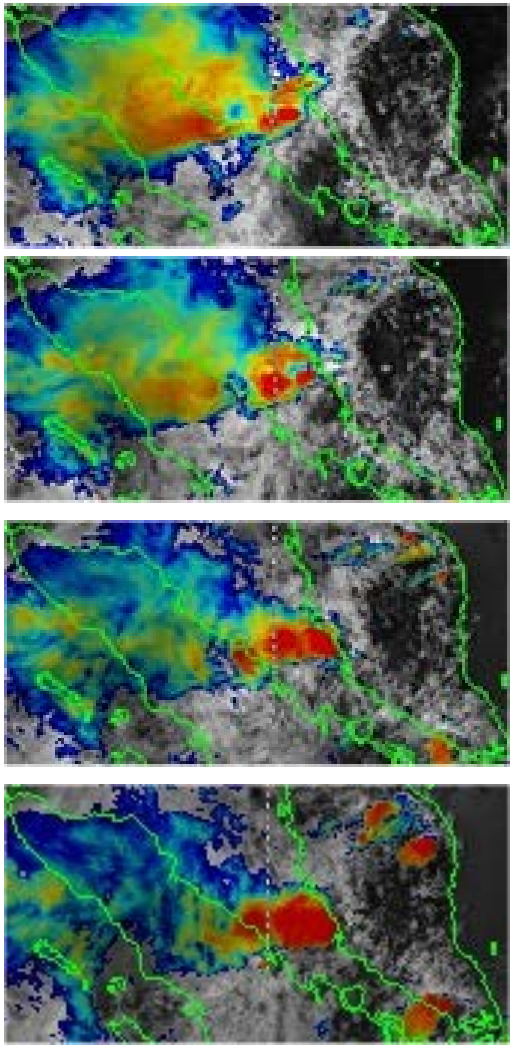
0530UTC

0630UTC

0730UTC

0830UTC

Himawari-8 Day convection RGB



Himawari-8 Sandwich product

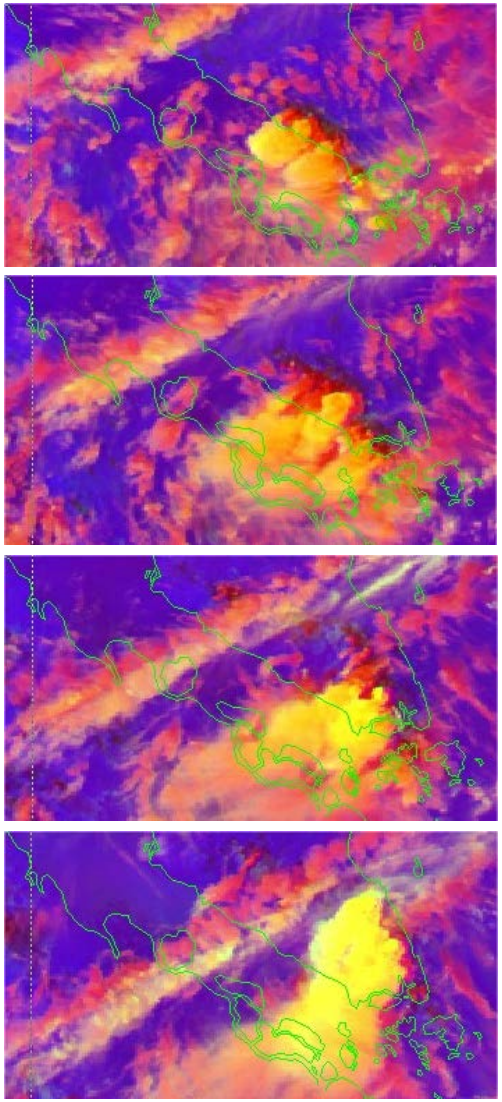
images courtesy JMA

Investigating the Day Convection RGB product

Limitation in the method – monitoring storm outflow boundaries

Thick high level cloud Large ice particles	Cb cloud with strong updrafts Small ice particles
Thin Cirrus cloud (large ice particles)	Thin Cirrus cloud (small ice particles)
Ocean	Land

Sumatra / Malaysia convection 16th September 2015



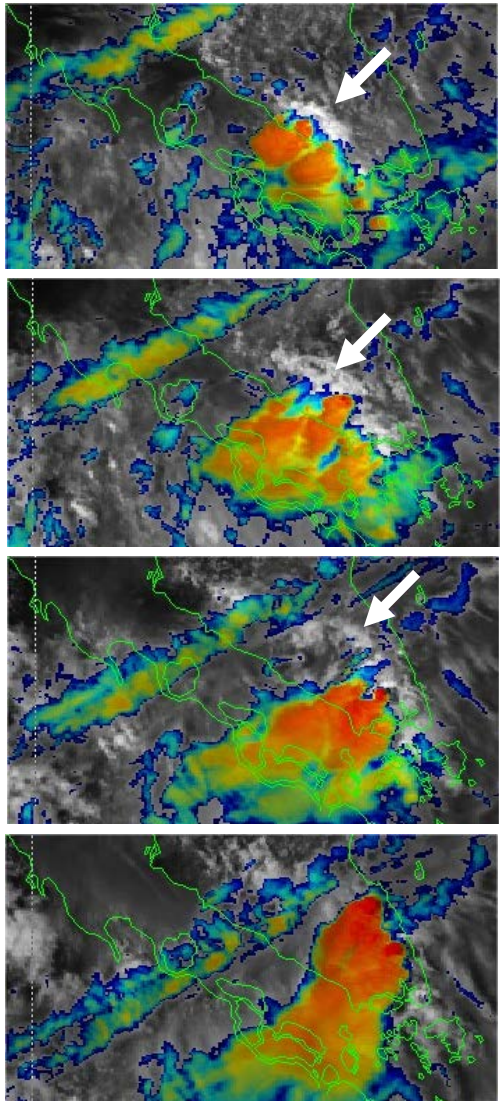
Himawari-8 Day Convection RGB

0430UTC

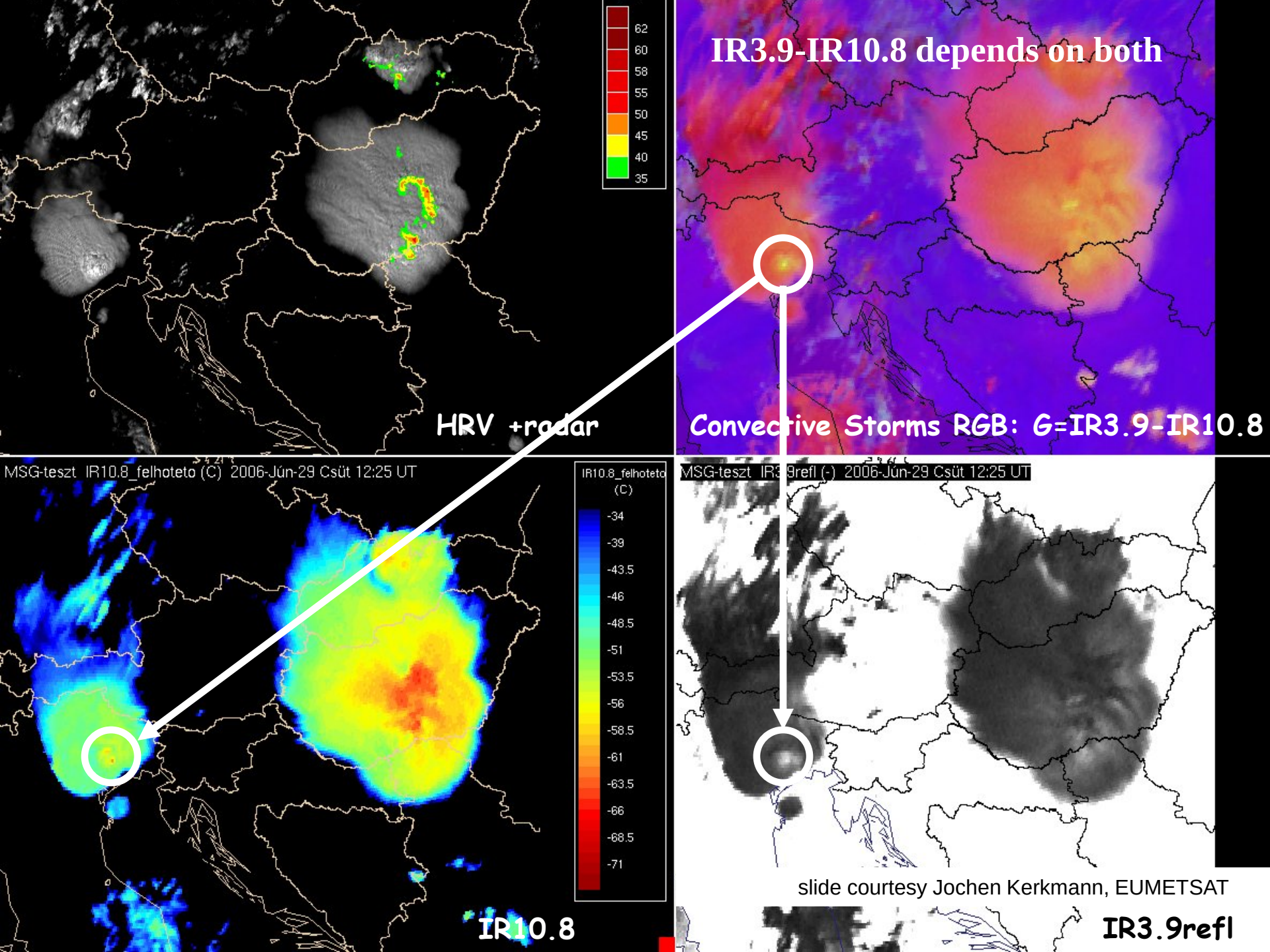
0530UTC

0630UTC

0730UTC



Himawari-8 Sandwich product

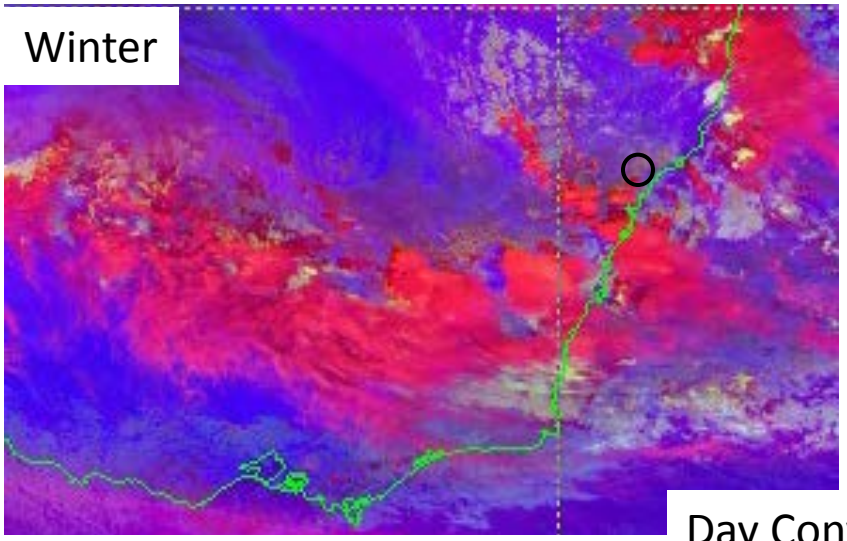


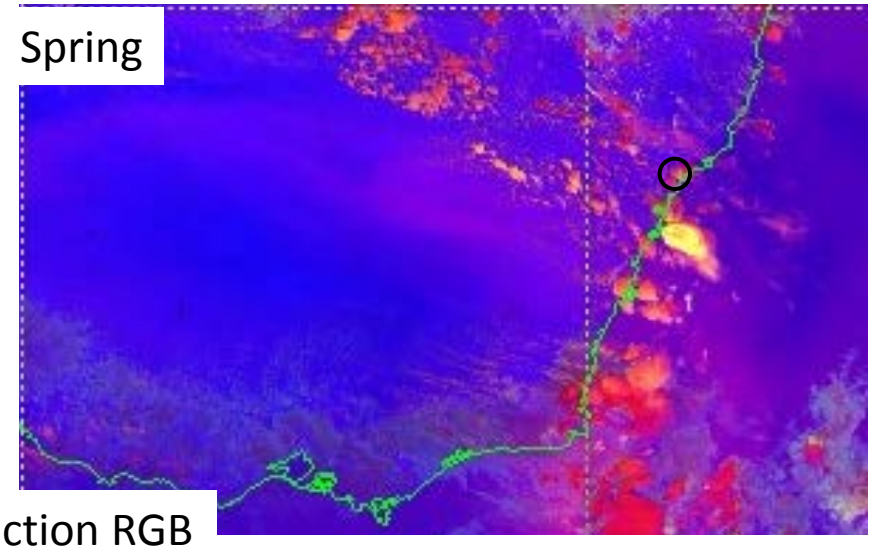
slide courtesy Jochen Kerkmann, EUMETSAT

images courtesy JMA

Winter vs spring severe storms, Southeast Australia

(Himawari-8 data)



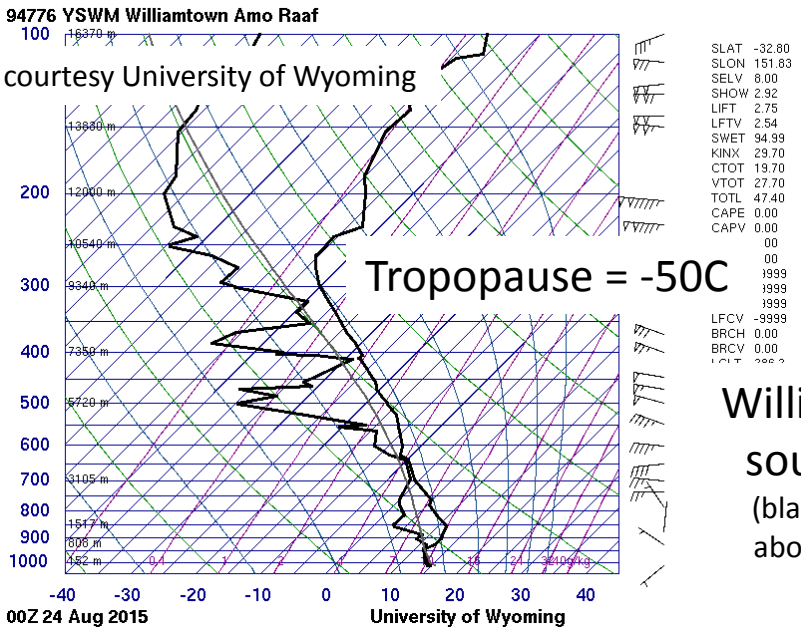


Day Convection RGB

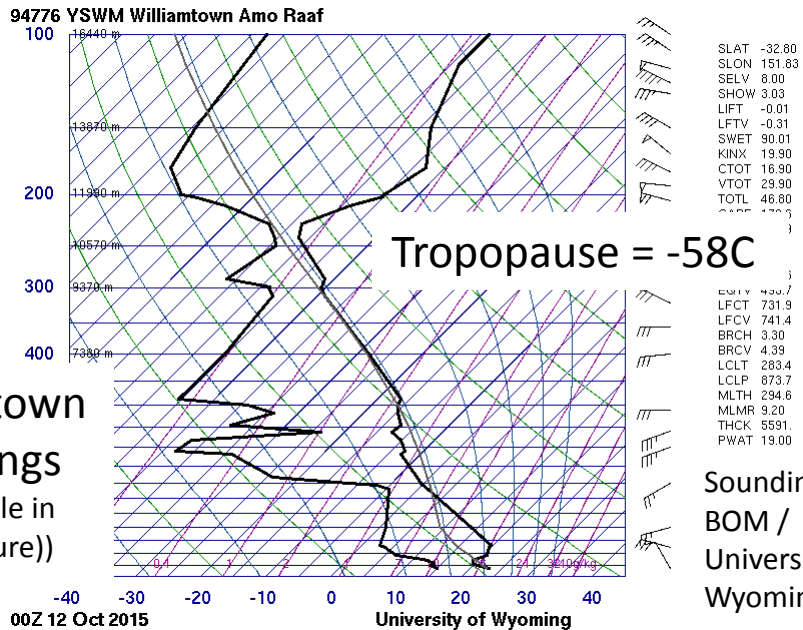
24 August 2015, 0300UTC

12 October 2015 0430UTC

images courtesy University of Wyoming



Tropopause = -50C



Tropopause = -58C

Williamtown soundings

(black circle in above figure))

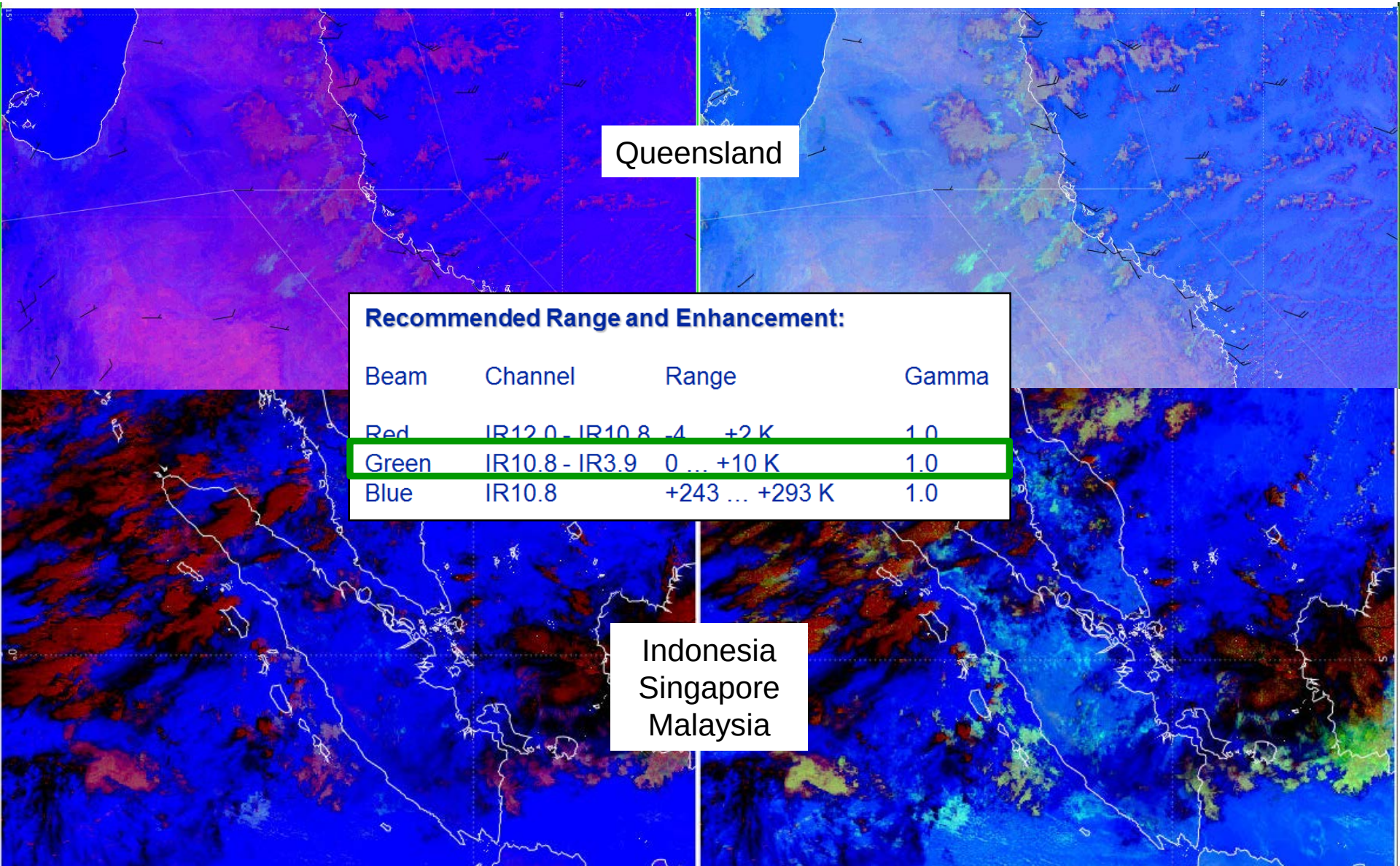
Soundings BOM / University of Wyoming

Images courtesy BOM/JMA

Tuning the Night Microphysics RGB product (J.Kerkmann EUMETSAT)

Standard Night Microphysics (Seviri Recipe)

Tuned Night Microphysics (**Green beam -5 to +5**)

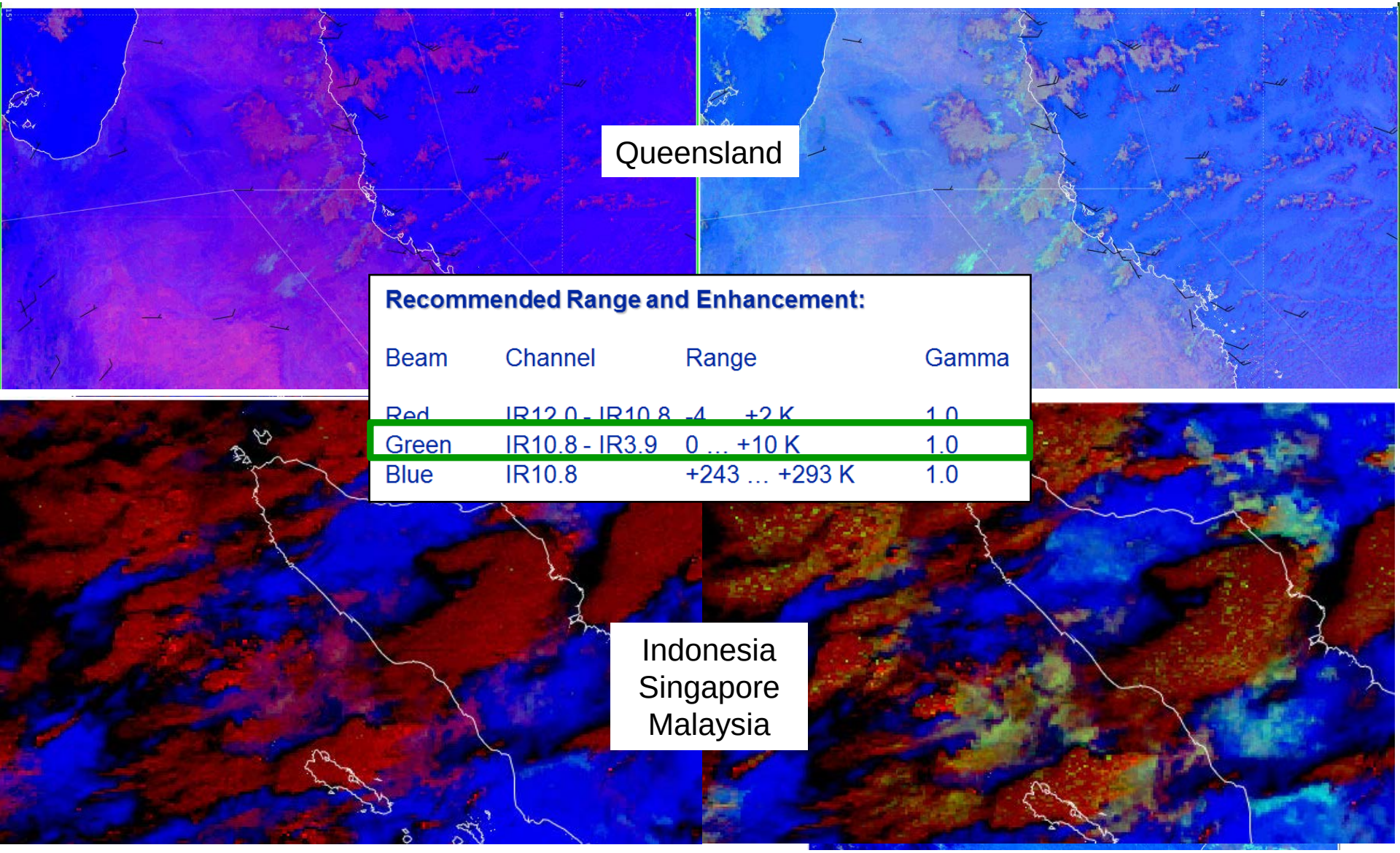


Images courtesy BOM/JMA

Tuning the Night Microphysics RGB product (J.Kerkmann EUMETSAT)

Standard Night Microphysics (Seviri Recipe)

Tuned Night Microphysics (**Green beam -5 to +5**)



Recommended Range and Enhancement:

Beam	Channel	Range	Gamma
Red	IR12.0 - IR10.8	-4 … +2 K	1.0
Green	IR10.8 - IR3.9	0 … +10 K	1.0
Blue	IR10.8	+243 … +293 K	1.0

Images courtesy BOM/JMA

Tuning Night Microphysics RGB (Indonesia/Malaysia, 2nd November 1730UTC)

image courtesy JMA

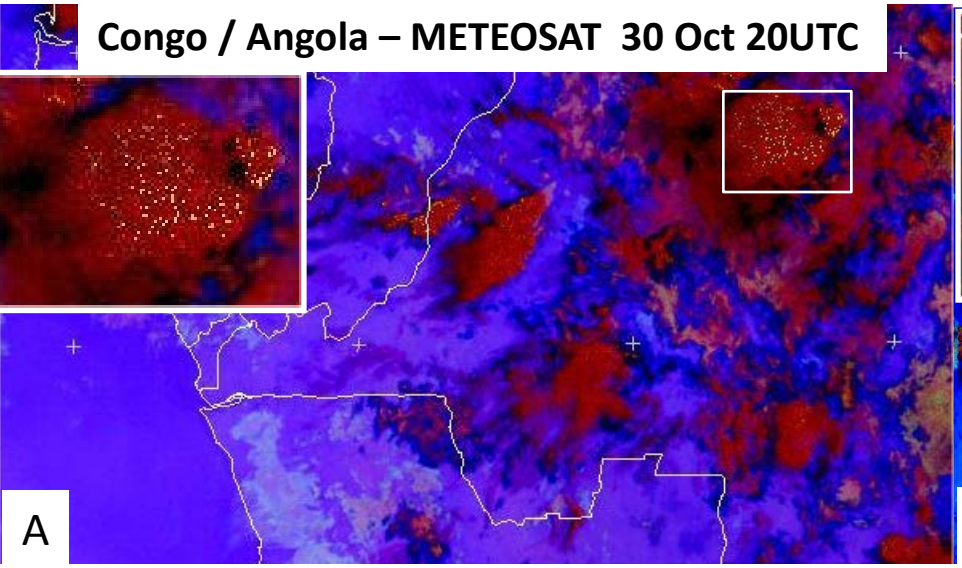
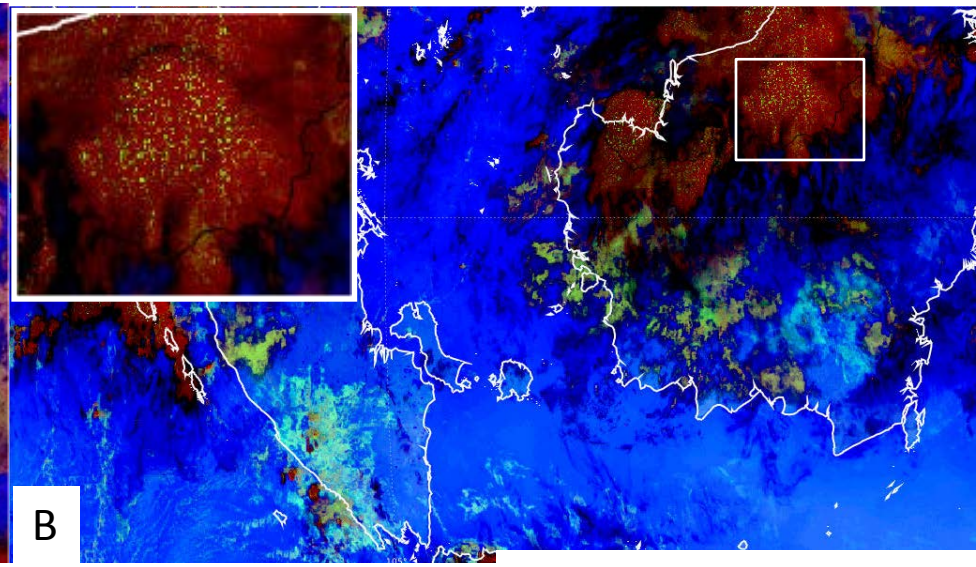
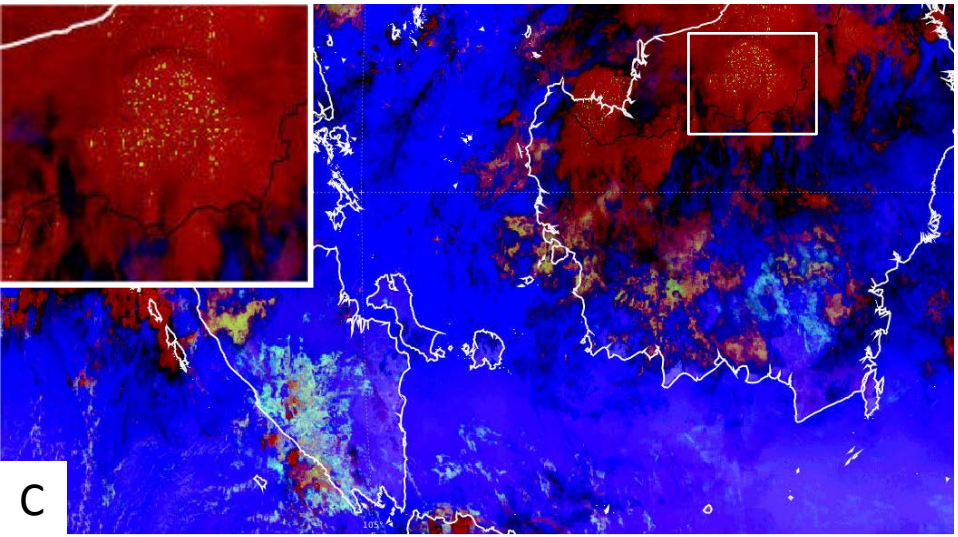


image courtesy BOM/JMA

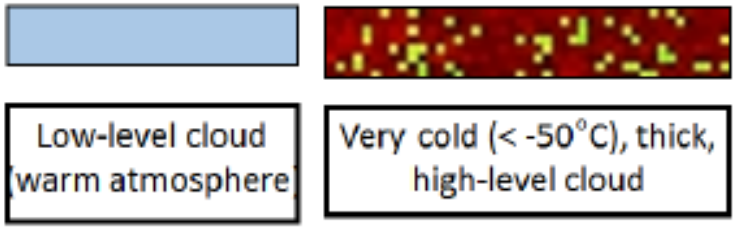


Exercise 6: Which RGB product do you prefer and why?



Modified Himawari-8 BOM RGB recipe

Himawari-8 Kerkmann RGB modification



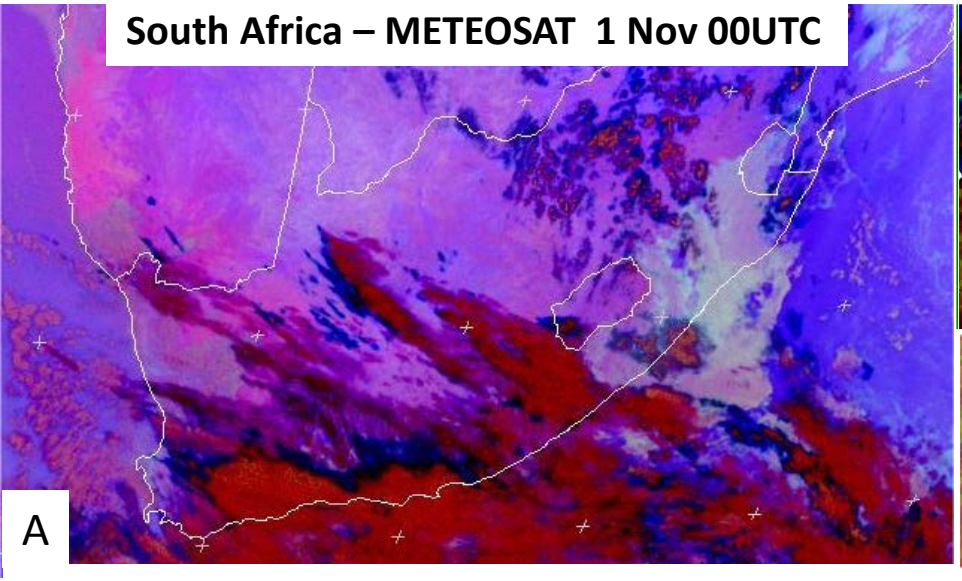
	RED	GREEN	BLUE (C)
B	-4 to 2	-5 to 5	-30 to 20
C	-6 to 2	-2 to 5	-30 to 20
RGB	-4 to 2	0 to 10	-30 to 20

Images courtesy BOM/JMA

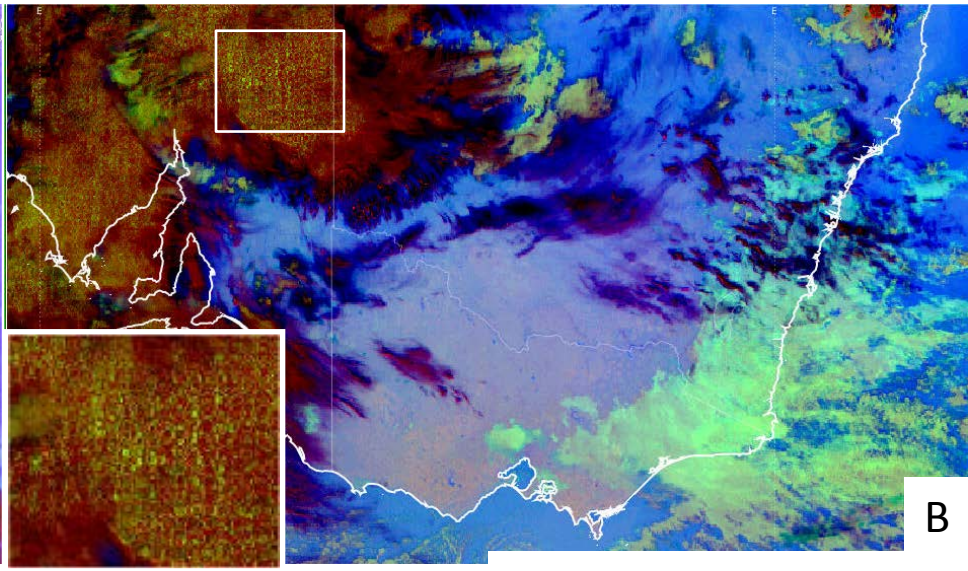
Tuning Night Microphysics RGB (SE Australia, 2nd November 1730UTC)

image courtesy JMA

image courtesy BOM/JMA



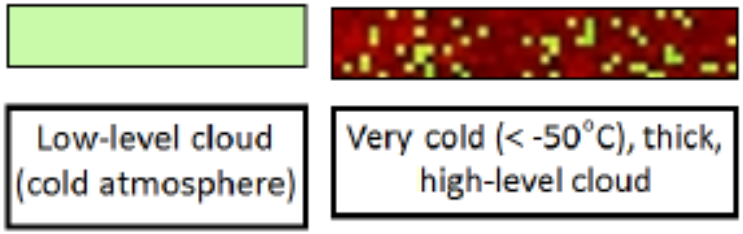
A

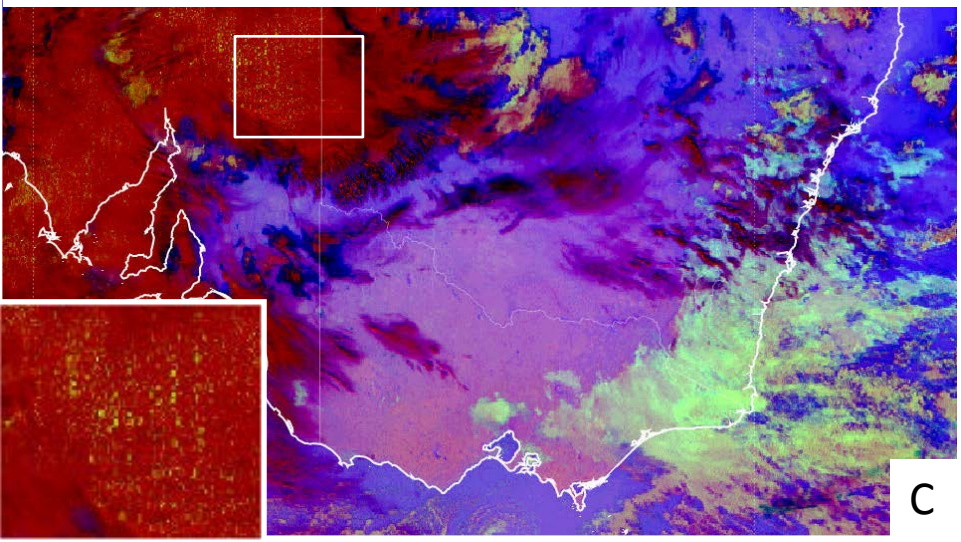


B

Exercise 7: Which RGB product do you prefer and why?

Himawari-8 Kerkmann RGB modification





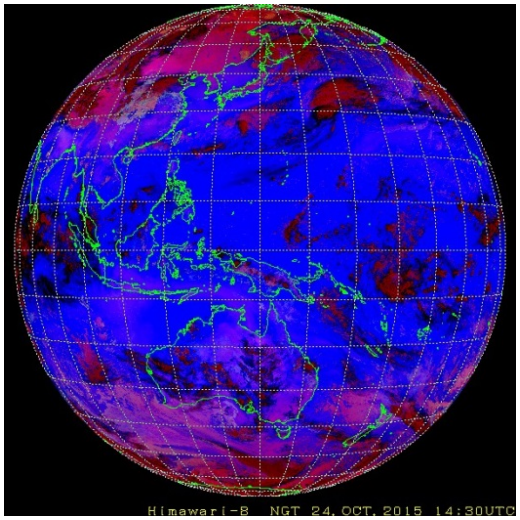
C

Modified Himawari-8 BOM RGB recipe

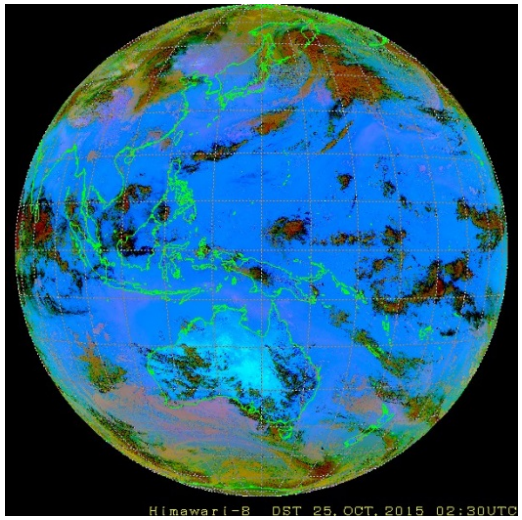
	RED	GREEN	BLUE (C)
B	-4 to 2	-5 to 5	-30 to 20
C	-6 to 2	-2 to 5	-30 to 20
RGB	-4 to 2	0 to 10	-30 to 20

Summary: The most popular RGB products from Forecaster feedback at BOM

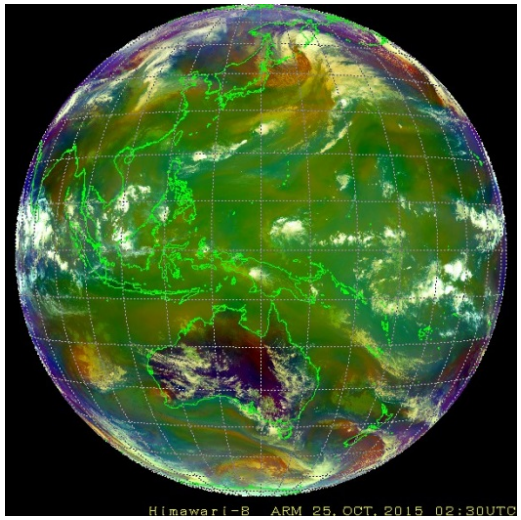
Images courtesy JMA



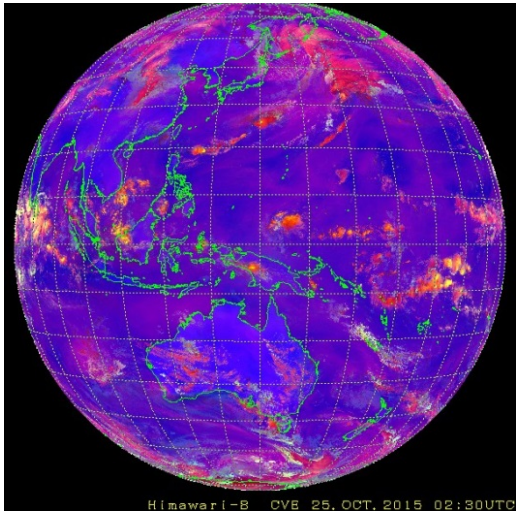
Night Microphysics RGB



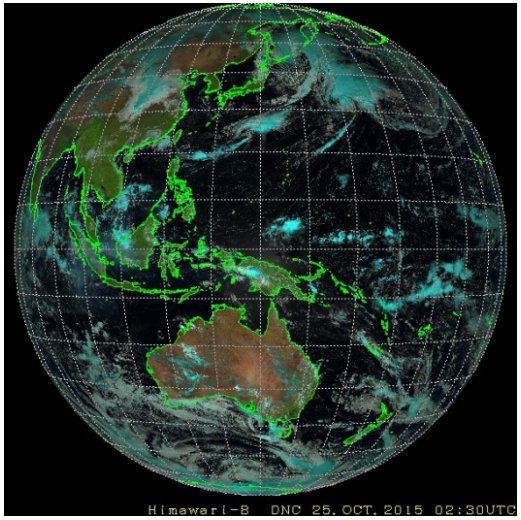
Ash / Dust RGB



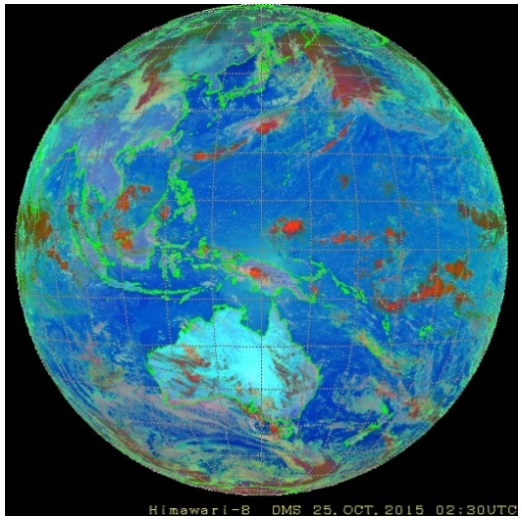
Airmass RGB



Day Convection RGB



Natural Colour RGB



Day Microphysics RGB

Day Convection RGB "Forecaster friendly" sheet

(see also web address http://www.virtuallab.bom.gov.au/training/hw-8-training/introduction-resources-and-case-studies/ for further reference)

Beam	Channel (band)	Range	Gamma
Red	**WV6.2**(8) – **WV7.3**(10)	-35 to +5	1.0
Green	**IR3.9**(7) – **IR10.8**(13)	-5 to +60	1.0
Blue	**NIR1.6**(5) – **VIS0.6**(3)	-0.75 to +0.25	1.0

Channel combination "recipe" (from EUMETSAT)

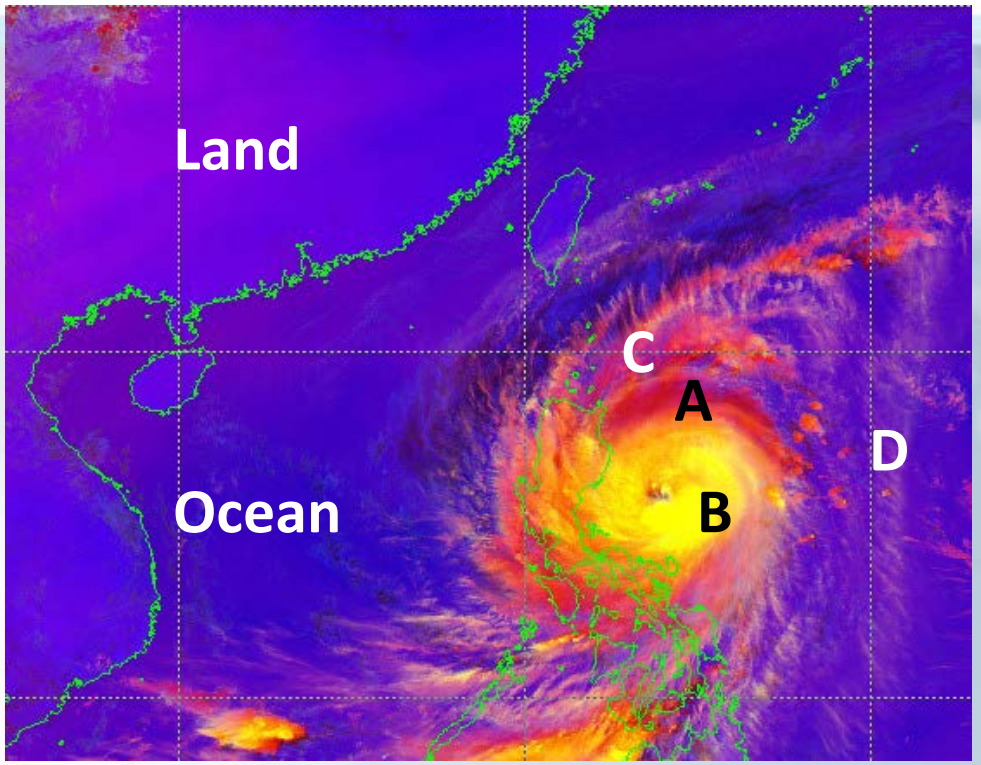
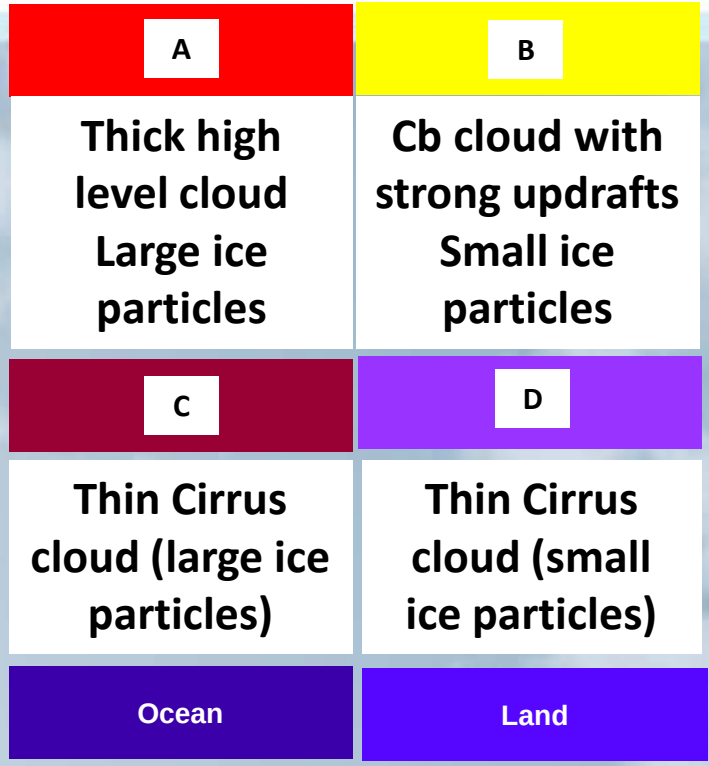


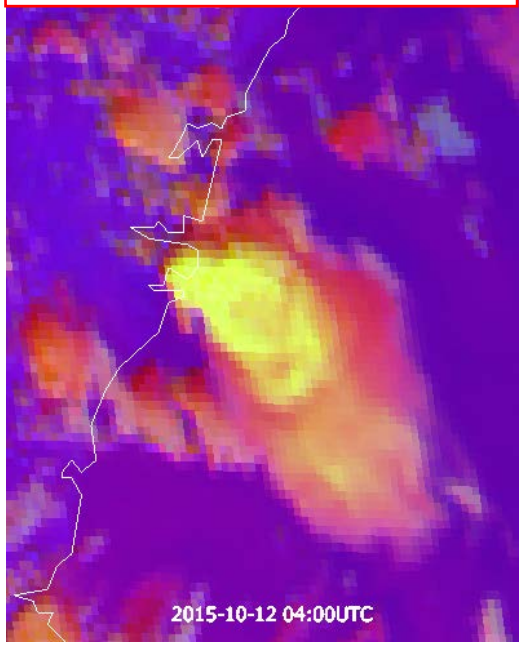
Image courtesy JMA

RGB product image

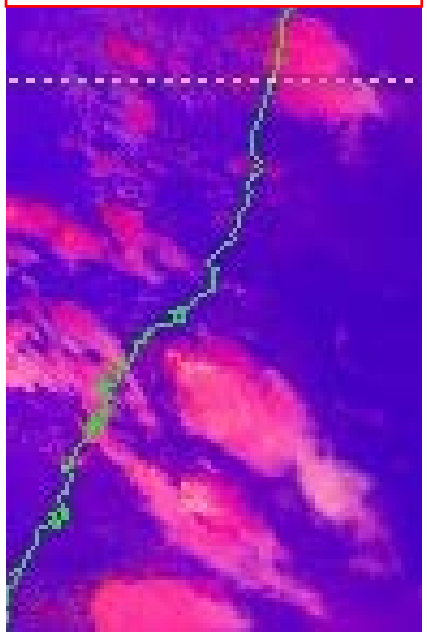


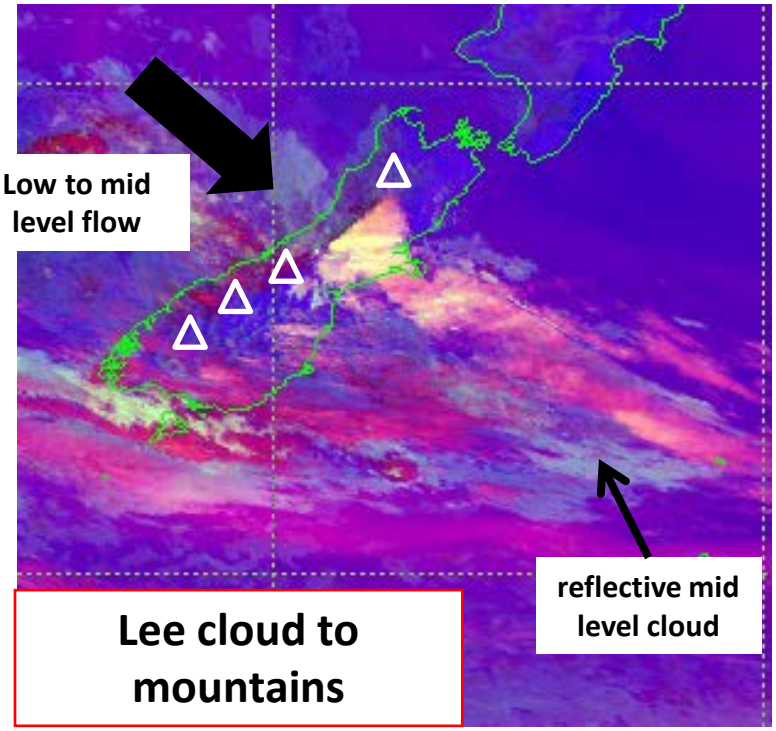
Colour interpretation palette

Daytime

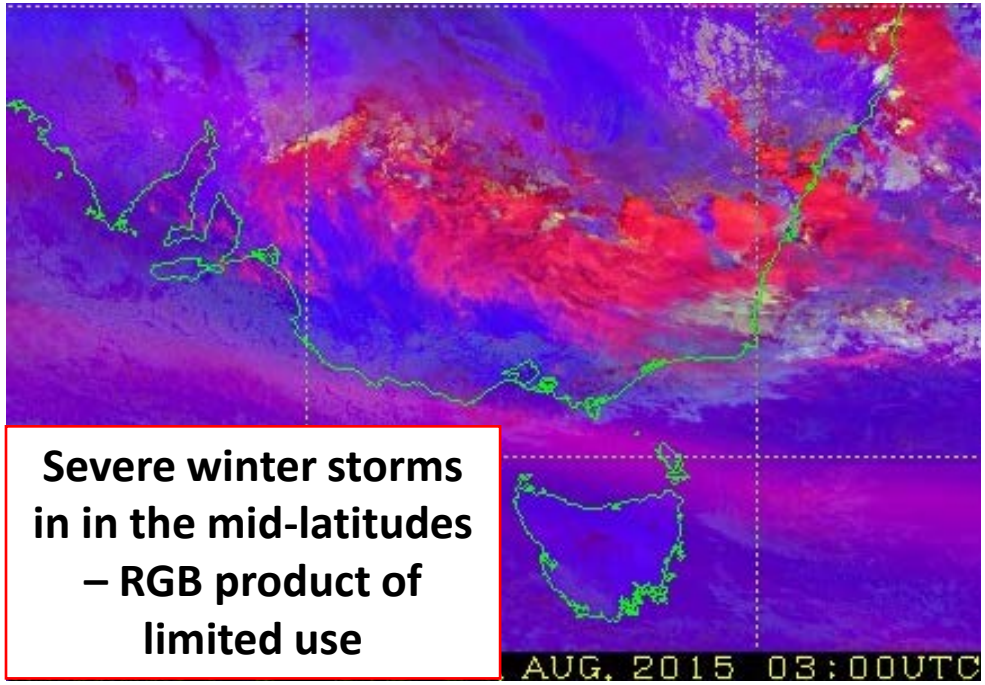


After sunset

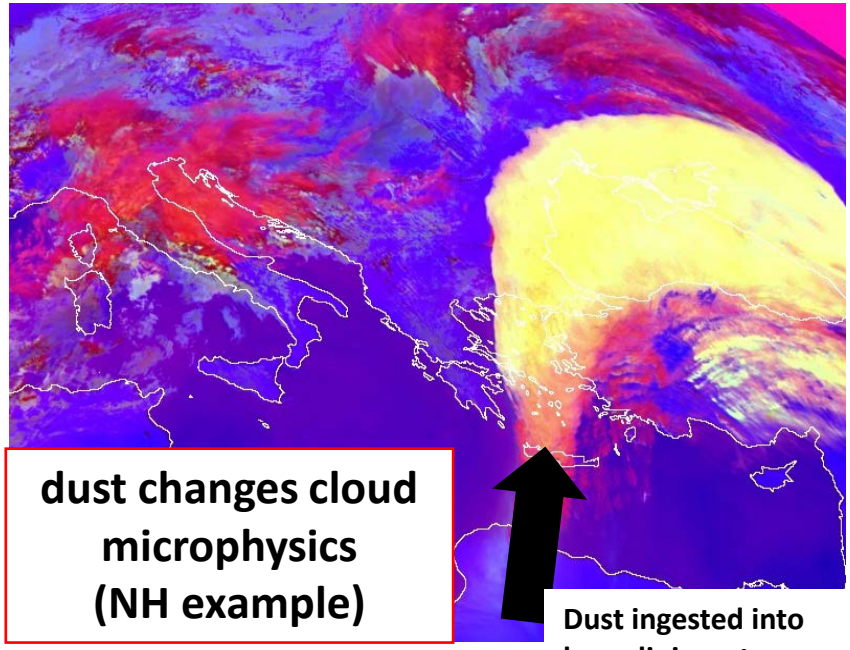




Lee cloud to mountains



Severe winter storms in in the mid-latitudes – RGB product of limited use



dust changes cloud microphysics (NH example)

Summary

- During this session the RGB products as endorsed by WMO/EUMETSAT were introduced.
- RGB products as generated from Himawari-8 data over the Australasia-Pacific region were compared to METEOSAT RGB products and similarities and differences were noted.
- Animations of the Day Convection RGB product and the Airmass RGB product were assessed for usefulness over the Australasia-Pacific region.
- The Day Convection RGB and Night Microphysics RGB products were examined in greater detail for Australasian case studies.
- As a summary, the RGB products currently favoured by Bureau Forecasters were shown.
- "Forecaster Friendly" RGB reference sheets have been presented.
- Useful resources and references have been presented.