



Australian Government

Bureau of Meteorology

# " The usefulness of RGB products: the perspective of the Australian Bureau of Meteorology "

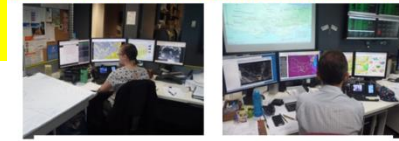
Presenter: Bodo Zeschke. Bureau of Meteorology  
Training Centre, Australian VLab Centre of Excellence  
Point of Contact

**Should you use these resources please acknowledge the Australian Bureau of Meteorology Training Centre. In addition, you need to retain acknowledgement in the PowerPoint slides of the Japan Meteorological Agency, the Australian Bureau of Meteorology and any other sources of information.**

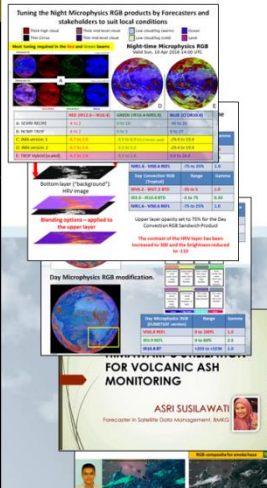
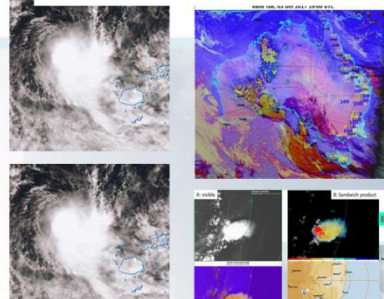
# Contents of this session

1

Please start the Power Point Slide Show to activate the animation



Forecaster use of Himawari-8 data

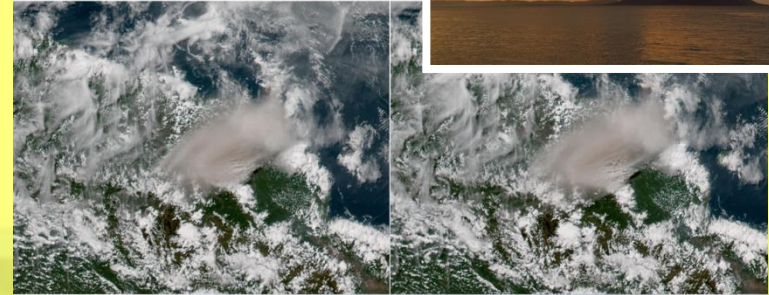


The new capabilities of Himawari-8 / 9

2

on courtesy JMA/BOM

**Animation:** Utilising the multichannel Himawari-8 to assist in the continuous determination of its areal extent and

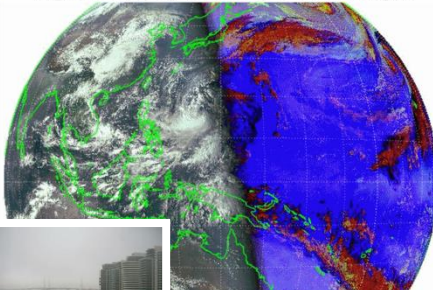


True Colour RGB: Volcanic Ash

3



A better solution: turning on the "cats eye" Night Microphysics RGB product at night



Night Microphysics RGB: Fog/Low Cloud

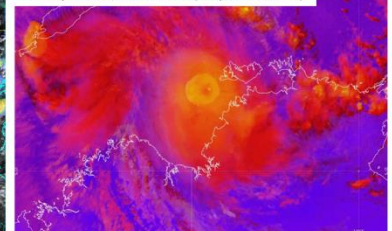
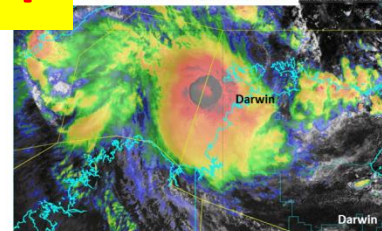
4

Livch Product (tropical tuned)

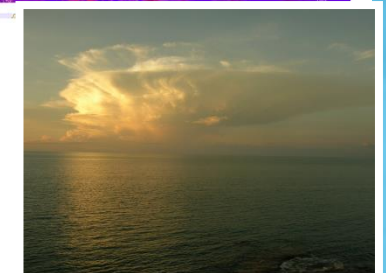
Satellite

20th April 2009

C: Day Convection RGB (tropical tuned)



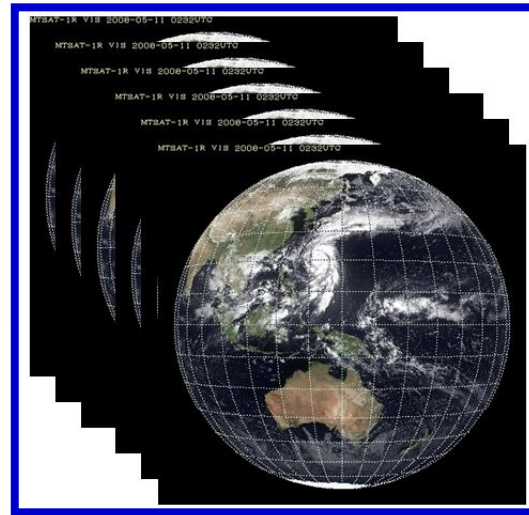
Day Convection RGB: Thunderstorms, Tropical Storms



# Changes from **MTSAT-2** to **Himawari-8**

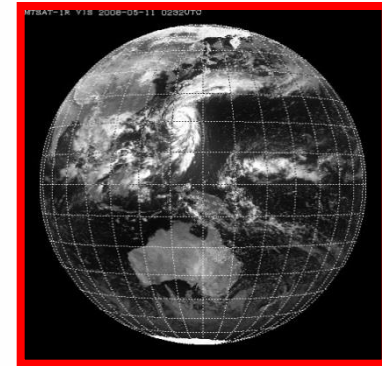
Band	Central Wavelength [μm]	Spatial Resolution
1	0.43 - 0.48	1Km
2	0.50 - 0.52	1Km
3	0.63 - 0.66	0.5Km
4	0.85 - 0.87	1Km
5	1.60 - 1.62	2Km
6	2.25 - 2.27	2Km
7	3.74 - 3.96	2Km
8	6.06 - 6.43	2Km
9	6.89 - 7.01	2Km
10	7.26 - 7.43	2Km
11	8.44 - 8.76	2Km
12	9.54 - 9.72	2Km
13	10.3 - 10.6	2Km
14	11.1 - 11.3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

## Himawari-8



10 minute images in colour

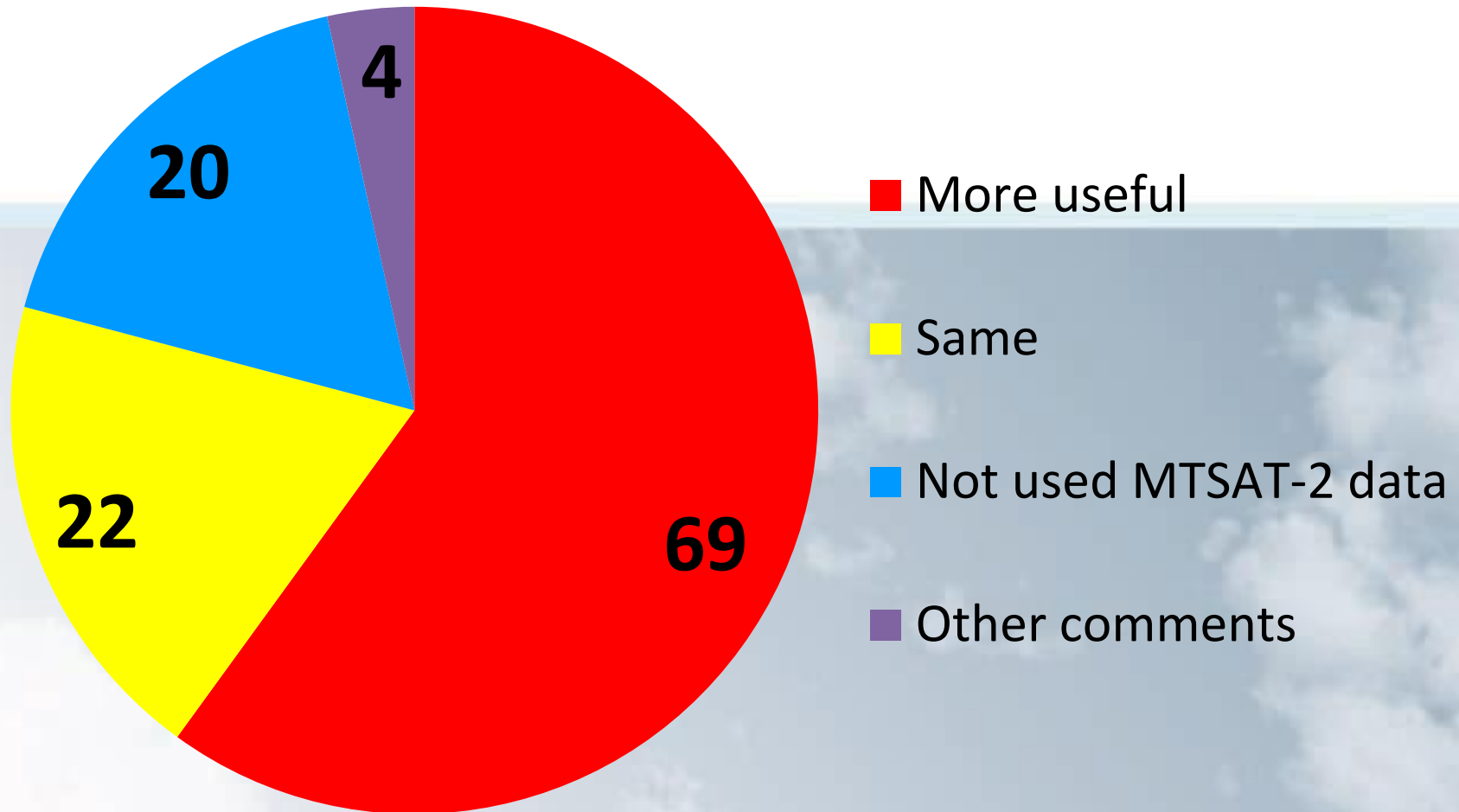
## MTSAT-2



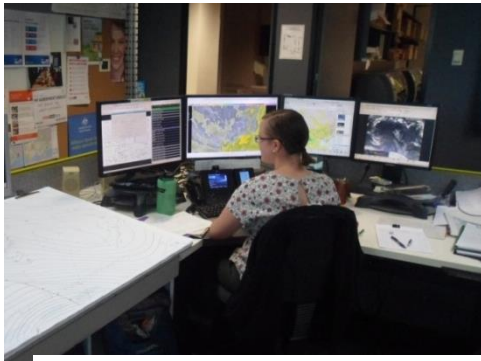
Hourly / half hourly images in greyscale

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

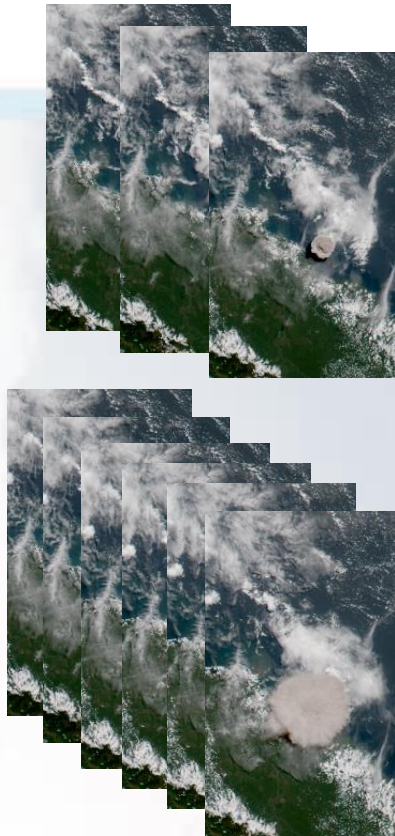
**Question to 115 Australian Bureau of Meteorology staff\*:** Compare the usefulness of Himawari-8 data to MTSAT-2 data when forecasting.



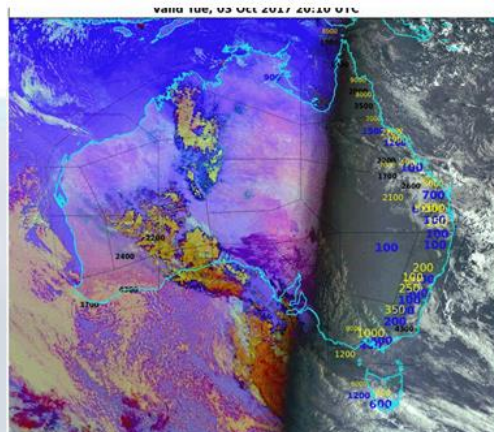




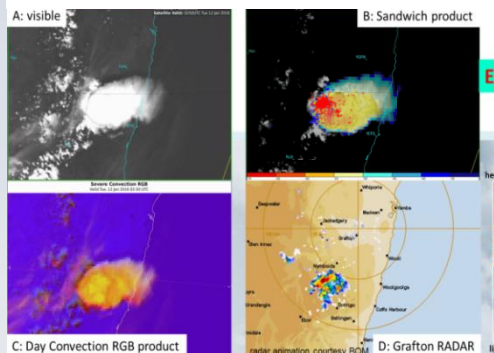
## Forecaster use of Himawari-8 data



Various speeds of animation



### Day / night product transition



Multi-panel displays

### 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

**Blending options - applied to the upper layer**

	WV6.2 - WV7.3 BTD	-35 to 5	1.0
IR3.9 - IR10.8 BTD	-5 to 75	0.33	
NIR1.6 - VIS0.6 REFL	-75 to 25%	1.0	

Upper layer opacity set to 75% for the Day Convection RGB Sandwich Product

The contrast of the HRV layer has been increased to 300 and the brightness reduced to -110

### Day Microphysics RGB modification.

Day Microphysics RGB (EUMETSAT version)	Range	Gamma
VIS0.8 REFL	0 to 100%	1.0
IR3.9 REFL	0 to 60%	2.5
IR10.8 BT	+203 to +323K	1.0

ASRI SUSILAWATI  
Forecaster in Satellite Data Management, BMKG

Level-2 products such as fire hotspots, aerosol optical depth, angstrom exponent...

Adapting the EUMETSAT tuned products to Himawari-8 data by regional forecasters and other operational staff

# Adapting the EUMETSAT tuned products to Himawari-8 data by regional forecasters and other operational staff

<http://www.virtuallab.bom.gov.au/archive/regional-focus-group-recordings/>

The screenshot shows the website of the Melbourne VLab Centre Of Excellence, part of the Australian Government Bureau of Meteorology. The page is titled "Regional Focus Group Discussion Recordings". It contains a list of recordings with columns for "Recordings (file size)" and "Content of the Regional Focus Group meetings". The content area mentions that the next meeting will be held during October 2016.

Recordings (file size)	Content of the Regional Focus Group meetings
	The next Regional Focus Group meeting will be held during October 2016.

There are a lot of resources pertaining to WMO RAV stakeholders development of Himawari-8 data and data products posted on this web page.

This includes the recordings of over four years of monthly Australian VLab Centre of Excellence Regional Focus Group meetings.

The screenshot shows a list of recordings on the website. The first recording is titled "Dust detection methods using various satellite products and their limitations (Dr. Hye Sook Park, Korea Meteorological Administration) 31 minutes duration (45Mb .wmv file) (80Mb .mp4 file)". Below this, there is a section for the "7 July 2016 Regional Focus Group meeting" with topics of discussion presented by Mr Bodo Zeschke. The topics include: "Introduction, stakeholder feedback to the survey 'Topics for discussion at future RFG meetings'" (17 minutes duration (16Mb .wmv file) (34Mb .mp4 file)), "The GEOCAT GOES-R fog/low cloud algorithm. Latest work at the Bureau in adapting the product to RAV with a tropical and midlatitude example 31 minutes duration (49Mb .wmv file) (98Mb .mp4 file)", and "Summary and Conclusion 2 minutes duration (2Mb .wmv file) (4Mb .mp4 file)". A note at the bottom states: "Please download the following resources prior to the session. Note that there are four animations embedded within the PowerPoint slide. For some computers the animations do not all work. In that case please examine the .wmv and .mp4 files".

<ul style="list-style-type: none"><li>• <b>Dust detection methods using various satellite products and their limitations</b> (Dr. Hye Sook Park, Korea Meteorological Administration) 31 minutes duration (45Mb .wmv file) (80Mb .mp4 file)</li></ul>
<p><b>7 July 2016 Regional Focus Group meeting</b></p> <p>Topics of discussion: Presented by Mr Bodo Zeschke</p> <ul style="list-style-type: none"><li>• <b>Introduction, stakeholder feedback to the survey "Topics for discussion at future RFG meetings"</b> 17 minutes duration (16Mb .wmv file) (34Mb .mp4 file)</li><li>• <b>The GEOCAT GOES-R fog/low cloud algorithm. Latest work at the Bureau in adapting the product to RAV with a tropical and midlatitude example</b> 31 minutes duration (49Mb .wmv file) (98Mb .mp4 file)</li><li>• <b>Summary and Conclusion</b> 2 minutes duration (2Mb .wmv file) (4Mb .mp4 file)</li></ul> <p>Please download the following resources prior to the session. Note that there are four animations embedded within the PowerPoint slide. For some computers the animations do not all work. In that case please examine the .wmv and .mp4 files</p>



# True Colour RGB: Detection and monitoring of volcanic ash

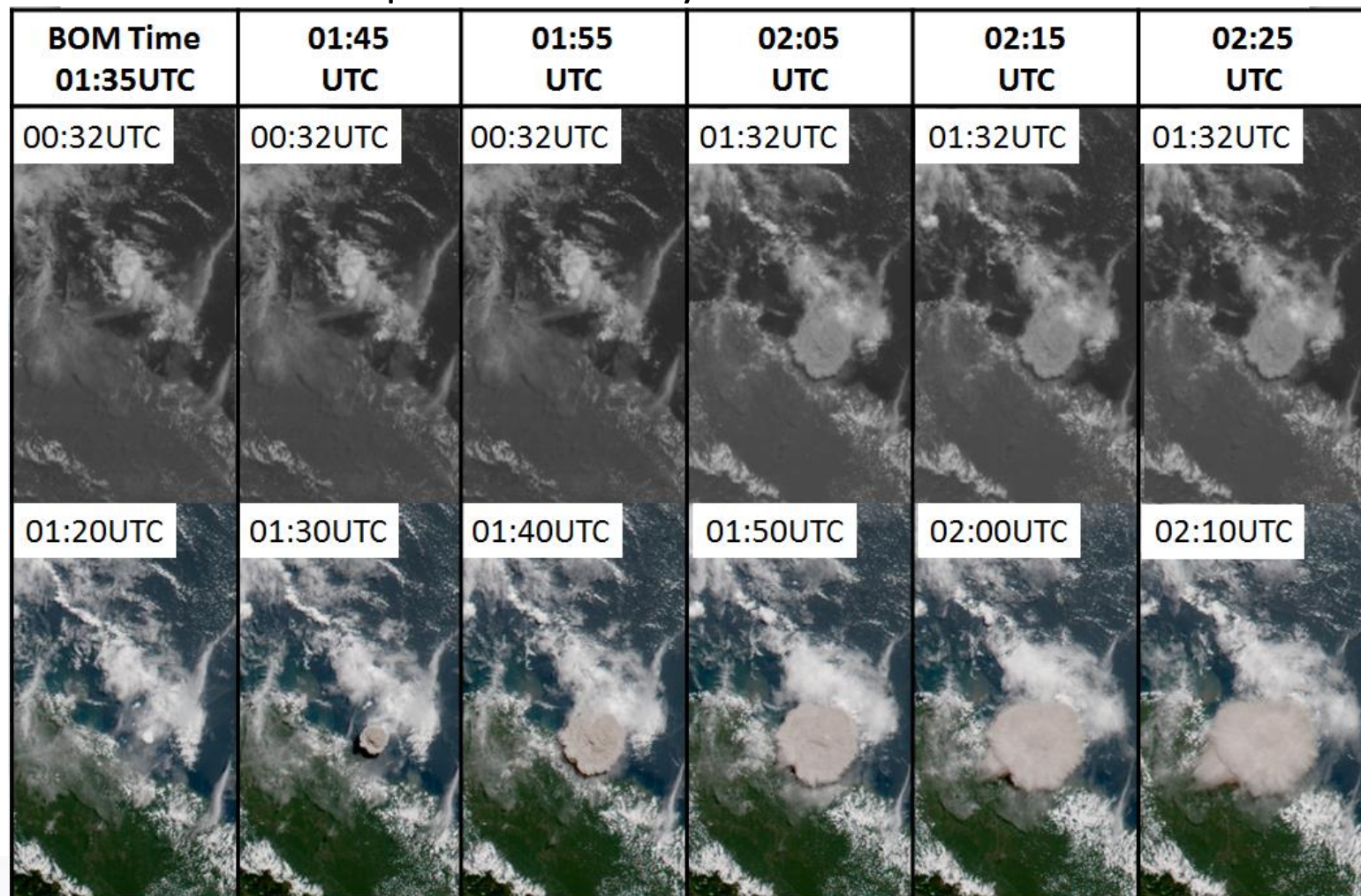
Tavurvur eruption, Papua New Guinea, June 2009



image from Wikimedia Commons (author Taro Taylor)

# MTSAT-2 greyscale visible channel compared to Himawari-8 True Colour RGB

Manam volcanic eruption of 31<sup>st</sup> July 2015 0135 to 0225UTC



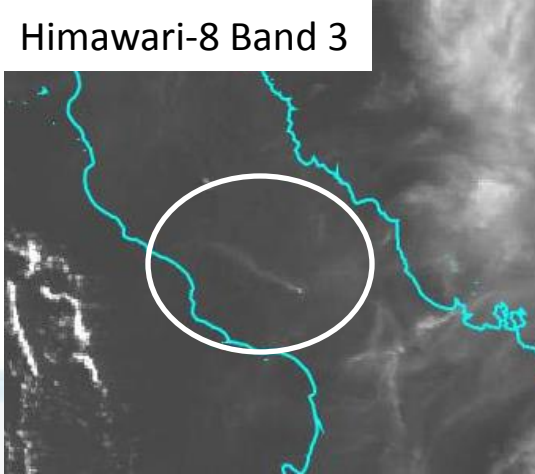
**10 minute Himawari-8 data permits the eruption to be captured in near real time**  
**The Himawari-8 product shows the brown volcanic ash and the white cloud**



# Some limitations in monitoring volcanic ash eruptions by satellite

images courtesy JMA/BOM

Himawari-8 Band 3



Small plumes (Bagana, PNG 30 May 2016)

Forwarded to Darwin VAAC by Luth Boroh



Thin ash

(Rinjani eruption, 3 November 2015)

Ash RGB product

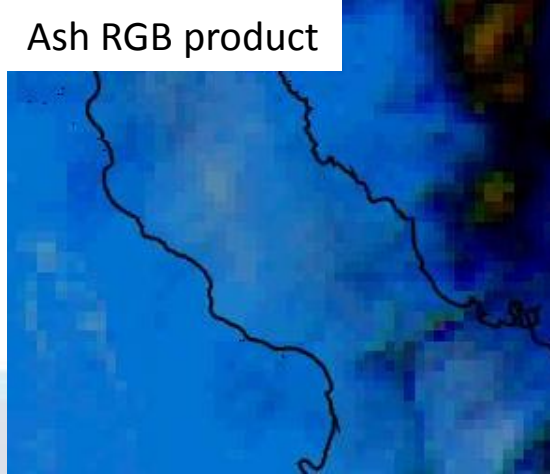
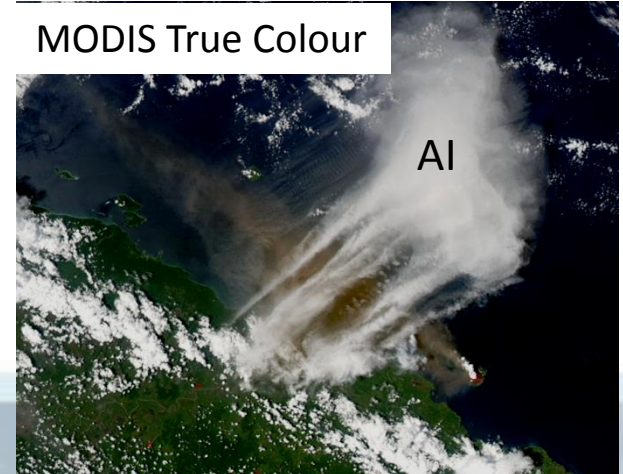


image courtesy NASA

MODIS True Colour

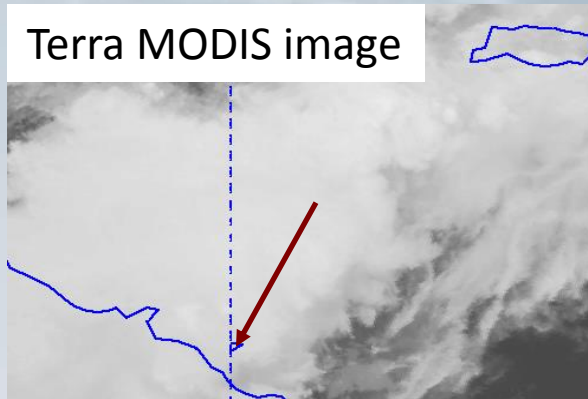


Ash coated with ice (AI)

(Manam, PNG 24 October 2004)

Photo courtesy of David Innes, Air Niugini

Terra MODIS image



Ash below cloud – to FL330

(Manam eruption, 10 November 2004)



# Rinjani eruption: MODIS image and pilot report

**Note: the satellite monitors the plume in the near vertical whereas pilots observe the plume obliquely. Due to the longer path length of radiation passing obliquely through the plume, Pilots may see evidence of volcanic ash where this is not detectable in satellite imagery.**



image courtesy NASA/EOSDIS/Lance Rapid Response

TERRA MODIS imager 0310UTC, 4<sup>th</sup> November 2015.



Pilot photos from 03UTC,  
4<sup>th</sup> November 2015.

Forwarded to Darwin VAAC by Luth Boroh

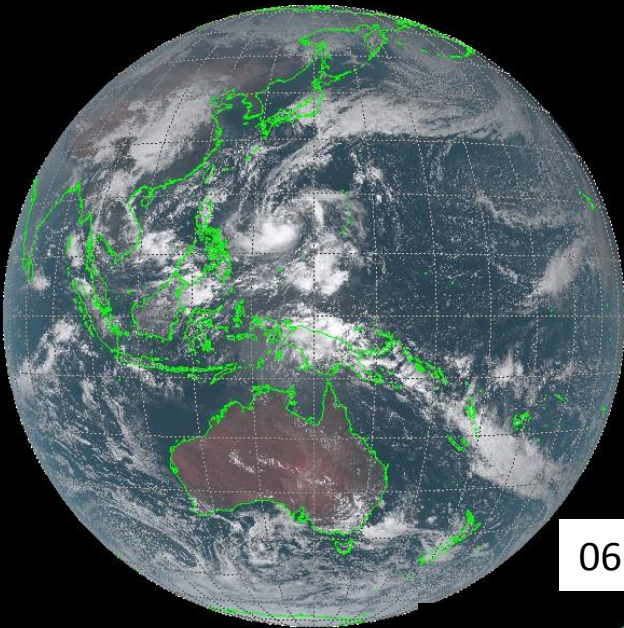




# Limitations of the True Colour RGB product



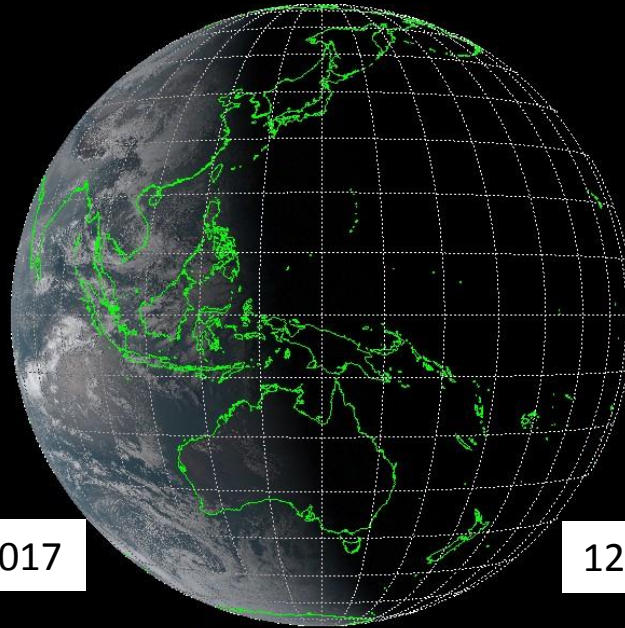
**Cannot be  
used at night**



03UTC 25Oct 2017

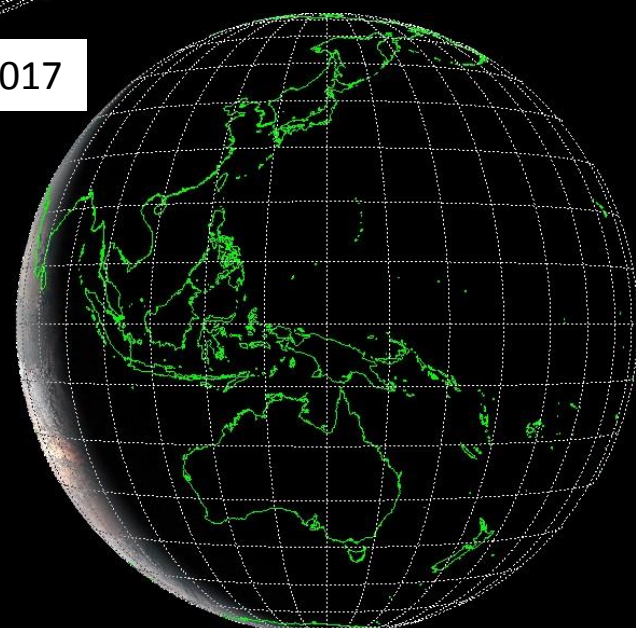
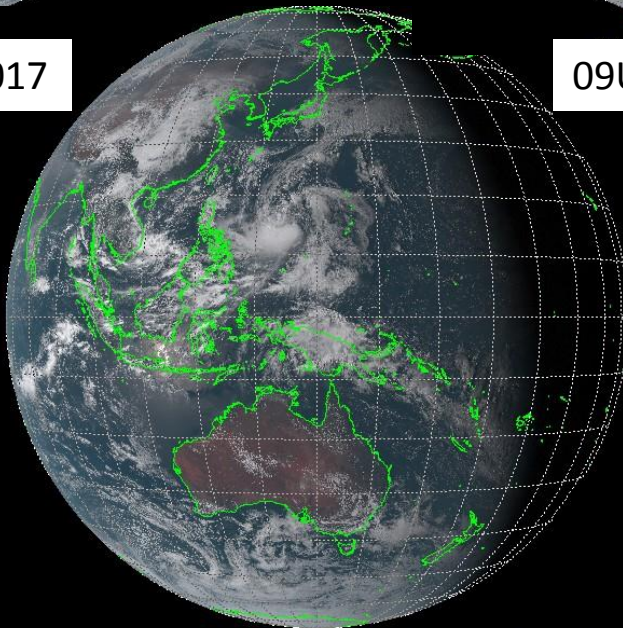


06UTC 25Oct 2017



12UTC 25Oct 2017

09UTC 25Oct 2017



Himawari-8 TRF 25.OCT.2017 08:10UTC

Himawari-8 TRF 25.OCT.2017 12:10UTC

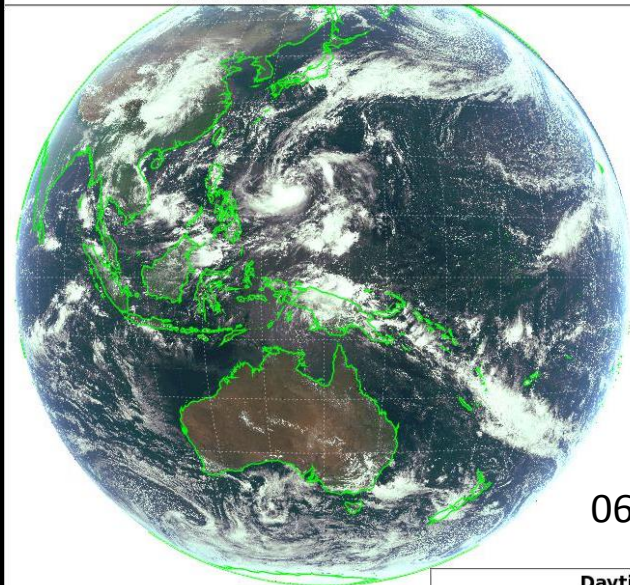


# One solution: using the infrared window channel (Himawari-8 Band 13) at night



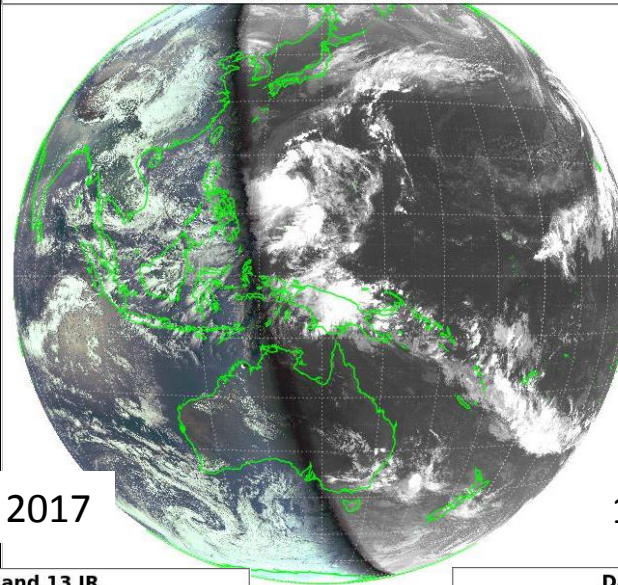
**However, Band 13 generally cannot reveal low cloud / fog**

Daytime True Colour / Band 13 IR  
Valid Wed, 25 Oct 2017 03:00 UTC



06UTC 25Oct 2017

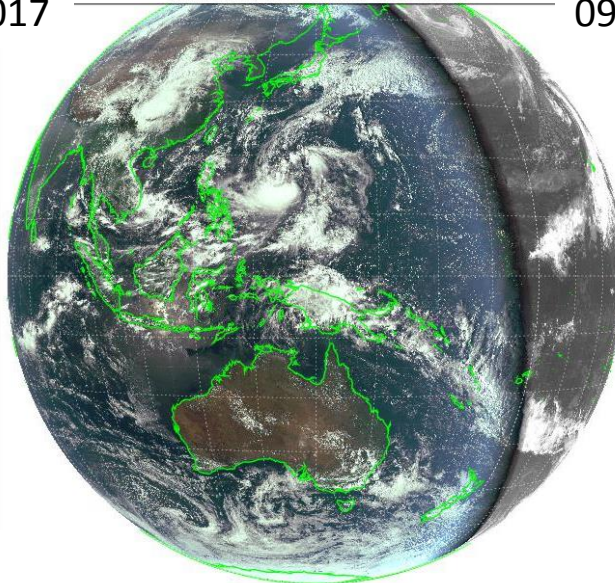
Daytime True Colour / Band 13 IR  
Valid Wed, 25 Oct 2017 09:00 UTC



12UTC 25Oct 2017

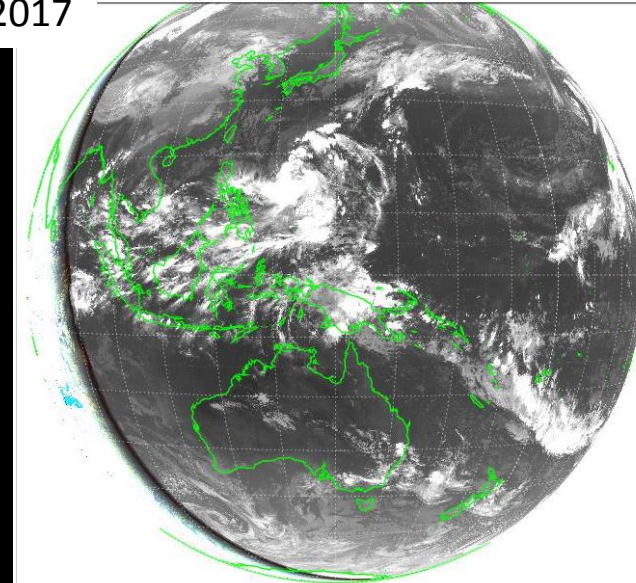
Daytime True Colour / Band 13 IR  
Valid Wed, 25 Oct 2017 06:00 UTC

03UTC 25Oct 2017



09UTC 25Oct 2017

Daytime True Colour / Band 13 IR  
Valid Wed, 25 Oct 2017 12:00 UTC

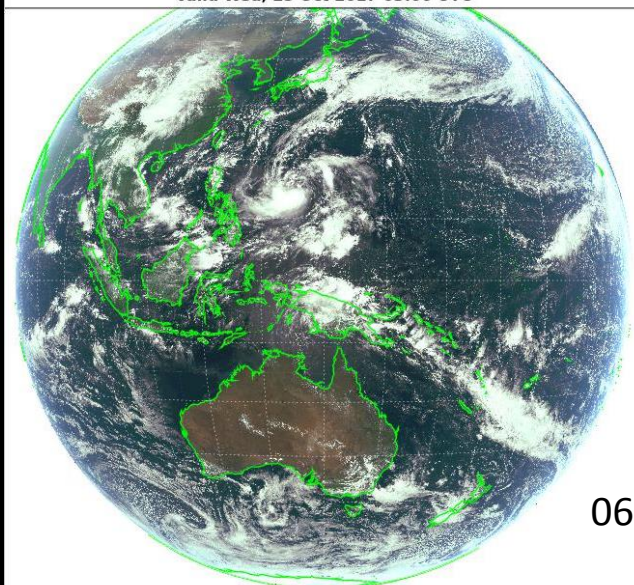




# A better solution: using the "cats eye" Night Microphysics RGB product at night

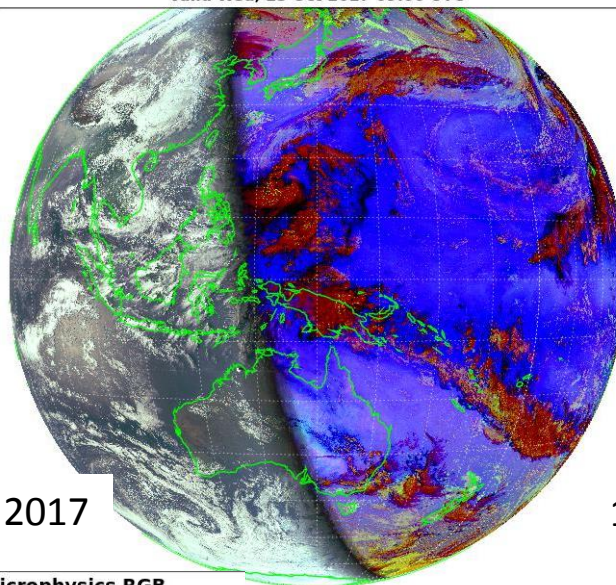


Daytime True Colour / Band 13 IR  
Valid Wed, 25 Oct 2017 03:00 UTC



06UTC 25Oct 2017

Daytime True Colour / Night Microphysics RGB  
Valid Wed, 25 Oct 2017 09:00 UTC

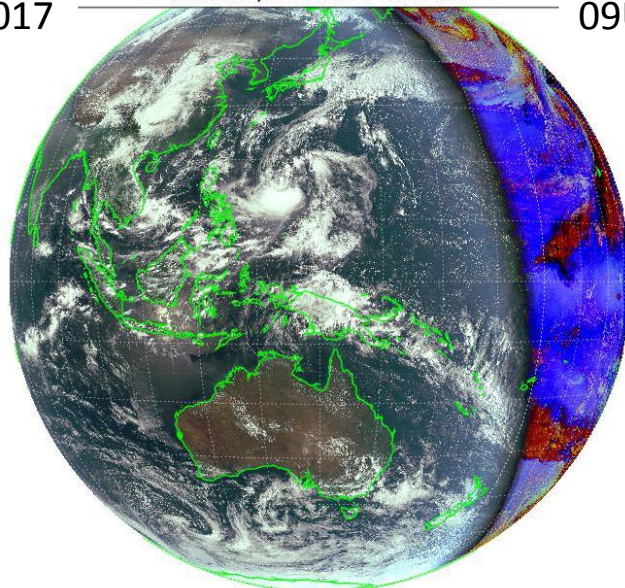


12UTC 25Oct 2017



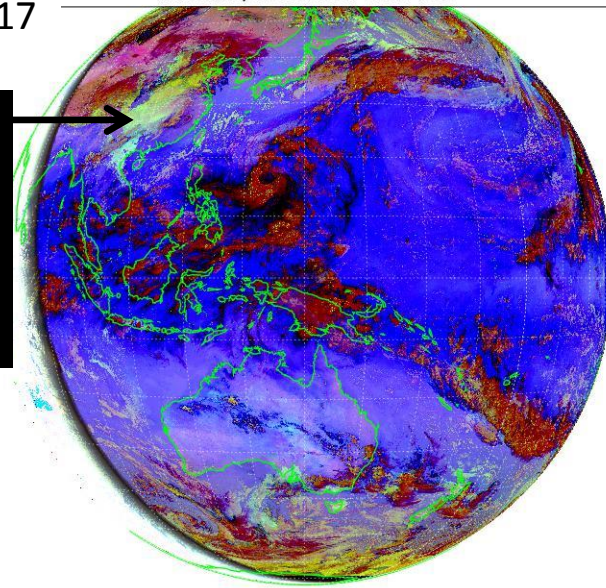
Colour / Night Microphysics RGB  
Valid Wed, 25 Oct 2017 06:00 UTC

03UTC 25Oct 2017



09UTC 25Oct 2017

True Colour / Night Microphysics RGB  
Valid Wed, 25 Oct 2017 12:00 UTC



fog /  
low  
cloud at  
night







# Night Microphysics RGB product for fog/low cloud detection

(Melbourne fog clearing 20<sup>th</sup> April 2009)

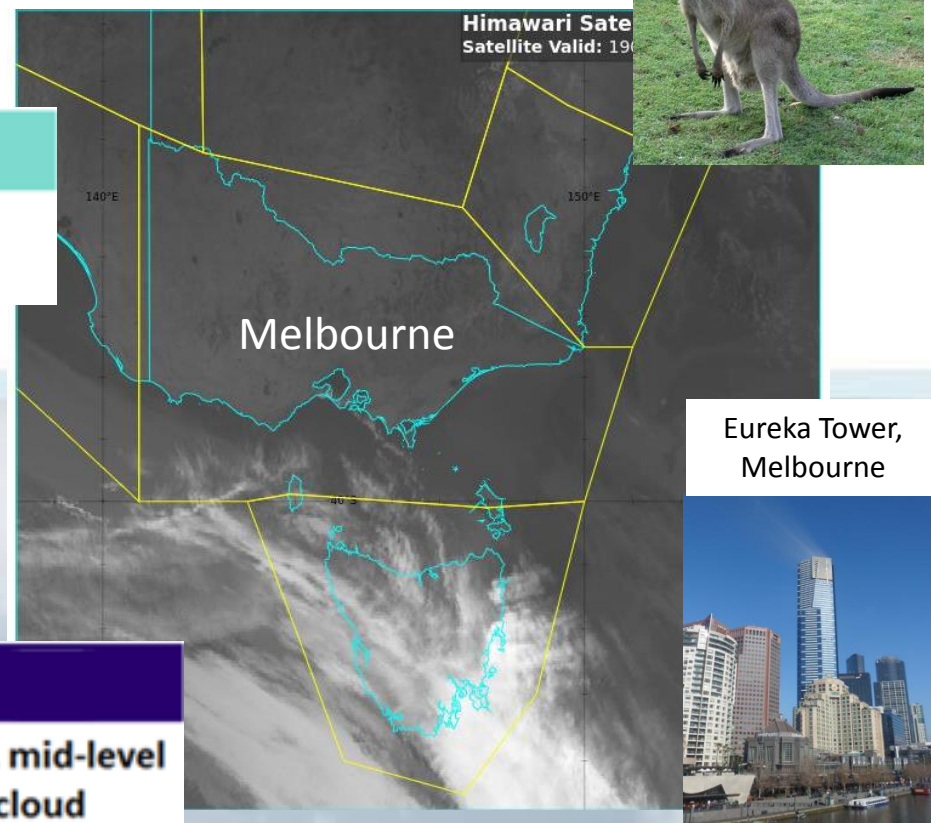
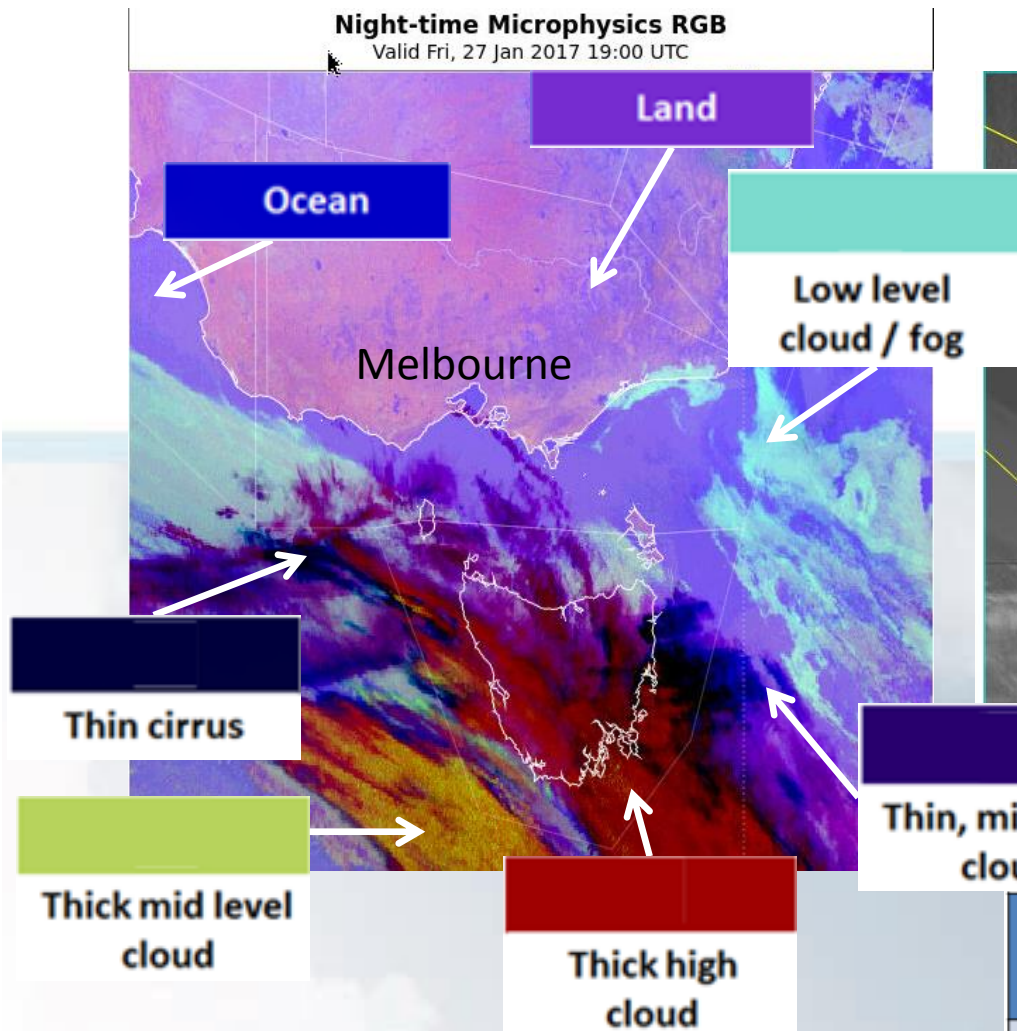




# The Night Microphysics RGB product compared to the infrared product

(Southeastern Australia, 19UTC 27<sup>th</sup> January 2017)

images courtesy JMA/BOM



Night Microphysics RGB (JMA tuned version 2, Murata and Shimizu 2015)	Range	Gamma
<b>IR12.4 – IR10.4 BTD</b>	<b>-6.7 to 2.6</b>	<b>1.0</b>
<b>IR10.4 – IR3.9 BTD</b>	<b>-3.1 to 5.2</b>	<b>1.0</b>
<b>IR10.4 BT</b>	<b>-29.4 to 19.4</b> (243.6 to 292.4K)	<b>1.0</b>

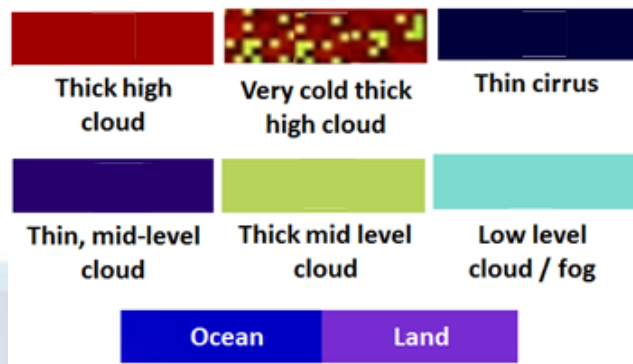
Night Microphysics RGB formula

Melbourne image courtesy B.Zeschke

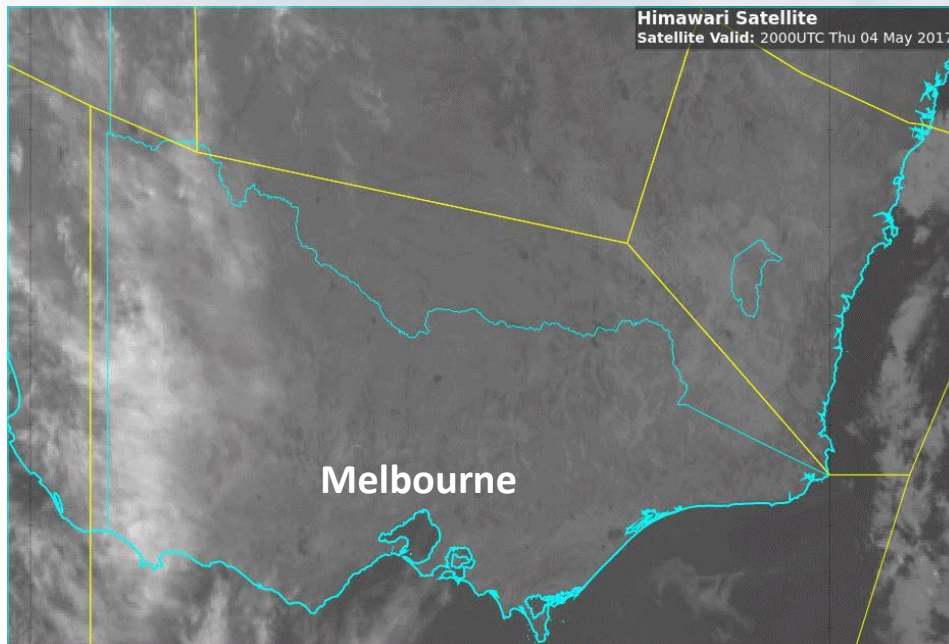
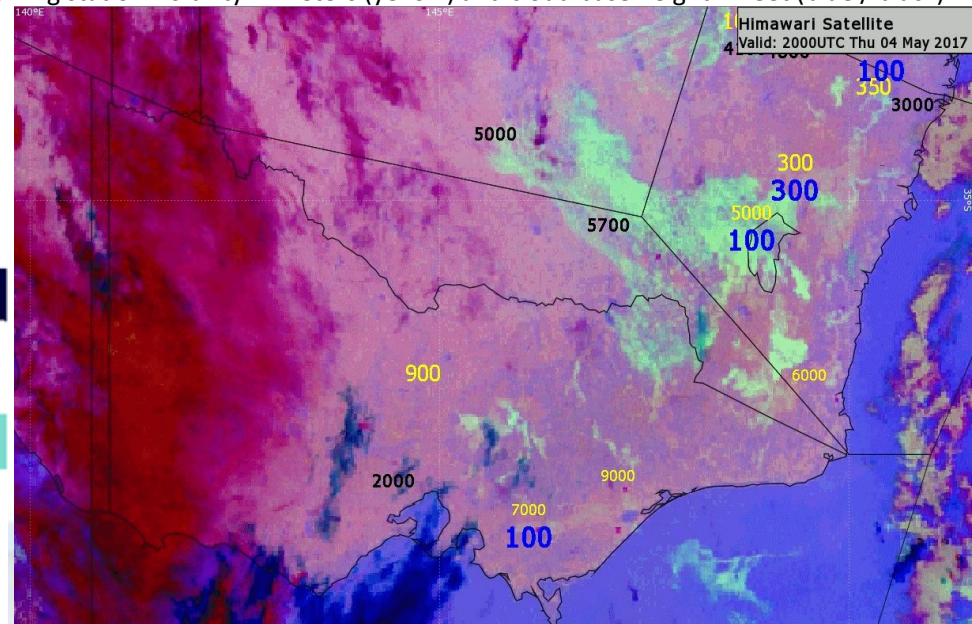


# The advantages of the Night Microphysics RGB product

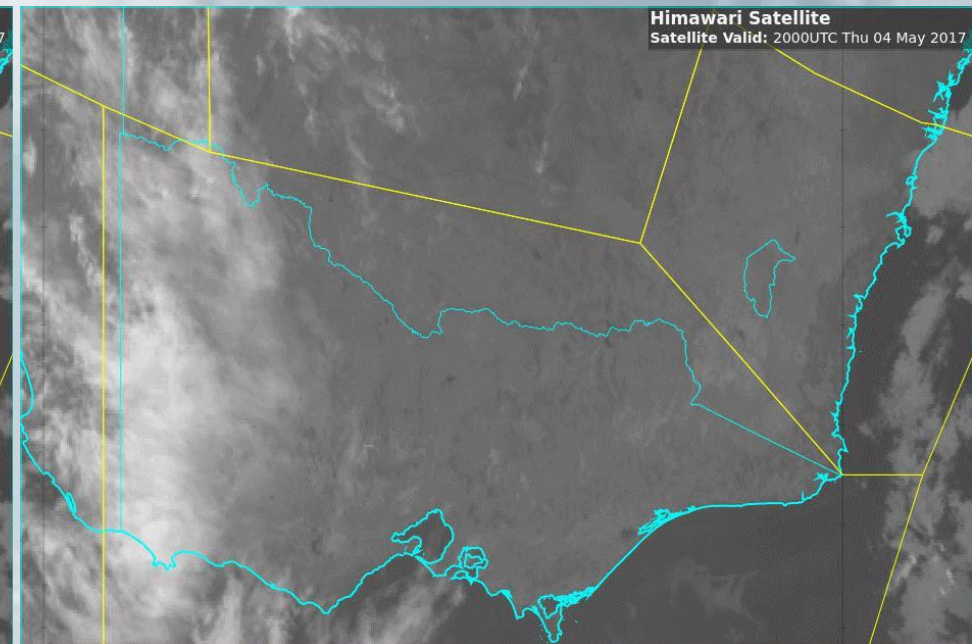
Southeast Australia 20UTC 4<sup>th</sup> May 2017



Night Microphysics RGB  
showing station visibility in meters (yellow) and cloud base height in feet (blue / black)



short wave infrared (3.9micron)



Infrared (10.4 micron)

**Question to 115 Australian Bureau of Meteorology staff\*: How useful have you found the new Himawari-8 data when briefing stakeholders (pilots etc.)?**

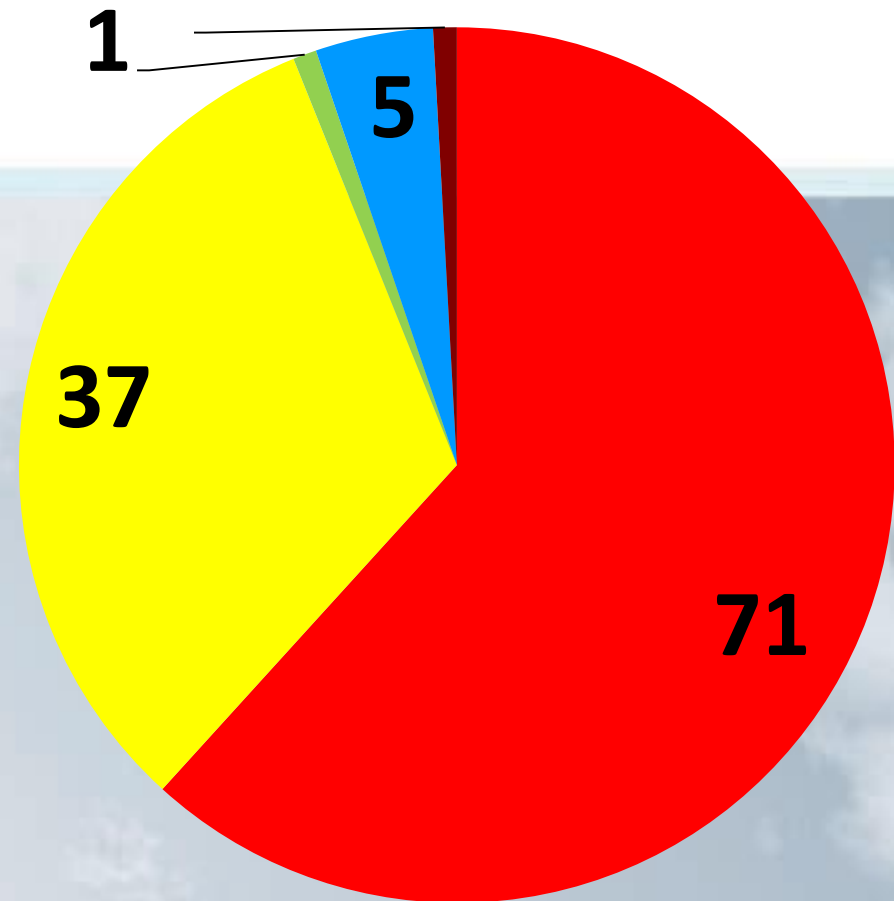
■ Very useful

■ Useful

■ No satellite data used

■ Have not conducted briefings

■ Other comments



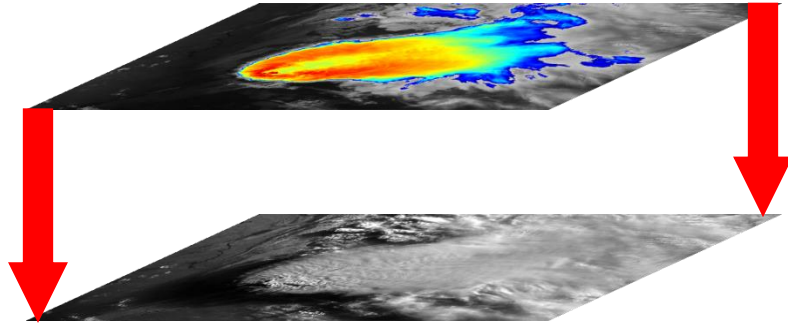


# The "Hector" thunderstorm of northern Australia

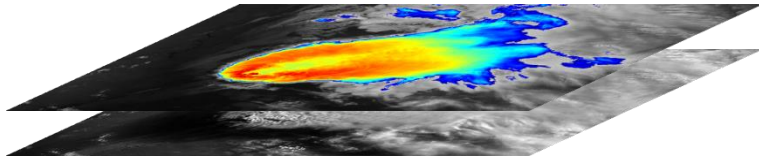


# Some satellite products for the monitoring of Convection: the BOM version of the "Sandwich Product"

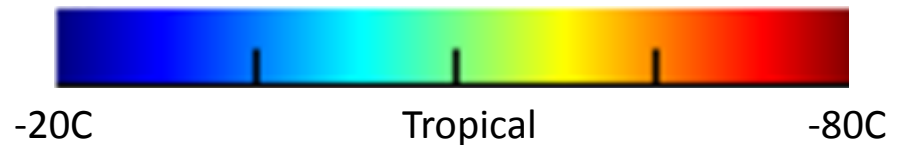
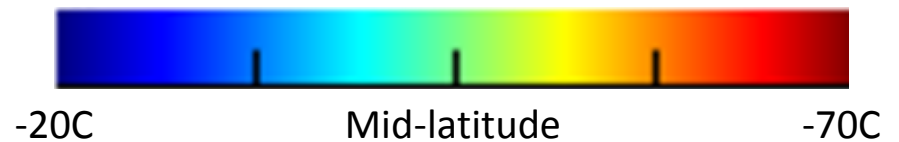
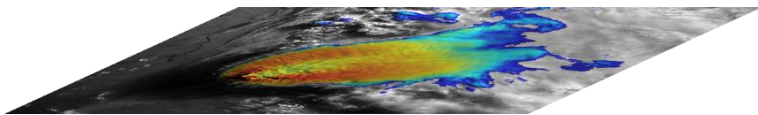
Upper layer: IR10.4 BT image



Bottom layer ("background"):  
HRV image



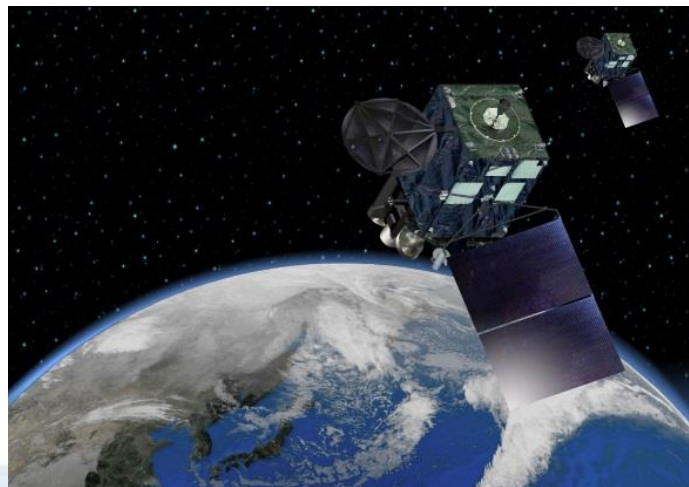
**Blending options – applied to  
the upper layer**



Upper layer opacity set somewhere between  
40 to 75%

**I have chosen 50% for the Sandwich  
Product,**

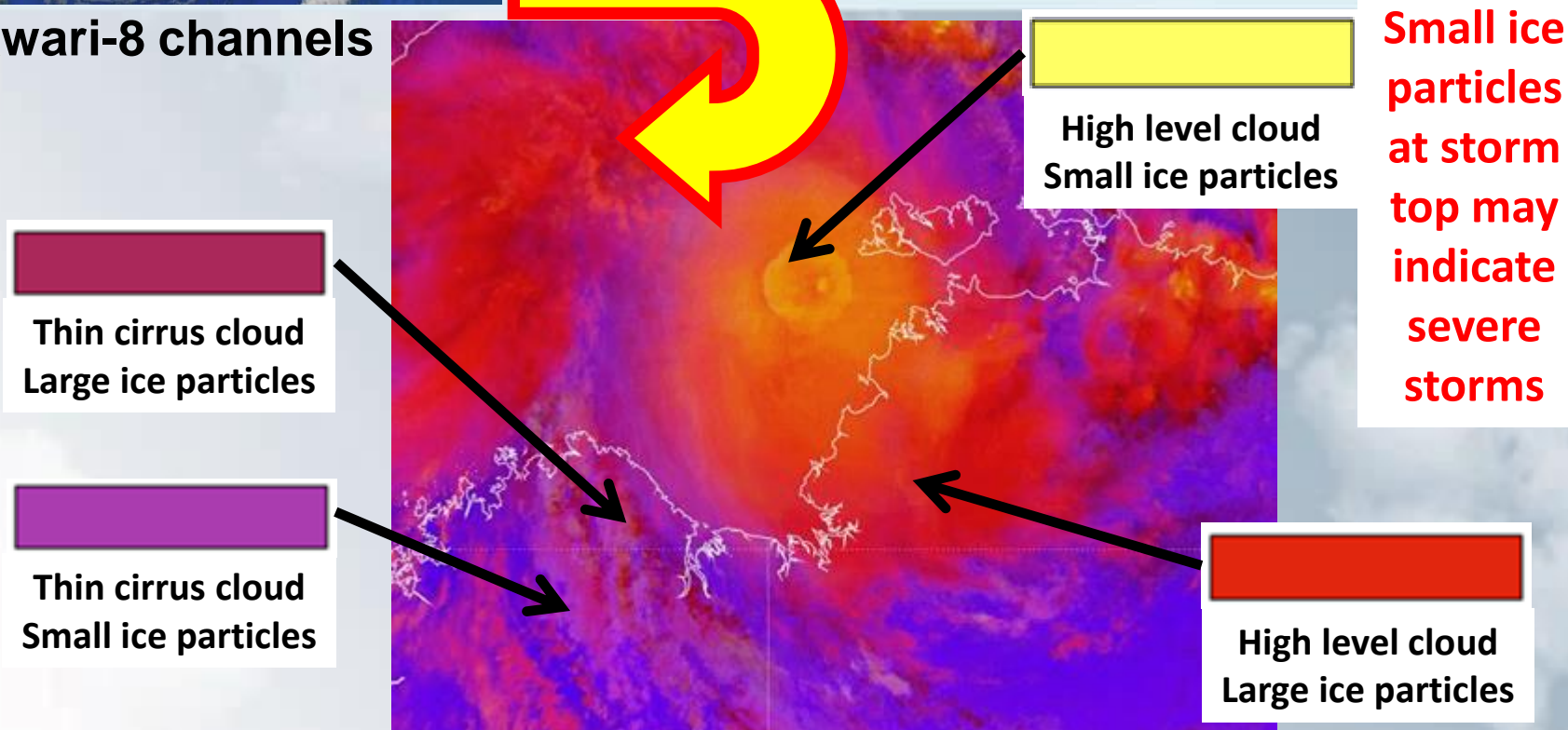
# Introducing the Day Convection RGB



Himawari-8 channels

Day Convection RGB	Range	Gamma
6.2 – 7.3 micron	-35 to 5	1.0
3.9-10.4 micron	-5 to 60	0.5
1.6-0.6 micron	-75 to +20%	1.0

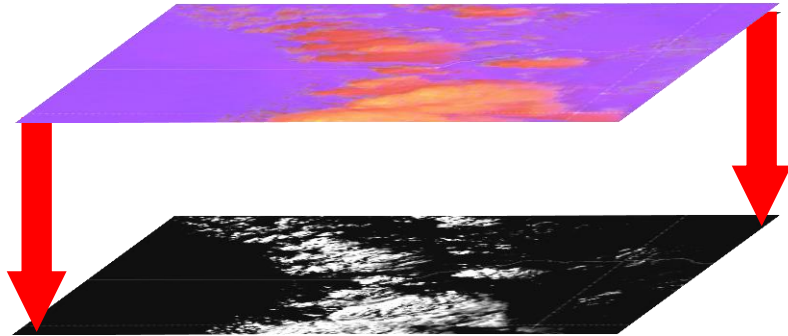
**CHANNEL COMBINATION** (mid-latitude EUMETSAT recipe)



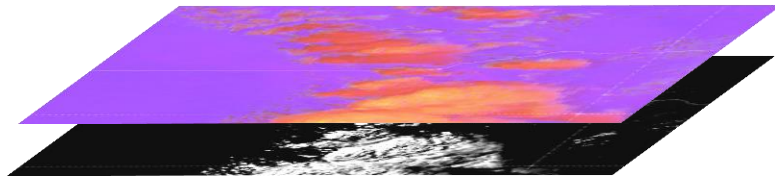


# Some satellite products for the monitoring of Convection: The Day Convection RGB / Visible Sandwich Product"

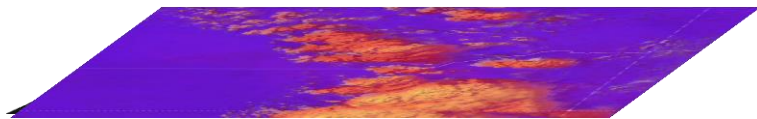
Upper layer: Day Convection RGB image



Bottom layer ("background"):  
HRV image



**Blending options – applied to  
the upper layer**



Day Convection RGB (Mid-latitude)	Range	Gamma
WV6.2 - WV7.3 BTD	-35 to 5	1.0
IR3.9 - IR10.4 BTD	-5 to 60	0.5
NIR1.6 - VIS0.6 REFL	-75 to 25%	1.0

Day Convection RGB (Tropical)	Range	Gamma
WV6.2 - WV7.3 BTD	-35 to 5	1.0
IR3.9 - IR10.4 BTD	-5 to 75	0.33
NIR1.6 - VIS0.6 REFL	-75 to 25%	1.0

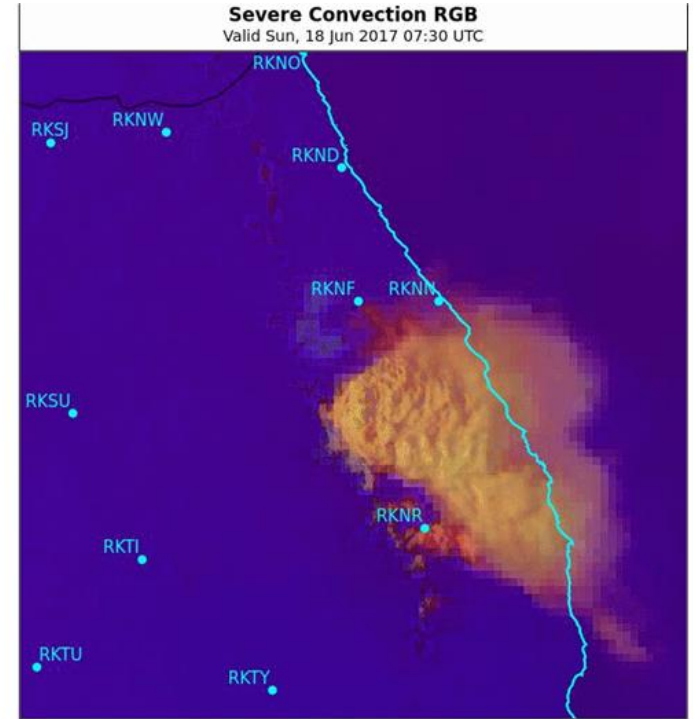
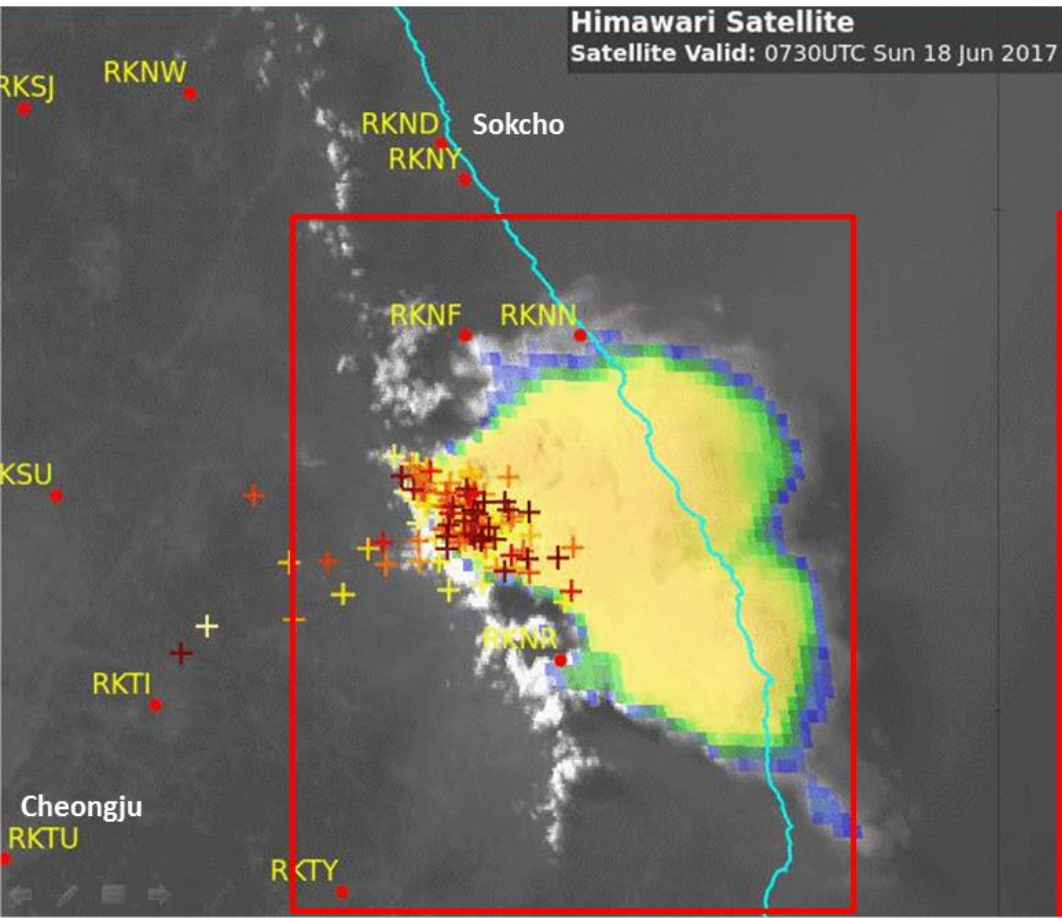
Upper layer opacity set to 75% for the Day  
Convection RGB Sandwich Product

**The contrast of the HRV layer has been  
increased to 300 and the brightness reduced  
to -110**

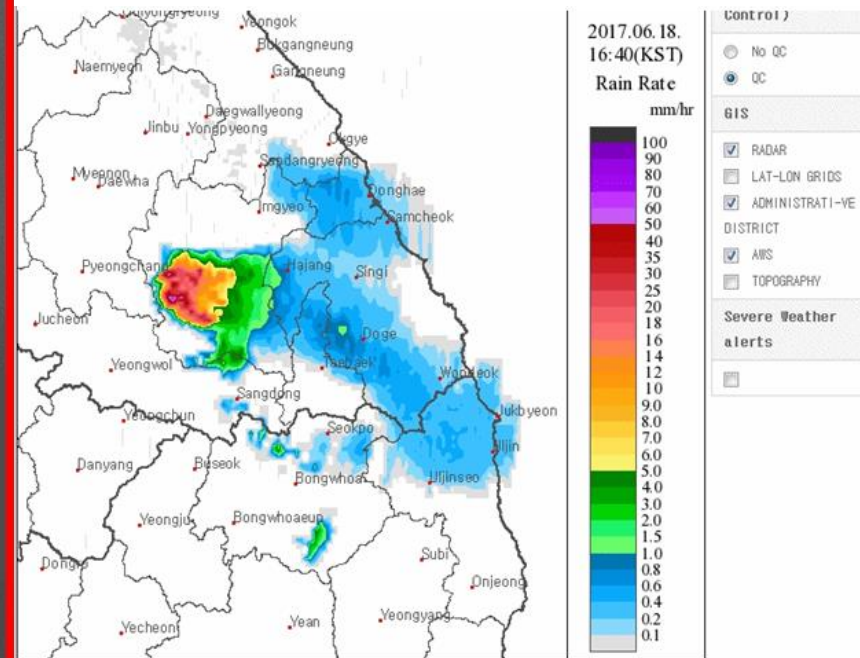
# Development, 18 June 2017

Sandwich Product with lightning data,  
RADAR (QC) and Day Convection RGB  
Sandwich product (0730 UTC)

images courtesy JMA/BOM, lightning data courtesy WeatherZone



RADAR image courtesy KMA





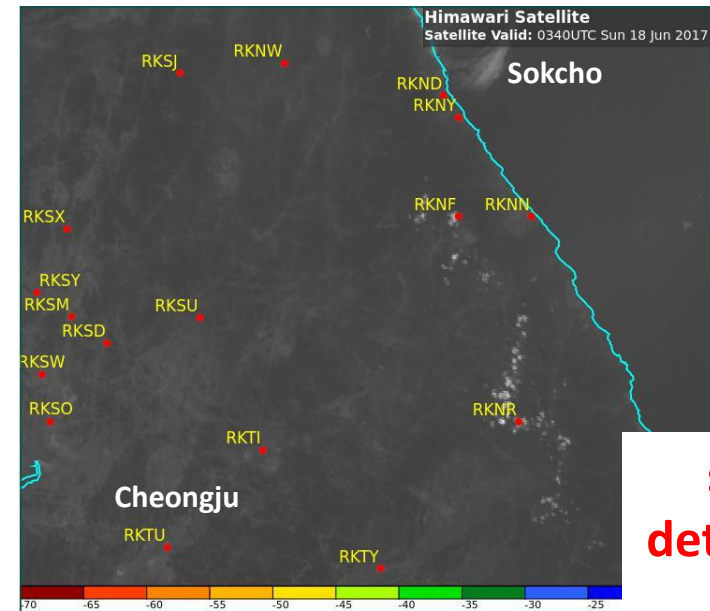
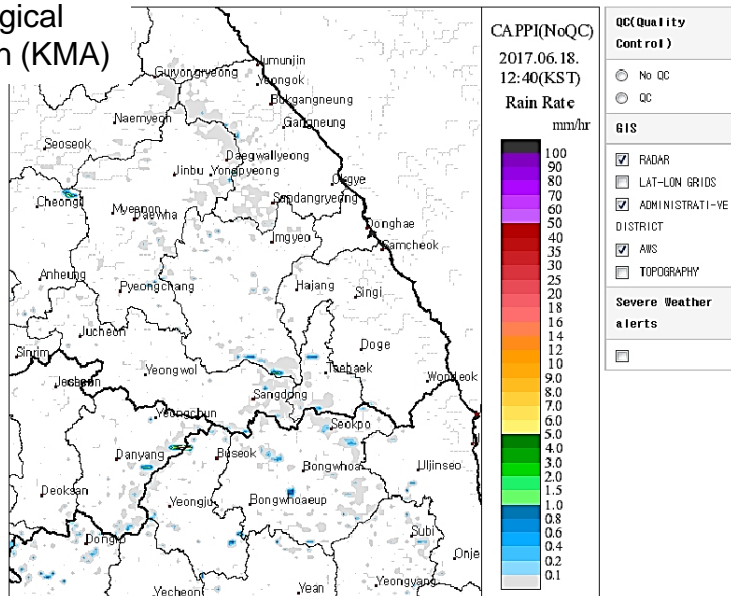
# First cumulus field develops in satellite imagery:

RADAR images  
courtesy Korea

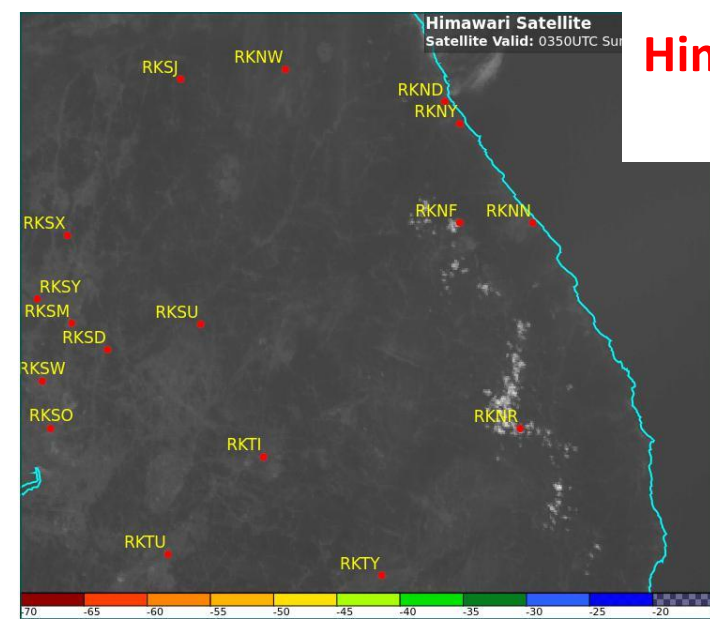
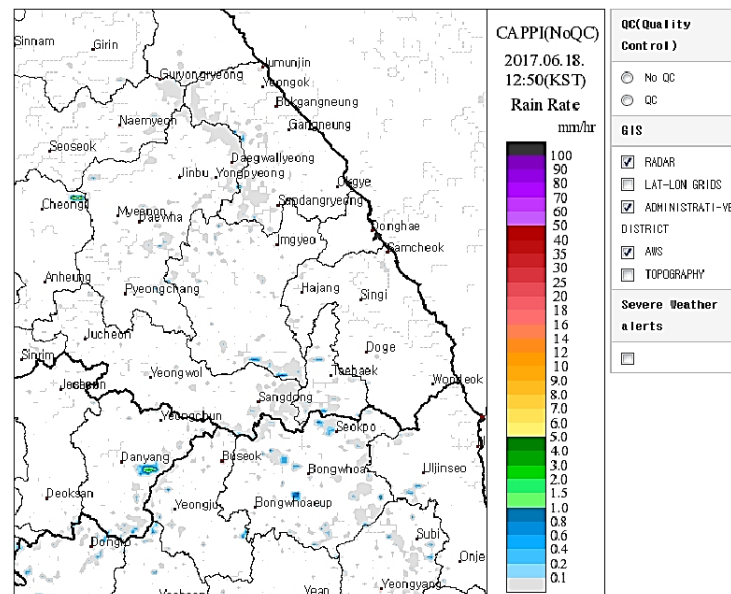
Meteorological  
Administration (KMA)

0340-0350UTC (1240-1250KST)

satellite images courtesy  
JMA/BOM



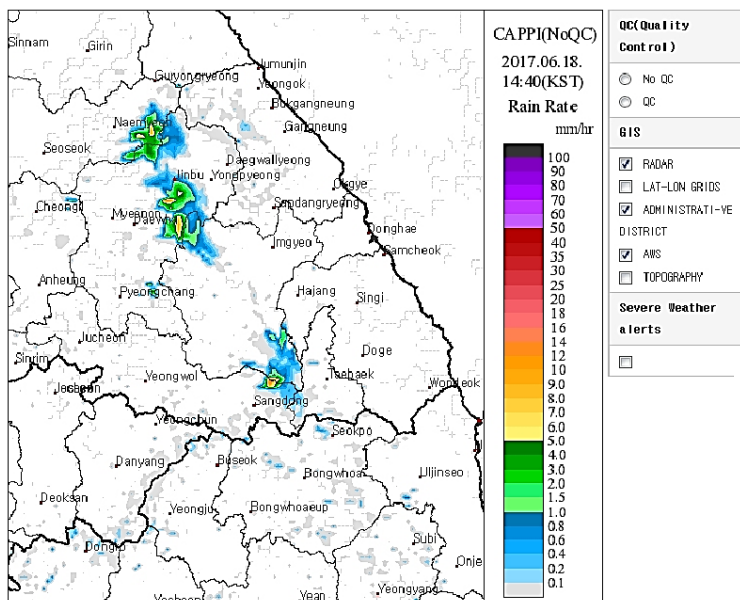
signal  
detected in  
the  
Himawari-8  
data



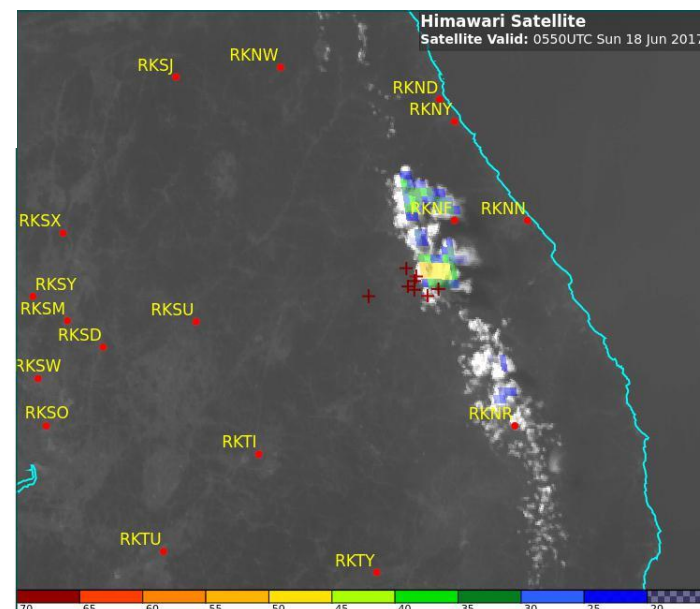
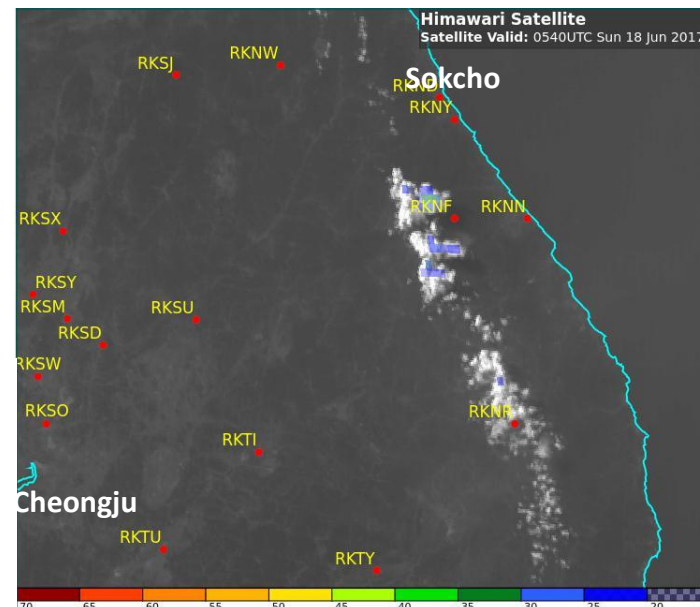
RADAR images  
courtesy Korea  
Meteorological  
Administration (KMA)

# First lightning strikes recorded: 0540-0550UTC (1440-1450KST)

satellite images courtesy  
JMA/BOM



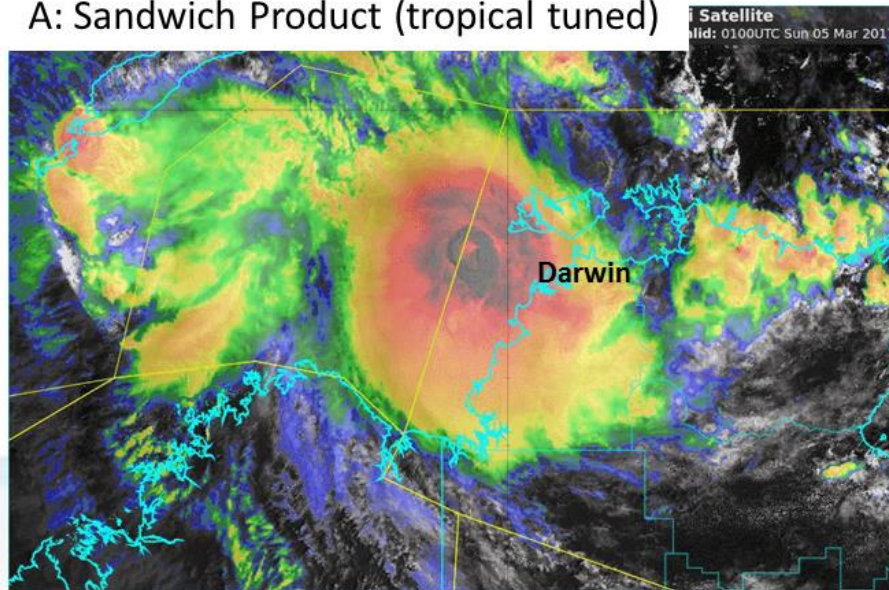
signal  
detected in  
both the  
Himawari-8  
and radar  
data



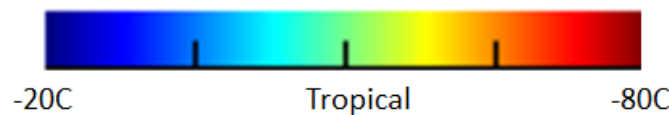
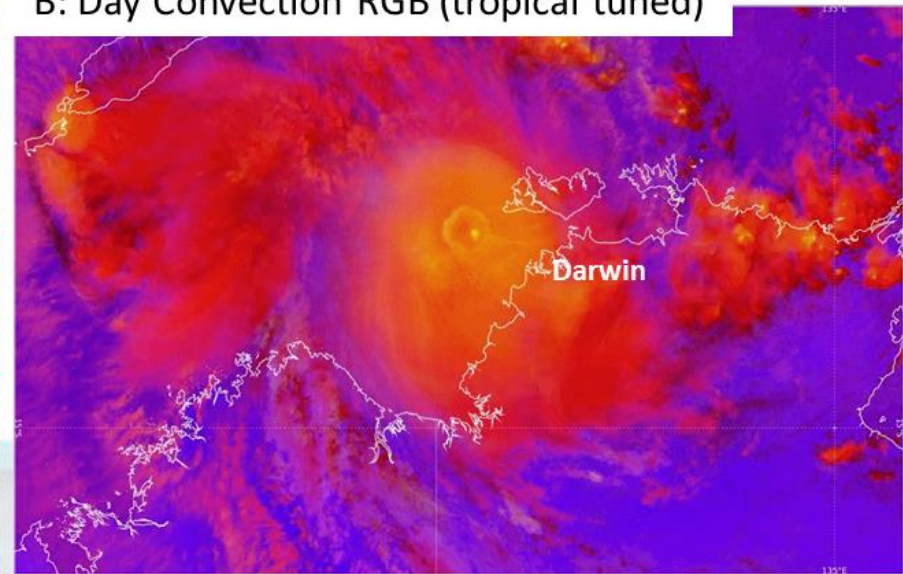


images courtesy JMA/BOM

A: Sandwich Product (tropical tuned)



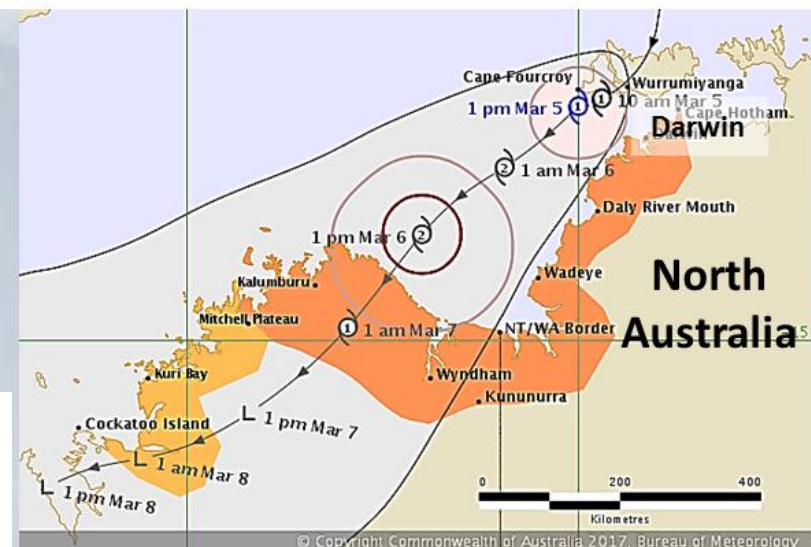
B: Day Convection RGB (tropical tuned)



**Convection associated with  
Tropical Cyclone Blanche**  
Sandwich and Day Convection RGB  
products 5<sup>th</sup> March 2017, 01UTC

**Monitoring cloud top temperatures and ice  
crystal size to determine Tropical Cyclone  
intensity and development**

Tropical Cyclone Threat Map



Threat map courtesy BOM

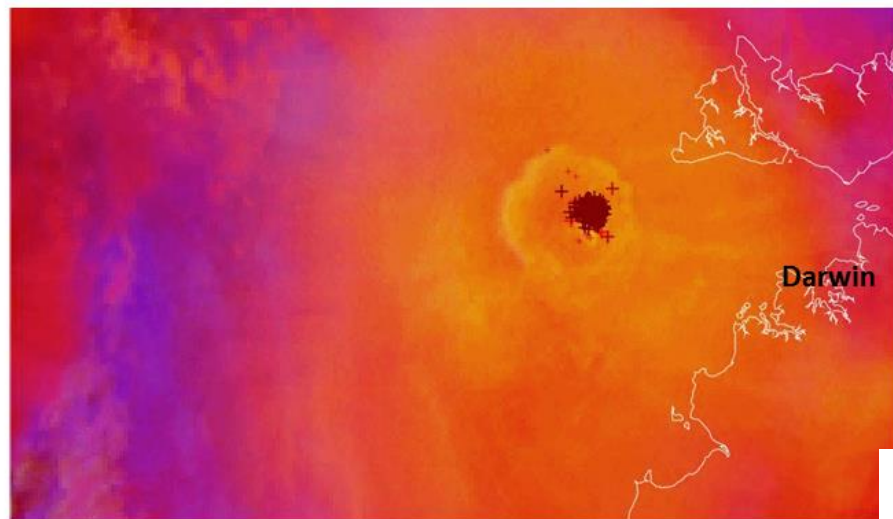


# A closer look – Convection RGB / Sandwich product variations

lightning data courtesy  
GPATS

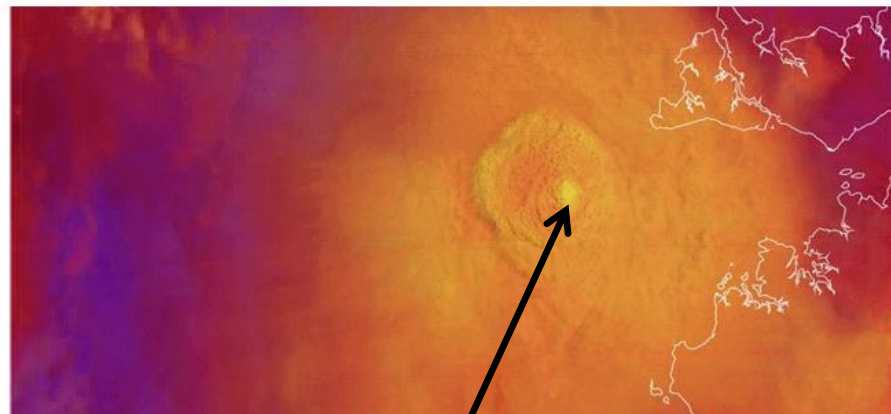
TC Blanche convection 5<sup>th</sup> March 2017, 01UTC

**A:** Day Convection RGB (tropical tuned & lightning)

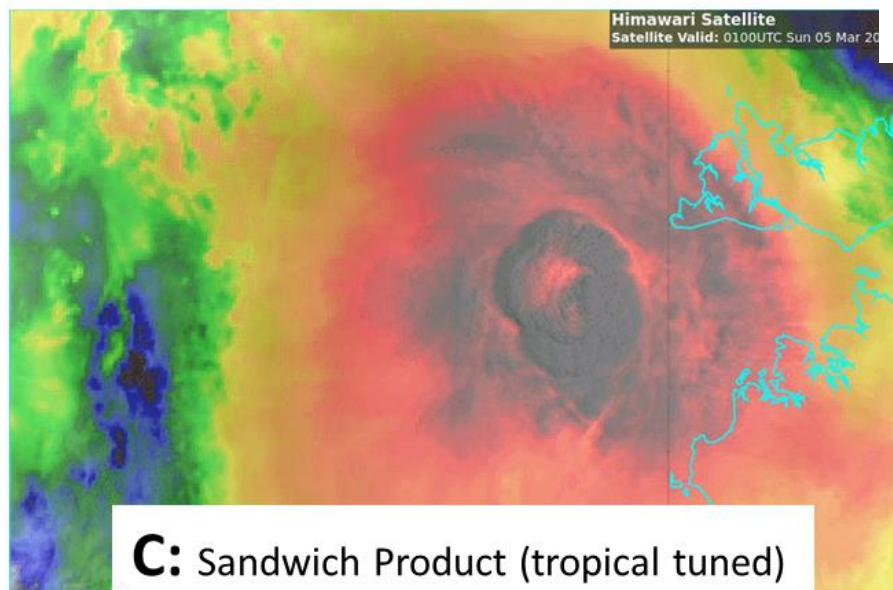


**B:** Day Convection RGB (tropical) Sandwich Product

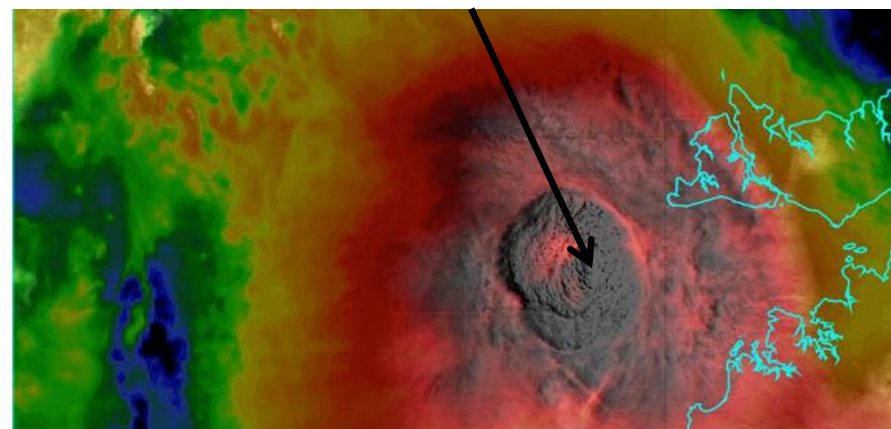
Brightness -110% Contrast 300% Transparency 75% for HRVIS



**Potentially severe convective outbreak on  
the flank of the tropical cyclone**



**C:** Sandwich Product (tropical tuned)



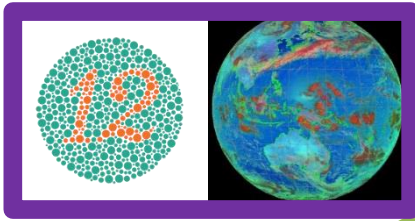
**D:** Sandwich Product Version 2

Brightness -170%, Contrast 400% for HRVIS. Transparency of enhanced IR as 50%

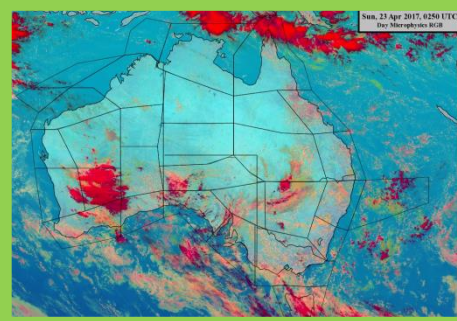


# Question to 115 Australian Bureau of Meteorology staff\*:

## Limitations in the Himawari-8 data



3



34

29

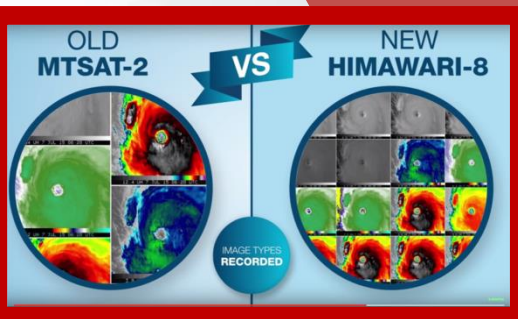
87

■ Delay in Data Display

■ Large amount of Data /  
high Data frequency

■ Complexity of Products

■ Colour Vision  
Deficiency

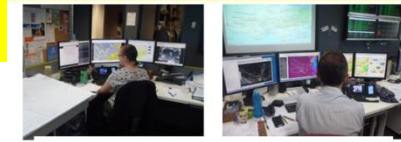


\* Results to be published in the research paper "How Himawari-8 data has revolutionised the work of Bureau Forecasters", Zeschke et al. 2018

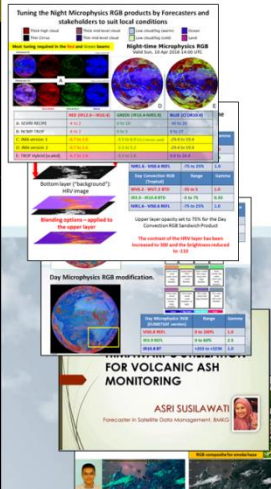
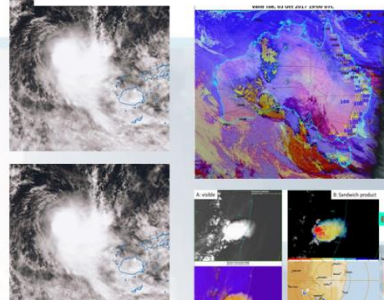
# Summary of the session

1

Please start the Power Point Slide Show to activate the animation



Forecaster use of Himawari-8 data

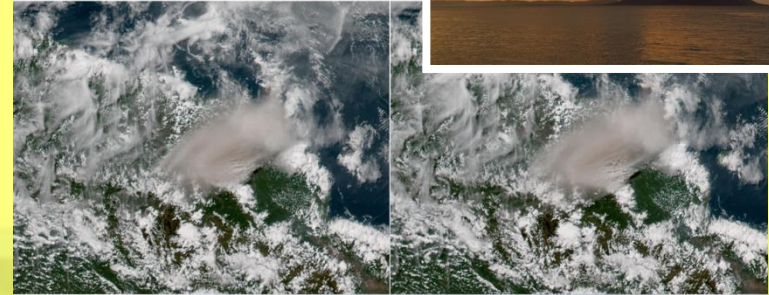


The new capabilities of Himawari-8 / 9

2

on courtesy JMA/BOM

**Animation:** Utilising the multichannel Himawari-8 to assist in the continuous determination of its areal extent and

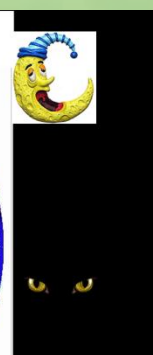
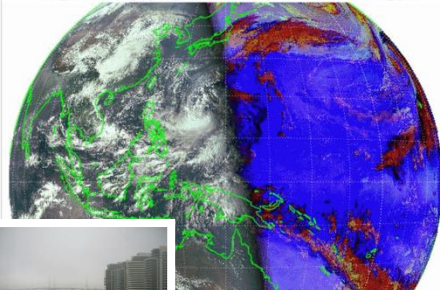


True Colour RGB: Volcanic Ash

3



A better solution: turning on the "cats eye" Night Microphysics RGB product at night



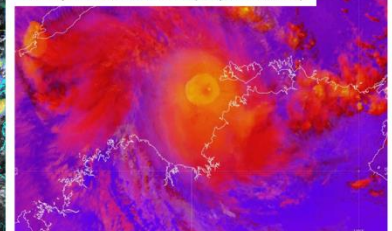
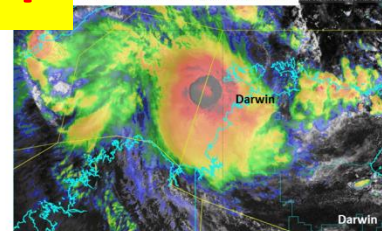
Night Microphysics RGB: Fog/Low Cloud

4

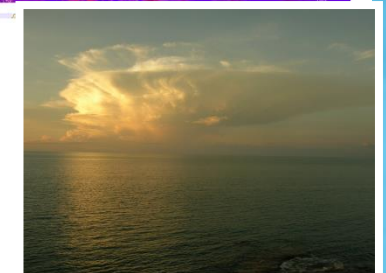
Livch Product (tropical tuned)

Satellite


Day Convection RGB (tropical tuned)



Day Convection RGB: Thunderstorms, Tropical Storms







**ありがとうございます**

**Thank You**

**ありがとうございます**

**Thank You**