Australian VLab Centre of Excellence
Science Week 2015

Australian Government
Bureau of Meteorology

Introductory Session
includes
The future role of humans in Weather Forecasting

(Facilitator: Bodo Zeschke, BMTC)

Introduction – the Science Week 2015 web page

http://www.virtuallab.bom.gov.au/events/science-week-2015/

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Home > Events > Science Week 2015

Home

Science Week 2015

Online sessions pertaining to the latest developments in meteorological science with respect to operational forecasting, including sessions about the new generation of geostationary satellites. Hosted by the Australian Bureau of Meteorology Training Centre.

- WMO VLab Homepage
- Melbourne CoE ISOBAR login
- Join a Webinar
- Contact Us

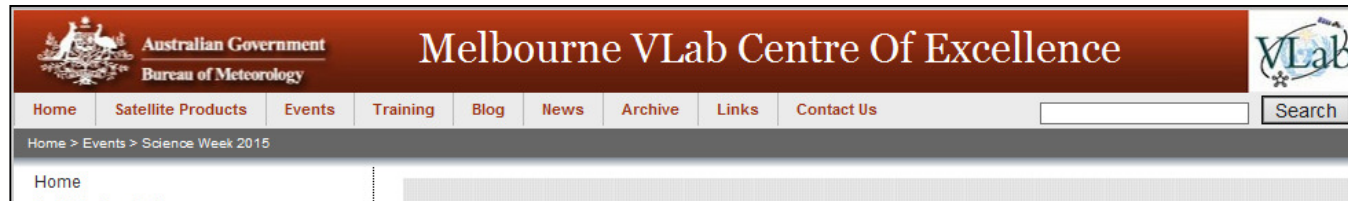This course is complimentary to employees of International Government Meteorological Agencies

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Page count: 0000394

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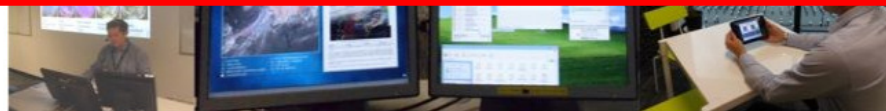
Introduction - Content of Science Week 2015

http://www.virtuallab.bom.gov.au/events/science-week-2015/science-week-2015-timetable-and-registration-sessions/

RED – new generation of satellites and associated data (Himawari-8, FY-4, GEOKOMPSAT-2A)

GREEN – NWP topics

BLUE – Other Forecasting Topics

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Home > Events> Science Week 2015 > Science Week 2015 Timetable and Registration for Sessions

Science Week 2015 - Timetable & Webinar Registration

Time (AEST)	Time (UTC)	Monday 27th July	Tuesday 28th July	Wednesday 29th July	Thursday 30th July
0930 - 1030	2330 - 0030	Introductory Session includes The future role of humans in Weather Forecasting (Facilitator: Mr.Bodo Zeschke) REGISTER		NWP use in Convective Forecasting Facilitator: Mr.Harald Richter (CAWCR) REGISTER	Himawari-8 RGB Products applied to the Australasian and Pacific regions Facilitator: Mr.Bodo Zeschke (BMTC) REGISTER
1100 - 1200	0100 - 0200	Review of Japanese new geostationary satellite Himawari-8 Facilitator: Mr.Tasuku Tabata, Japan Meteorological Agency (JMA) Introduction of JMA VLab Support Site on RGB Composite Imagery Facilitator: Mr.Akihiro Shimizu (JMA) REGISTER	Development of GEO-KOMPSAT-2A and its meteorological products Facilitator: Mr.Sung-Rae Chung (Korea Meteorological Administration) REGISTER	Developments in the High Resolution ACCESS Models Facilitator: Mr.Peter Steinle (CAWCR) REGISTER	Using NWP for Tropical Cyclone forecasting: updates for 2015 Facilitator: Mr.Joe Courtney (BMTC) REGISTER
1330 - 1430	0330 - 0430	Implementation of Himawari-8 data into Bureau Operations Facilitator: Mr.Denis Margetic (BOM) REGISTER	Aircraft icing and Clear Air Turbulence - SIGMETs without PIREPs Facilitator: Mr.Thomas Adams (Met Service NewZealand) REGISTER	Quantitative Precipitation Nowcasting (QPN) at the Bureau. Facilitator: Mr.Duncan Tippins (BMTC) REGISTER	Using RGB and Derived Products: Practical Session Facilitator: Mr.Bodo Zeschke (BMTC) REGISTER
1530 - 1630	0530 - 0630	Exploring the potential of the high spatial and temporal resolution Himawari-8 data Facilitator: Mr.Bodo Zeschke (BMTC) REGISTER	Current and future meteorological satellites of the China Meteorological Administration Facilitator: Dr.Feng Lu (China Meteorological Administration) REGISTER	Weather Briefing from the South African Weather Service Facilitator: Mrs.Lee-Ann Simpson (South African Weather Service) REGISTER	

Introduction - Science Week 2015
Pre-course Resources and Activities

http://www.virtuallab.bom.gov.au/events/science-week-2015/science-week-2015-pre-course-activities/

Questions to the Presenter(s)

Pre-course Resources (please download these prior to the session)

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Home > Events > Science Week 2015 > Science Week 2015 - Pre-course Activities

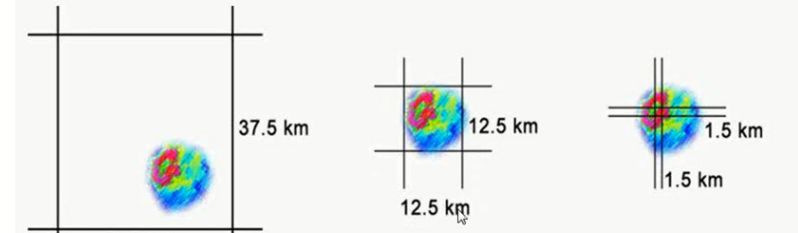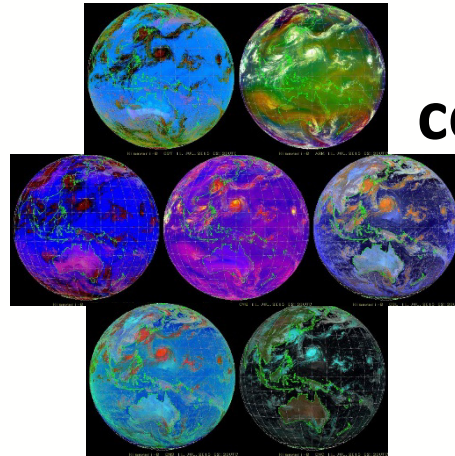## Science Week 2015 - Pre-course Resources and Activities

Instructions

In order to assist in making Science Week more interactive a series of pre-course resources have been provided. These resources are highlighted in yellow. Attendees to Science Week are encouraged to download these resources prior to the sessions. The resources will be accessed and discussed during the Science Week sessions.

Please download these files onto your computer (right mouse click on the link, then "Save Target As" or "Save Link As")

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Monday 27th July (detail)

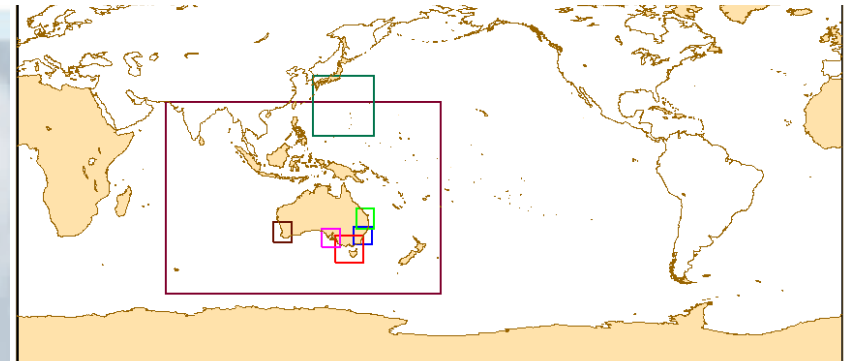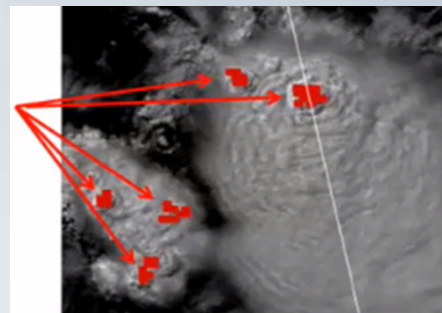| Time (AEST)	Time (UTC)	Monday 27th July
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1100	0100	**Review of Japanese new geostationary satellite Himawari-8** Facilitator: Mr.Tasuku Tabata, Japan Meteorological Agency (JMA) Presentation, part 1 (16Mb) Presentation, part 2 (17Mb) Presentation, part 3 (27Mb) Presentation, part 4 (14Mb)

Full Color Disk Image every 10 minutes

Some new developments covered in Science Week 2015

37.5 km   12.5 km   1.5 km
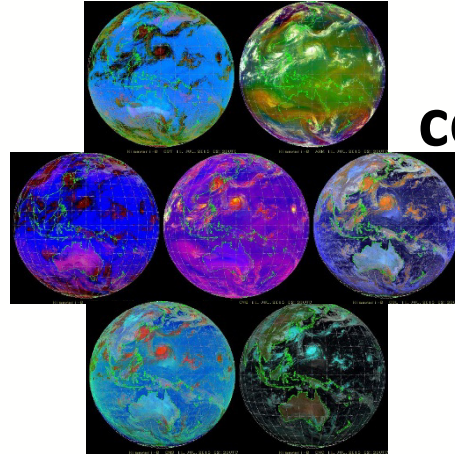
12.5 km   1.5 km

ACCESS-AP2
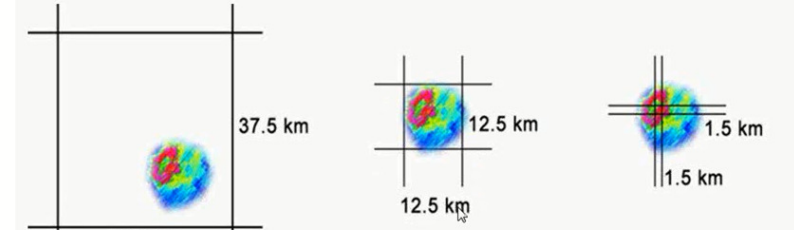NWP applied to TC, TS Forecasting

Himawari-8 data and associated products

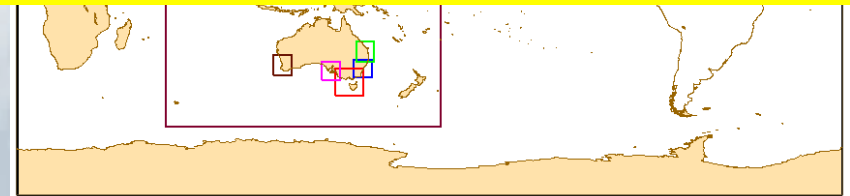Full Color Disk Image
every 10 minutes

Some new developments
covered in Science Week 2015

37.5 km
12.5 km
1.5 km
12.5 km
1.5 km

ACCESS-AP2
NWP applied to TC, TS Forecasting

The future role of humans in Weather Forecasting

The future role of humans in Weather Forecasting

- I gave a presentation at Melbourne University about this topic earlier this year.

- I have referenced a number of conference papers on this topic (references given in the back).

- In particular, "The Future of Humans in an increasingly Automated Forecast Process – An Interactive Forum".
http://www.ametsoc.org/boardpges/bogm/forecasterforum.html

- In particular, contributions by Harold Brooks (NOAA) and Charles Doswell (NOAA).

- Have also discussed this topic with Senior Forecasters at the VIC RFC. Feedback from Science Week 2015 has also been incorporated.

- My take on this is to identify where humans can add value to the Forecasting process by effectively using the new satellite data and NWP.

- I am going to stay well clear of "policy". However, if you are interested in this you can study the references given at the end of this presentation.

Full Color Disk Image
every 10 minutes

How will the current data impact the Forecaster

37.5 km   12.5 km   1.5 km

1.5 km

12.5 km

ACCESS-AP2
NWP applied to TC, TS Forecasting
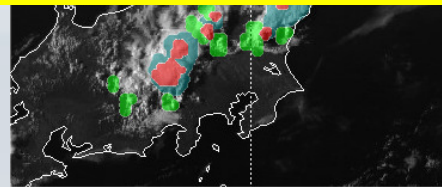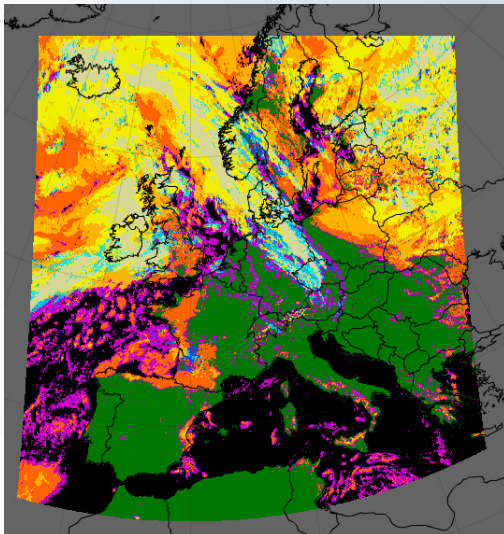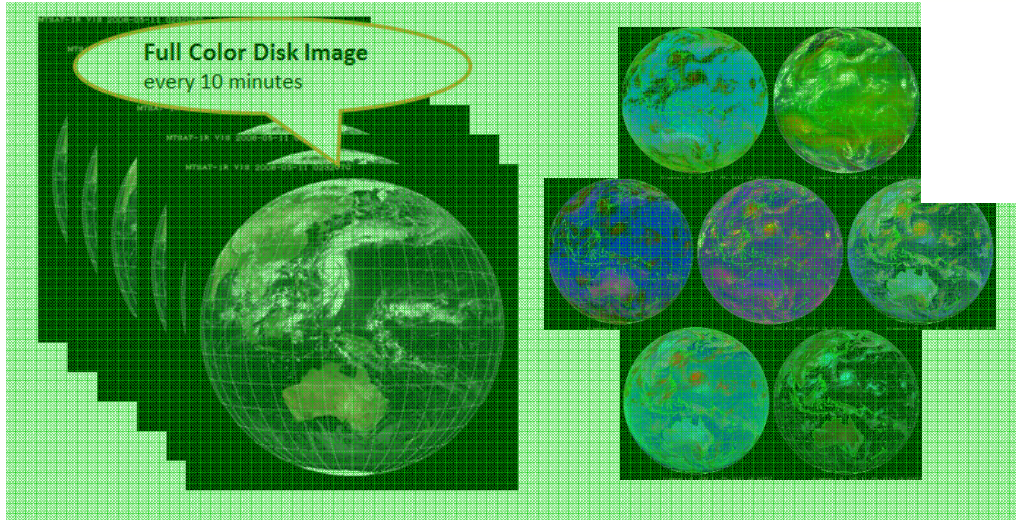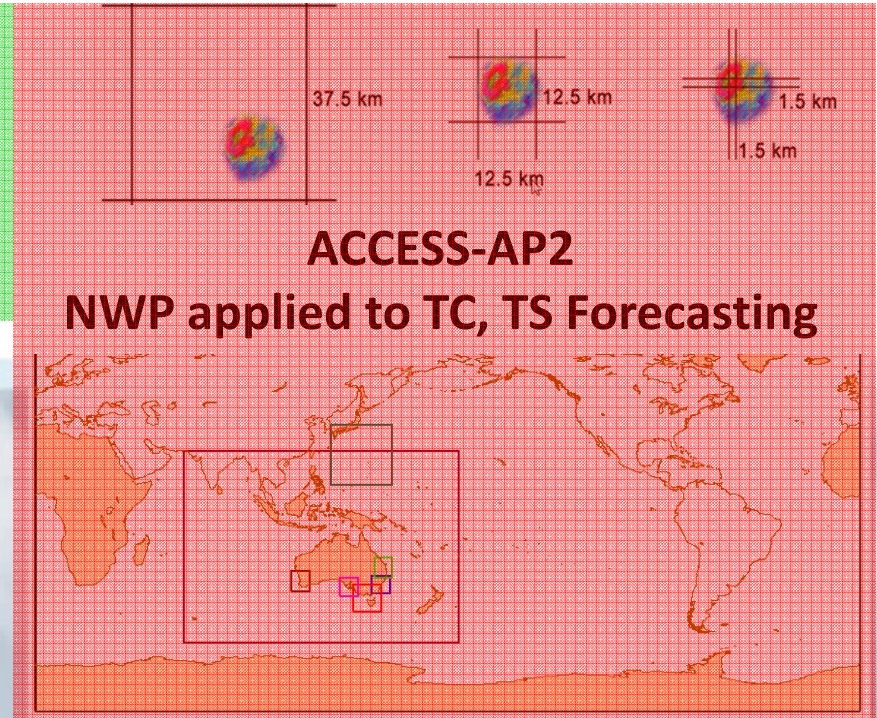
Himawari-8 data and associated products
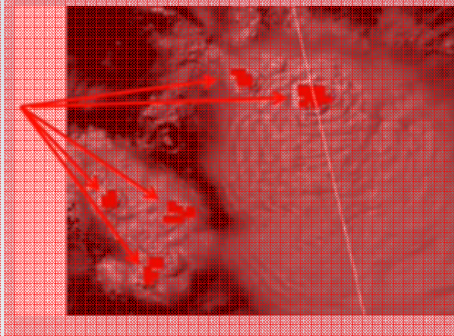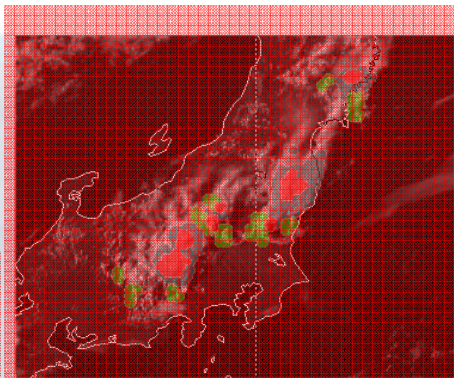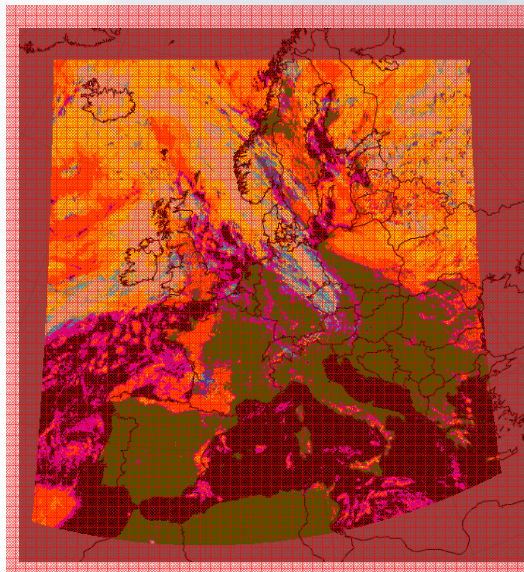
The Forecaster and NWP

- Weather forecasting is evolving in a world characterized by accelerating scientific and technological change. This scientific and technological change has led to some confusion and concern about the role of humans in forecasting the weather (Doswell)

- Over the next few days you will be presented with many new advances in satellite data and NWP during Science Week 2015

- In particular, you will see that NWP has become more sophisticated. Indeed, NWP has started to dominate aspects of the Forecasting Process.

- One of the current issues facing the Weather Forecasters is deciding which weather forecasting jobs can best be done by a human and which by a computer.

- On this slide I have annotated products that can be automated and NWP in red and the satellite data in green.

Steps in producing a useful forecast
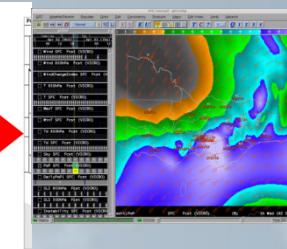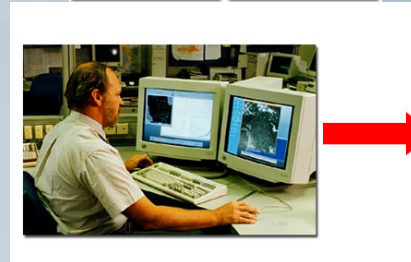
- **Observations made and assembled**:
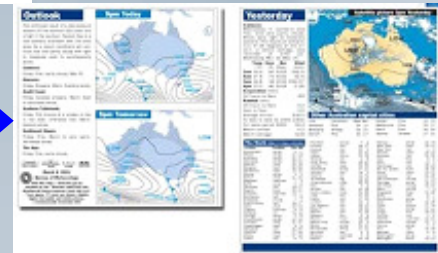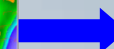

- **Supercomputer processing**:
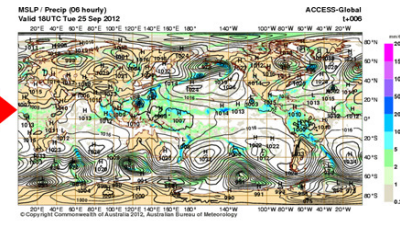
- **Forecaster Analysis and Diagnosis**:

- **Prognosis / Forecast made:**

- **Dissemination:**

images from BOM
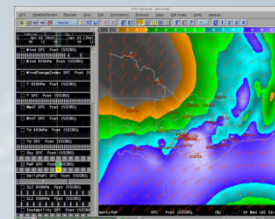
Diagnosis and Prognosis within the Forecast Process (1)
(from Doswell)

- Scientific weather forecasting proceeds by combining a diagnosis of the atmosphere's current state with a prognosis (a trend).

- Diagnosis involves the re-creation of a coherent whole from those component parts considered during analysis; that is, a synthesis.

- It is impossible to overstate the importance of diagnosis in weather forecasting. In order to make scientific predictions of the weather, a person must have knowledge of the *weather processes* ongoing at diagnosis time.

- If diagnosis is done properly some prognosis is bound to develop in the forecaster's mind. When guidance is consistent with that, confidence in both guidance and the subjective prognosis increases. When the guidance differs substantially from the scenario built up during diagnosis, the job must be to resolve that conflict.

Diagnosis and Prognosis within the Forecast Process (2)
(from Doswell)

- Performing map analysis is an essential component in diagnosis; it allows models of atmospheric behaviour to be compared with the data. This is the way a forecaster forms an understanding of what is happening in the atmosphere. *Rather than freeing time to do science, taking map analysis away from forecasters minimizes their opportunity to function as practitioners of meteorological science* .

- Forecasters should be in close touch with the data (i.e., doing map analysis), and should be as scientifically aware as is humanly possible. It is inconceivable that these goals can be achieved if diagnosis is relegated to computerized schemes.

- Note that time is most available for diagnosis *before* the weather situation becomes critical. Thus, it makes sense to concentrate on diagnosis during relatively calm weather, in order to *anticipate* the arrival of a challenging weather situation.

Diagnosis and Prognosis within the Forecast Process (3)

- It is important, through regular practise and even during calm weather events to keep analysis / diagnosis / prognosis skills "honed". If you don't use the skills you will lose them… (Doswell)

- Analysis and diagnosis of meteorological data can occur both as the traditional manual chart drawing as well as online analysis / diagnosis. Indeed the new Forecasters favour the online analysis as it permits them to overlay a lot of data (observations and NWP). Hence they can assimilate a greater volume of data (Ted Williams BOM)

Human versus automated processes (including NWP)

Advantage of Human	Advantage of automated processes (including NWP)
• Superior in the processing of visual data (pattern recognition) • Very good at integrating diverse data and abstract knowledge • Can use both quantitative and qualitative information in providing a more complete diagnosis. • Very good at translating the forecast weather patterns into forecasts of tangible weather. • Often superior in responding to more difficult / hazardous weather situations	• Uniquely suited to doing repetitive tasks • Uniquely suited to carrying out large numbers of computations quickly • Synthesis of data is purely quantitative • NWP provides the broad pattern (though mesoscale models are changing this)

Human versus automated processes (including NWP) (1)

Processing Visual Data (Pattern Recognition)
- Human beings possess skills which are useful for forecasting, particularly in the processing of visual data. Pattern recognition is not a simple task to program, but it is one at which human beings are particularly adept (Brooks 1).

Repetitive Tasks and large number of computations
- Machines are uniquely suited to doing repetitive tasks or tasks in which it is either unsafe or extremely costly to use human beings. Further, the ability to carry out large numbers of computations in a very short time makes machines the only avenue for numerical solution of the equations of motion in NWP (Brooks 1)

Quantitative and qualitative information
- Since machines do not have access to qualitative information, they cannot provide as complete a diagnosis as humans (Doswell).

Human versus automated processes (including NWP) (2)

Quantitative and qualitative information / integration of diverse data
- We cannot afford to turn our backs on important meteorological input simply because it is non-quantitative or subjective. In fact, it is this integration of diverse data and abstract knowledge that humans are so good at and which is so hard to teach to a computer since the synthesis is not totally quantitative (Doswell)

Translating the forecast weather pattern into forecasts of tangible weather
- While NWP has proven its skill at forecasting weather patterns, translating those patterns into forecasts of *tangible* weather is considerably more difficult (Doswell)
- The human has a role in interpreting NWP (Ted Williams BOM)
- The human is best at communicating the weather situation to different users in different ways, in conveying uncertainty. As NWP outputs are quantitative the outputs cannot satisfy all the stakeholders (Roger Deslandes, Ted Williams BOM, Science Week 2015)

Human versus automated processes (including NWP) (3)

<u>Humans are often better in responding to difficult / hazardous situations</u>
- There are numerous benefits to human analysis--recognition of "unusual" observations, which may represent errors or significant changes that indicate that an important weather event is imminent (Brooks 1).
- While the processing of radar data should be done in an automated fashion, it has been my experience that there are human beings who are sufficiently skilled in pattern recognition and the application of the appropriate conceptual model to outperform radar algorithms for severe weather (Brooks 1)

<u>Other points</u>
- It is very important to be able to quantify, through verification, where Forecasters add value (Roger Deslandes, BOM)
- Emphasis on Forecasters providing impact based decision support services (Roger Deslandes, BOM)

Summary exercise: Forecaster tasks vs NWP driven tasks
(please annotate F or N on the list below)

- Analysis / diagnosis / prognosis (chart or onscreen)
- Rescuing NWP from error
- Anticipating rare events
- Good service to the public
- Routine forecasts
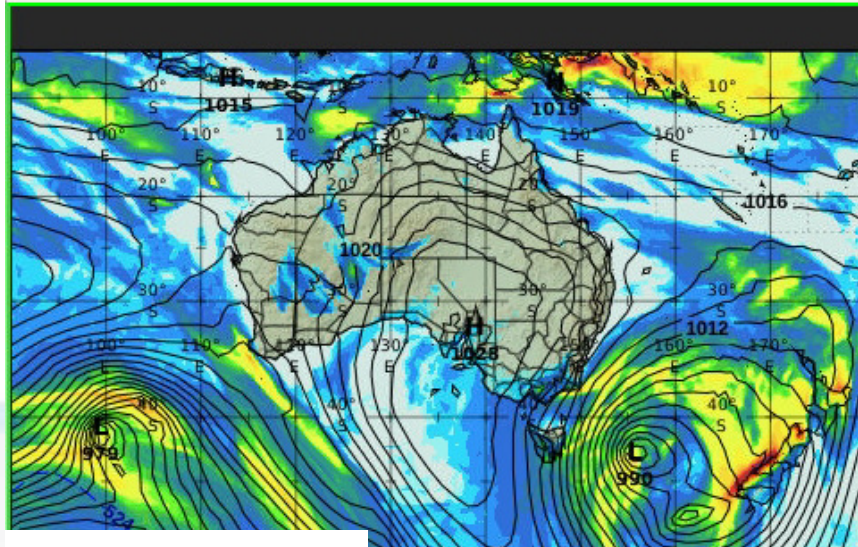- Longer term forecasts

images courtesy BOM

Scenario: Greater focus on short term (1-2 day forecasts)

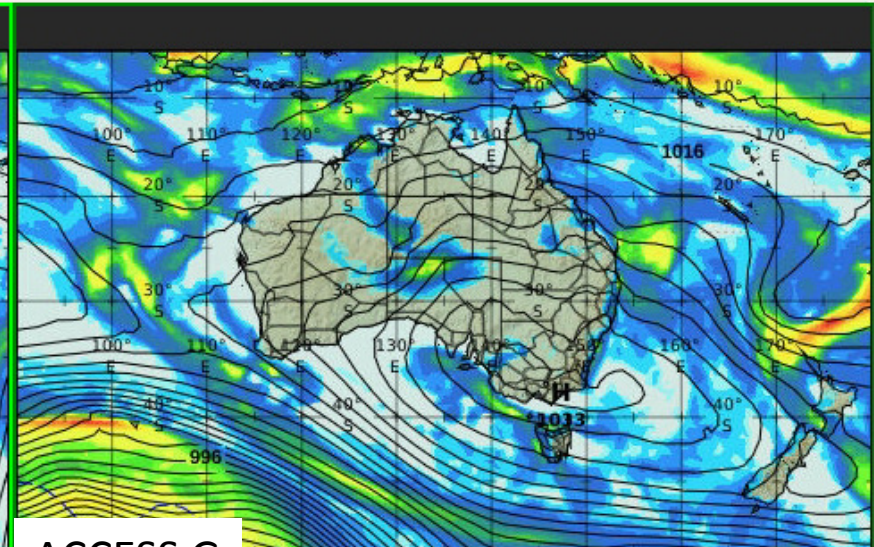For longer term forecasts (3+ days), Ensemble models will become more important
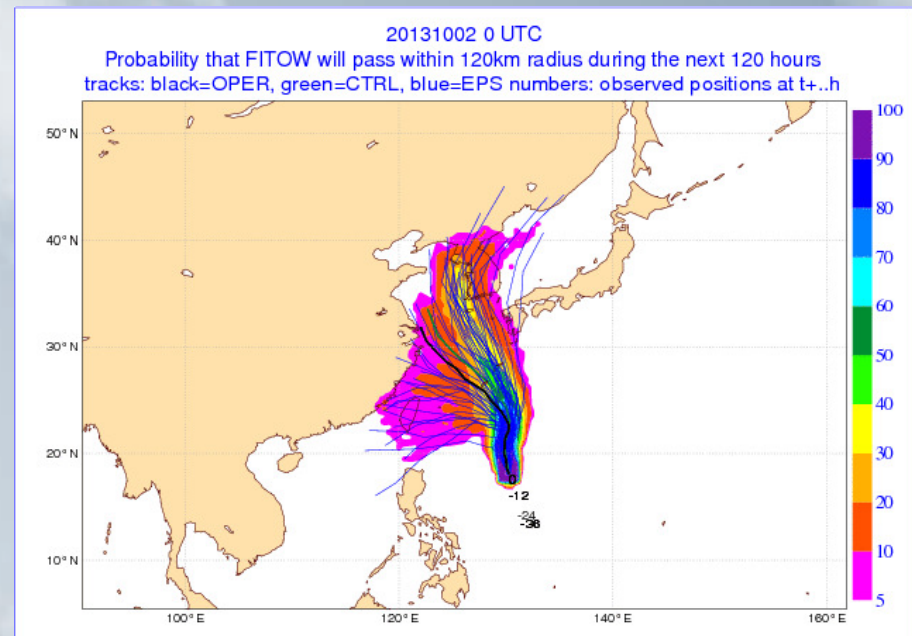
ECMWF Ensemble Tracks 00Z (from ECMWF)

Scenario: When long term NWP forecasts differ
(180 hour forecast for 12UTC 2nd June 2015) images courtesy BOM

EC Deterministic

ACCESS G
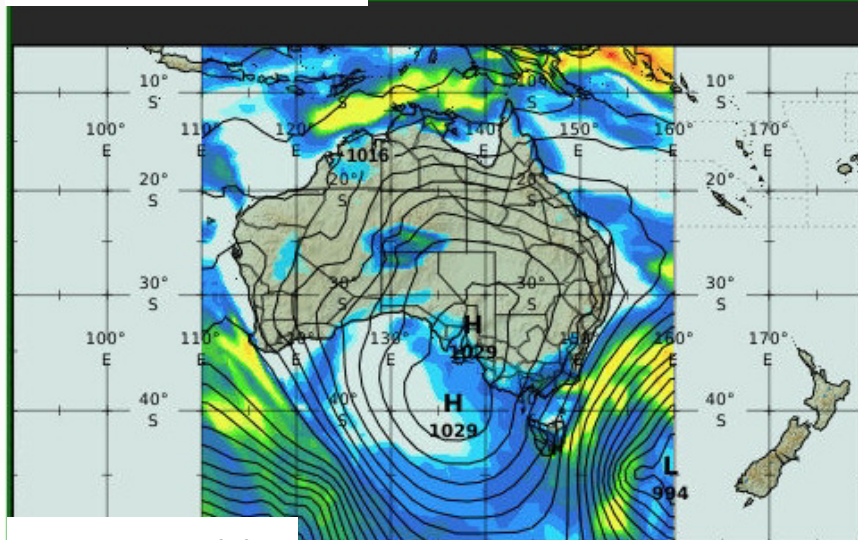
EC Ensemble
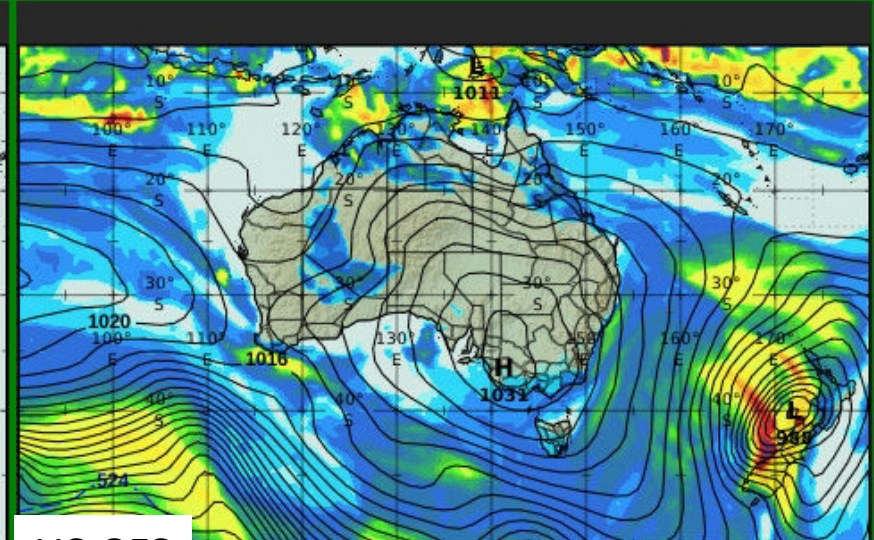
US GFS

Scenario: High impact forecasting (short and long term)
(Black Saturday Fire)

Victoria Heatwave
January 13-16 2014

Probability
T2m > 100° F
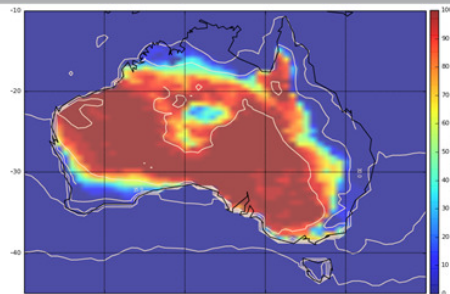
14 January
Lead time ~ 7 days

15 January
Lead time ~ 8 days

16 January
Lead time ~ 9 days

Bureau of Meteorology

CSIRO

images courtesy BOM

Scenario: The Forecaster as a communicator
(Explaining forecasts, new data and products, briefings during emergencies etc.)

The future role of humans in Weather Forecasting – summary (1)

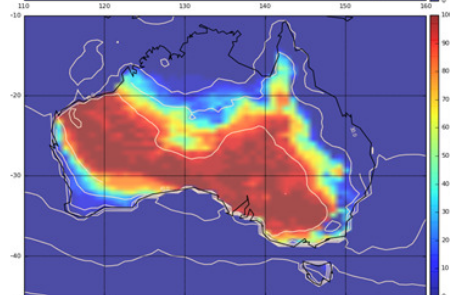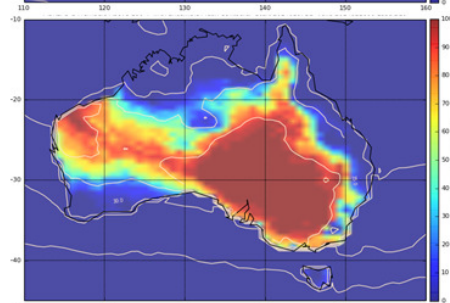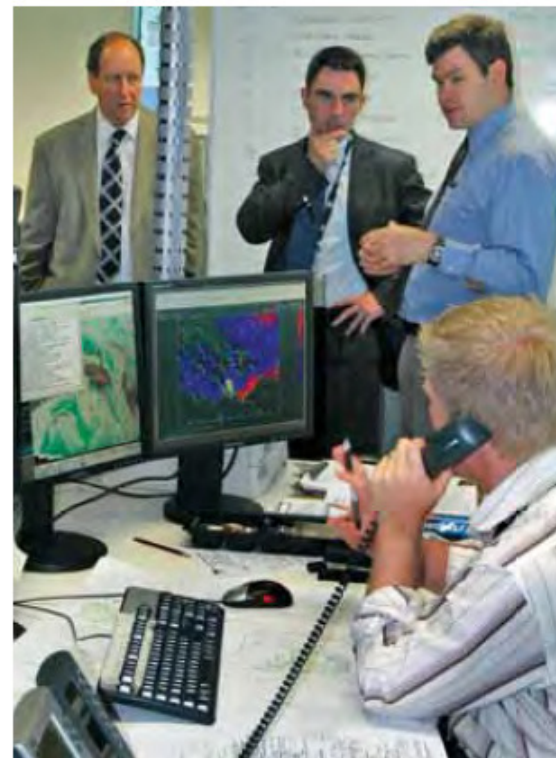- With the advent of high resolution satellite data and NWP, Forecasters would spend lot of time on the short term (1-2 day) forecasts. Routine human analysis/diagnosis/prognosis of the meteorological data will continue to play a crucial role

- The importance of forecast validation cannot be underestimated. This has been shown to give human Forecasters the "edge" over NWP (Project Phoenix, Canadian Met Service)

- High impact forecasting (eg. as for the 2009 Black Saturday Fires) would also require a lot of the Forecasters time and this would involve the analysis of forecasts out to longer times. (in particular, Forecasters will have to couch the Forecasts in terms of the probabilities associated with the impact of the event)

- For longer term forecasts (3+ days), ensemble models will become more important. The Forecaster will still need to assess which model is performing best on the long term and implement this.

The future role of humans in Weather Forecasting - summary (2)

- Forecasters would be very important in managing high impact, severe event forecasting. For example, NWP cannot always forecast severe convection etc. in the required detail. In this case the Forecasters experience in analysis/diagnosis/prognosis and his/her situational awareness is critical.

- Forecasters would be very important in "rescuing" the NWP forecast from potentially large errors (eg. timing of frontal passage and resultant maximum / minimum temperature and timing of rainfall)

- As more people use the services the Forecaster role will include being a good communicator, delivering information specifically adapted for better decision making by the public, the media, emergency services etc. Forecasters will work a lot more in collaboration with Emergency Services, Politicians etc. This is a change from the traditional concept of the Forecaster as having only strong maths and science skills.

Scenario: The Forecaster as an analogy to an airline pilot

image courtesy BOM

image from Wikipedia

Summary

Australian Government
Bureau of Meteorology

- Introduced the content of Science Week 2015
- Discussed the future role of humans in Weather Forecasting
  - More emphasis on short-term forecasting
  - Crucial to keep analysis / diagnosis / prognosis skills "sharp"
  - Managing high-impact, severe weather forecasting
  - Rescuing NWP from major errors.
  - Forecaster as a "communicator" to the stakeholders
  - Forecaster – airline pilot analogy.

References (1)

Stuart et al. 2006: "The Future of Humans in an increasingly Automated Forecast Process". American Meteorological Society Essay, BAMS, November 2006

http://www.ametsoc.org/boardpges/bogm/forecasterforum.html

This Forum has many posts, including the following referenced here

- Human forecasters and technology. Harold Brooks (1)

- The Possible Future Role of Humans in Weather Forecasting. Harold Brooks (2)

- The role of diagnosis in weather forecasting. Charles A. Doswell III and Robert A. Maddox

- The human element in weather forecasting. Charles A. Doswell III

References (2)

"Canada's Project Phoenix", an "Aviation Week 2012" presentation by Patrick McCarthy. Link on the Australian Vlab Centre of Excellence web page at http://www.virtuallab.bom.gov.au/archive/aviation-week-2012/