

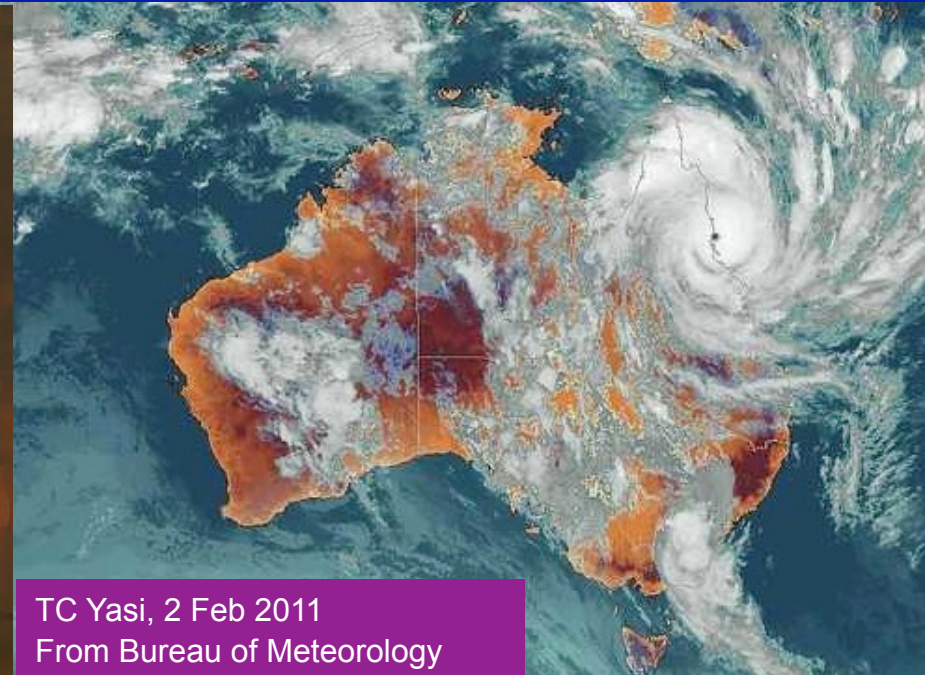
What is an extreme (weather or climate) event?

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Source: Hannah Phillips, Labertouche



TC Yasi, 2 Feb 2011
From Bureau of Meteorology

Overview

- What is an extreme event?
- Some definitions of weather and climate extremes
- Some recent examples of extreme events
 - 2009 heat waves and bushfires in SE Australia
 - 2011 heavy rainfall and floods

What is an extreme event?

Oxford Dictionary definitions:

- **Extreme:**
 - Reaching a high or the highest degree, very great
 - Not usual; exceptional
 - Very severe or serious
- **Event:** a thing that happens or takes place, especially one of importance

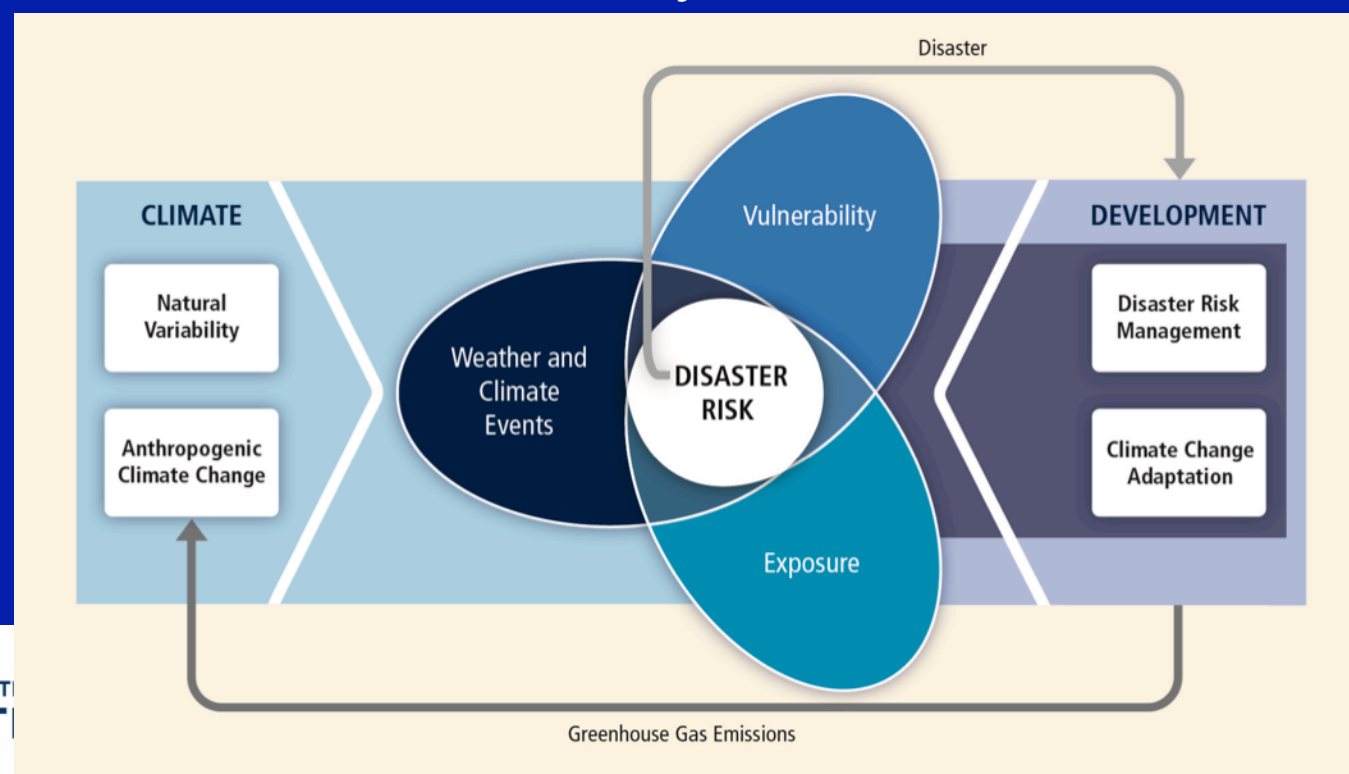
What could this be in the weather and climate context?
Discuss some extreme events relevant to your region.

Weather and climate extremes

Extreme event - the occurrence of a value of a weather variable above (or below) a threshold value near the upper (or lower) ends of the range of its observed values in a specific region.

Return period - An estimate of the average time interval between occurrences of an event (e.g., flood or extreme rainfall) of a defined size or intensity.

From IPCC
Special Report on
Extremes (2011)



Weather and climate extremes

- Very wide range of space and time scales
- Language used in climate science is not very precise
 - High impact (but not really extreme)
 - Exceedance over a relatively low threshold
eg 10th, 90th percentile of daily temperature or precipitation
 - Rare events (long return period)
 - Unprecedented events (in the available record)
- Range from very small scale (tornadoes, hail storms) to large scale (drought, heat waves)
- Extremes in one location may be normal in another

Weather and climate extremes

“Every year, disasters related to weather, climate and water hazards cause significant loss of life and set back economic and social development by years, if not decades.”

“From 1970 to 2012, 8,835 disasters, 1.94 million deaths and US\$ 2.4 trillion of economic losses were reported globally as a result of droughts, floods, windstorms, tropical cyclones, storm surges, extreme temperatures, landslides and wildfires, or by health epidemics and insect infestations directly linked to meteorological and hydrological conditions.”

*From WMO (2014) **Atlas Of Mortality And Economic Losses From Weather, Climate And Water Extremes (1970–2012)***

2009 heat waves and bushfires in SE Australia

On 7 February 2009, Australia experienced its worst natural disaster, when bushfires near Melbourne killed more than 170 people and destroyed more than 1800 homes.



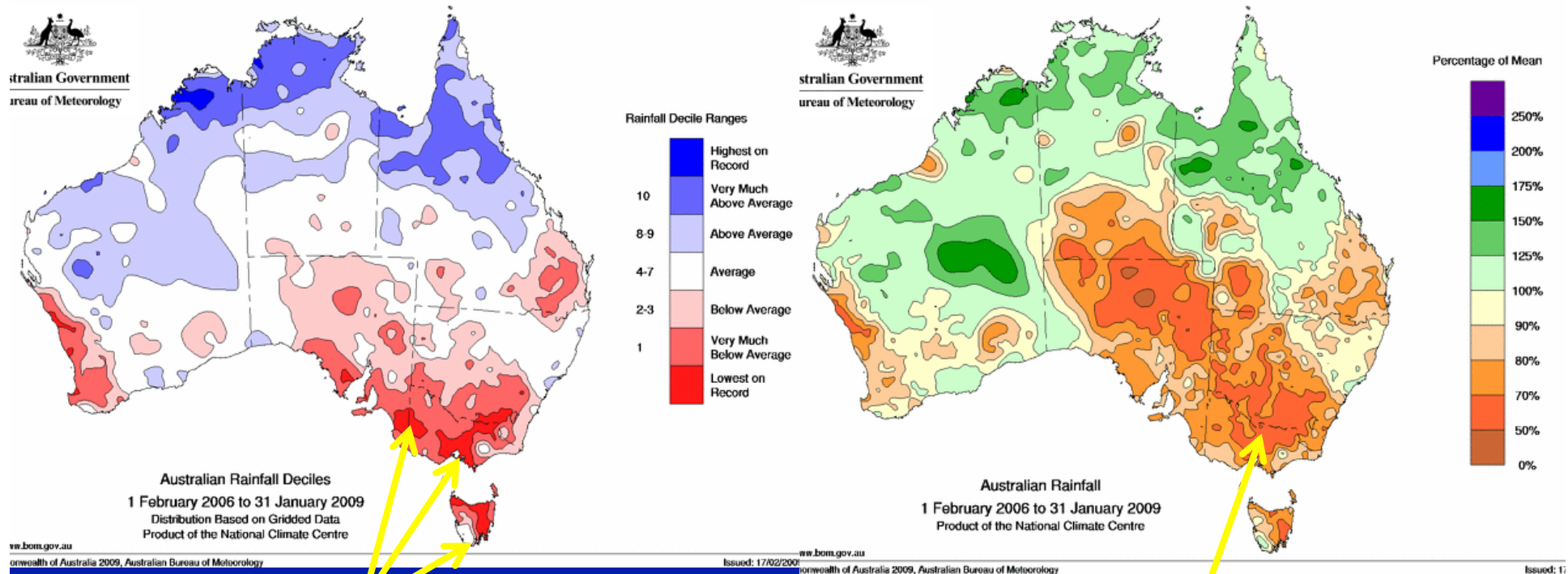
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Source: Hannah Phillips, Labertouche

The Australian setting 2009: long drought

(reds and oranges dry; blues and greens wet)

Rainfall deciles (3 year anomaly) 3 year rainfall % of normal



Lowest on record

~50% - 60% of normal
ie, we have missed out on over 1 year
of rainfall in 3 years

Stage 1: Record temperatures during Monday 26 to Friday 30 January 2009

Record temperatures in many parts of SE Australia

This week, Melbourne set three temperature records:

- a new record for mean temp $(\text{Max} + \text{Min})/2$,
- Friday was the second hottest day (max temp of 45.1°C) on record, and
- three successive days of max temperatures above 43°C for the first time in recorded history.



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Animals through SE Aust experienced heat stress



Picture circulated on Internet

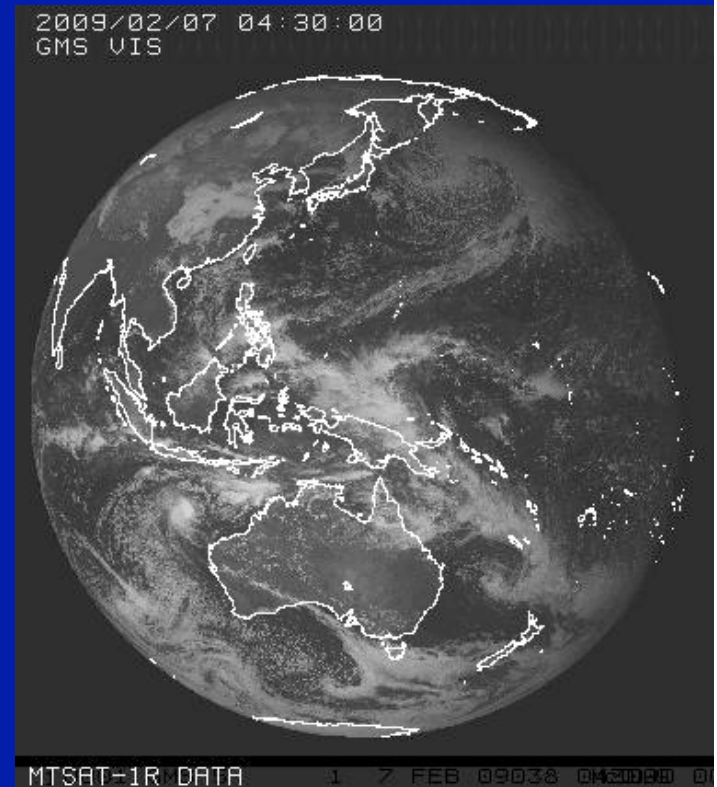
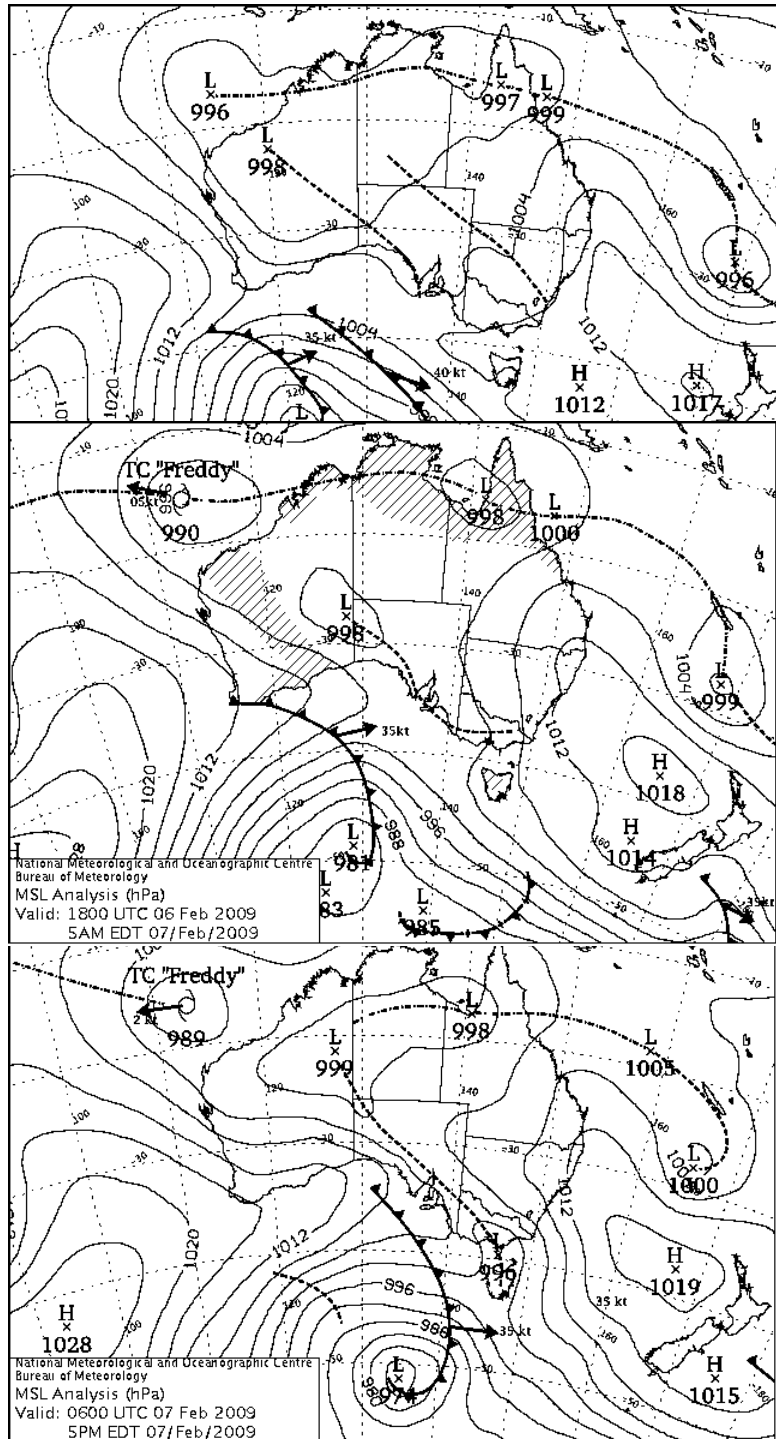
MSLP charts

Second stage of heat wave

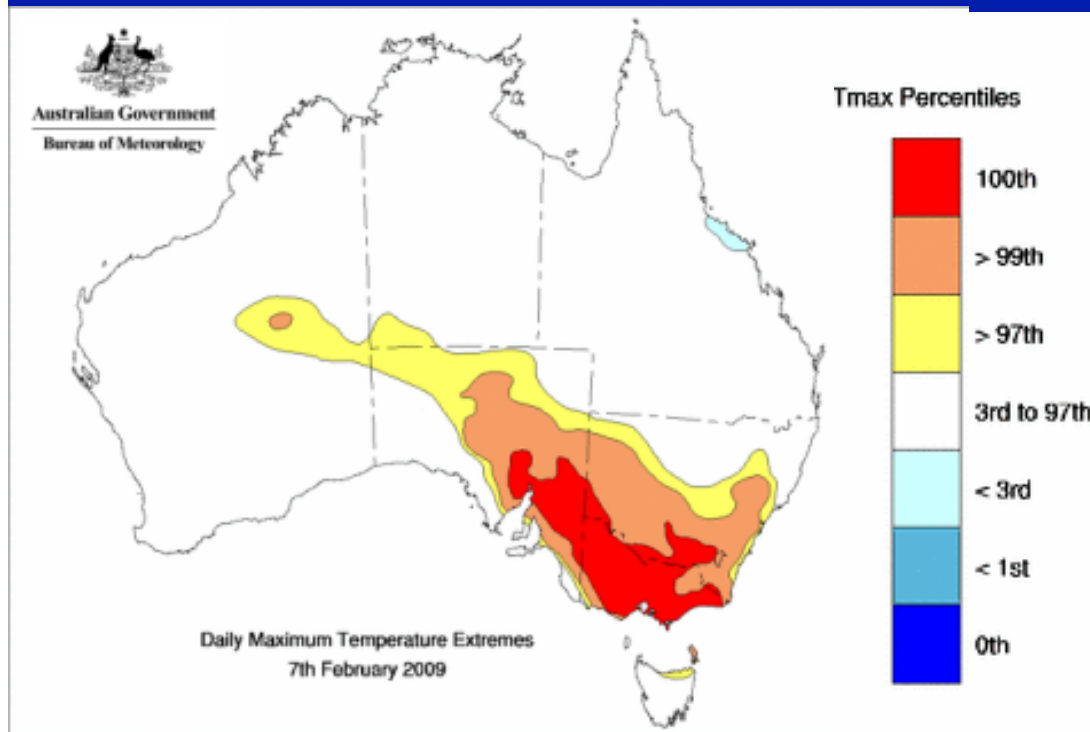
6 Feb 06UTC

6 Feb 18UTC

7 Feb 06 UTC



Stage 2: Widespread records set on 7 Feb 2009



Victorian state record at Hopetoun (48.8) – world record for so far south, as was Avalon (47.9)

8 Victorian sites broke previous all-time record (47.2), 14 previous Feb record (46.7), 33 pre-2004 Feb record (45.6)

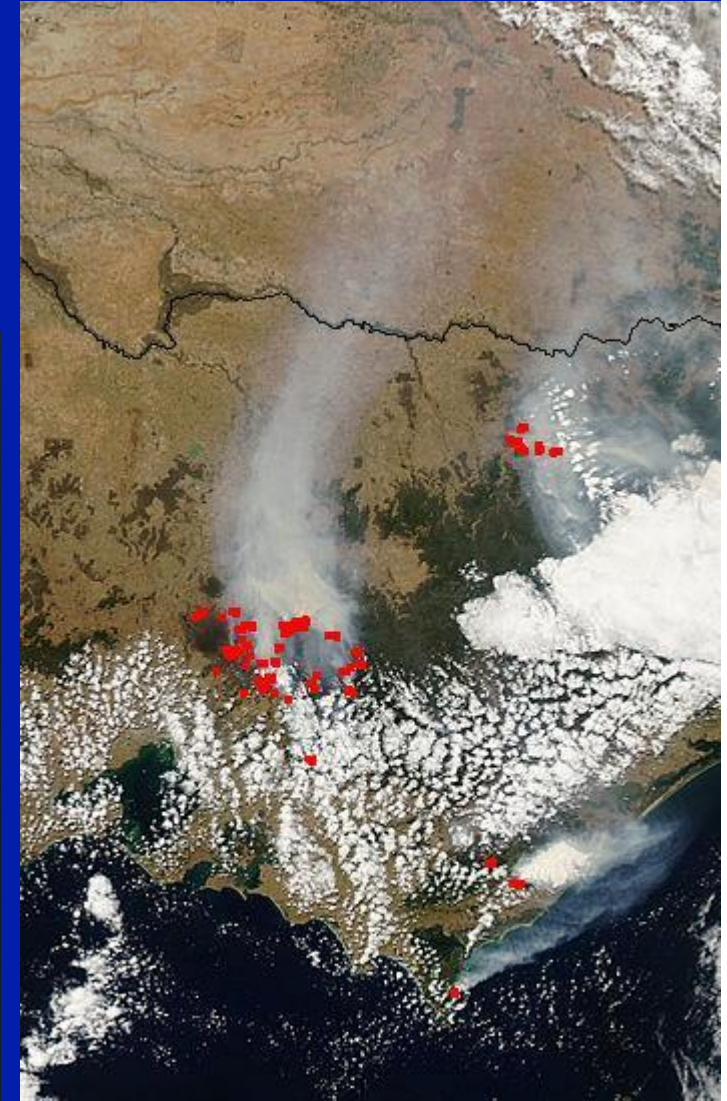
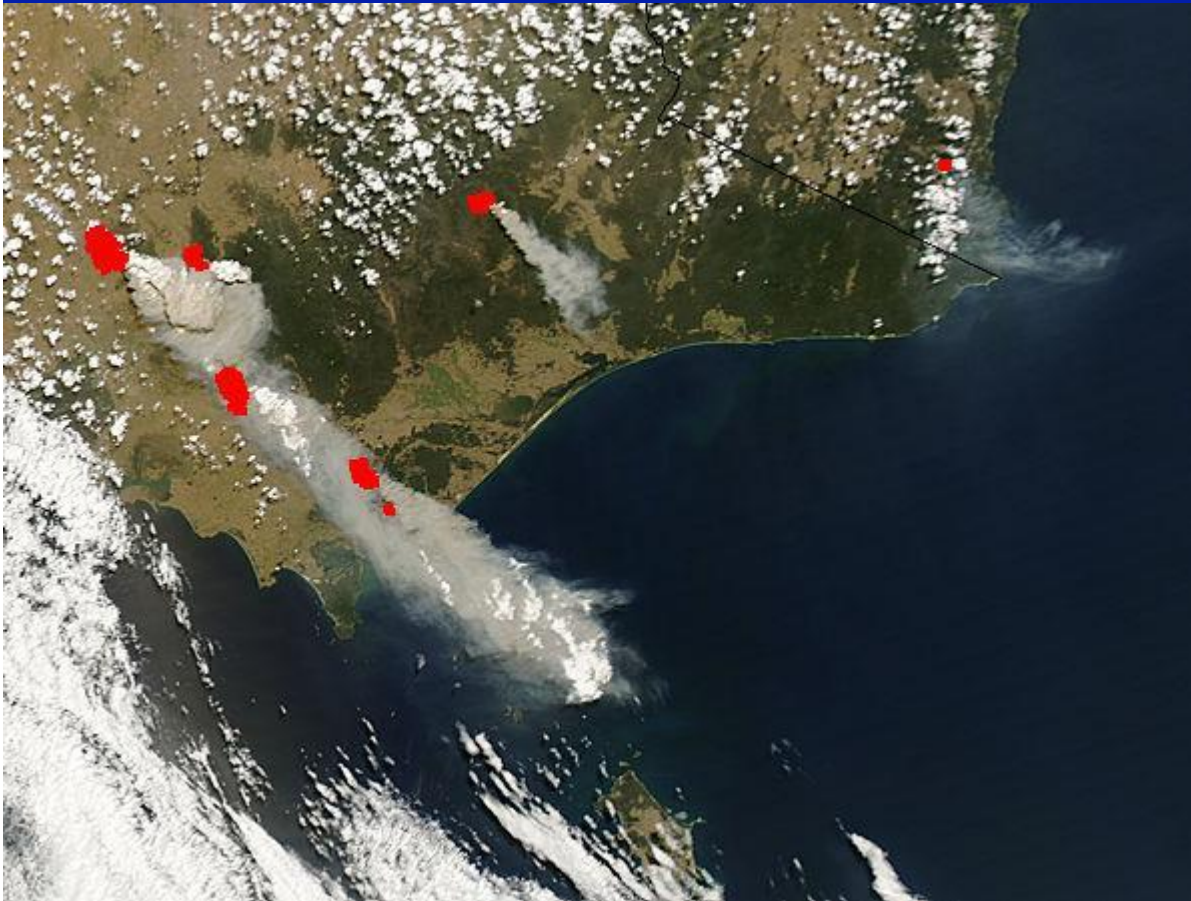
All-time record at Melbourne (46.4°C) – broke old all-time record by 0.8 and old Feb record by 3.2.



From www.smh.com.au/photogallery/2009/02/07/1233423569062.html, <http://www.theage.com.au/photogallery/2009/02/09/1234027920316.html> <http://www.abc.net.au/news/events/bushfires/>



Modis fire images (NASA)



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Climate drivers and bushfires

Bushfires are a regular occurrence in SE Australia with previous disastrous fires on

- Ash Wednesday, 16 February 1983
- Black Friday, 13 January 1939

Associated with very dry preceding conditions, very high temperatures, very strong NW winds ahead of a cold front, and then a sudden wind change followed by strong SW winds

Fire danger rating from FDI

Fire danger rating used by fire fighting agencies to warn of fire danger based on forecast weather conditions

FDI scale based on FDI = 100 on Black Friday, 13 January 1939

Fire danger rating	FFDI range	Suppression
Very high	25 to 50	Initial efforts generally fail but may succeed
Extreme	> 50	Virtually impossible

Unprecedented FDI of 140 to 190 at different sites on 7 February 2009

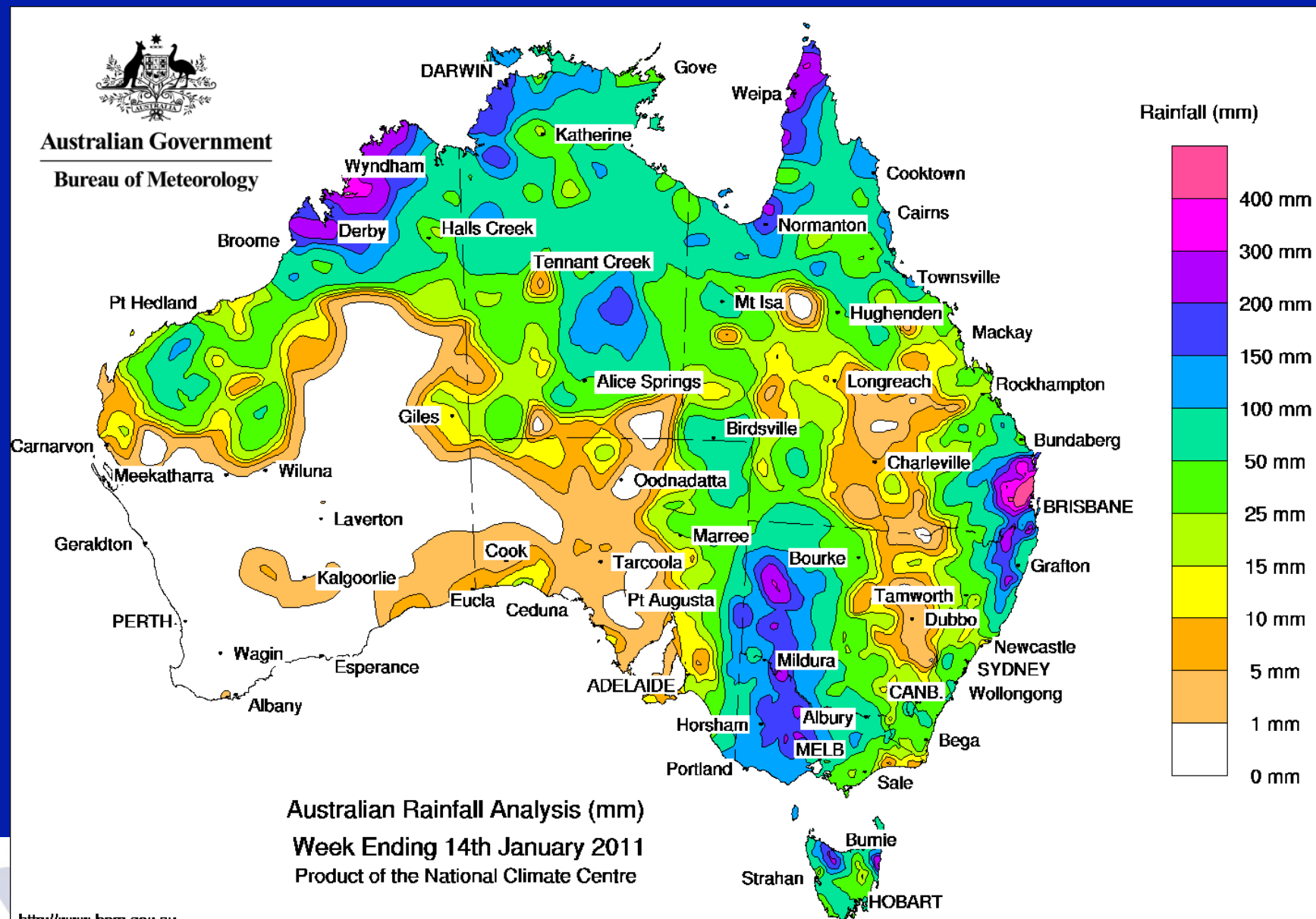
Extreme weather events 2010-11

- Heavy rainfall events in Queensland and Victoria
- Flooding in eastern Australia
- Cat 5 TC Yasi making landfall on north Qld coast

Special Climate Statements from Bureau of Meteorology <http://reg.bom.gov.au/climate/current/special-statements.shtml>

10 statements issued in 2010-11, usually 1 to 3 per year

Rainfall totals 8-14 Jan 2011



Queensland floods Jan 2011



Toowoomba and Lockyer valley flash floods, 10 Jan 2011

- 10-12 Jan: “An upper-level low combined with a humid easterly flow to bring very heavy rain to southeast Queensland and northeast New South Wales” BoM SCS24b
- Highest daily total 298 mm on 10 Jan in Peachester
- Highest 3-day total 617 mm at Peachester
- Not record heavy rainfalls in SE Queensland
- Much heavier rainfall during 25-27 Jan 1974, with many 3-day totals in excess of 1000 mm
- 30 people killed in flash floods in Toowoomba and Lockyer valley

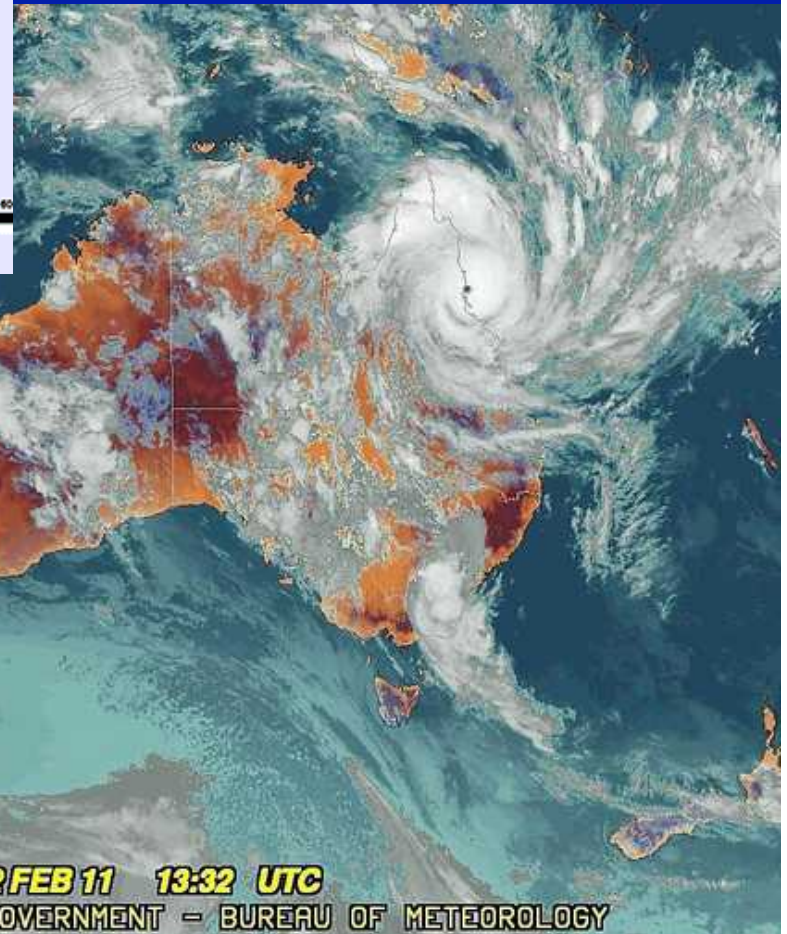
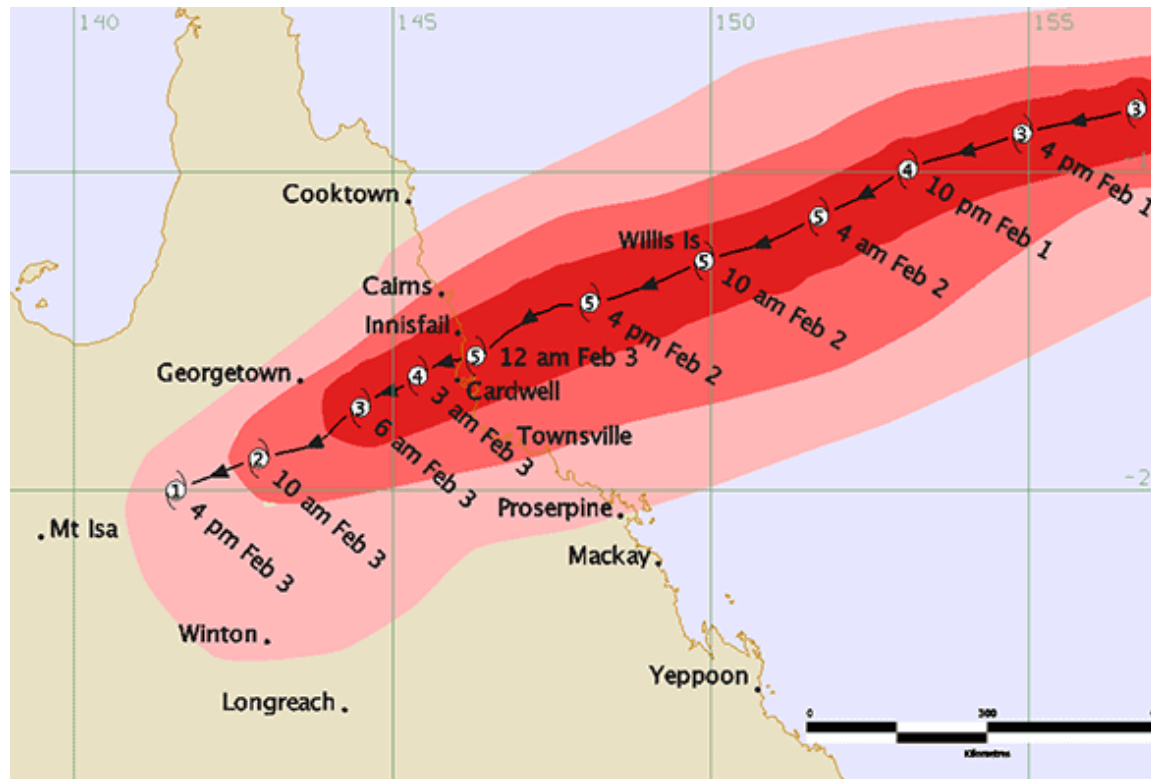
Brisbane floods, 13 Jan 2011

- Very heavy rainfall in Brisbane River catchment during 10-12 Jan
- Flood peak of 4.46m on Brisbane River, flooding thousands of homes and businesses in Brisbane
- Higher flood peak on Brisbane R in Jan 1974 of about 5.6m
- Brisbane's three-day and peak one-day totals of 600 mm and 314 mm in 25-27 Jan 1974 comparing with 166 mm and 111 mm in 2011 (BoM SCS24b)

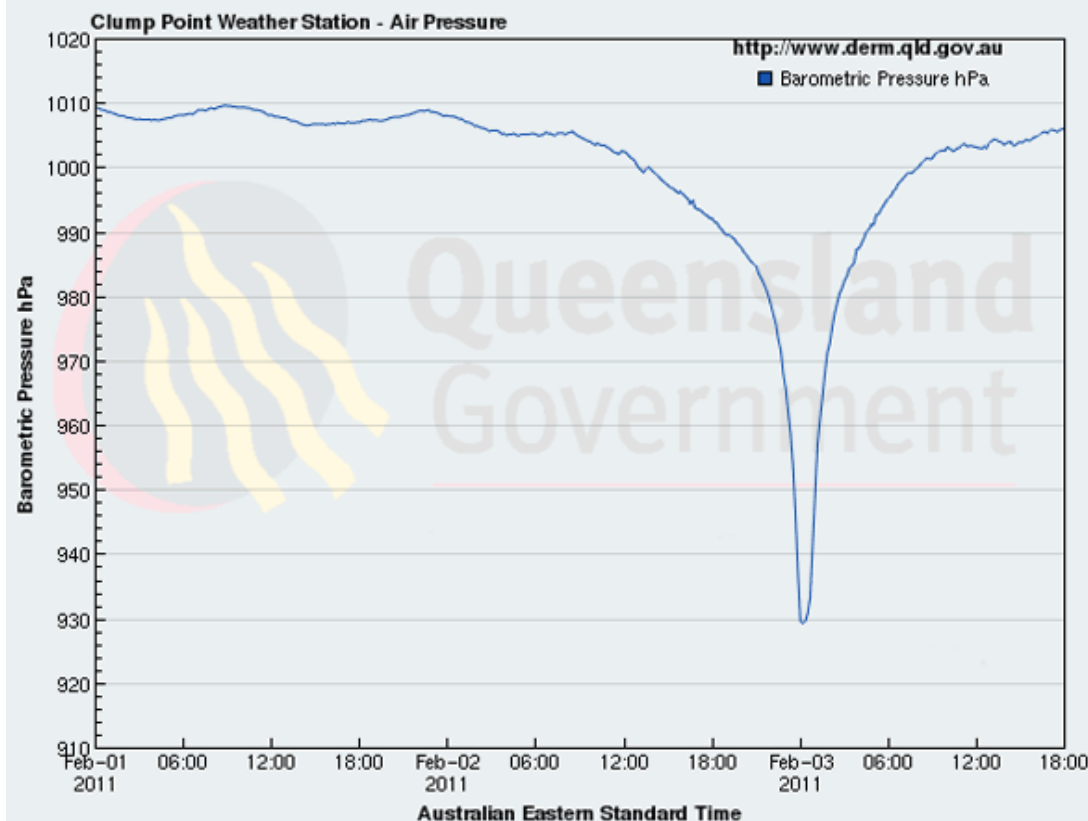
Victorian floods, 12-14 Jan 2011

- “Tropical air was drawn into a trough near the eastern border of South Australia, placing much of Victoria, Tasmania and western New South Wales in an extremely moist air mass” (BoM SCS24b)
- Record daily rainfall in Jan: 161 mm Jeparit (Vic) on 12 Jan, 282 mm Falmouth (east coast of Tas) on 13 Jan
- Exceptionally high moisture content of the atmosphere for such a southern location. The total precipitable water in the atmosphere at Melbourne on 13 Jan was 65.0 mm, well in excess of the previous record of 54.5 mm

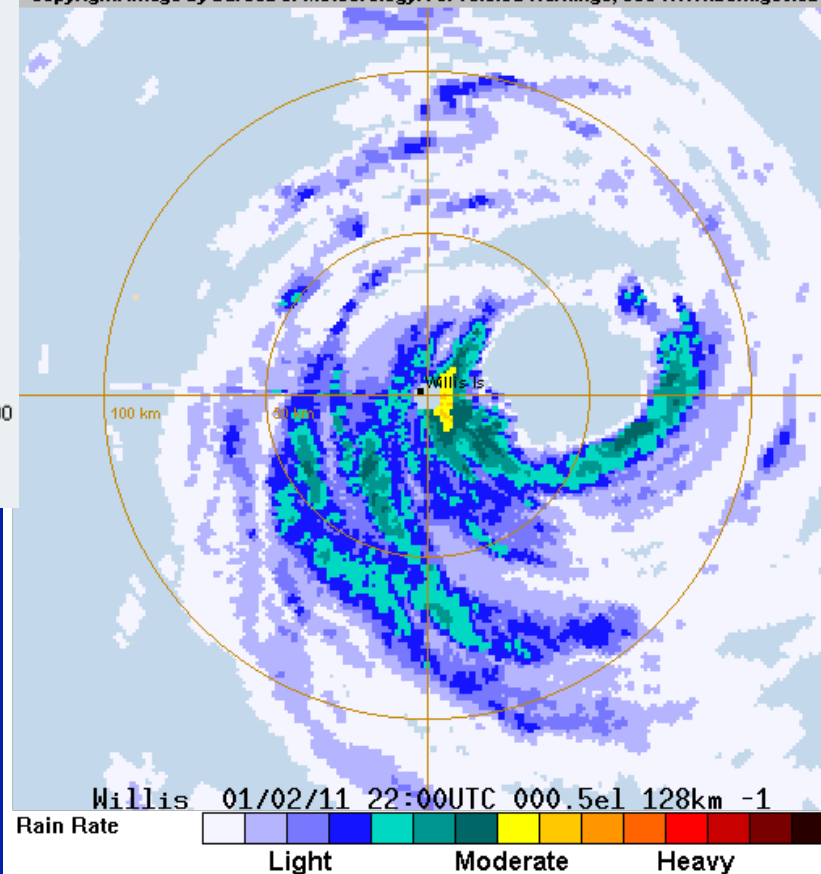
Severe TC Yasi 1 - 3 Feb 2011



Severe TC Yasi 1 - 3 Feb 2011



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Severe TC Yasi 1 - 3 Feb 2011



Cardwell, near Mission Beach

Dunk Island resort



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Summary

Extreme weather and climate events are important because of their impacts but are difficult to quantify because they are rare and occur across multiple scales.

Different extremes are likely to affect specific regions.

References

IPCC Special Report on Extremes (2012) *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*

WMO (2014) *Atlas Of Mortality And Economic Losses From Weather, Climate And Water Extremes (1970–2012)*