



Australian Government

Bureau of Meteorology



Effective use of high temporal and spatial resolution Himawari-8 data

AOMSUC-6 Training Event

Bodo Zeschke

Australian Bureau of Meteorology Training Centre

Australian VLab Centre of Excellence



Content

- During this session the high temporal and spatial resolution Himawari-8 data will be briefly introduced.
- A summary will be given of feedback from Australian Bureau of Meteorology Forecasters and other stakeholders who have used high resolution satellite data operationally.
- This will be illustrated using 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.



Australian Government
Bureau of Meteorology

Useful online resources that we shall explore



[Bureau Home](#) > [Australia](#) > High-definition satellite images

High-definition satellite images

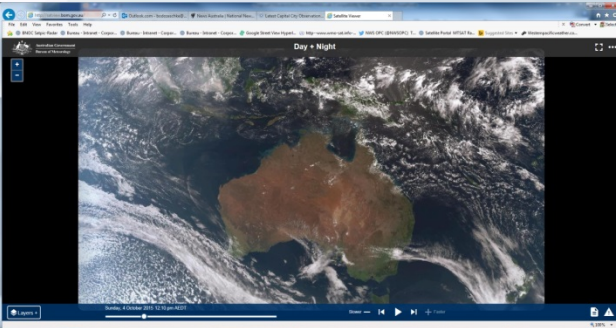
See images from Himawari-8 in the new satellite viewer

This demonstration product is most suitable for people with fast internet connection and high data allowance.

Explore images now

Bureau Himawari-8 Viewer

<http://www.bom.gov.au/australia/satellite/>



Melbourne VLab Centre Of Excellence

Effective use of Himawari-8 data in Thunderstorm detection, monitoring and forecasting

General comments

Below are summarised ways in which the increased spatial and temporal resolution and the additional channels of Himawari-8 can assist the Forecaster in detecting, nowcasting and forecasting of this meteorological phenomenon. Further information including case study animations etc. can be obtained for those points highlighted in **bold** in the below table:

Spatial Resolution	<p>Pre-Cb development</p> <ul style="list-style-type: none"> Improved resolution of local mesoscale triggers (seabreeze fronts, local convergence lines) <p>Cb severity identification and development</p> <ul style="list-style-type: none"> Stormtop and overshooting top Brightness Temperatures (BT) can be more accurately determined with less "pixel averaging" in the high resolution satellite data. The satellite data will provide a clearer picture of storm top signatures such as overshooting tops, the "warm wake" or "enhanced V" (thermal couplet) that are often associated with severe storms. <p>Other important implications</p> <ul style="list-style-type: none"> More effective implementation of Derived Products such as the Cloud Top Cooling Product and the Automatic Overshooting Top Detection Algorithm.
Temporal Resolution	<p>Pre-Cb development</p> <ul style="list-style-type: none"> Permits better determination of the areas where convection may develop (eg. moist low level regions) Better detection and monitoring of Synoptic / Mesoscale triggers to convection (dry lines / seabreeze fronts, local convergence lines). It is possible to detect these features in the 10 minute satellite data before they are apparent in the radar signal. Better identification and monitoring of cumulus development that may transition into Cb (ie. clumping of cumulus and development of towering cumulus). It is possible to detect these features in the 10 minute satellite data before they are apparent in the radar signal. Rapid infrared-based cloud top cooling rates corresponding to developing Cb can be better monitored. <p>Cb severity identification and development</p> <ul style="list-style-type: none"> Easier and earlier discrimination between persisting and dissipating storms (pulse convection versus organised convection). Better monitoring of the movement and organisation of storms (eg. near-continuous monitoring of overshooting stormtops, splitting of supercells, organisation of storms into squall lines). Permits very short term forecasting of rapidly moving and potentially short lived convection (eg. monsoon squall lines). Better monitoring of steering flow by examining the movement of the storms in the high resolution imagery. Better monitoring of shear and its effect on the convective development. More readily able to detect rotation in Cb clouds. Better able to monitor storms associated with potentially intense rain rates (slow moving storms with persisting overshooting tops, train effect convection etc.) <p>Secondary features</p> <ul style="list-style-type: none"> Permits monitoring of the evolution of secondary features such as storm outflow boundaries and convection that may be generated by this. NWP cannot predict this yet.

National Himawari-8 Training Campaign

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

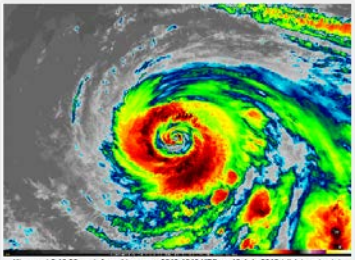
University of Wisconsin-Madison / Space Science and Engineering Center

CIMSS Satellite Blog

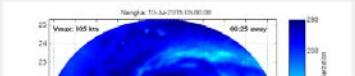
/ CIMSS / CIMSS Satellite Blog /

Unusual Double Eyewall structure in Himawari-8 Infrared Imagery of Typhoon Nangka

July 13th, 2015



Himawari-8 10.35 µm infrared imagery showed an unusual (for infrared imagery) double-eyewall structure in Typhoon Nangka over the western Pacific Ocean on 13 July 2015. For such a feature to appear in infrared imagery, the secondary circulations of both the inner and outer eyewall need to be intense enough to support the downdraft/cloud-clearing necessary to create the "moats" between them. Microwave imagery of the storm, below, viewed via MIMIC [from this site](#), also showed the double eyewall structure quite well. This double-eyewall signature typically indicates that a tropical cyclone is experiencing an eyewall replacement cycle (ERC), which signals that a (temporary) decrease in intensity is soon to follow.

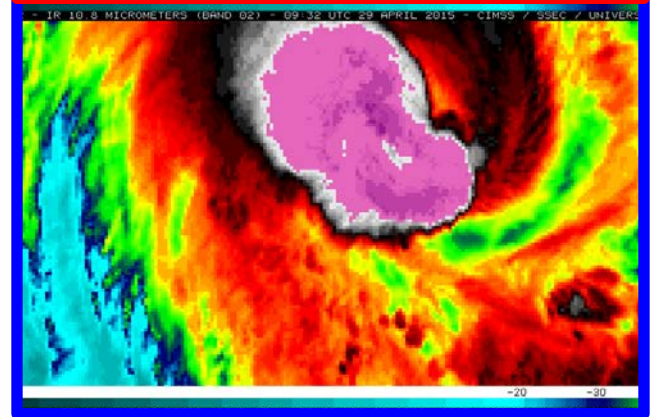
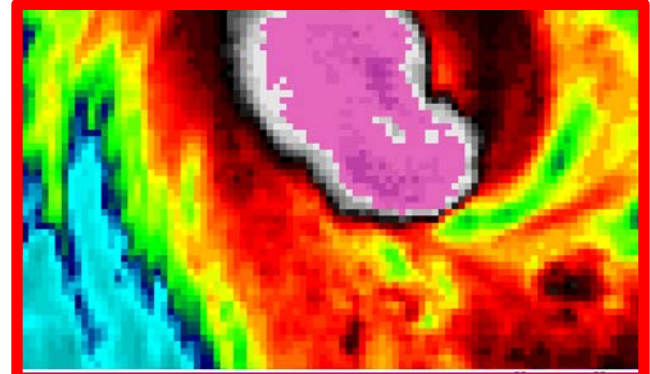
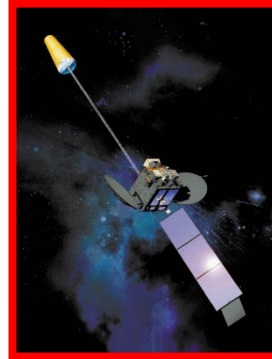


CIMSS Himawari-8 Satellite Blog

<http://cimss.ssec.wisc.edu/goes/blog/archives/category/himawari-8>

Comparing Himawari 8/9 with **MTSAT-2**

MTSAT 2



Himawari 8

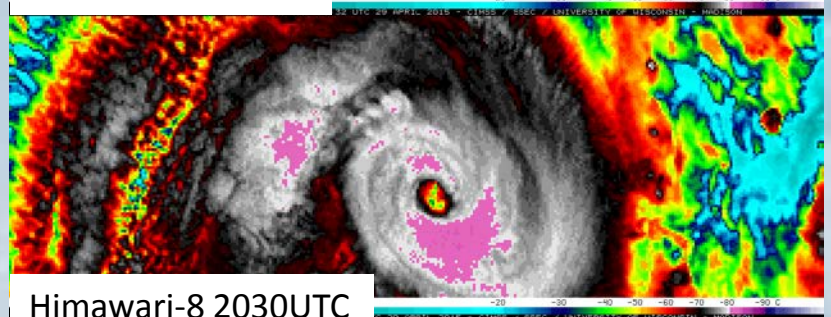
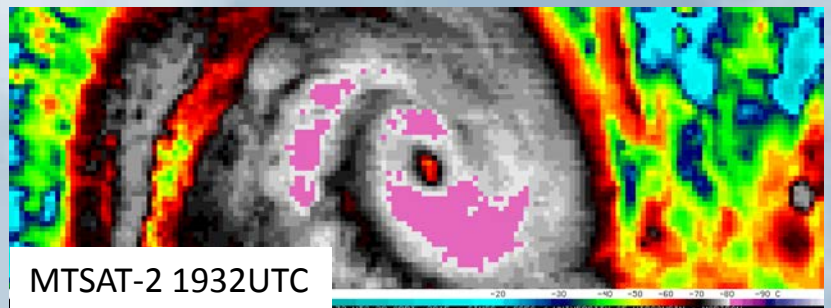
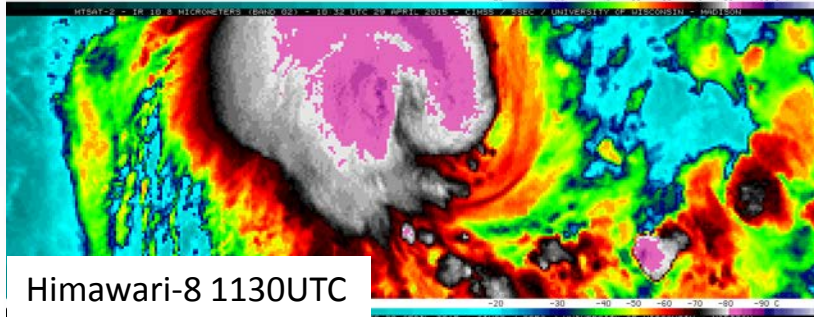
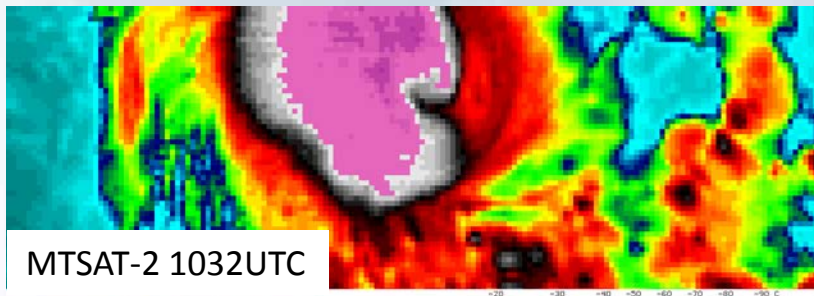
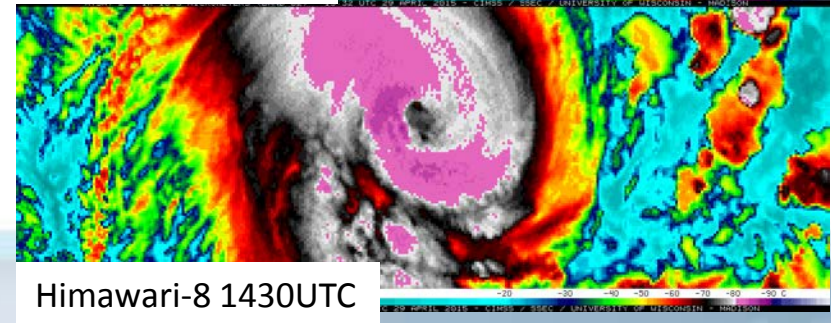
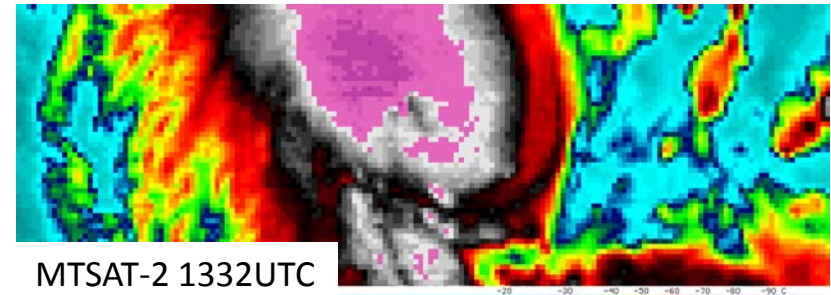
Band	Central Wavelength [μm]	Spatial Resolution
1	0.43 - 0.48	1Km
2	0.50 - 0.52	1Km
3	0.63 - 0.66	0.5Km
4	0.85 - 0.87	1Km
5	1.60 - 1.62	2Km
6	2.25 - 2.27	2Km
7	3.74 - 3.96	2Km
8	6.06 - 6.43	2Km
9	6.89 - 7.01	2Km
10	7.26 - 7.43	2Km
11	8.44 - 8.76	2Km
12	9.54 - 9.72	2Km
13	10.3 - 10.6	2Km
14	11.1- 11.3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

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

Exercise 1

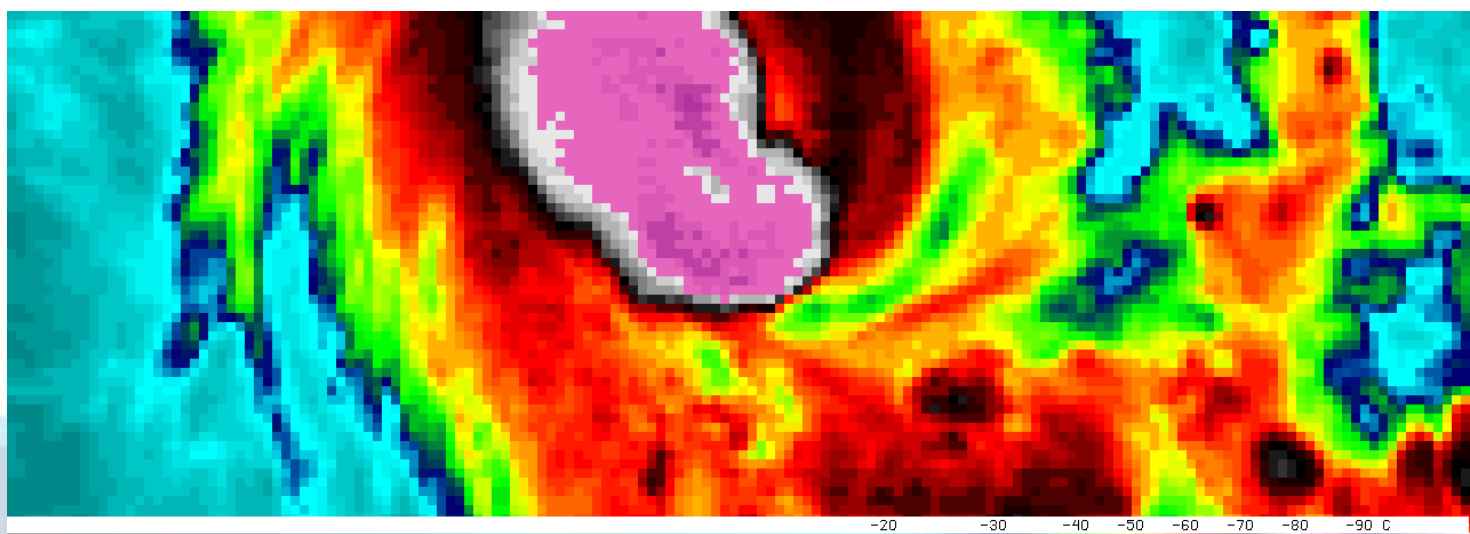
Annotate features of interest that the Himawari-8 data can show you

How are the Himawari-8 images an advantage over the MTSAT-2 images

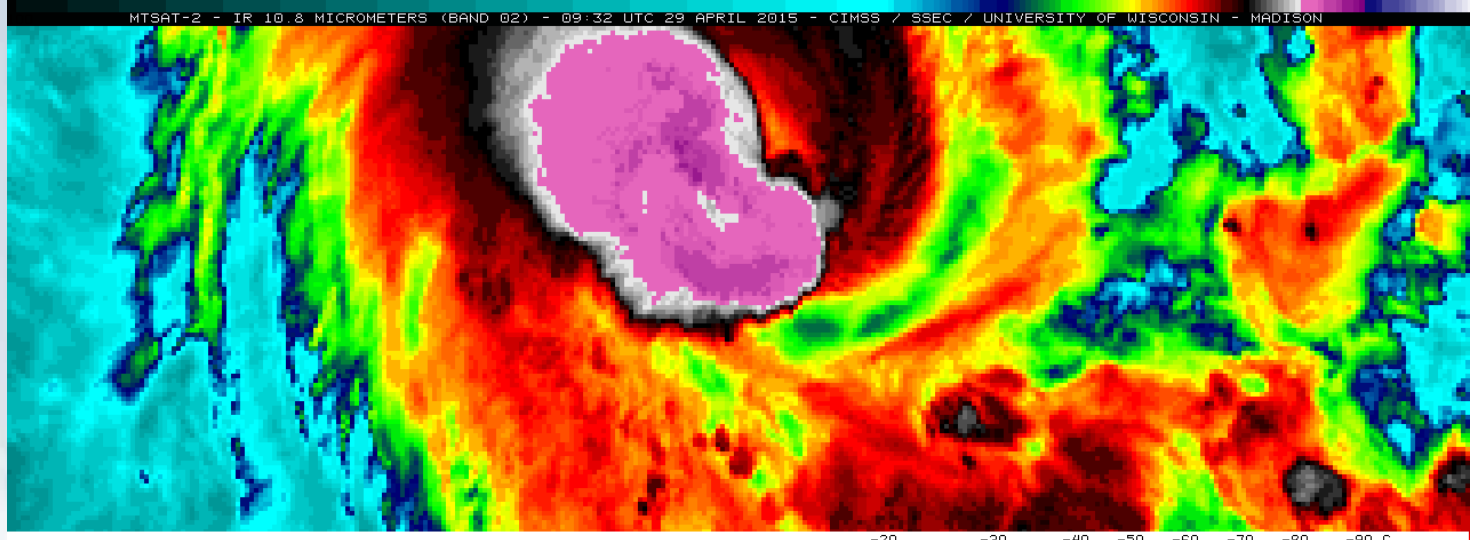


Tropical Cyclone Quang (29th April 0932 – 2232UTC)

Hourly data, 4km resolution
(MTSAT-2 enhanced 10.8 micron imagery)



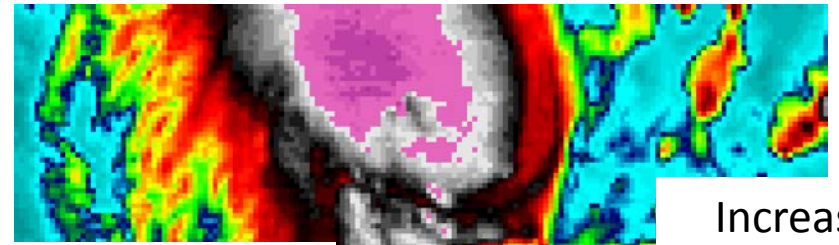
10 minute data, 2km resolution
(Himawari-8 enhanced 10.4 micron imagery)



Recommended answers

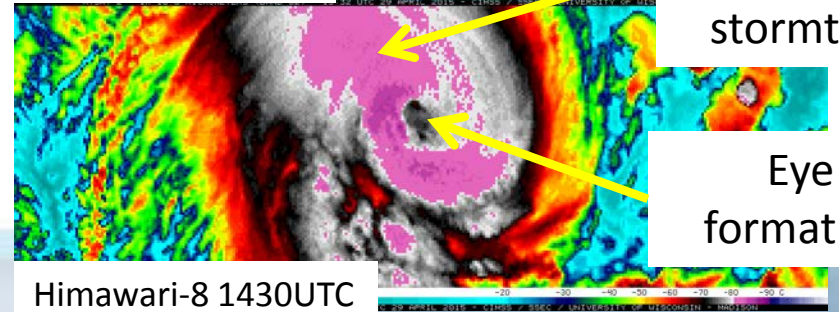
Annotate features of interest that the Himawari-8 data can show you

How are the Himawari-8 images an advantage over the MTSAT-2 images



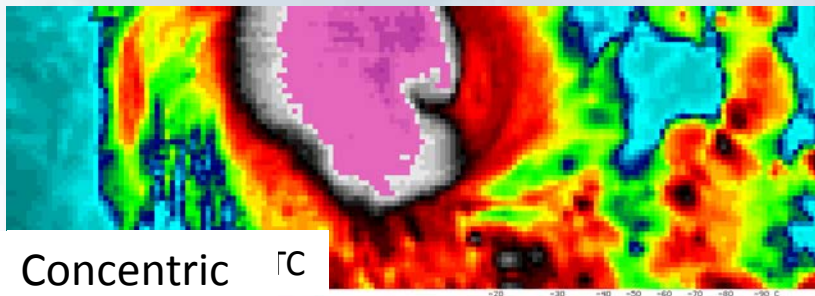
MTSAT-2 1332UTC

Increased resolution of stormtops

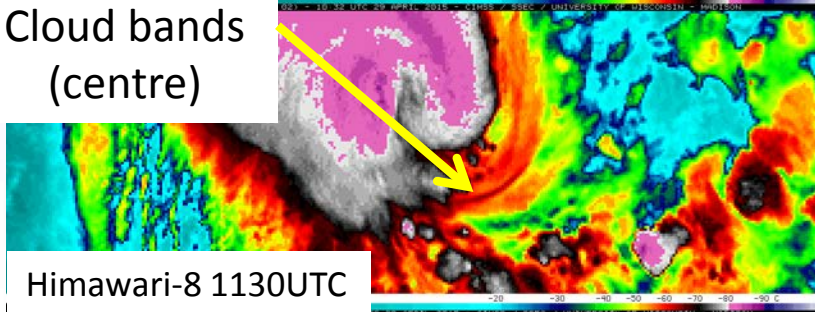


Himawari-8 1430UTC

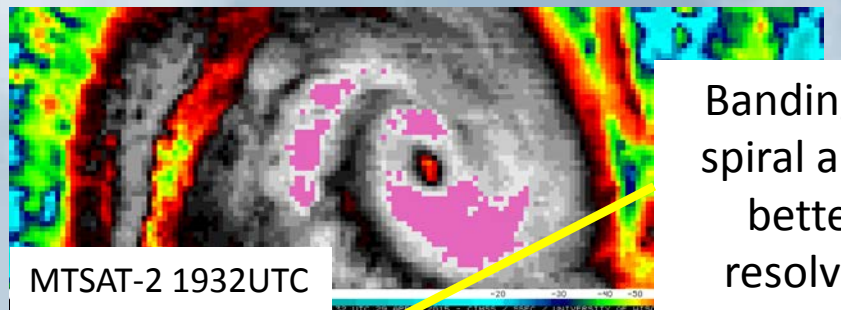
Eye formation



Concentric Cloud bands (centre)

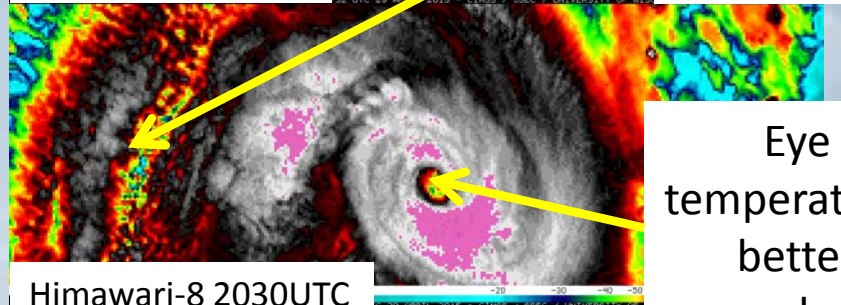


Himawari-8 1130UTC



MTSAT-2 1932UTC

Banding in spiral arms better resolved



Himawari-8 2030UTC

Eye temperatures better resolved

images courtesy of NOAA

Forecaster Feedback

<http://www.virtuallab.bom.gov.au/training/hw-8-training/>

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Home | Satellite Products | Events | Training | News | Archive | Links | Contact Us

Home > Training > National Himawari-8 Training Campaign

Home
Satellite Products
Events
Training
Basic Satellite Competencies
Advanced Satellite Meteorology Training
Region V Case Studies
The use of Satellite data in Tropical Cyclone Analysis
Useful Satellite Training Links
Regional Focus Group Weather and Forecast Discussion Links
National Himawari-8 Training Campaign
Rapid Scan (10 minute) Satellite Data Training Resources
RGB Product Training Resources from TERRA and AQUA MODIS
Timetable and Duration of Activities
National Himawari Training Campaign Objectives
Learning Action Map and Learning Outcomes
Tutorial Sessions and Feedback
Timeline and Instructions for Accessing Web Resources
Tutorial Sessions and Feedback Phase 2
Introduction Resources and Case Studies
News
Archive
Links
Contact Us

Phase 1: Familiarisation Resources (rapid scan)
Phase 2: Introduction, Resources and Case Studies
Phase 2: Tutorial Sessions and Feedback

Learning Outcomes
Instructions and Timeline
Objectives

Quick Links

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Home | Satellite Products | Events | Training | News | Archive | Links | Contact Us

Home > Training > National Himawari-8 Training Campaign > Introduction Resources and Case Studies

Australian VLab Centre of Excellence National Himawari-8 Training Campaign

Training Campaign Phase 2: Introduction, Resources and Case Studies

Introduction and Instructions

This Phase 2 of the Campaign will involve:

- Easily accessible resources for Stakeholder familiarisation with the new data from Himawari-8 and how it may be best used.
- A Blog page for ongoing discussion of case studies using Himawari-8 data. Blog resources from other organisations (eg CIMSS) also.
- Weekly tutorial sessions to consolidate the learning.
- Assessment resources on the BMTC Moodle web page.

How Forecasters can use the new Himawari-8 data effectively

Click on the links below to see how Forecasters can use the new Himawari-8 data effectively for the nowcasting and forecasting of the respective meteorological phenomena. Note that this is an evolving resource and your feedback and additional material is welcome.

General Comments	Broadscale / Synoptic Scale	Tropical Cyclones	Thunderstorms
Fog / Low Cloud	Fire and Smoke	Volcanic Ash	Dust
Turbulence	Other Features (to be added)	Other Features (to be added)	Other Features (to be added)

The summary table "How Forecasters can use the new Himawari-8 data effectively" is here.

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	Day Microphysics RGB
Additional RGB (to be added)	Night Microphysics RGB	Day Convection RGB	Additional RGB (to be added)

Useful additional Himawari-8 channels

(to be added at a future date)

Derived Products

(to be added at a future date)

Case Studies

(to be added at a future date)

[Return to main webpage](#)

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Last modified: Sun, 31 May 2015 23:28:14 +0000
Page count: 000070

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Summary: Improvements to TC monitoring using rapid scan, high-resolution Himawari-8 data

Higher spatial resolution	<p>TC cloud top features resolved in more detail (convective blow-ups, gravity waves, outflow channels, midget TC's)</p>
	<p>Better brightness temperature resolution in the IR. May assist in Dvorak analysis</p>
Higher temporal resolution	<p>Better monitoring the centre of a sheared system with a Central Dense Overcast (low level cloud lines)</p>
	<p>Better monitoring of rapid changes (eye development, midget TC development, eye replacement cycle, gravity waves development, convective development, development of outflow channels etc.)</p>
	<p>Better fix on the system centre. Central circulation may be tied to the RADAR signal. Mesovortices within eye monitored.</p>
	<p>Track of the TC better monitored and compared with NWP</p>
	<p>False eyes are more easily detected</p>
	<p>Better monitoring of the effects of atmospheric shear on TC development</p>
	<p>Higher density Cloud Drift Winds (CDW) associated with TC</p>
	<p>Higher density of data into NWP. Improved NWP output</p>

Exploring the Bureau's Himawari-8 Public Viewer

<http://satview.bom.gov.au/>

[Bureau Home](#) > [Australia](#) > High-definition satellite images

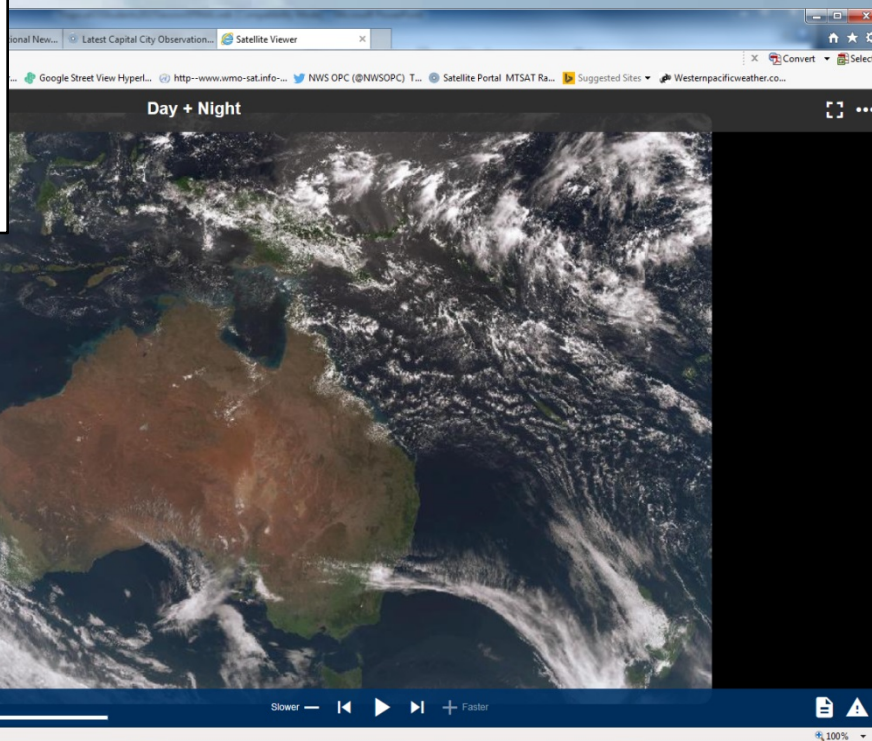
High-definition satellite images

See images from Himawari-8 in the new satellite viewer

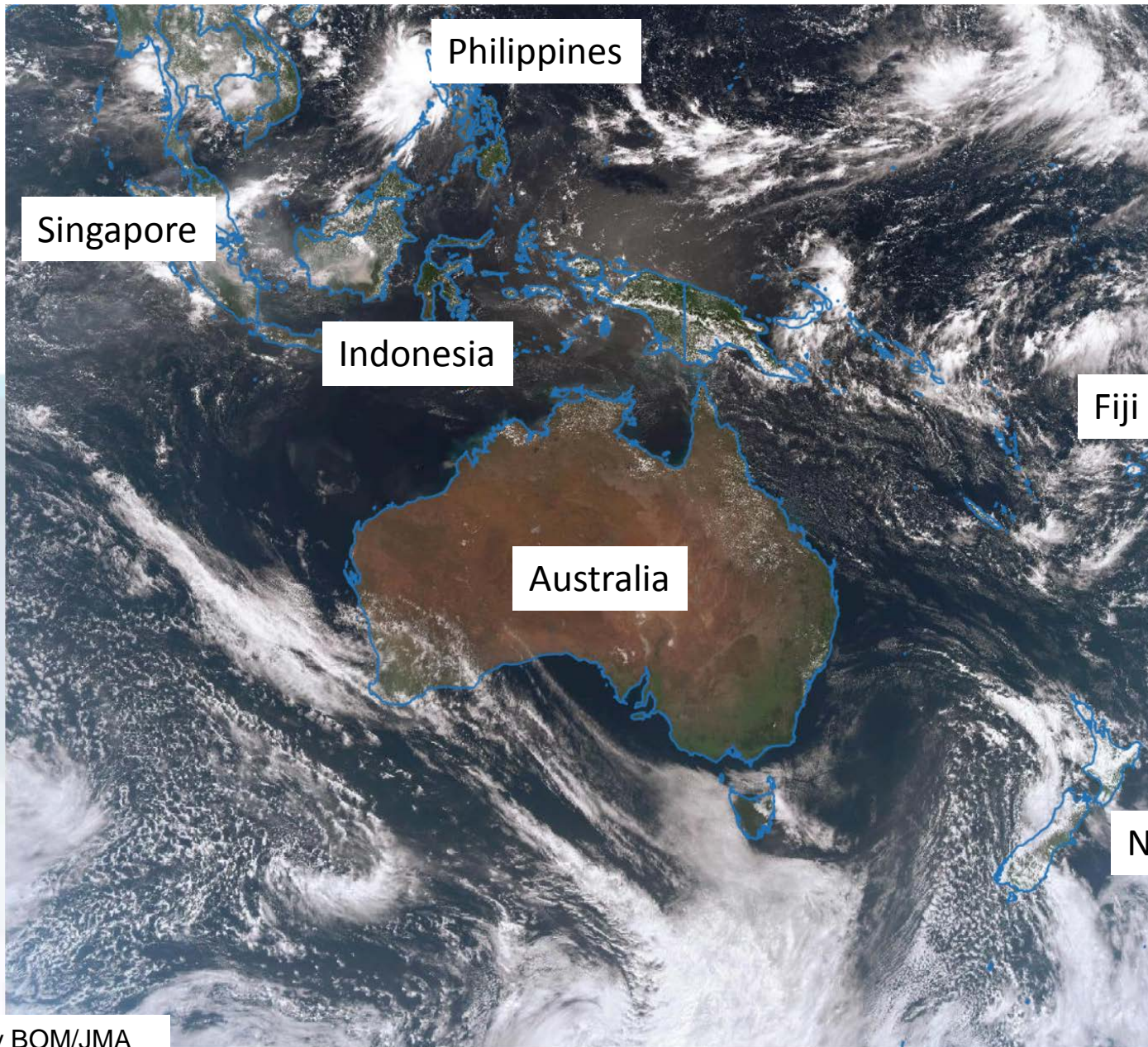
*This demonstration product is most suitable for people
with fast internet connection and high data allowance.*



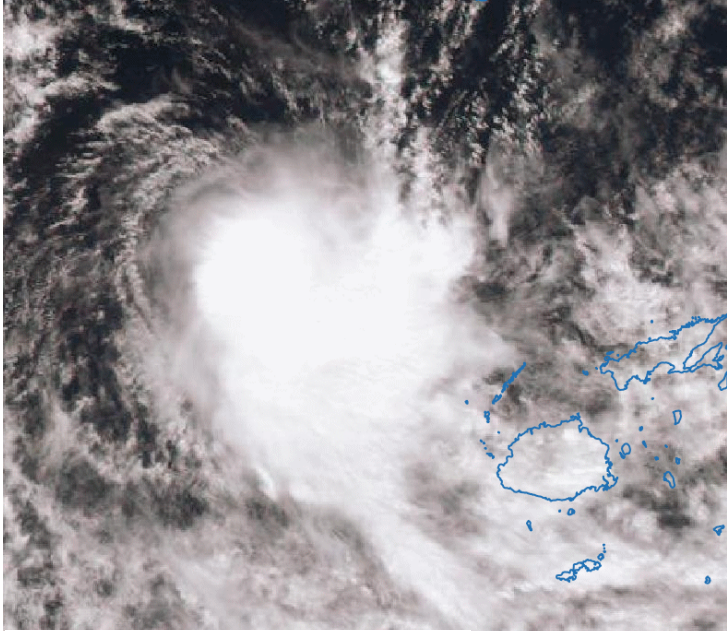
Explore images now



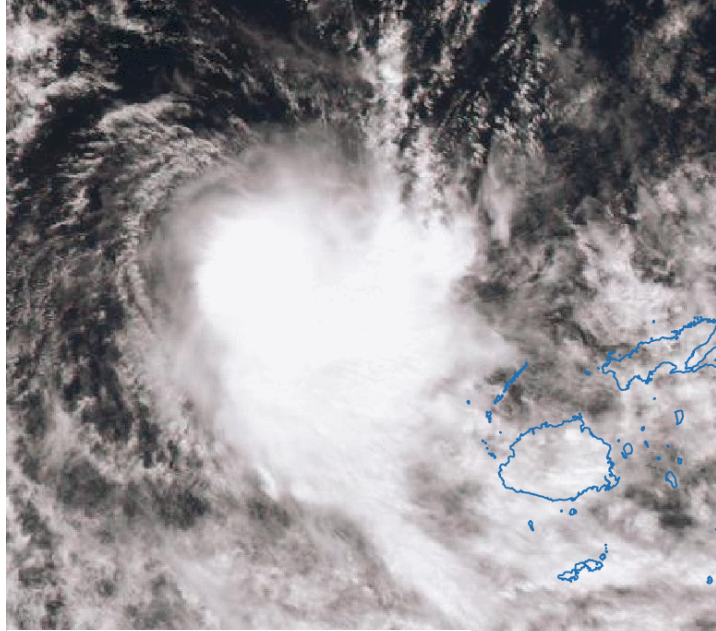
Himawari-8 Public Viewer full domain view



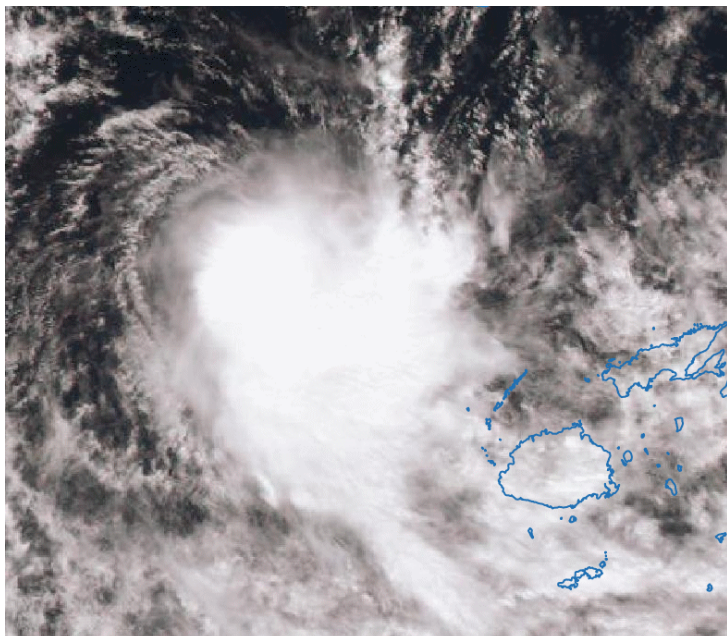
Australian Government
Bureau of Meteorology



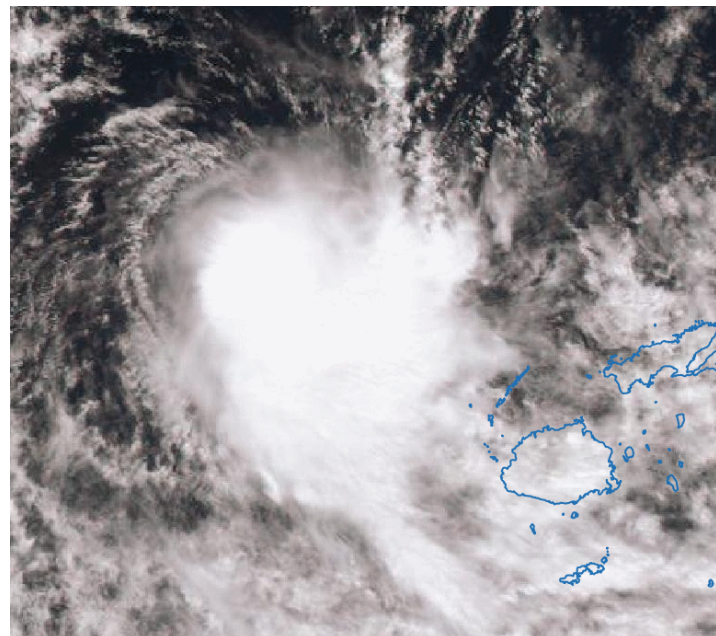
A: 2 slides per second



B: 5 slides per second



C: 10 slides per second



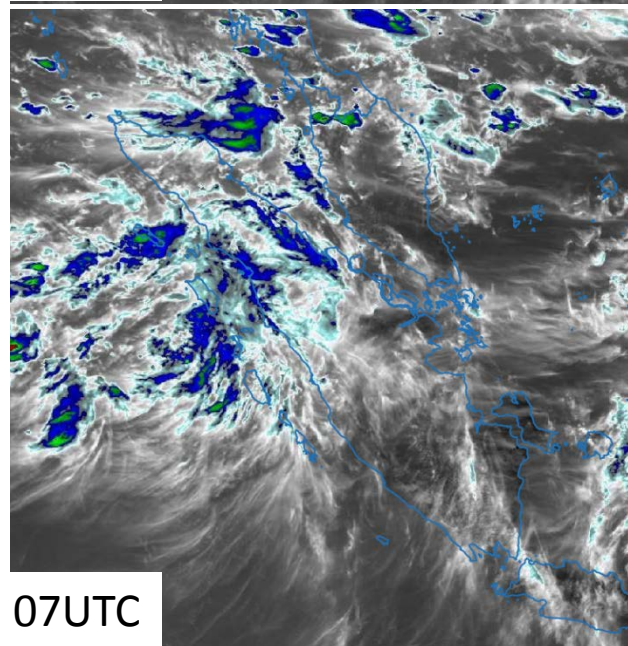
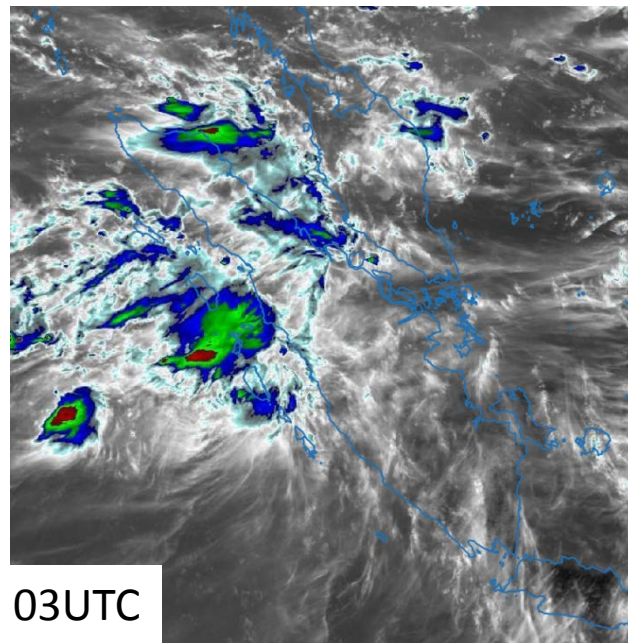
D: 15 slides per second

**Example:
Various speeds
of animation –
Low near Fiji,
17th October
2015**

**Question: which
animation
speed best
shows the
dynamics**

**Question: what
features can
you recognise
better under
higher
animation
speeds?**

Zehr enhanced IR channel



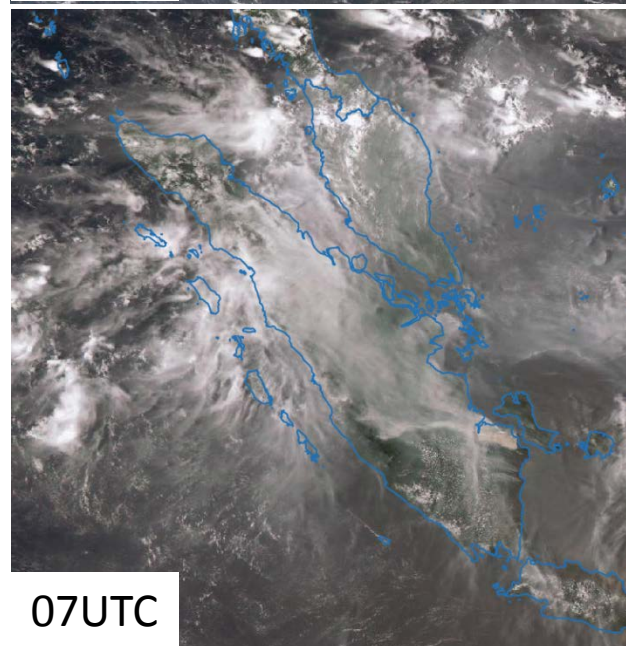
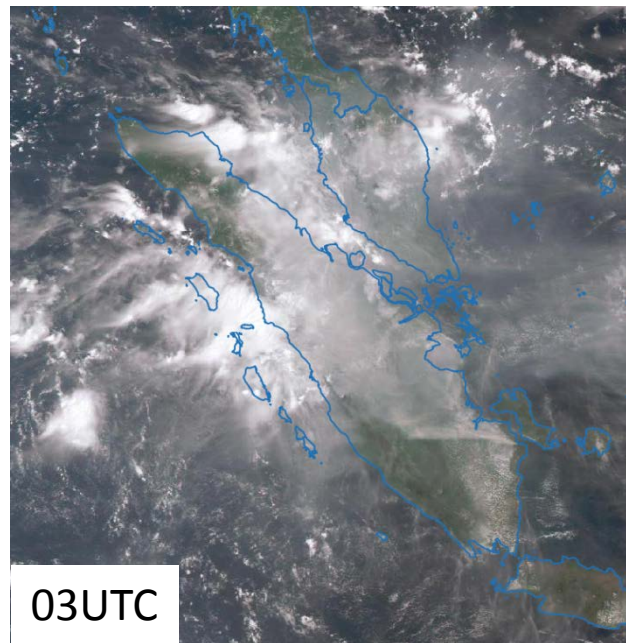
Southeast Asia smoke and storms, 19th October 2015

Exercise 2: what
does this rapid
animation 10
minute data tell
you about smoke
evolution?

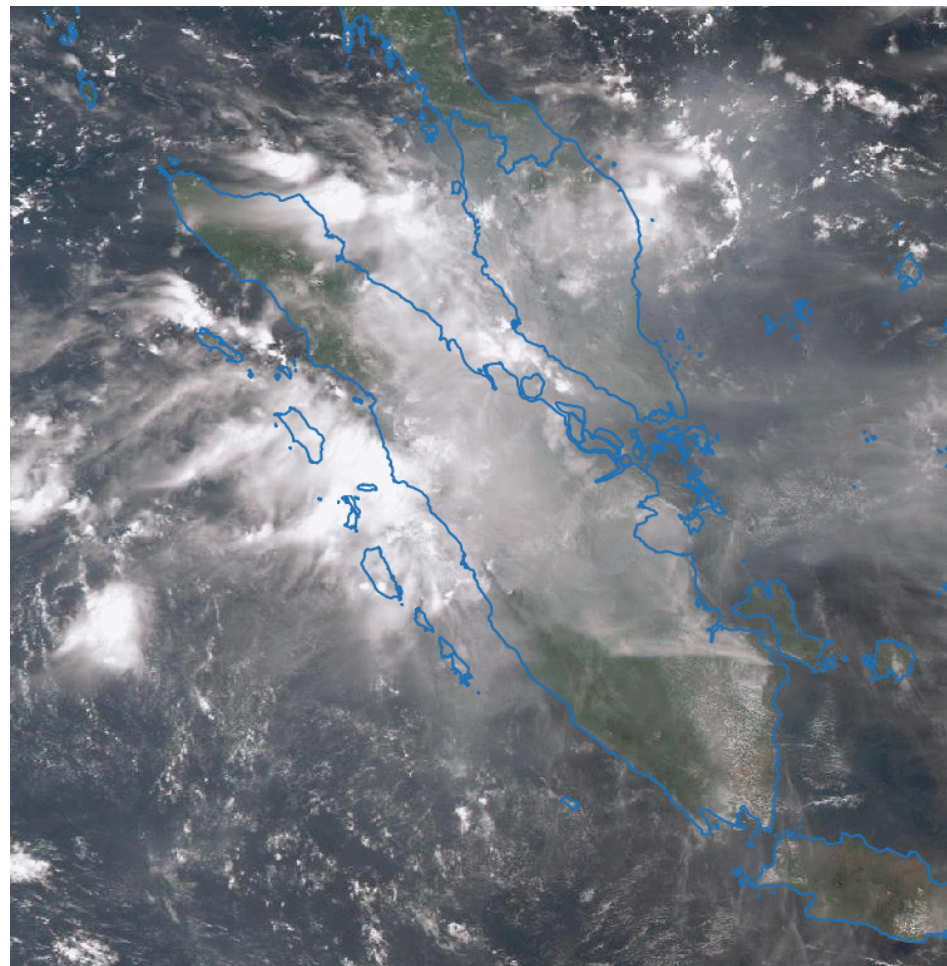
What does it tell
you about
thunderstorm
evolution?

Images courtesy BOM/JMA

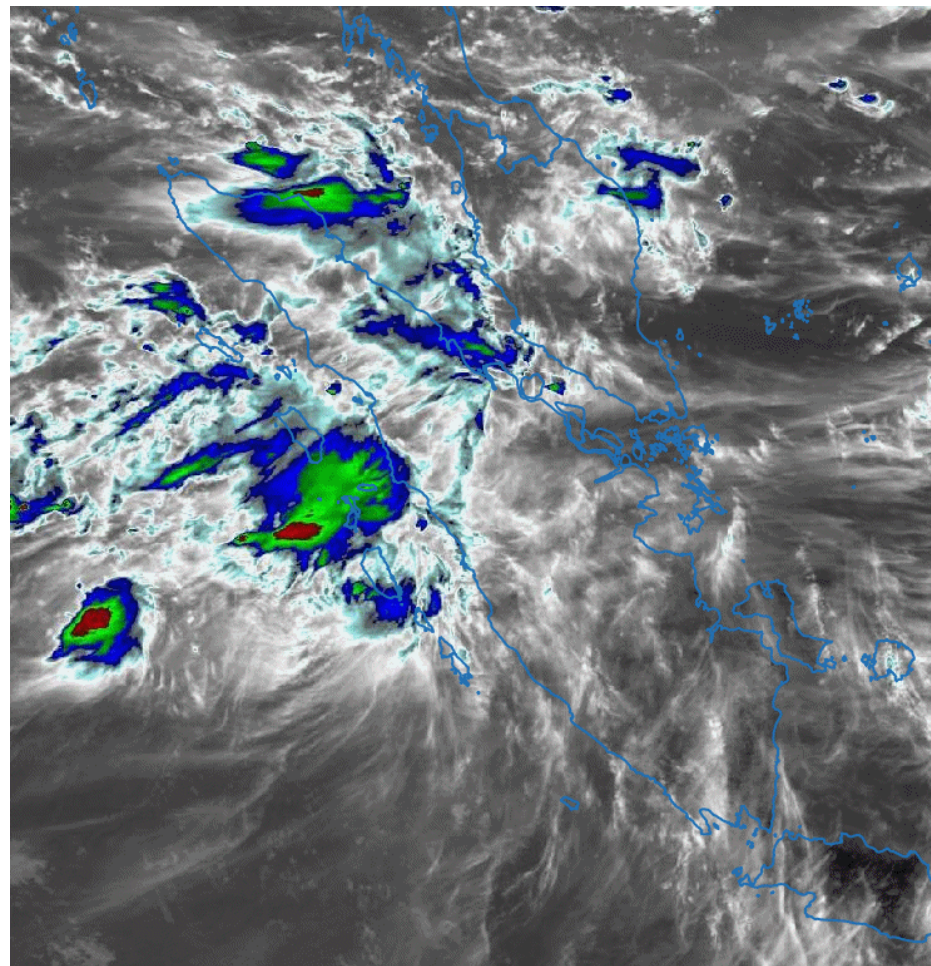
True Colour RGB product



Singapore, Malaysia and Indonesia smoke and storms, 19th October 2015, 10 frames a second



True Colour RGB product



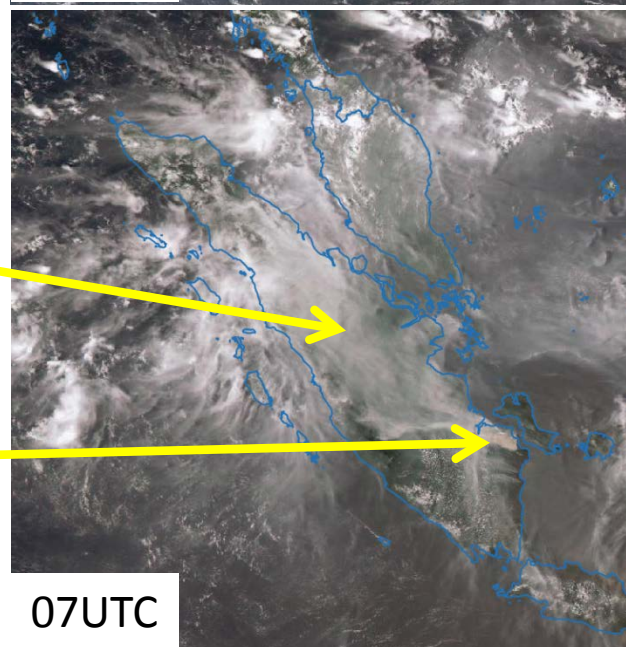
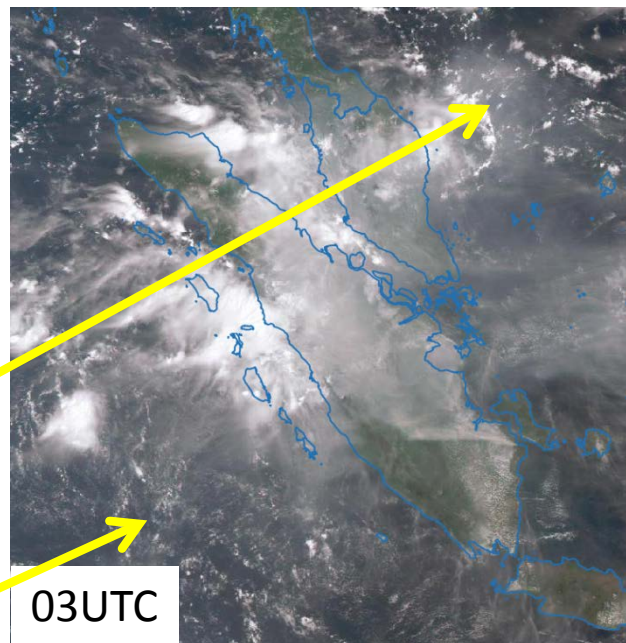
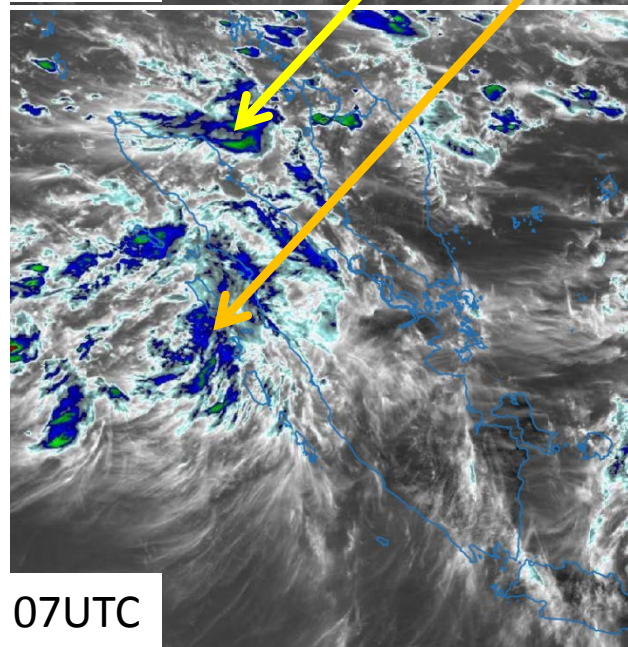
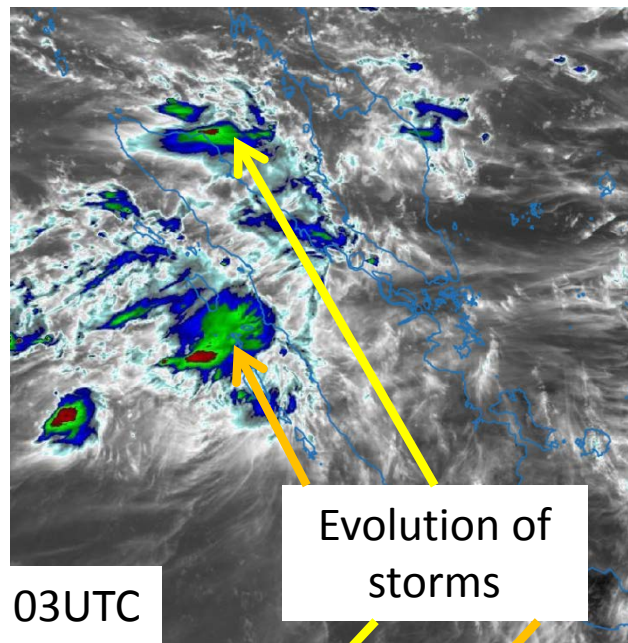
Zehr enhanced infrared channel

Animations courtesy BOM/JMA

Zehr enhanced IR channel

True Colour RGB product

Southeast Asia smoke and storms, 19th October 2015 - some solutions



Tracking of squall line

Shear identified. Low level flow can be monitored

Area of smoke better defined

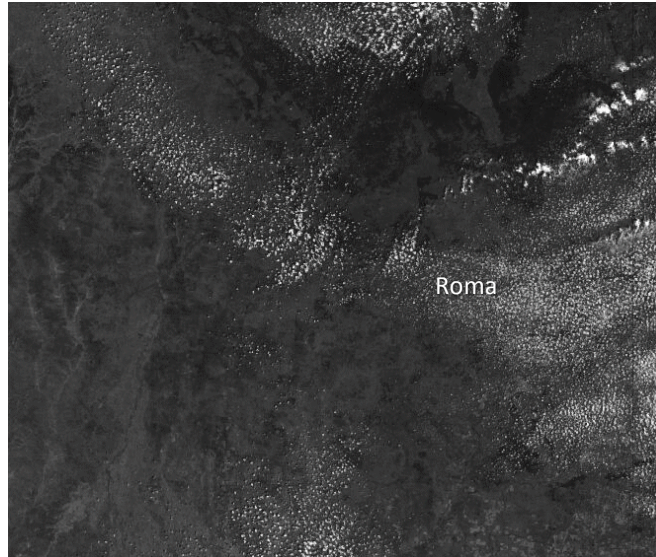
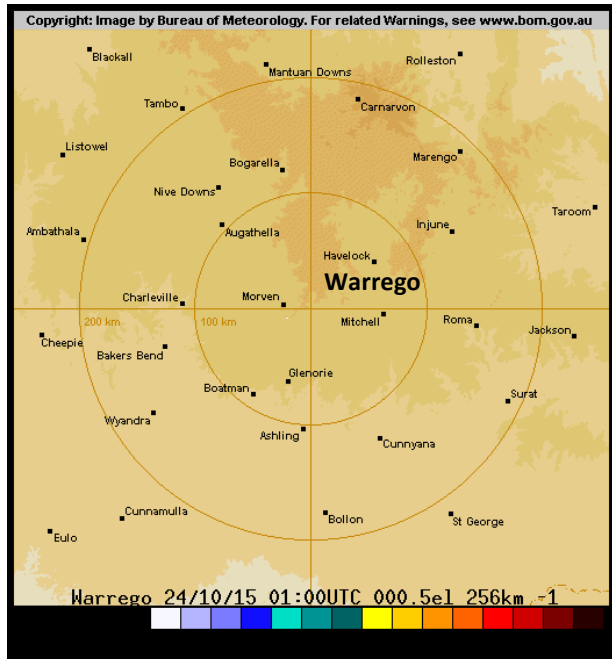
Smoke source and plume monitoring
07UTC

Exercise 3: Lets explore the Bureau's Himawari-8 Public Viewer

<http://satview.bom.gov.au/>

The screenshot shows a web browser window displaying the Himawari-8 Public Viewer. The browser's address bar shows the URL <http://satview.bom.gov.au/>. The page header includes the Australian Government logo and the text "Day + Night". The main content area displays a satellite image of Australia and the surrounding region. A red box highlights a "+" button in the top-left corner of the image area, with a text box next to it stating: "+ to zoom in – click on image". At the bottom of the image area, a control bar contains a "Layers +" button, a timestamp "Sunday, 4 October 2015 12:10 pm AEDT", a "Slower" button, a play button, a "Faster" button, and a "100%" zoom level indicator. A red box highlights the play and "Faster" buttons, with a text box below it stating: "Start animation and speed this up '+'".

Start animation and speed this up "+"

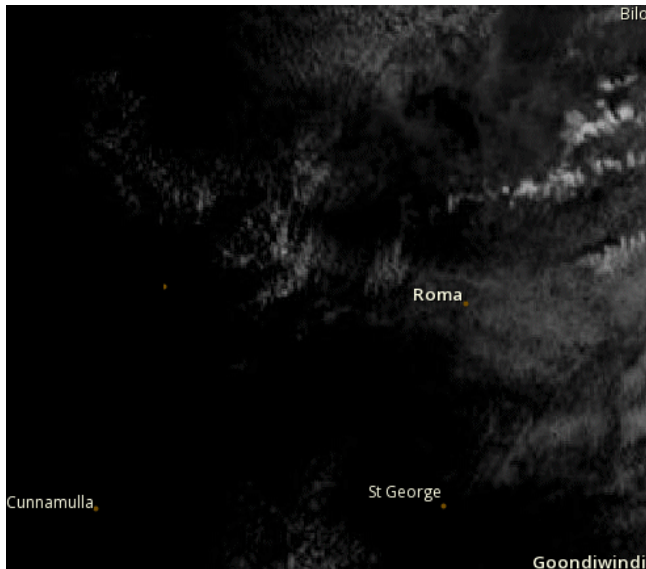


Visible channel (0.5km resolution)

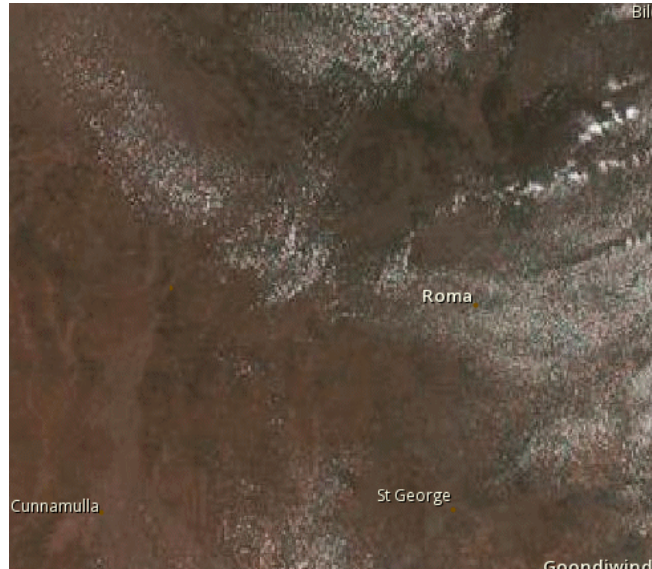
Queensland storms 24th October 2015 – 10 minute data compared with RADAR

Question: how is the satellite data an advantage over RADAR data?

How is RADAR data an improvement over satellite data?



Zehr enhanced IR (2km resolution)

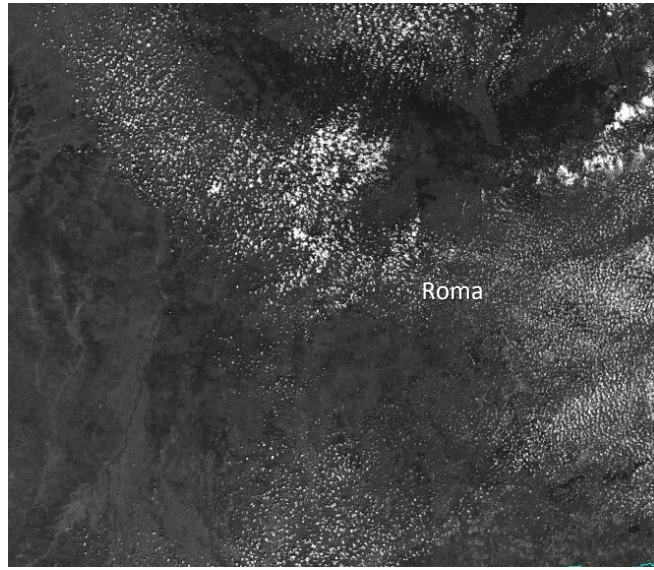
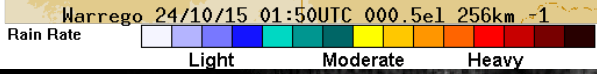
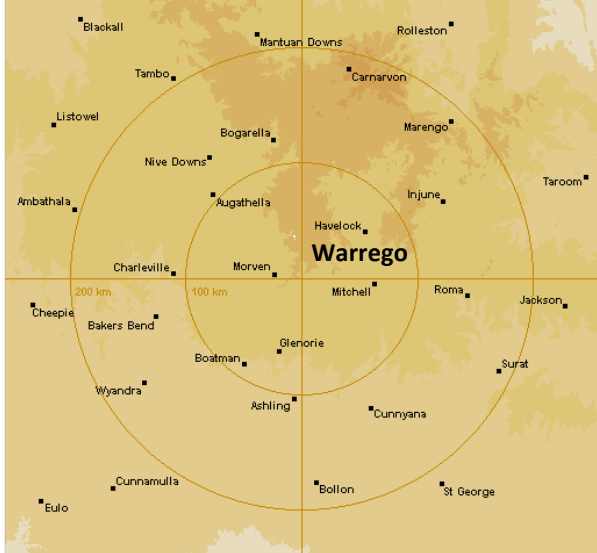


True Colour RGB (2km resolution)



Temperature (C)

Copyright: Image by Bureau of Meteorology. For related Warnings, see www.bom.gov.au



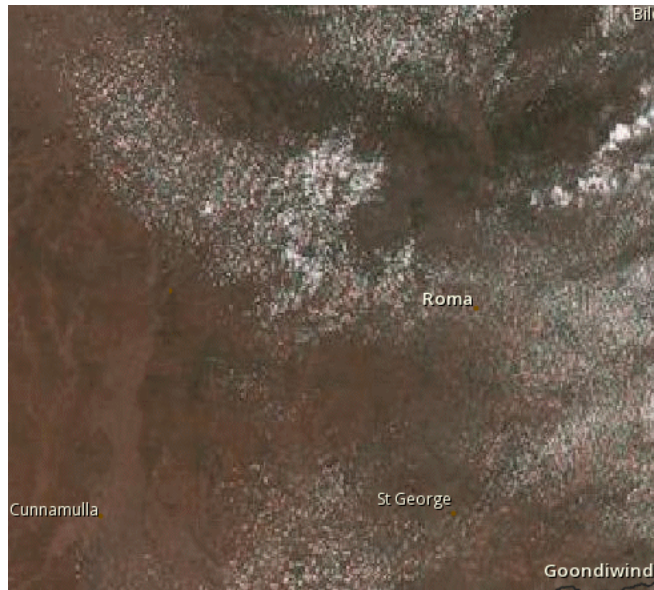
Visible channel (0.5km resolution)

Queensland storms 24th October 2015 – 10 minute data compared with RADAR

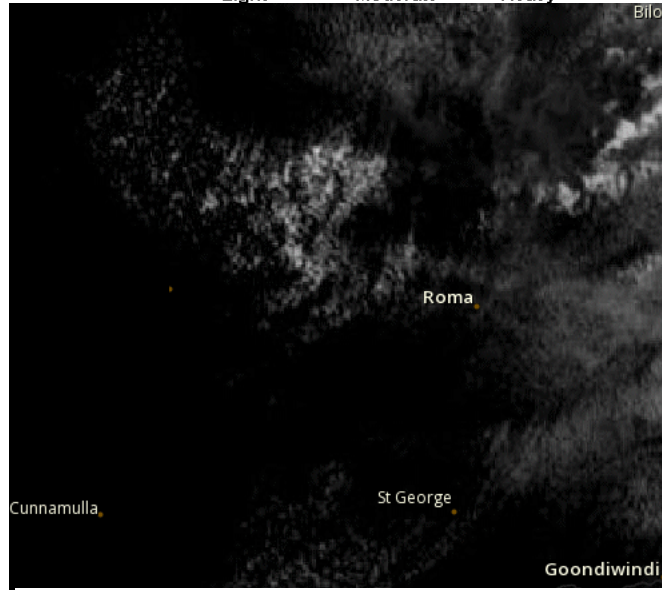
Reception time on Forecaster screen ~0156UTC

RADAR time stamp 0150UTC

Himawari-8 time stamp 0140UTC.



True Colour RGB (2km resolution)

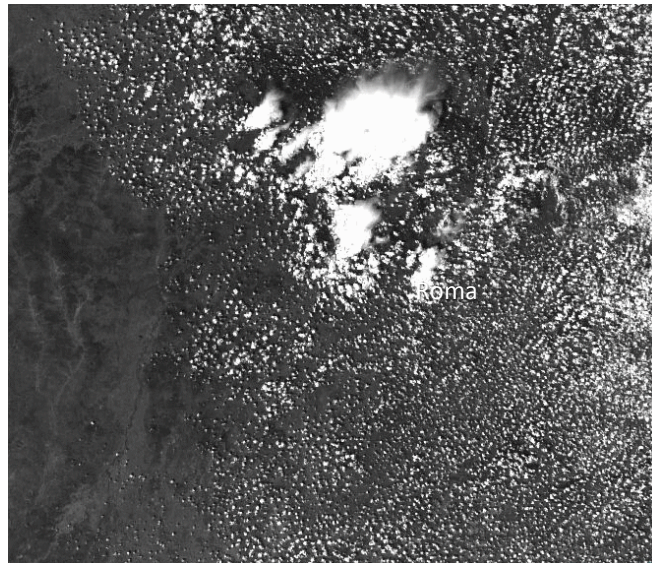
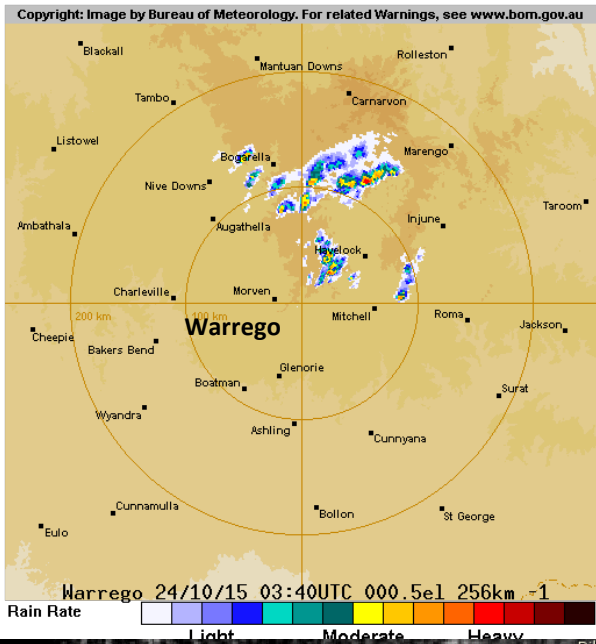


Zehr enhanced IR (2km resolution)



Temperature (C)

Images courtesy BOM/JMA



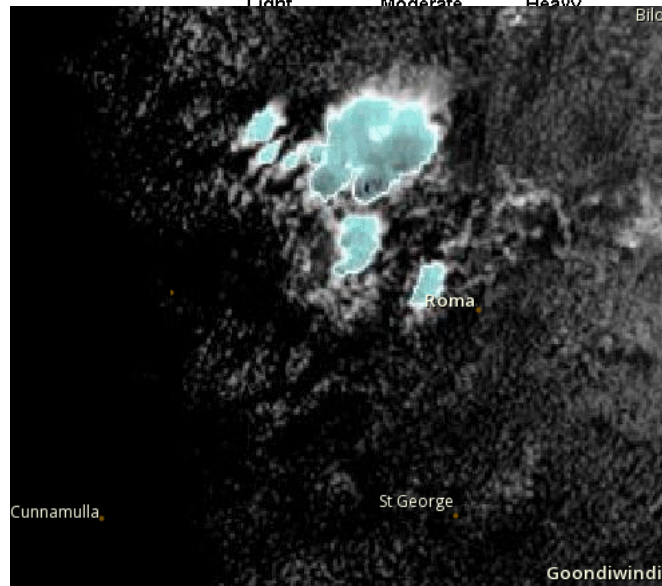
Visible channel (0.5km resolution)

Queensland storms 24th October 2015 – 10 minute data compared with RADAR

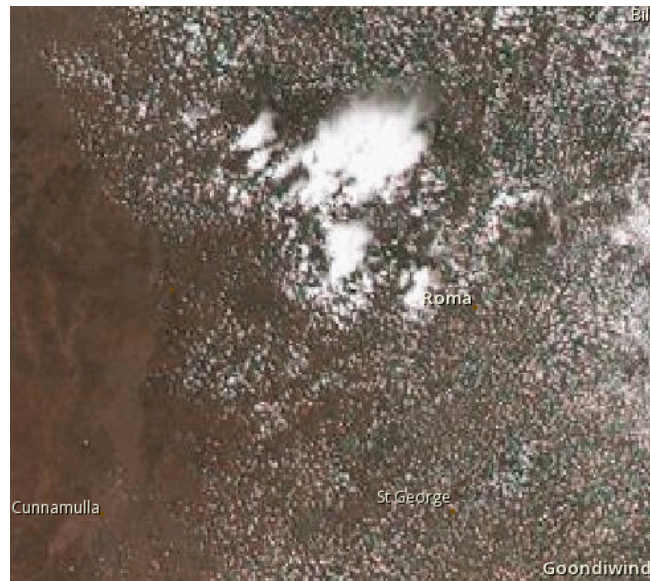
Reception time on Forecaster screen ~0356UTC

RADAR time stamp 0350UTC

Himawari-8 time stamp 0340UTC.

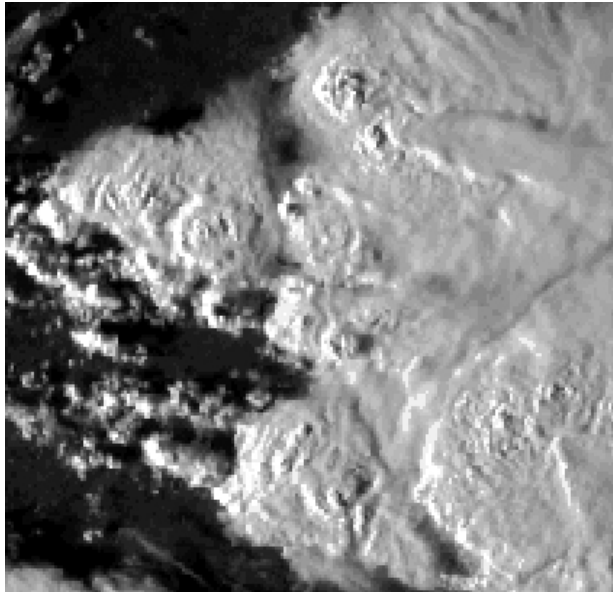


Zehr enhanced IR (2km resolution)

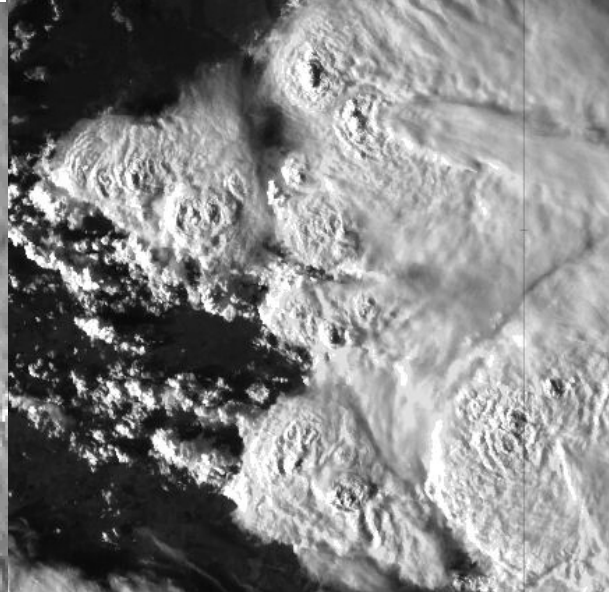


True Colour RGB (2km resolution)

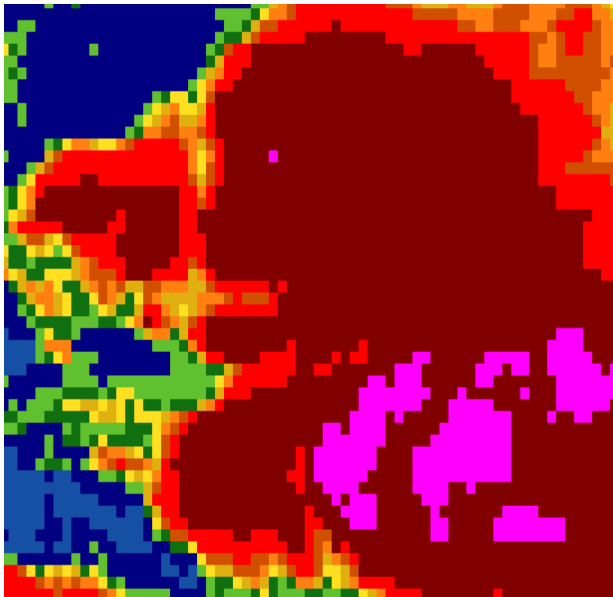
MTSAT-2 visible (1km resolution)



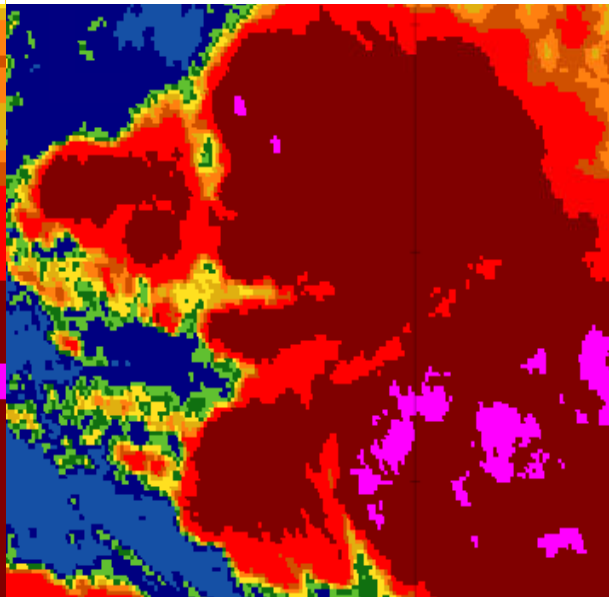
Himawari-8 visible (0.5km resolution)



MTSAT enhanced IR (4km resolution)



Himawari-8 enhanced IR (2km resolution)



Exercise 4: Northern NSW thunderstorms 28th October 2015

Himawari-8 (0640UTC) compared to MTSAT (0632UTC)

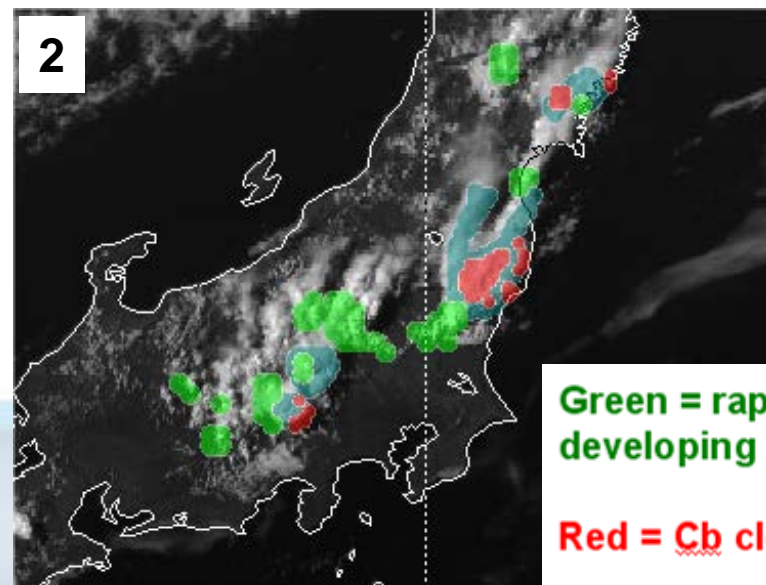
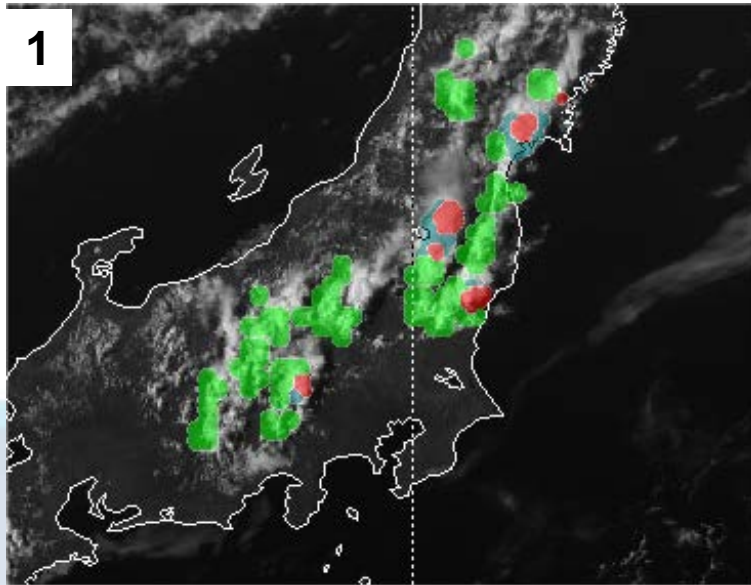
Question: how might the Himawari-8 data be an advantage here

Brightness Temperature Scale



210K 225K

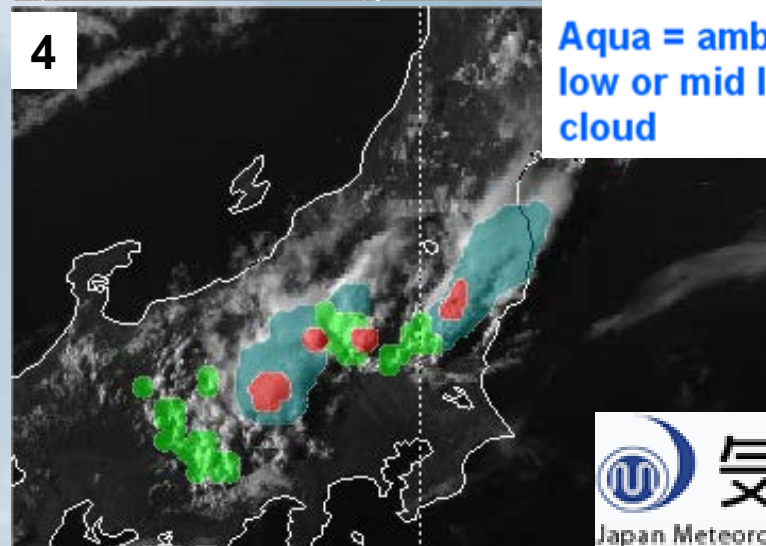
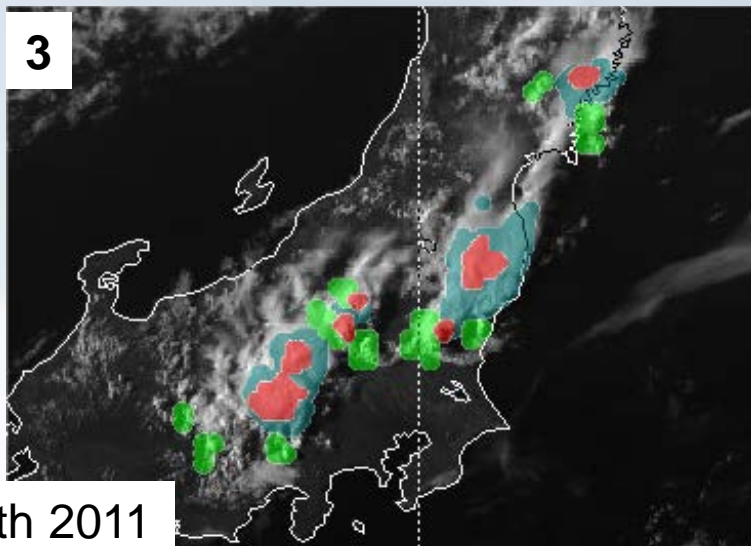
Rapidly Developing Cumulus Areas convective cloud detection algorithm (JMA)



Green = rapidly developing cloud.

Red = Cb cloud.

Aqua = ambiguous low or mid level cloud



July 10th 2011



These files were provided by Himawari-6 (MTSAT-1R) Rapid Scan Observations. These were performed for the sake of aviation users. Japanese Meteorological Agency

Summary: Improvements to Storm monitoring using rapid scan, high-resolution Himawari-8 data

Higher spatial resolution	<p><u>Pre-Cb development</u> Improved resolution of local mesoscale triggers (seabreeze fronts, local convergence lines)</p>
	<p><u>Cb severity identification an development</u> Stormtop and overshooting top Brightness Temperatures (BT) can be more accurately determined with less "pixel averaging" in the high resolution satellite data. The satellite data will provide a clearer picture of storm top signatures such as overshooting tops, the "warm wake" or "enhanced V" (thermal couplet) that are often associated with severe storms.</p>
	<p><u>Other important implications</u> More effective implementation of Derived Products such as the Cloud Top Cooling Product and the Automatic Overshooting Top Detection Algorithm.</p>
Higher temporal resolution	<p><u>Pre-Cb development</u> Permits better determination of the areas where convection may develop (eg. moist low level regions) Better detection and monitoring of Synoptic / Mesoscale triggers to convection (dry lines / seabreeze fronts, local convergence lines). It is possible to detect these features in the 10 minute satellite data before they are apparent in the radar signal. Better identification and monitoring of cumulus development that may transition into Cb (ie. clumping of cumulus and development of towering cumulus). It is possible to detect these features in the 10 minute satellite data before they are apparent in the radar signal. Rapid infrared-based cloud top cooling rates corresponding to developing Cb can be better monitored.</p>

Summary: Improvements to Storm monitoring using rapid scan, high-resolution Himawari-8 data

	<p><u>Cb severity identification an development</u> Easier and earlier discrimination between persisting and dissipating storms (pulse convection versus organised convection). Better monitoring of the movement and organisation of storms (eg. near-continuous monitoring of overshooting stormtops, splitting of supercells, organisation of storms into squall lines) Permits very short term forecasting of rapidly moving and potentially short lived convection (eg. monsoon squall lines). Better monitoring of steering flow by examining the movement of the storms in the high resolution imagery. Better monitoring of shear and its effect on the convective development. More readily able to detect rotation in Cb clouds. Better able to monitor storms associated with potentially intense rain rates (slow moving storms with persisting overshooting tops, train effect convection etc.)</p>
Higher temporal resolution	<p><u>Secondary features</u> Permits monitoring of the evolution of secondary features such as storm outflow boundaries and convection that may be generated by this. NWP cannot predict this yet.</p>
	<p><u>Other</u> More effective implementation of Derived Products such as the Cloud Top Cooling Product and the Automatic Overshooting Top Detection Algorithm and other Cb-alerting Algorithms.</p>

Summary

- During this session the high temporal and spatial resolution Himawari-8 data has been introduced, with emphasis on Tropical Cyclones, Thunderstorms and Smoke detection and monitoring.
- A number of case studies and practical exercises were conducted.
- Findings from these exercises were related to the feedback from Australian Bureau of Meteorology Forecasters and other stakeholders who have used high resolution satellite data operationally.
- Useful resources and references have been presented.