Australian Government
Bureau of Meteorology

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

AOMSUC-6 Training Event

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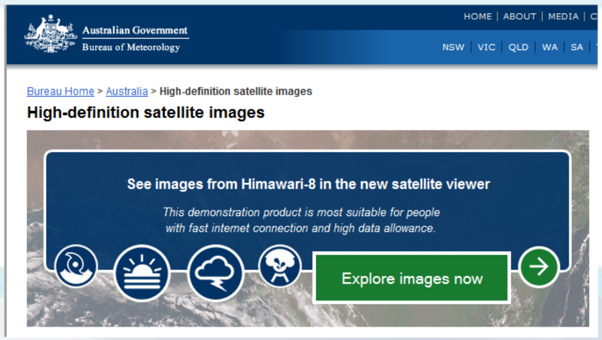
Australian Bureau of Meteorology Training Centre
Australian VLab Centre of Excellence

Content

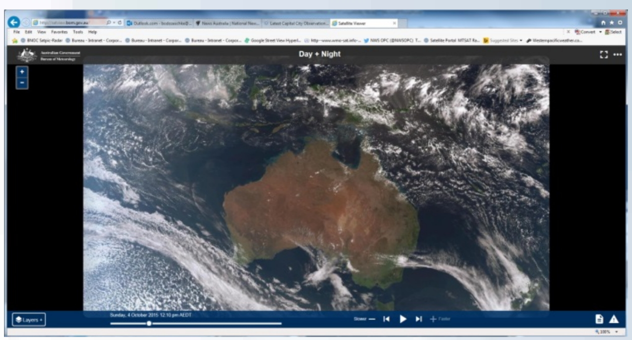
- During this session the high temporal and spatial resolution Himawari-8 data will be briefly introduced.
- A summary will be given of feedback from Australian Bureau of Meteorology Forecasters and other stakeholders who have used high resolution satellite data operationally.
- This will be illustrated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

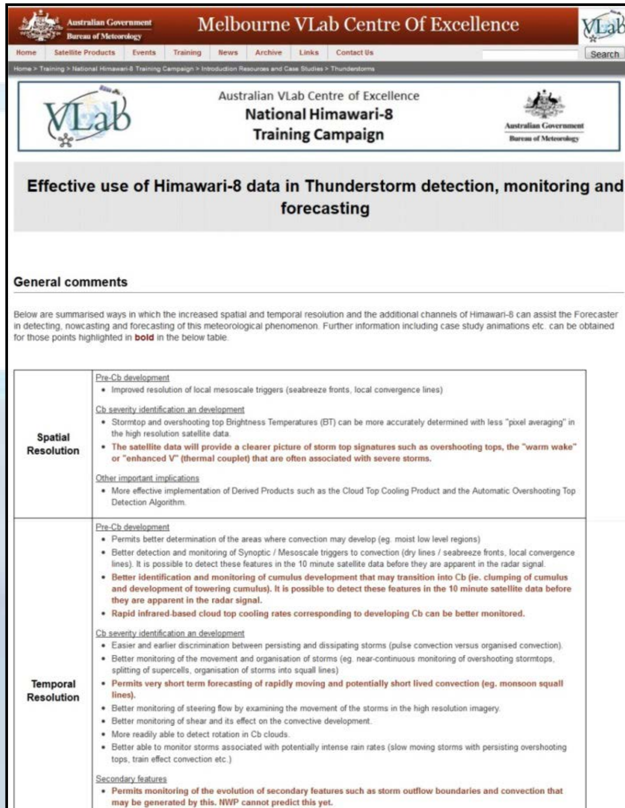
Useful online resources that we shall explore

Australian Government
Bureau of Meteorology

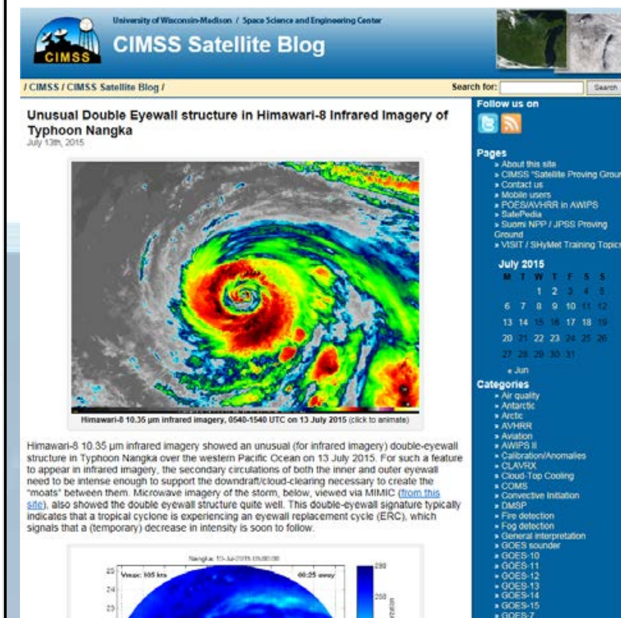


Bureau Himawari-8 Viewer
http://www.bom.gov.au/australia/satellite/





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

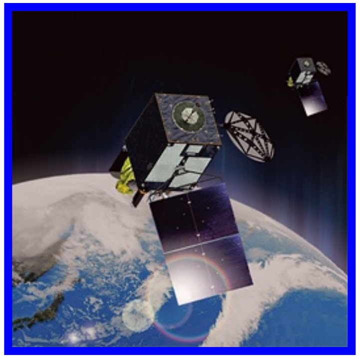


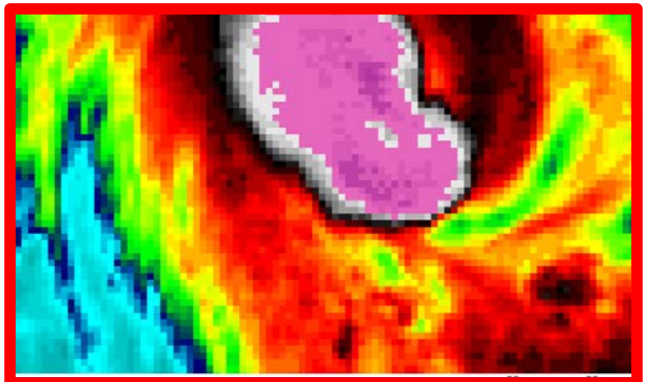
CIMSS Himawari-8 Satellite Blog
http://cimss.ssec.wisc.edu/goes/blog/archives/category/himawari-8

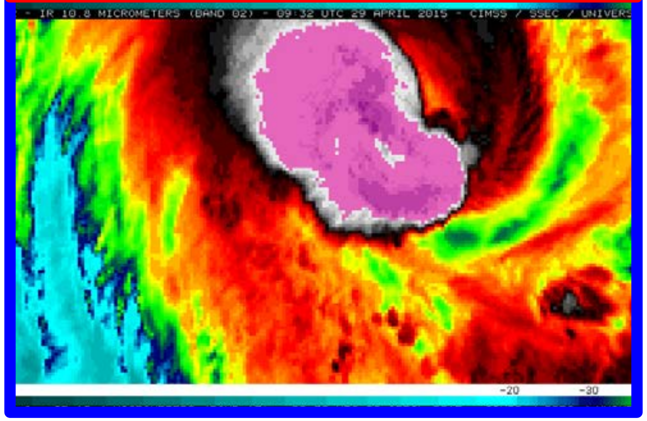
animation courtesy JMA/CIMSS

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

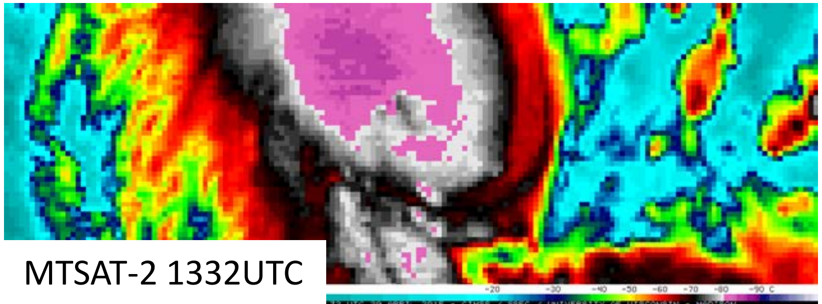
Band	Central Wavelength [μm]	Spatial Resolution
1	0.55 – 0.90	1Km
2	3.50 – 4.00	4Km
3	6.50- 7.00	4Km
4	10.3 – 11.3	4Km
5	11.5 – 12.5	4Km

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

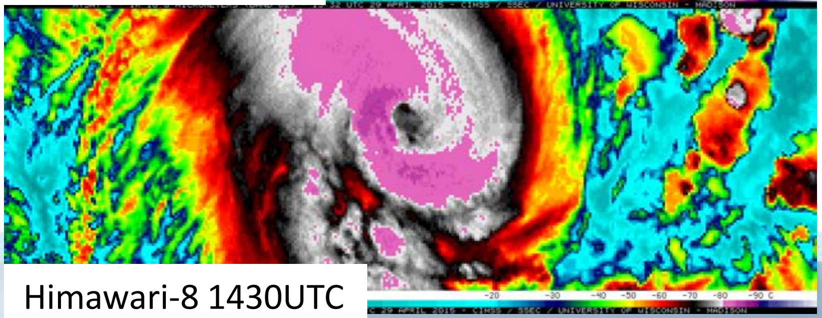
Exercise 1

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

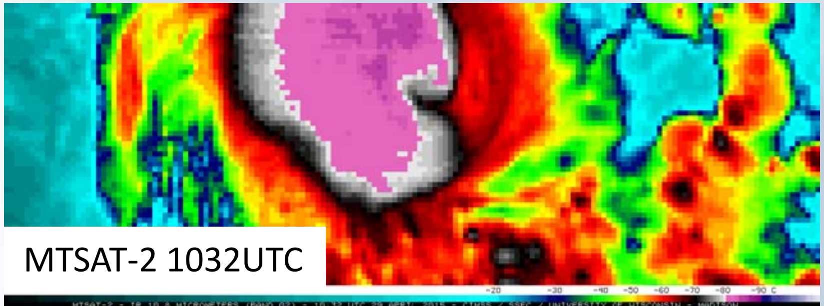
How are the Himawari-8 images an advantage over the MTSAT-2 images



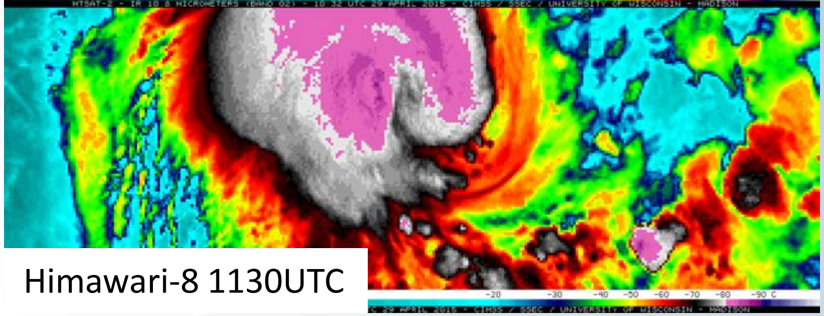
MTSAT-2 1332UTC



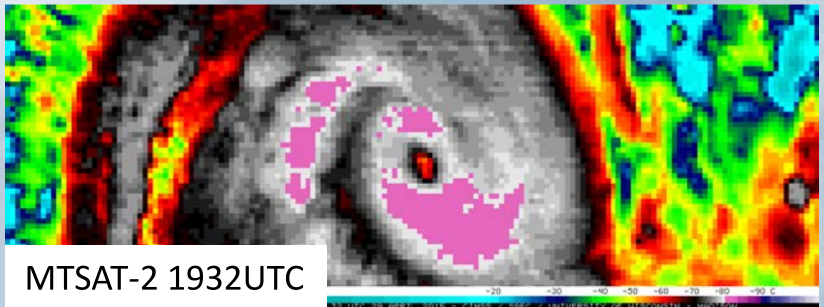
Himawari-8 1430UTC



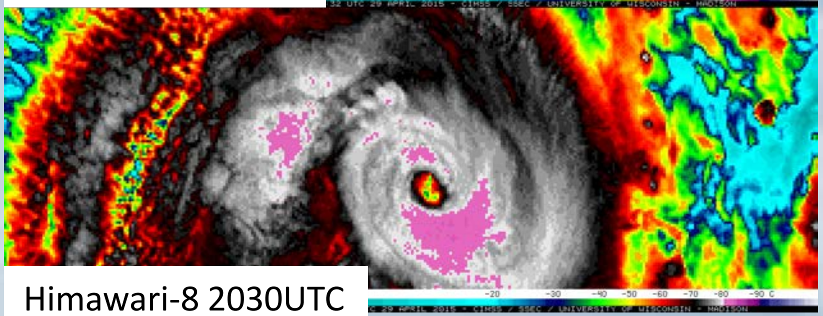
MTSAT-2 1032UTC



Himawari-8 1130UTC



MTSAT-2 1932UTC



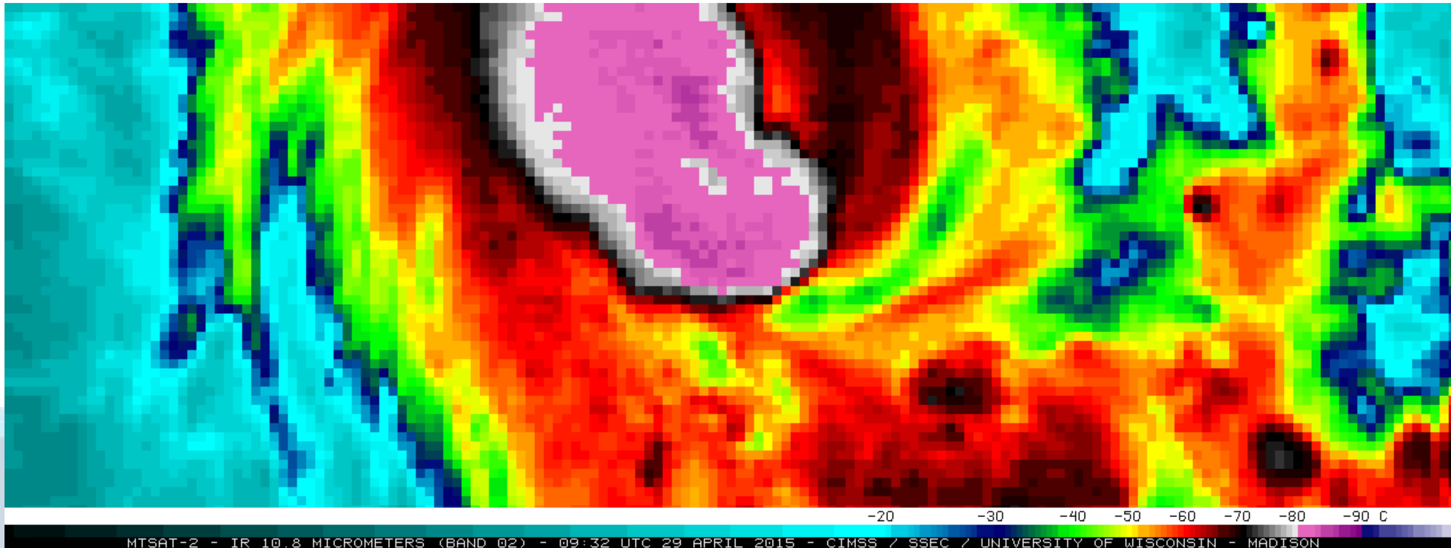
Himawari-8 2030UTC

images courtesy JMA/CIMSS

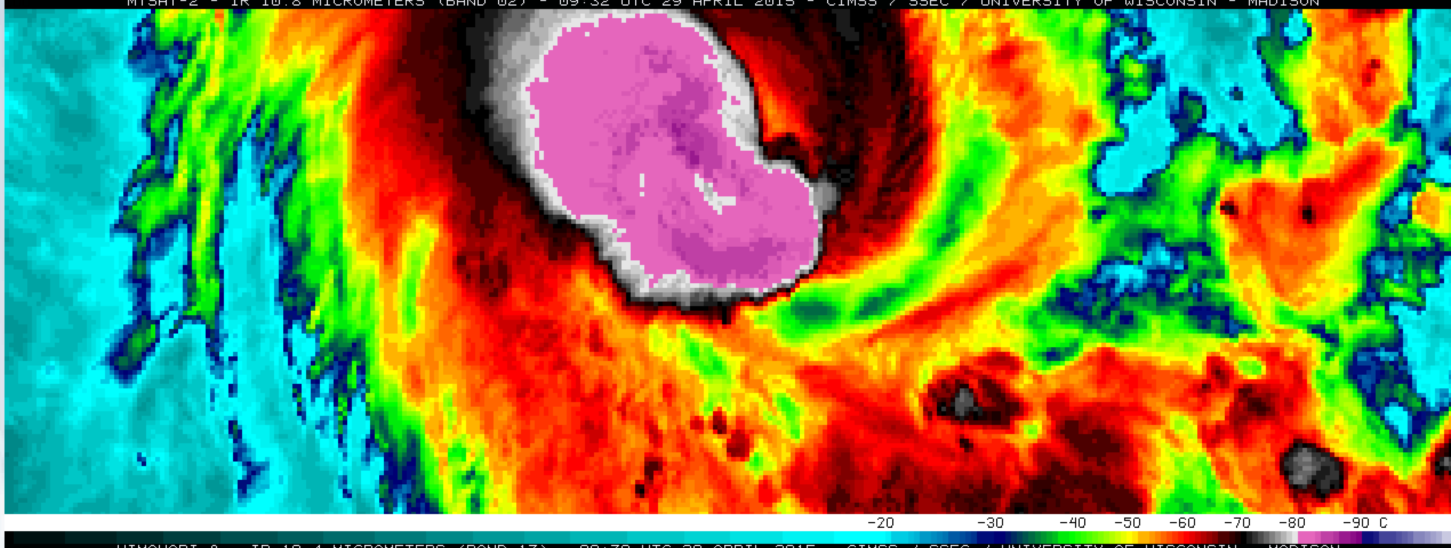
animations from the JMA / CIMSS Himawari-8 Blog site "Himawari-8 imagery of Tropical Depression 24S / Cyclone Quang northwest of Australia"

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)

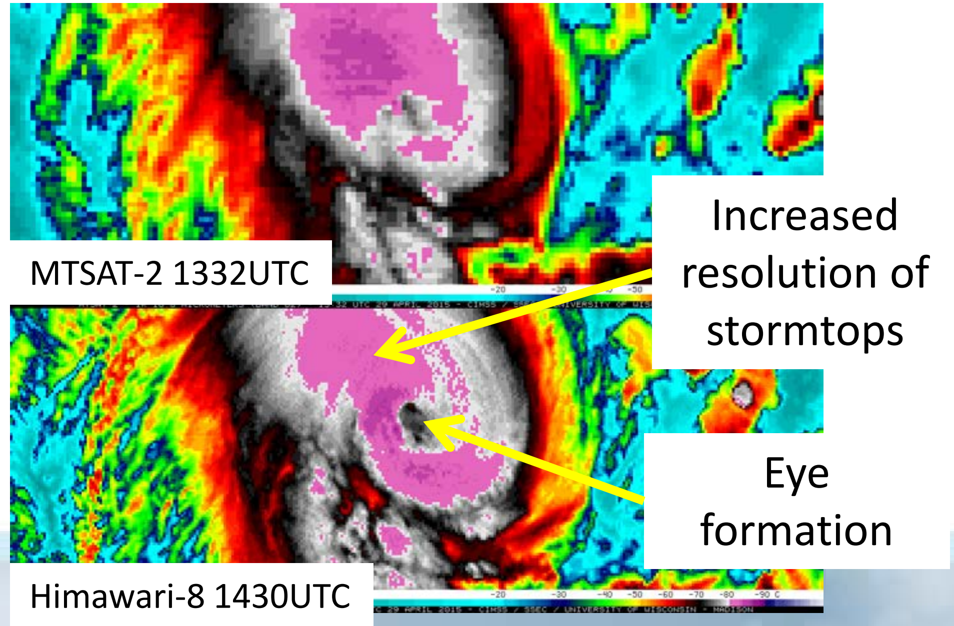


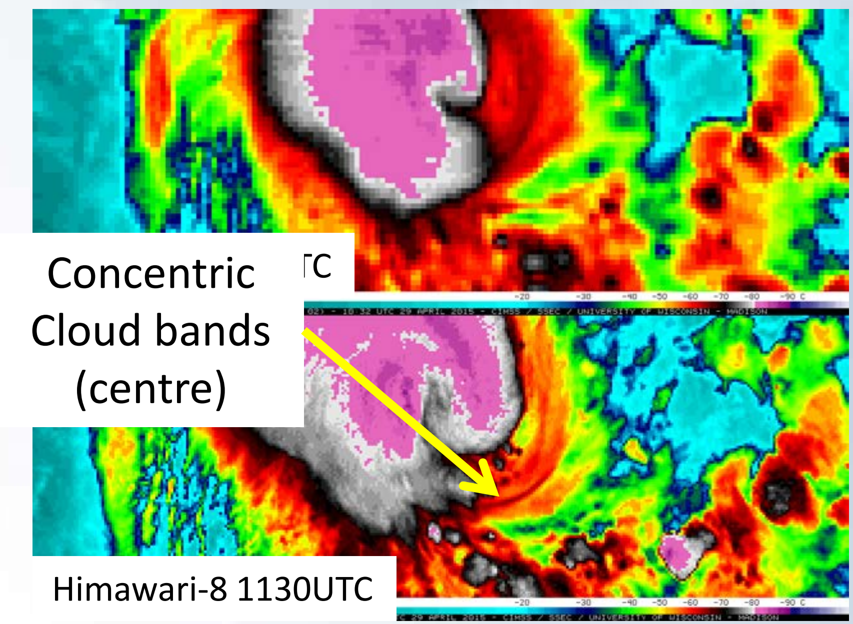
temperature

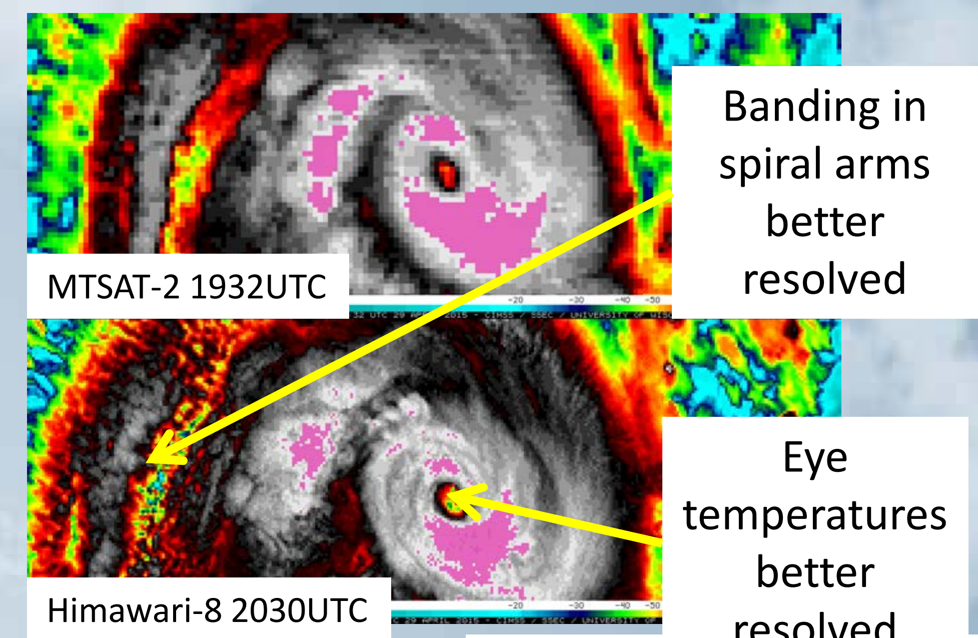
Recommended answers

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



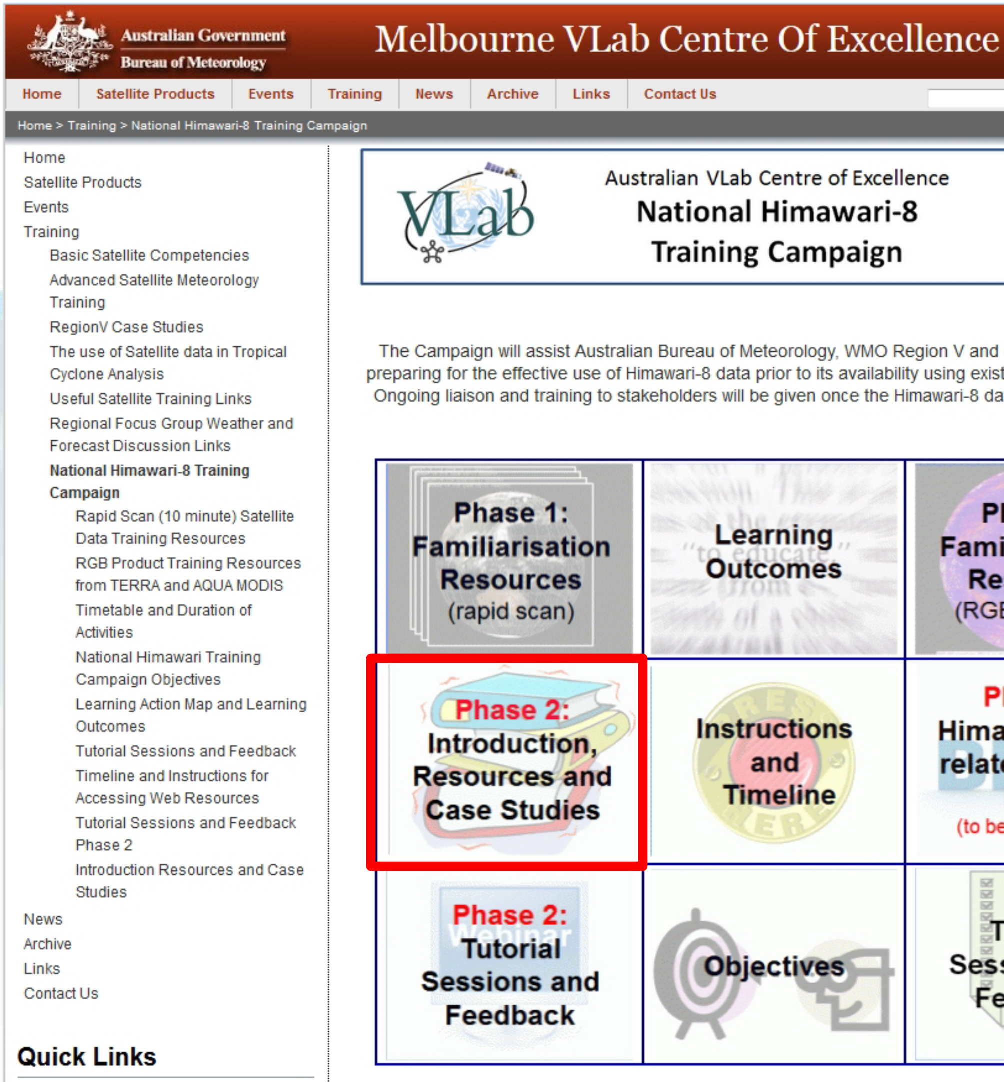


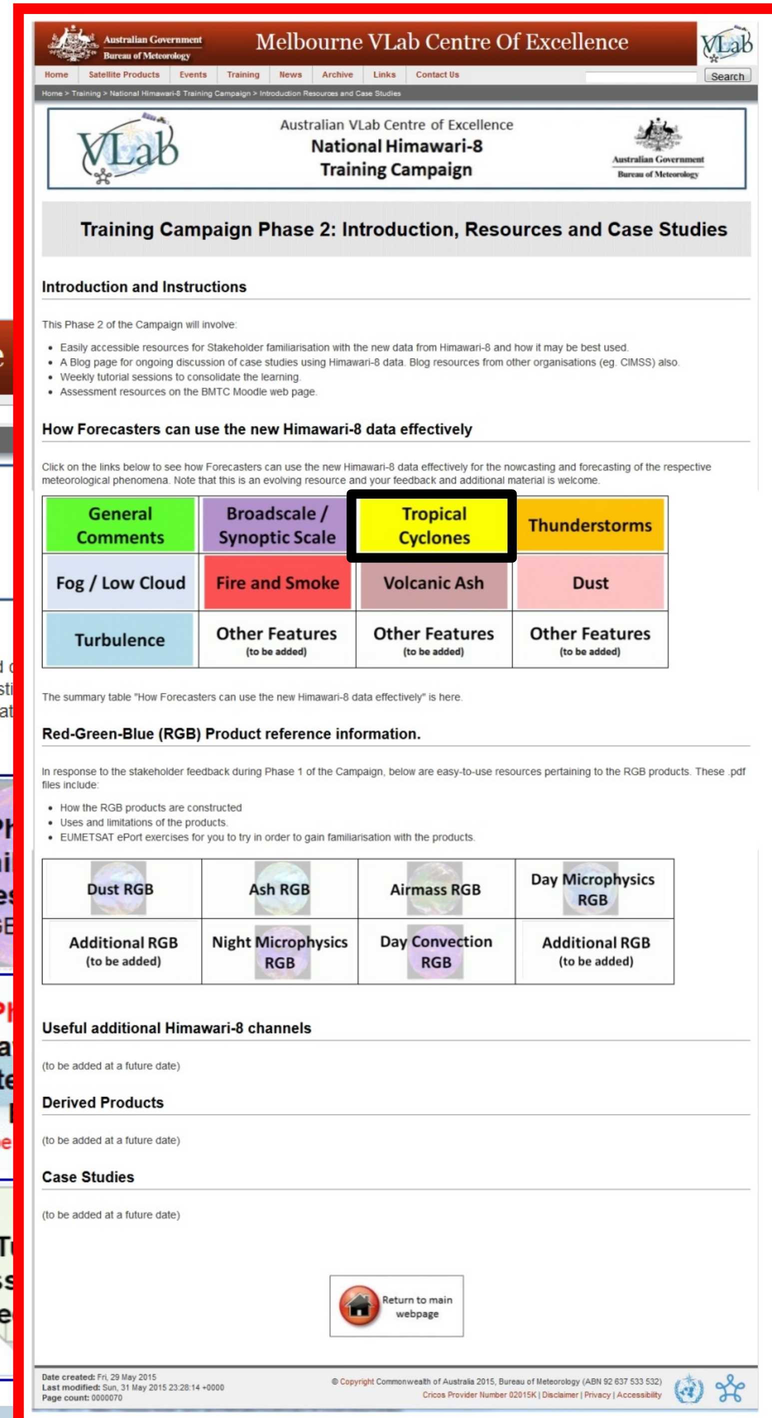


images courtesy JMA/CIMSS

Forecaster Feedback

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



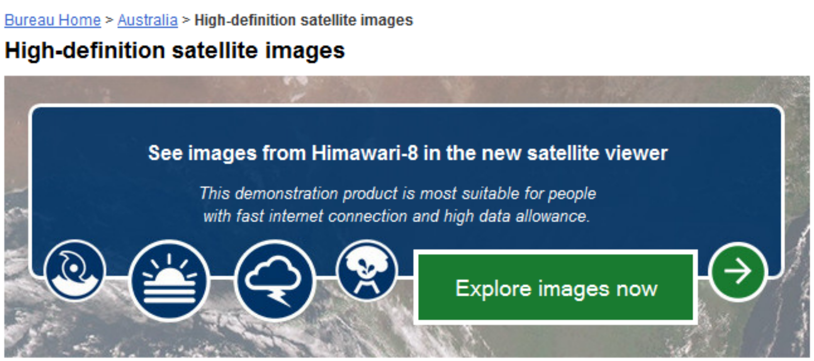


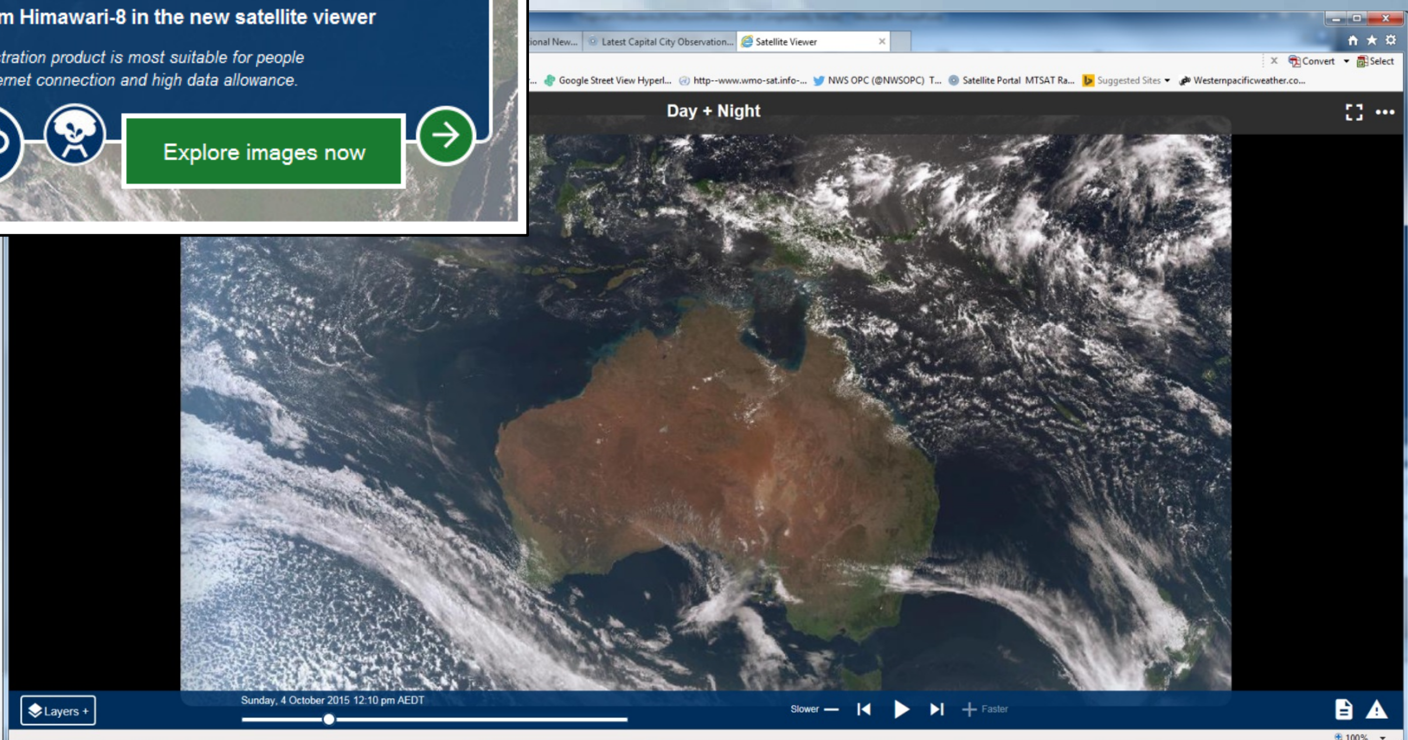
Summary: Improvements to TC monitoring using rapid scan, high-resolution Himawari-8 data

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

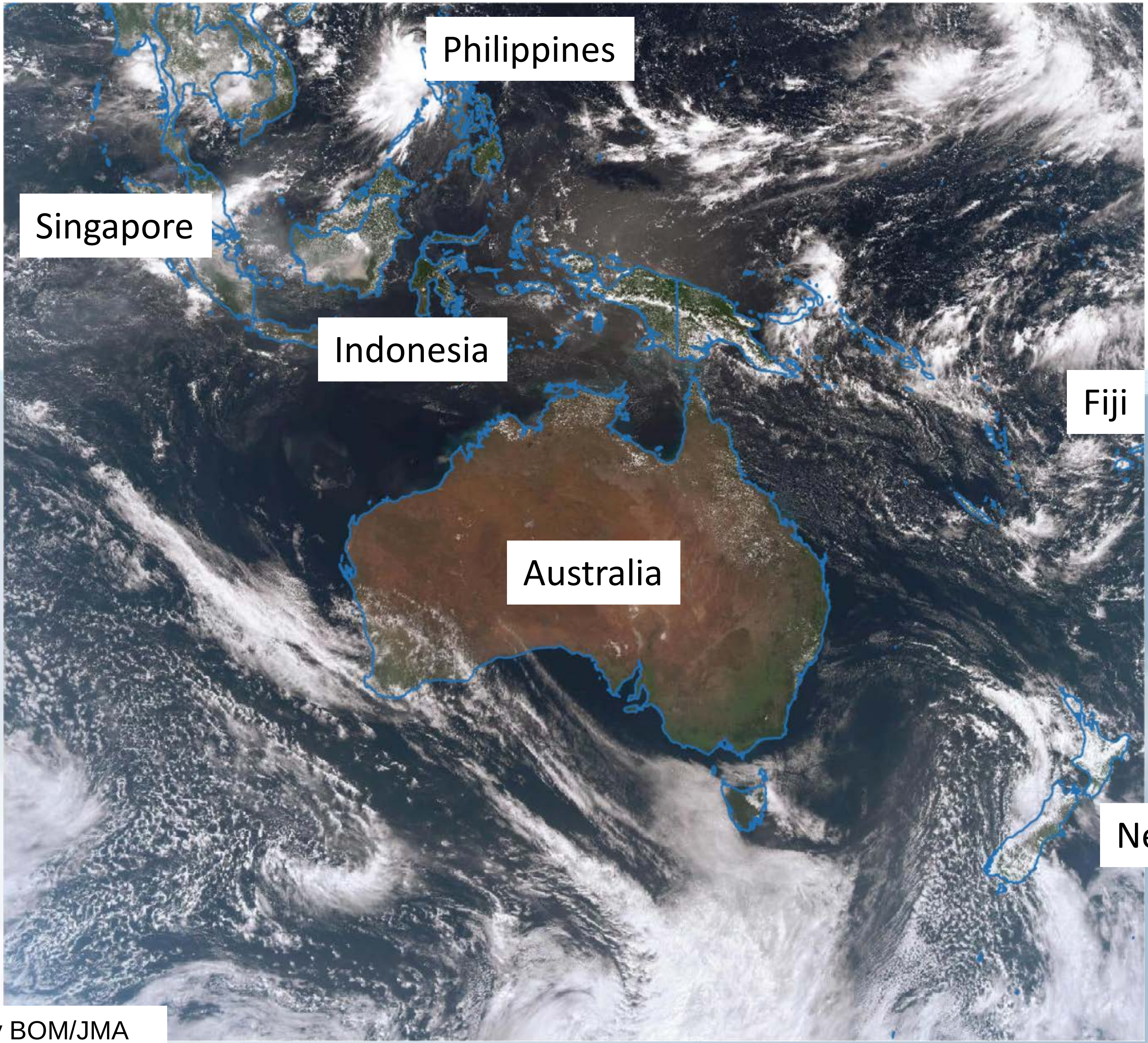
Exploring the Bureau's Himawari-8 Public Viewer

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



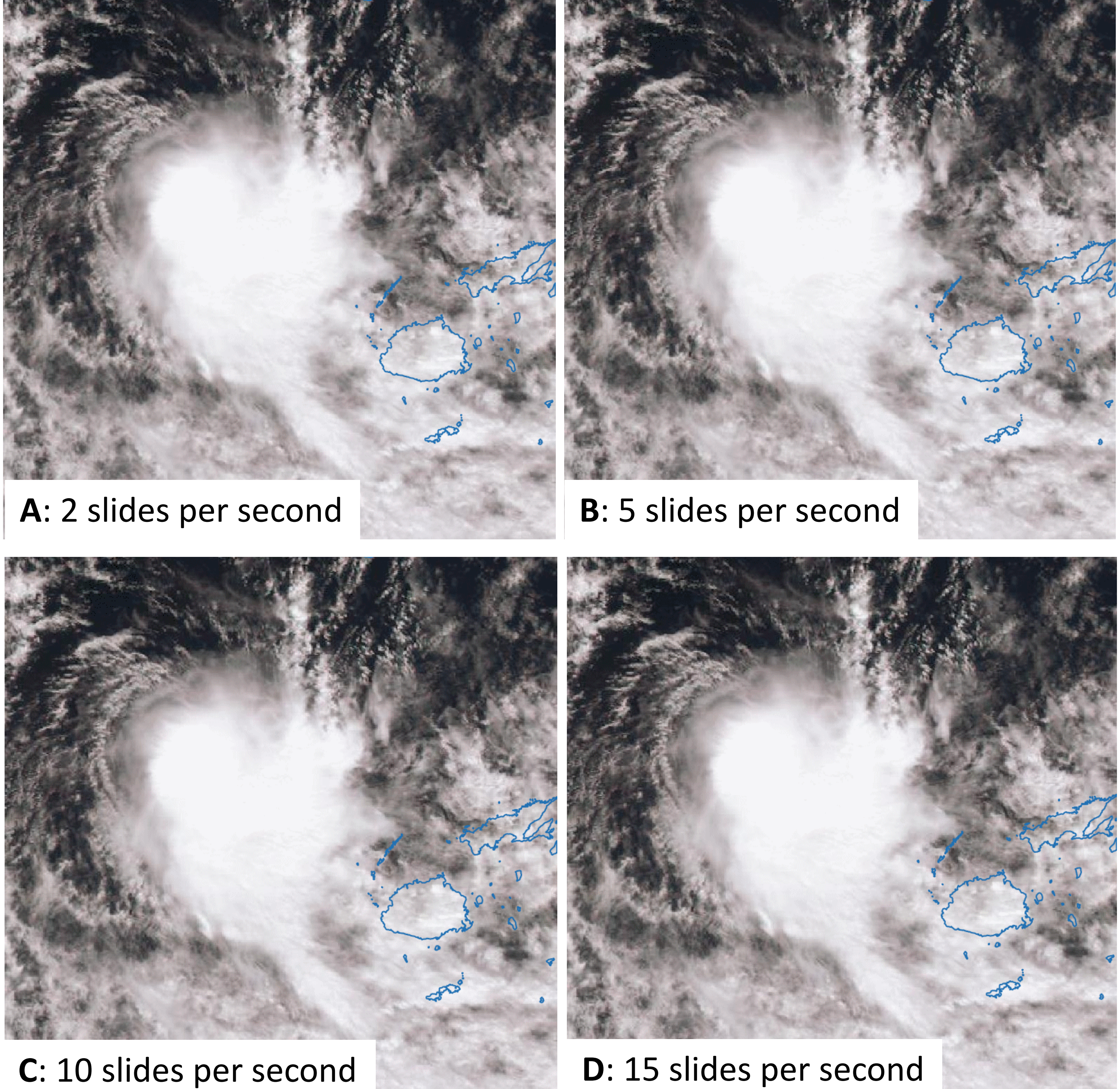


Himawari-8 Public Viewer full domain view



Australian Government
Bureau of Meteorology

image courtesy BOM/JMA



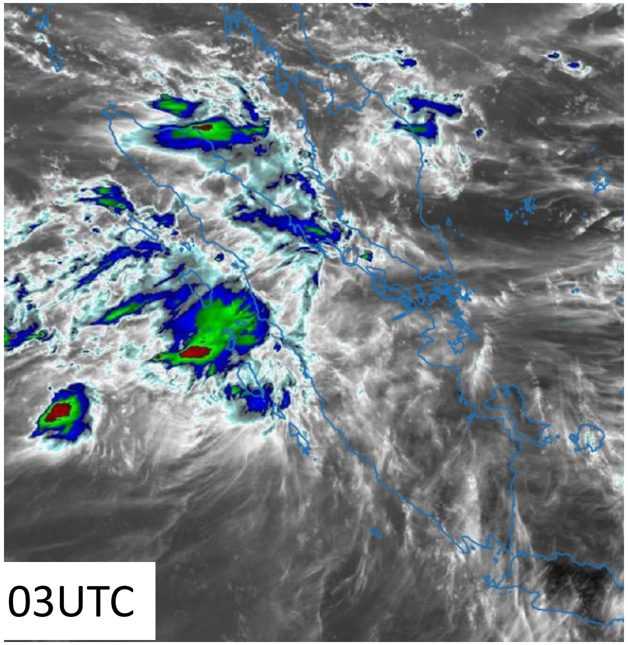
Example: Various speeds of animation – Low near Fiji, 17th October 2015

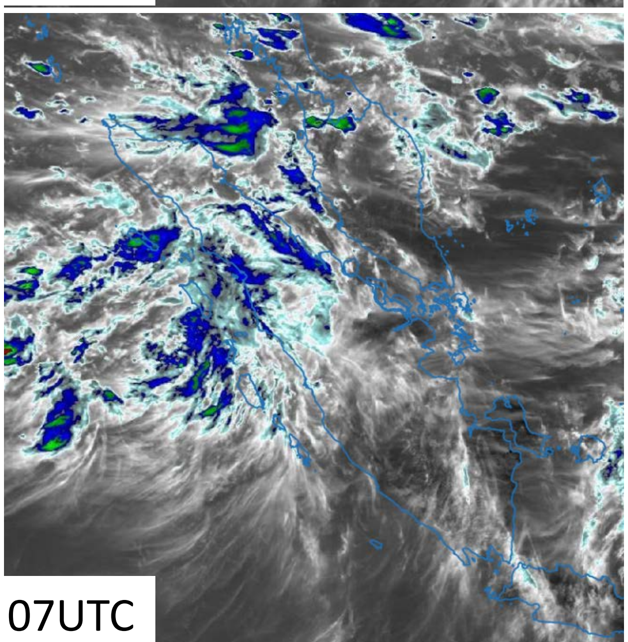
Question: which animation speed best shows the dynamics

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

Southeast Asia smoke and storms, 19th October 2015

Zehr enhanced IR channel



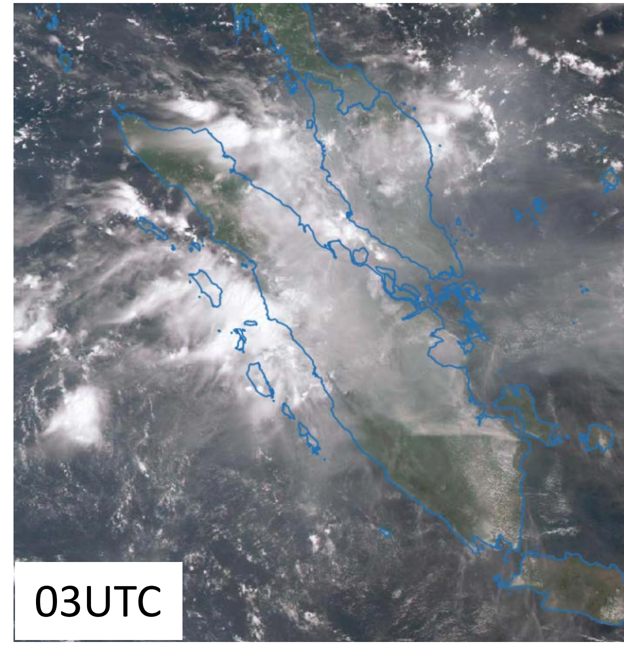


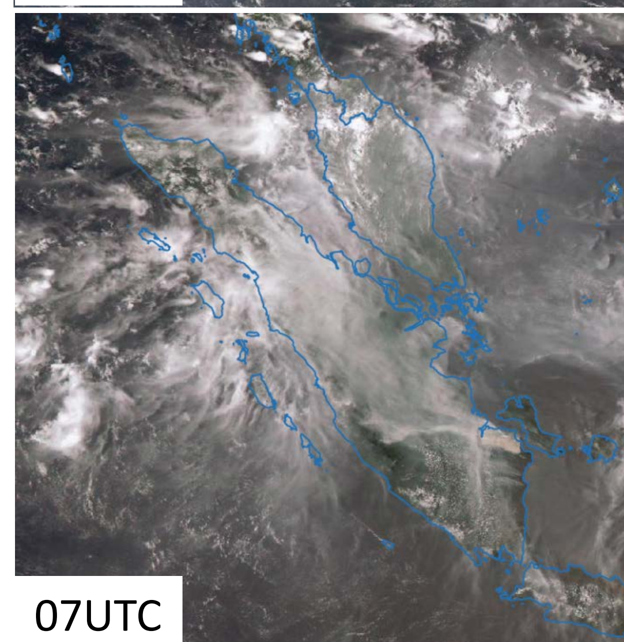
Exercise 2: what does this rapid animation 10 minute data tell you about smoke evolution?

What does it tell you about thunderstorm evolution?

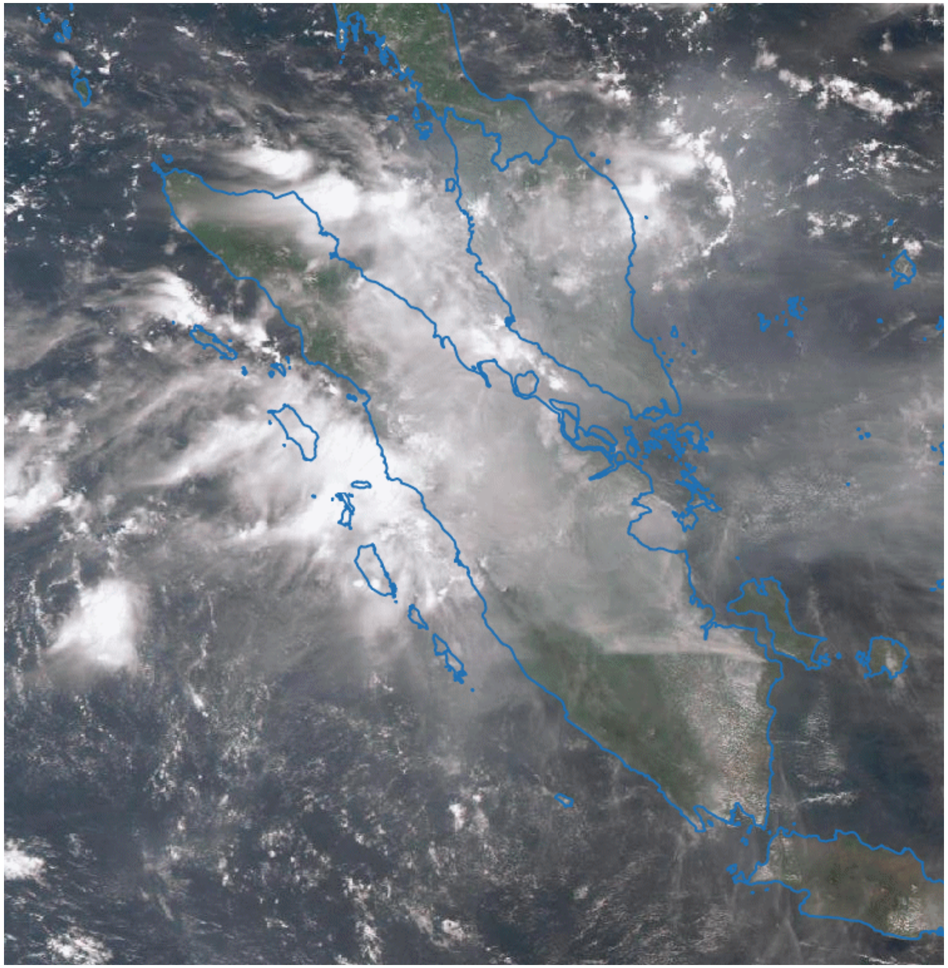
Images courtesy BOM/JMA

True Colour RGB product

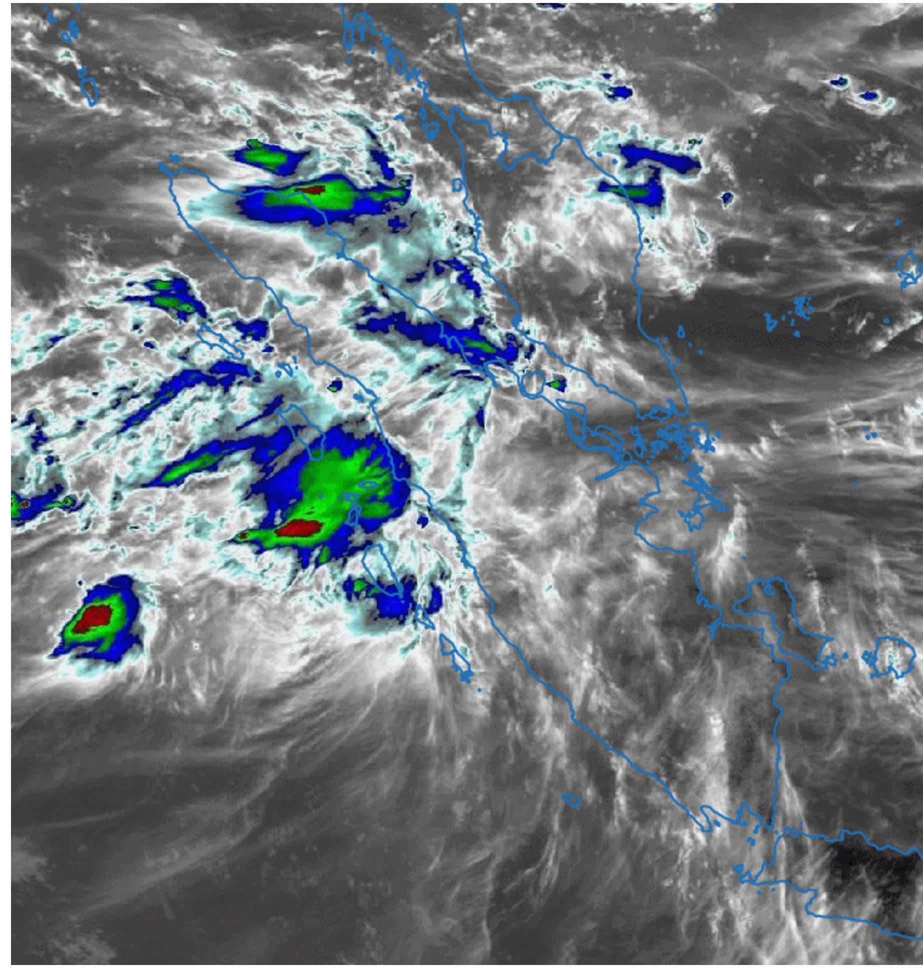




Singapore, Malaysia and Indonesia smoke and storms, 19th October 2015, 10 frames a second



True Colour RGB product



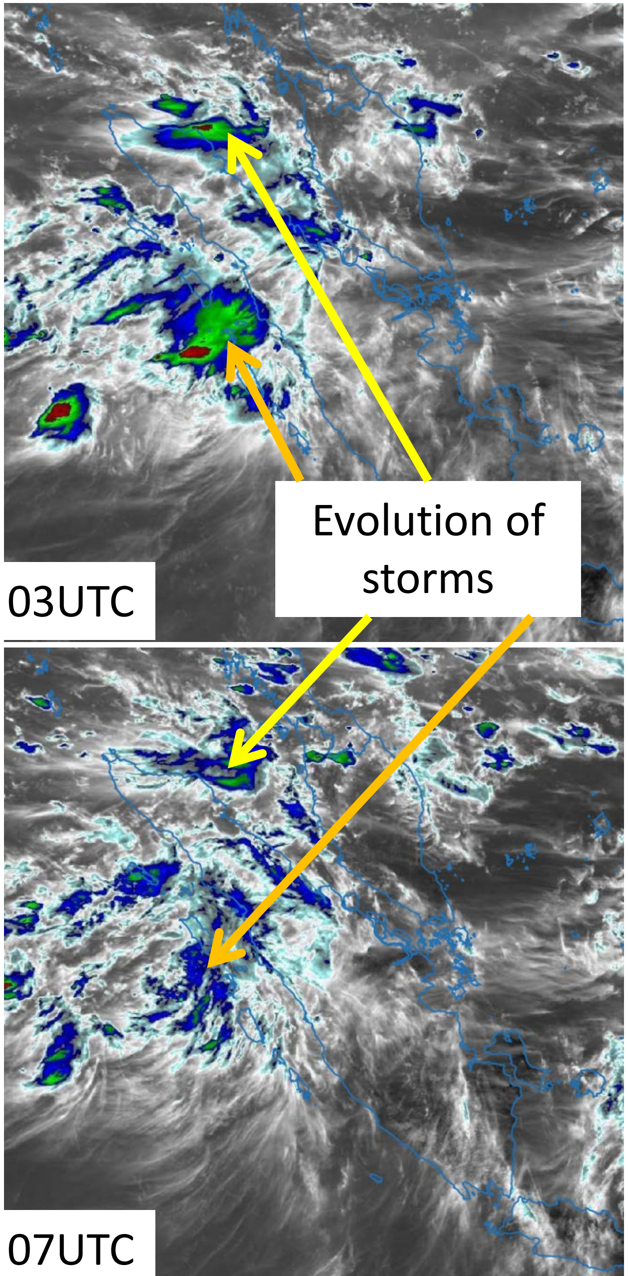
Zehr enhanced infrared channel

Animations courtesy BOM/JMA

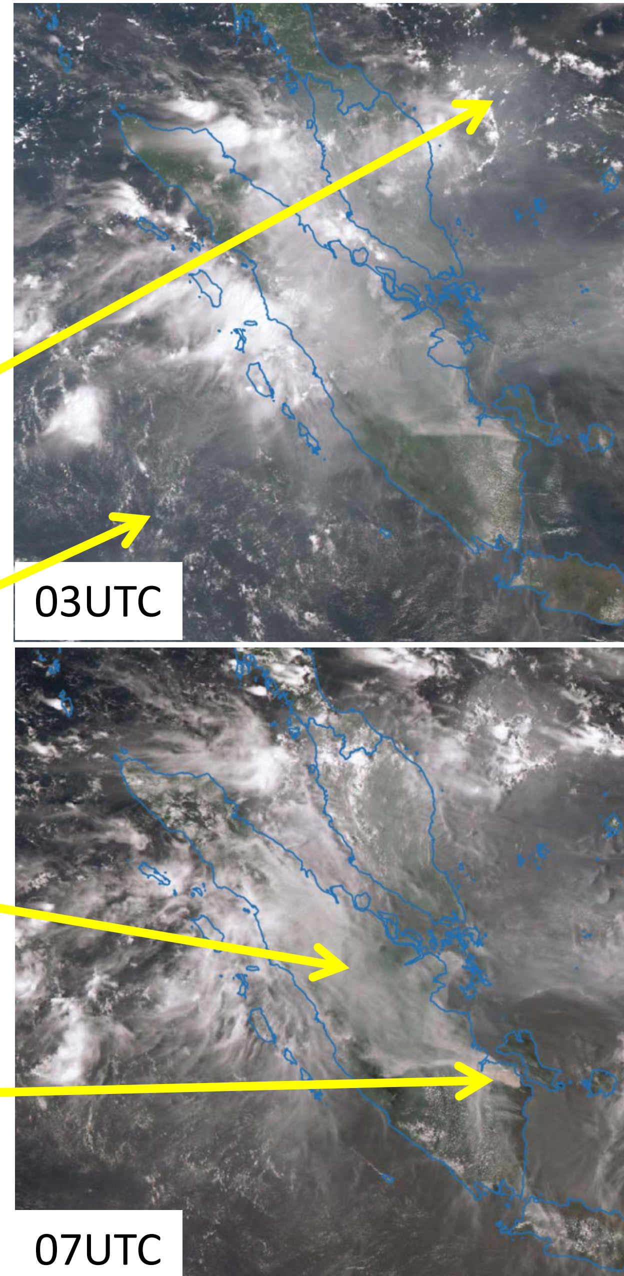
Southeast Asia smoke and storms, 19th October 2015

- some solutions

Zehr enhanced IR channel



True Colour RGB product



Tracking of squall line

Shear identified. Low level flow can be monitored

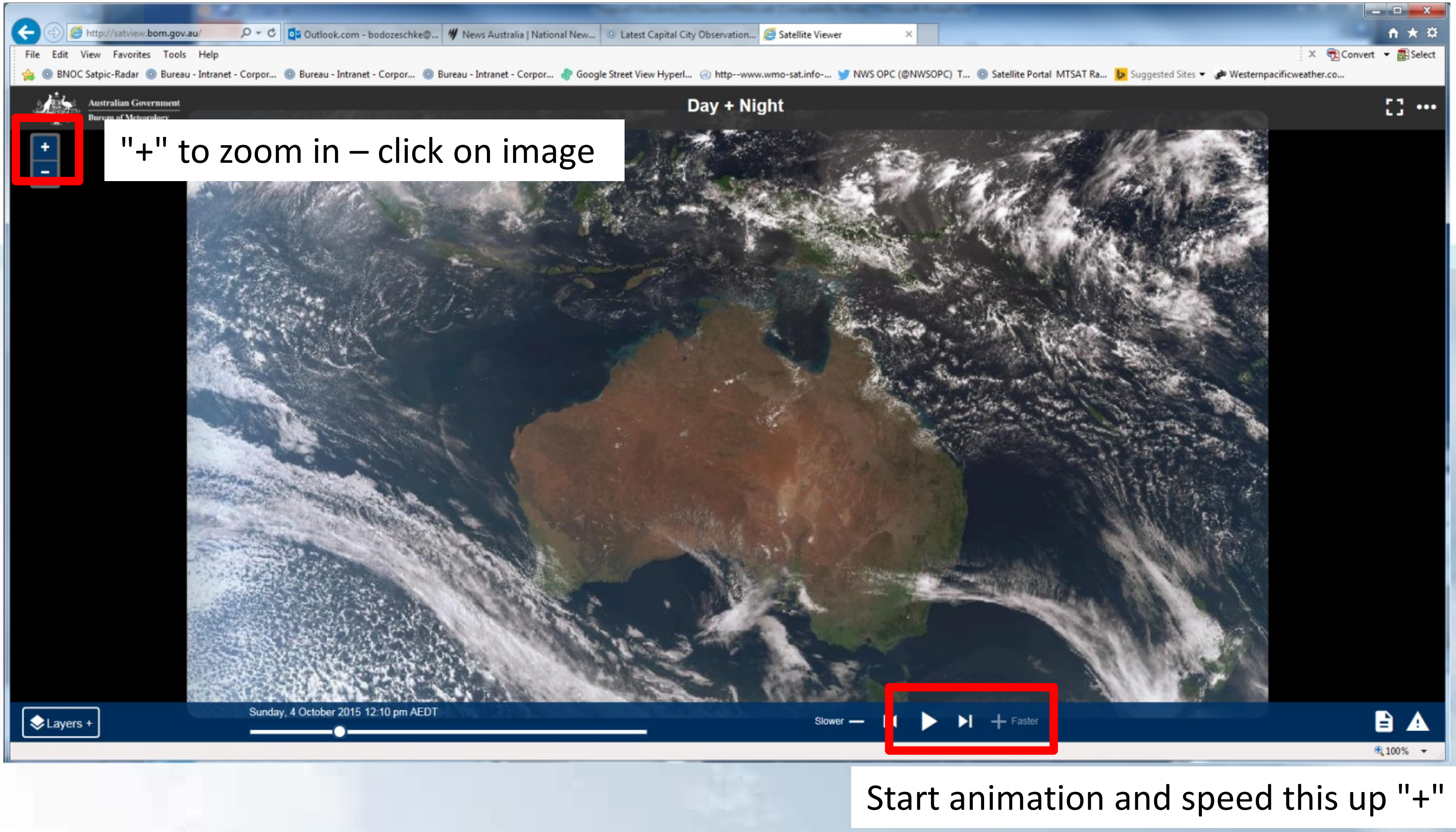
Area of smoke better defined

Smoke source and plume monitoring
07UTC

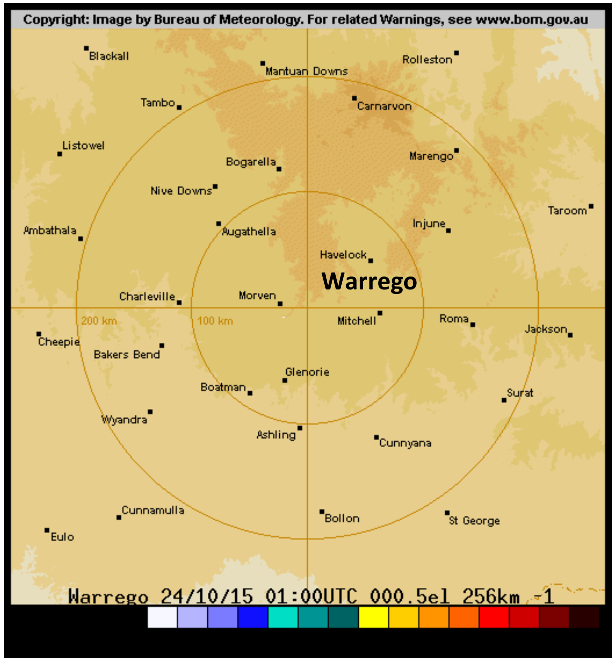
Images courtesy BOM/JMA

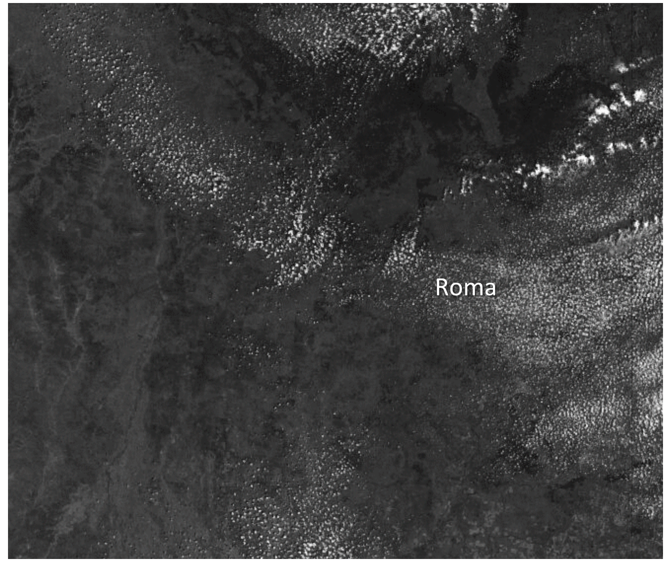
Exercise 3: Lets explore the Bureau's Himawari-8 Public Viewer

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

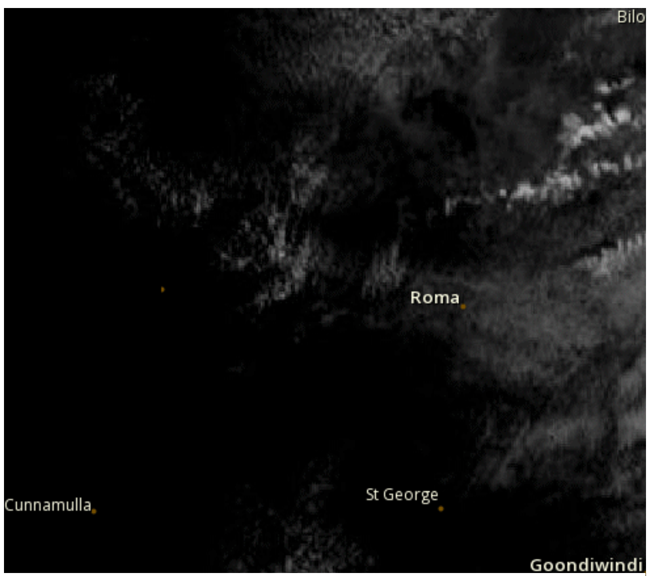


Queensland storms 24th October 2015 – 10 minute data compared with RADAR

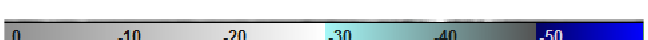




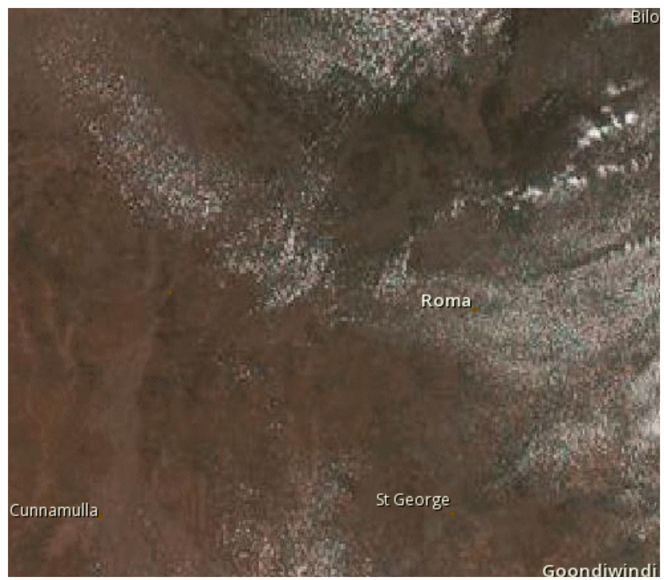
Visible channel (0.5km resolution)



Zehr enhanced IR (2km resolution)



Temperature (C)



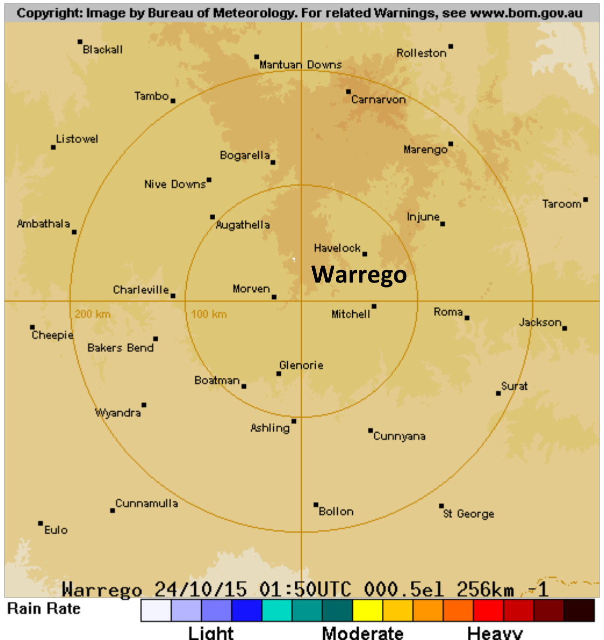
True Colour RGB (2km resolution)

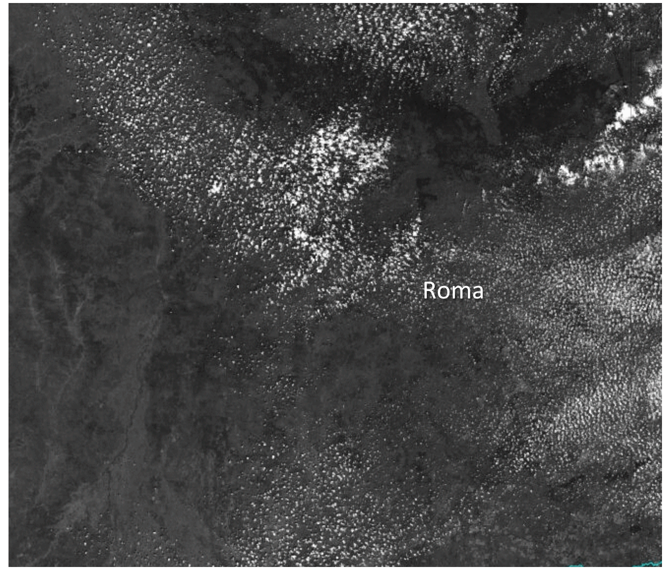
Question: how is the satellite data an advantage over RADAR data?

How is RADAR data an improvement over satellite data?

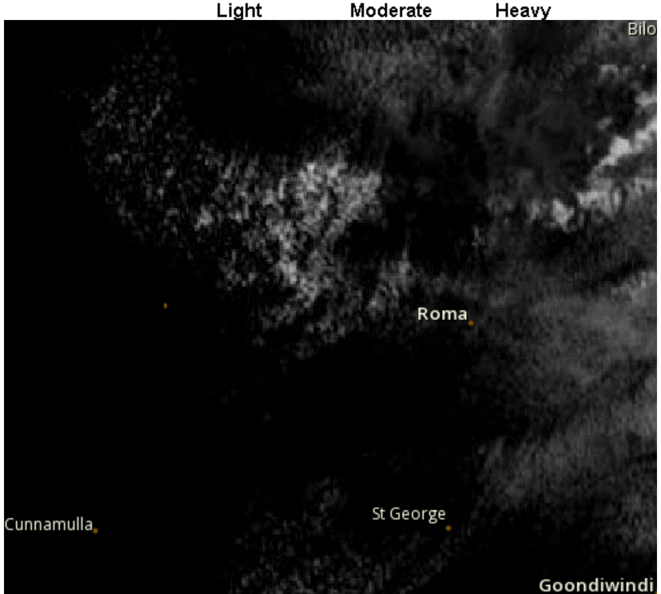
animations courtesy BOM/JMA

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

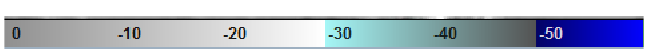




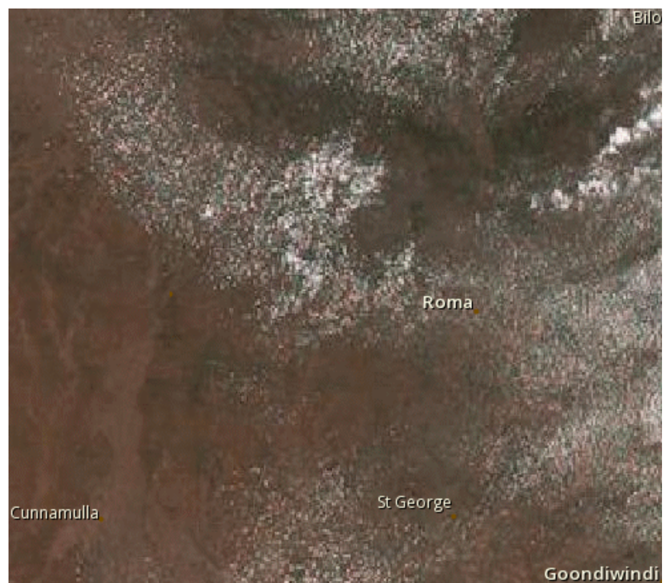
Visible channel (0.5km resolution)



Zehr enhanced IR (2km resolution)



Temperature (C)



True Colour RGB (2km resolution)

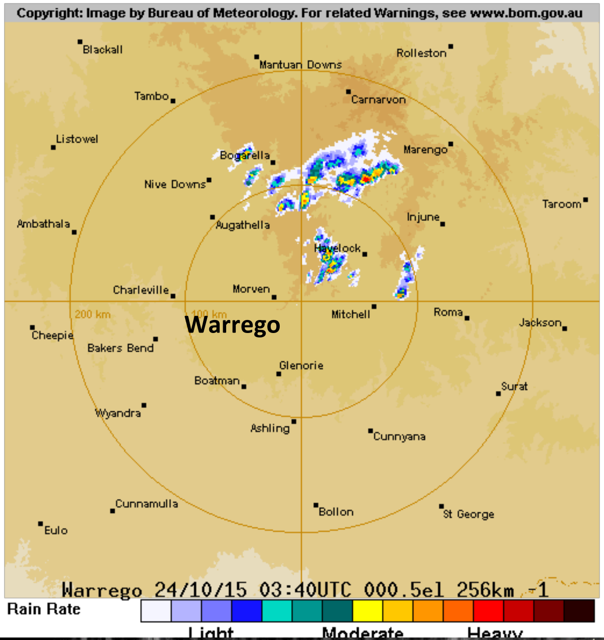
Reception time on Forecaster screen ~0156UTC

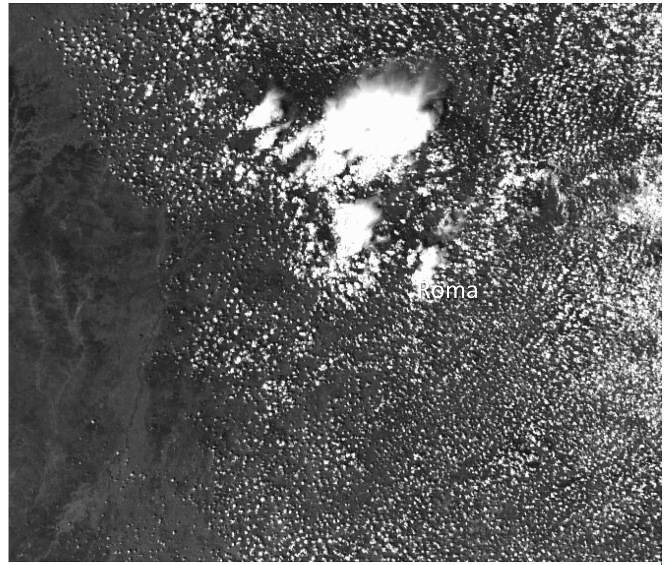
RADAR time stamp 0150UTC

Himawari-8 time stamp 0140UTC.

Images courtesy BOM/JMA

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



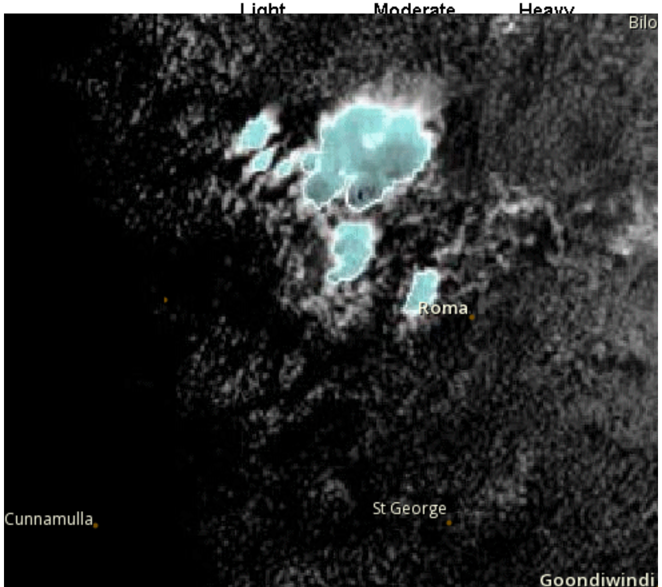


Visible channel (0.5km resolution)

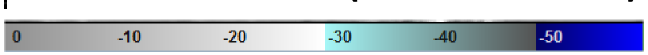
Reception time on Forecaster screen ~0356UTC

RADAR time stamp 0350UTC

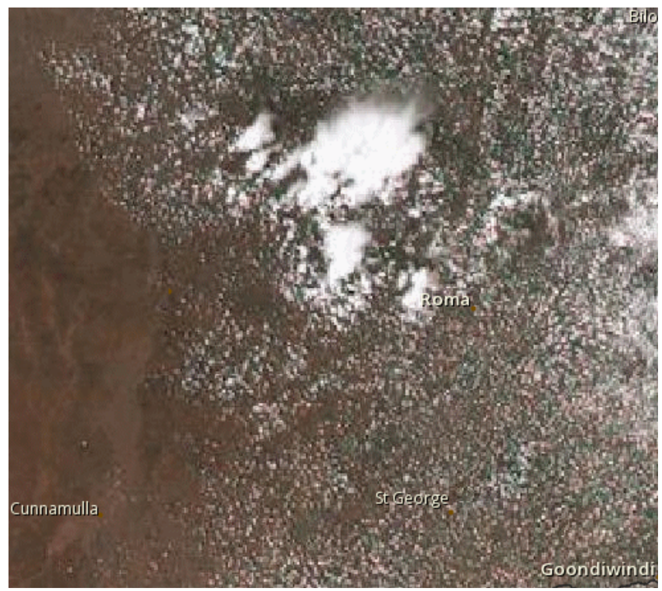
Himawari-8 time stamp 0340UTC.



Zehr enhanced IR (2km resolution)



Temperature (C)



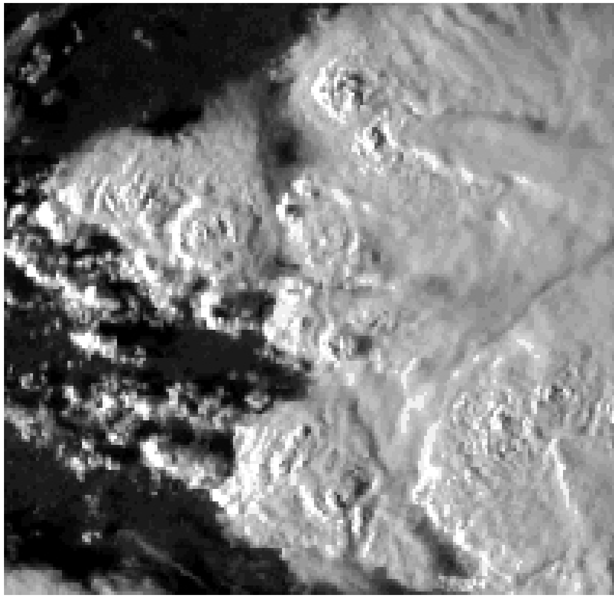
True Colour RGB (2km resolution)

Images courtesy BOM/JMA

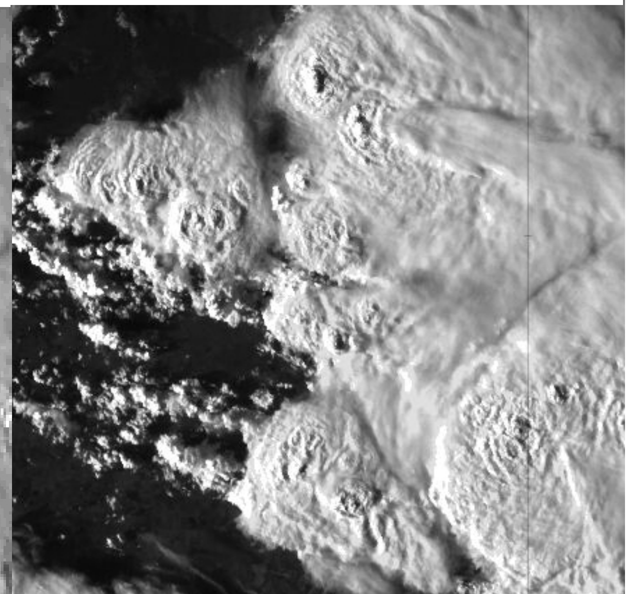
Exercise 4: Northern NSW thunderstorms 28th October 2015

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

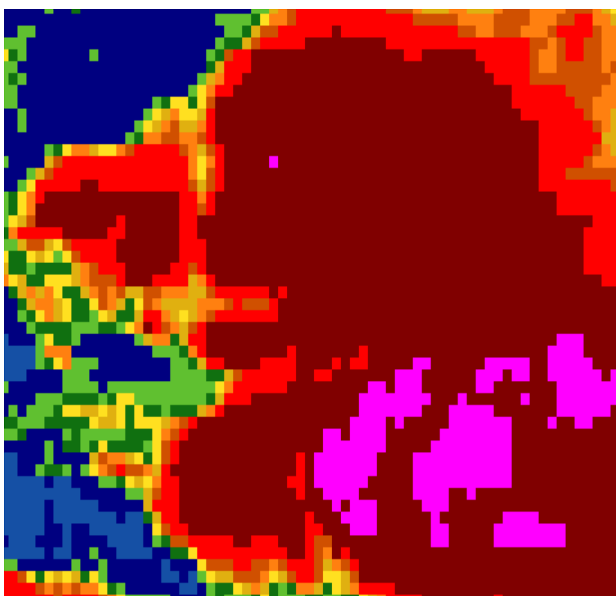
MTSAT-2 visible (1km resolution)



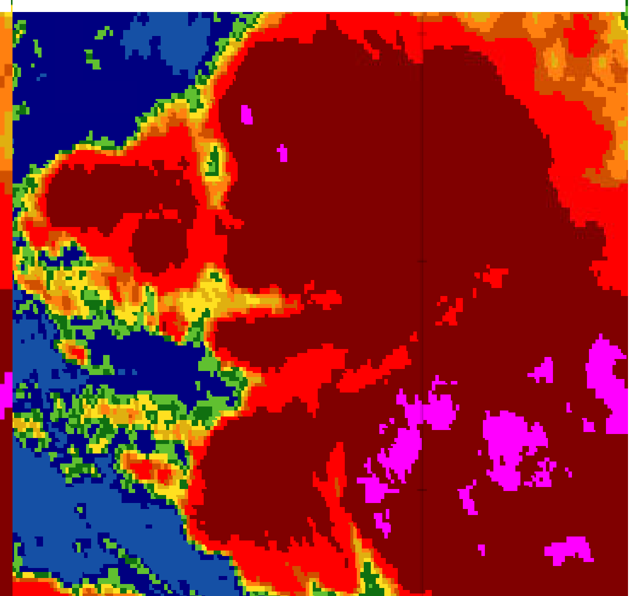
Himawari-8 visible (0.5km resolution)



MTSAT enhanced IR (4km resolution)



Himawari-8 enhanced IR (2km resolution)

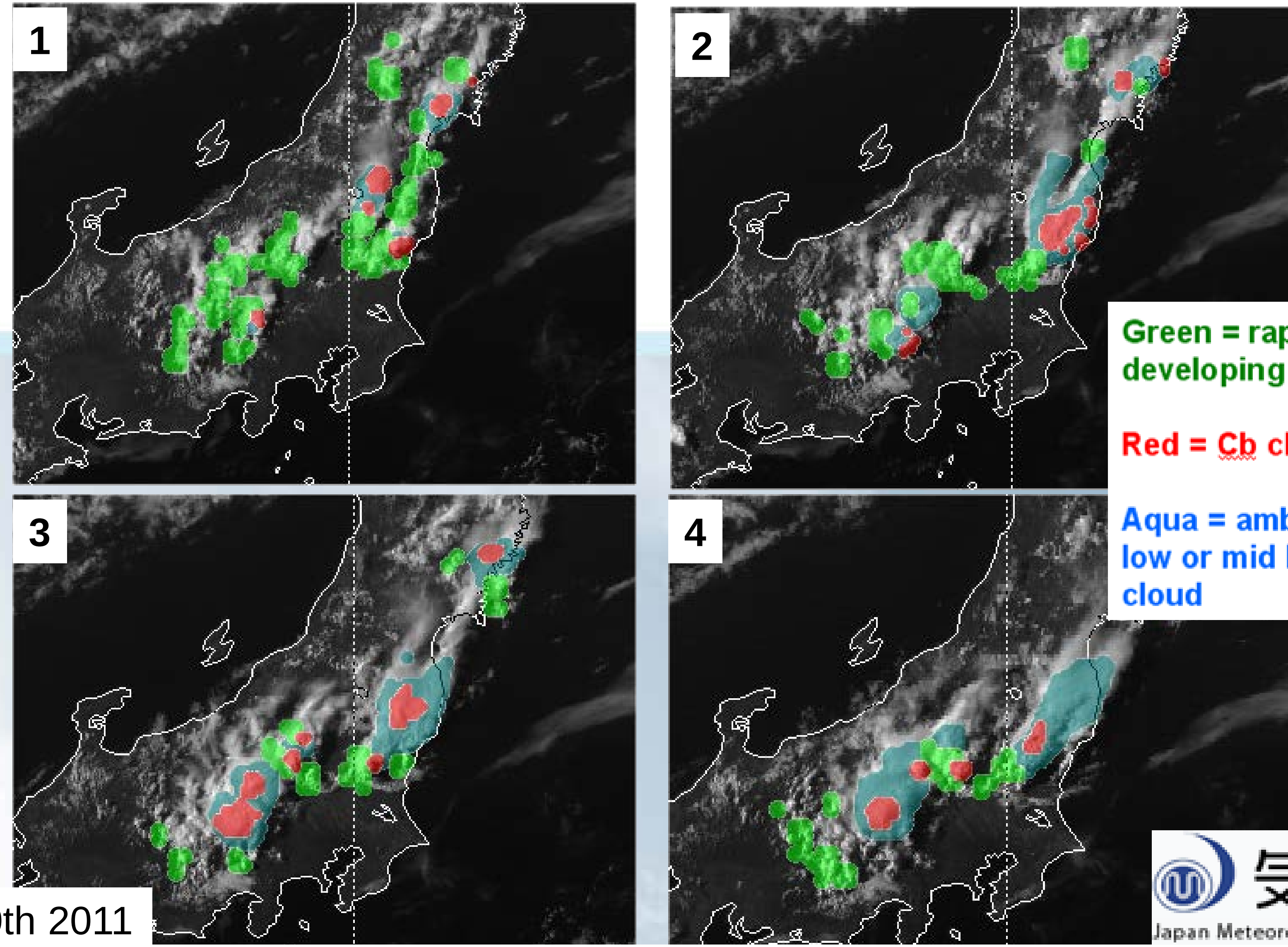


Question: how might the Himawari-8 data be an advantage here

Brightness Temperature Scale

images courtesy BOM/JMA

Rapidly Developing Cumulus Areas convective cloud detection algorithm (JMA)



Green = rapidly developing cloud.

Red = Cb cloud.

Aqua = ambiguous low or mid level cloud

July10th 2011

気象庁
Japan Meteorological Agency

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	Pre-Cb development Improved resolution of local mesoscale triggers (seabreeze fronts, local convergence lines)
	Cb severity identification an development **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.
	Other important implications **More effective implementation of Derived Products such as the Cloud Top Cooling Product and the Automatic Overshooting Top Detection Algorithm.**
Higher temporal resolution	Pre-Cb development 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.

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

Higher temporal resolution	Cb severity identification an development 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.)
	Secondary features 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.
	Other 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.

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.