



Australian Government

Bureau of Meteorology

Four Degrees or More?

Australia in a Hot World

Sidney Myer Asia Centre, Parkville, Melbourne

12th-14th July 2011

Australia at Four Degrees: Changes in Extreme Weather

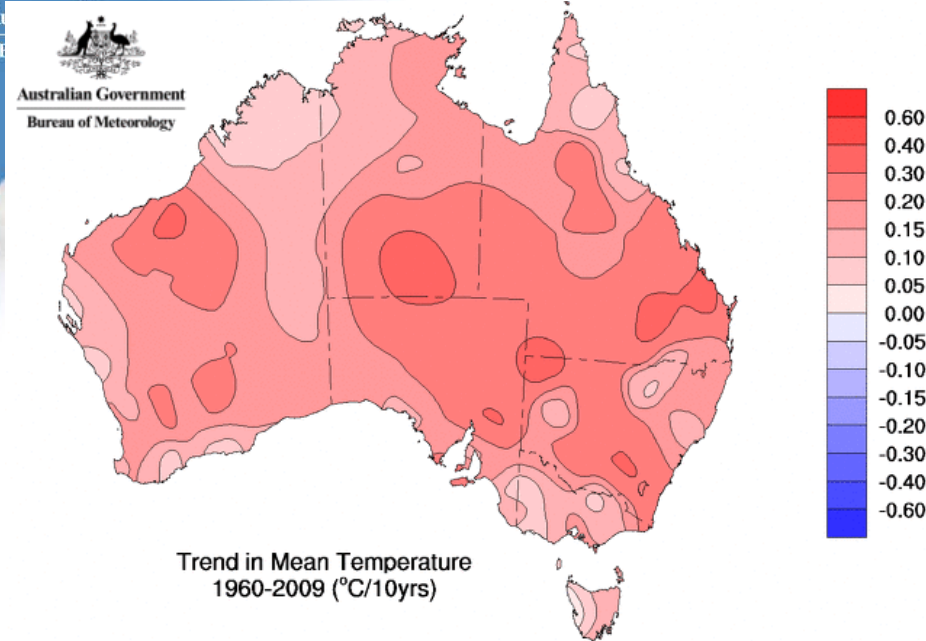
Dr Karl Braganza

Climate Monitoring Manager

Bureau of Meteorology, National Climate Centre



Australian Land Temperatures



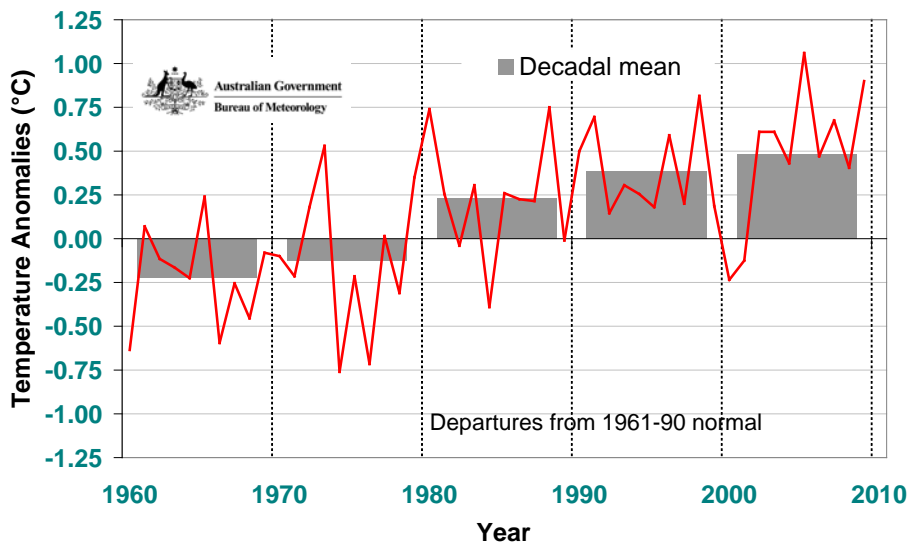
All of Australia has experienced warming over the past 50 years

Some areas, have experienced a warming of 1.5 to 2 °C

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Issued: 28/01/2010

Annual and Decadal Mean Temperature Anomalies For Australia

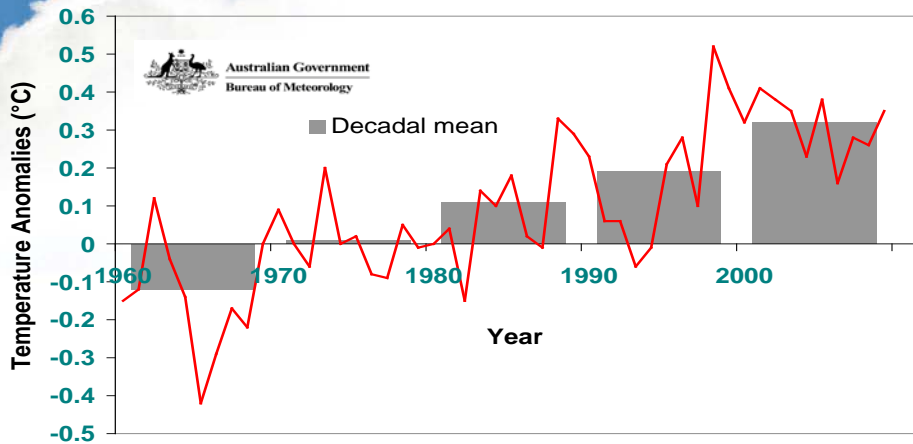


Warming, as measured by decadal averages, has been constant since the middle of last century

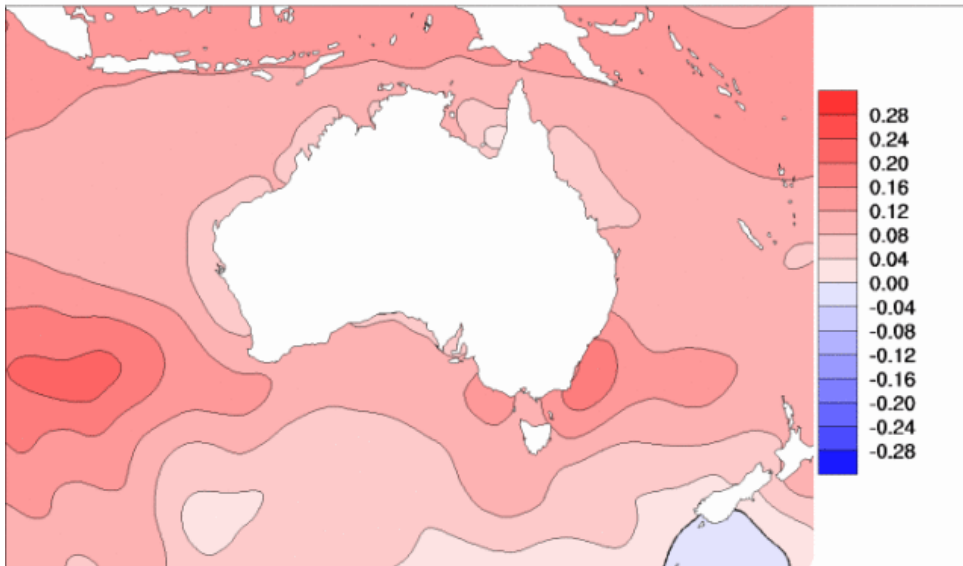


Australian Sea Surface Temperatures

Annual and Decadal Sea Surface Temperature For Australian Region



Trend in SST for the Australian Region (°C/10 yrs) annual 1960-2009



Sea Surface Temperature Increases are consistent with terrestrial warming.

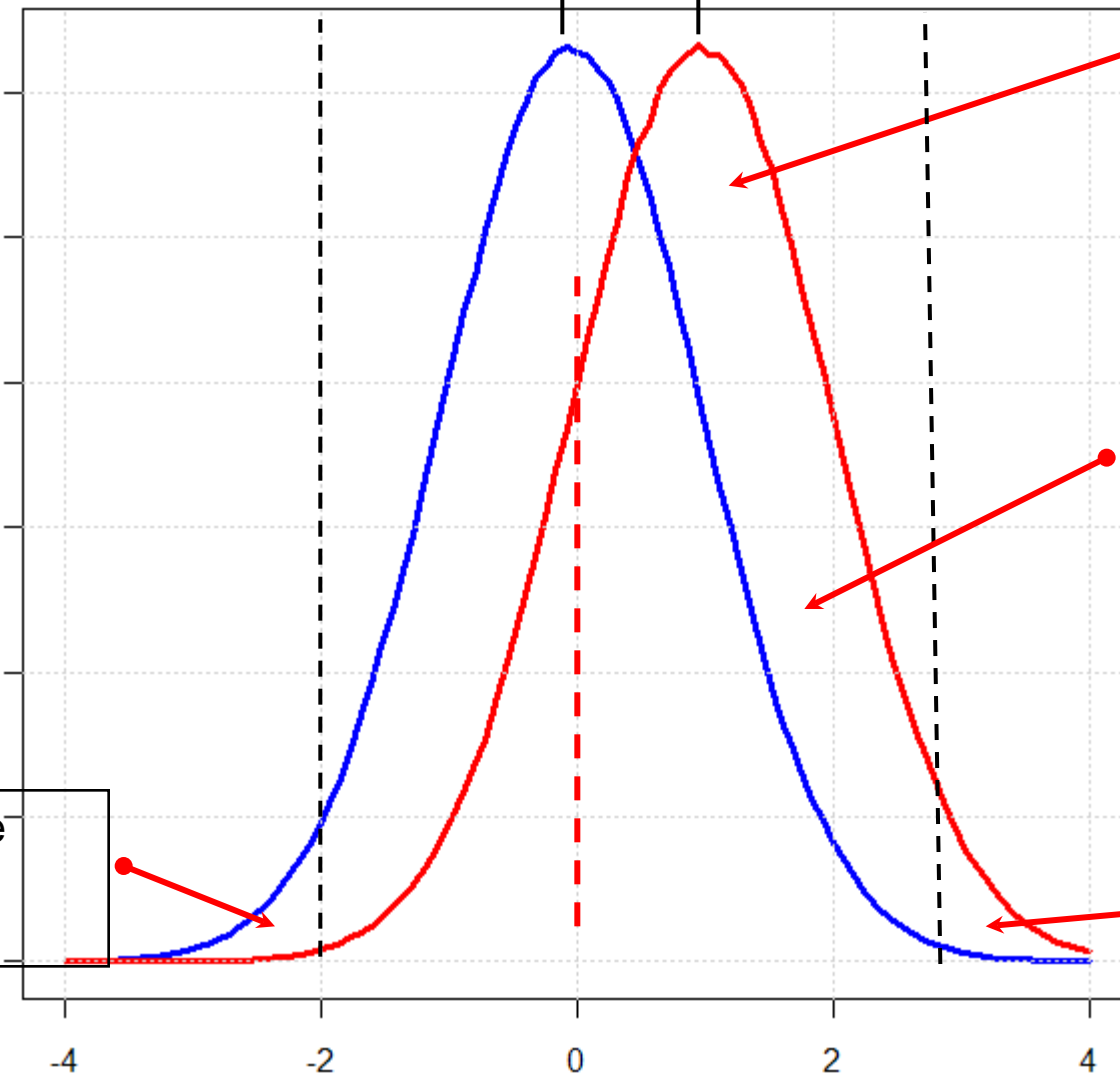
Warming in some areas has reached up to 1°C

Instrumentation associated with ocean monitoring is very different to those on the land.

Shift in the frequency of warm weather events

1955 → 2005

Number of days per year



Increase in the average maximum temperature

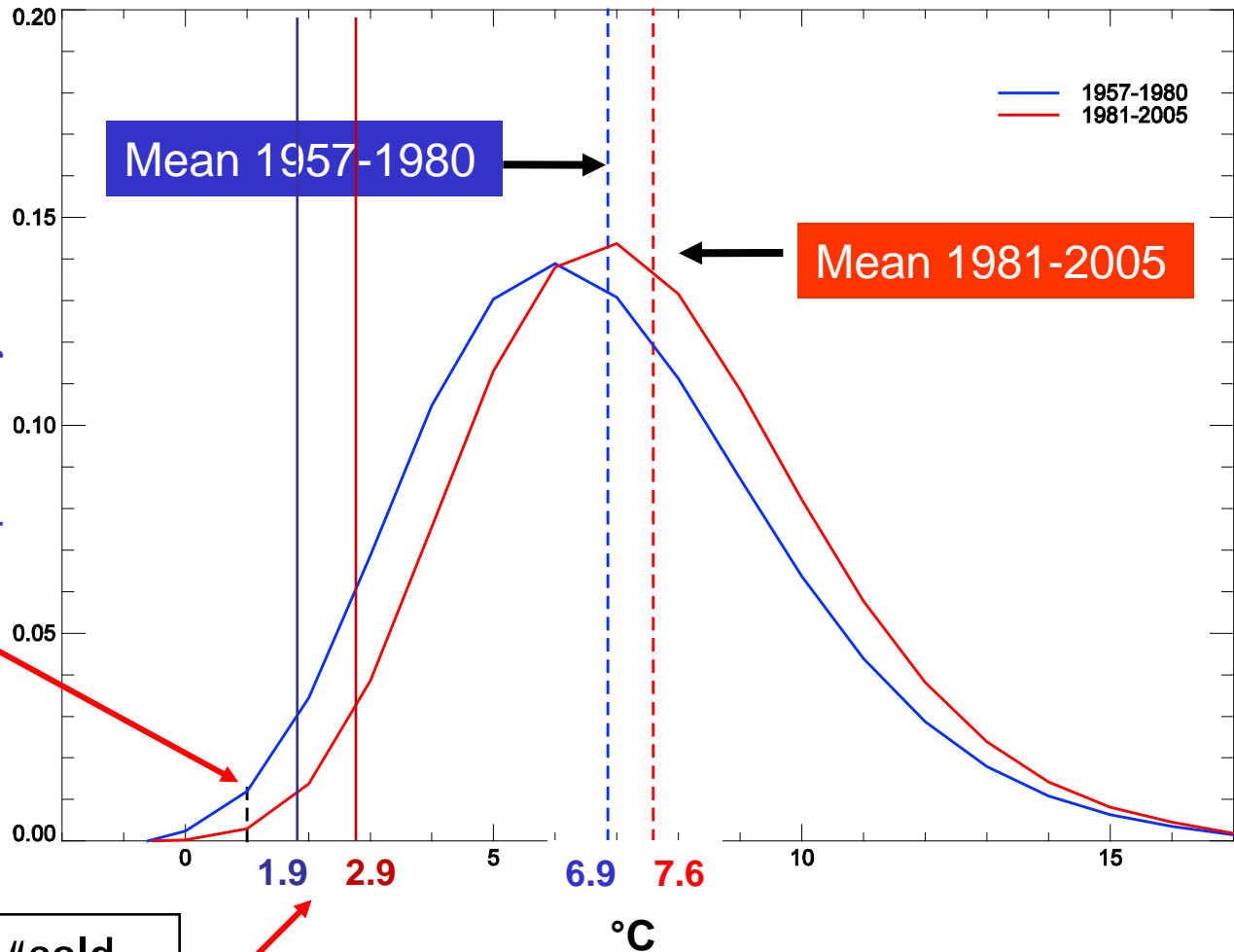
Same old warm weather; but much more of it

Weather we don't see anymore

Weather that is outside our historical experience

Maximum Temperature Anomaly (Degrees)

Melbourne Winter Night Time Temperatures

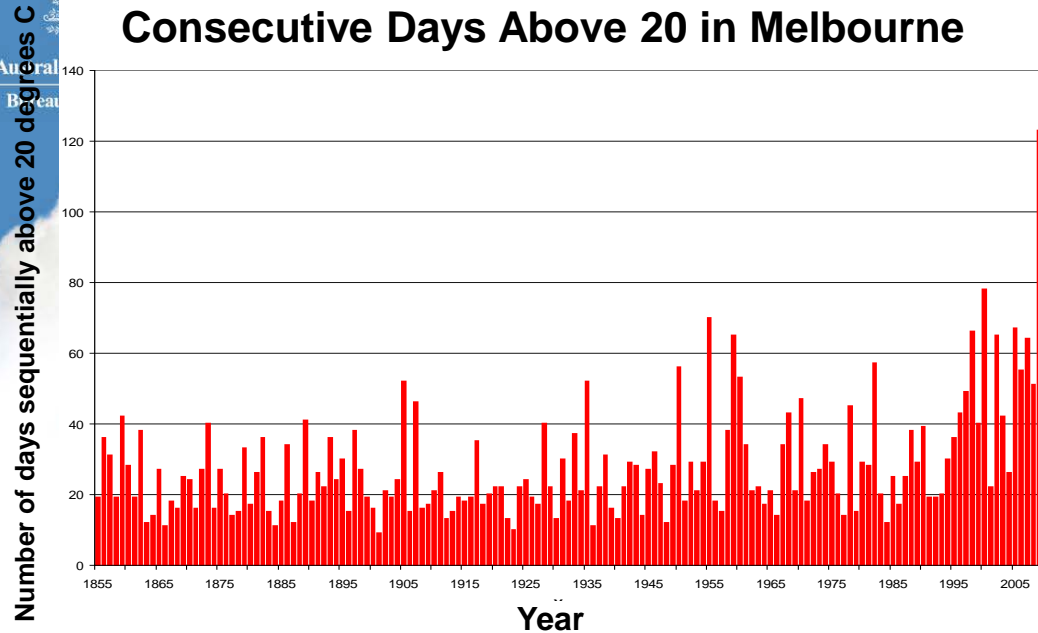


Average winter warming has led to a substantial decrease in probability of temperatures < 1°C

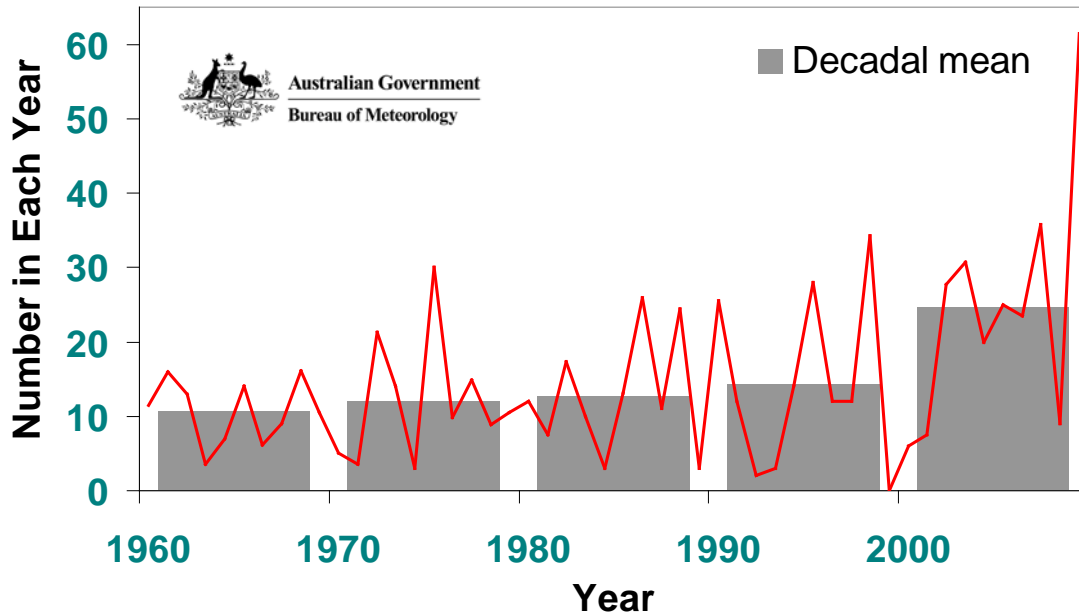
The number of "cold nights" has halved

Changes Temperature Extremes

Locations across Australia
have experienced less cold
weather in recent decades



Australian Maximum Temperature Records

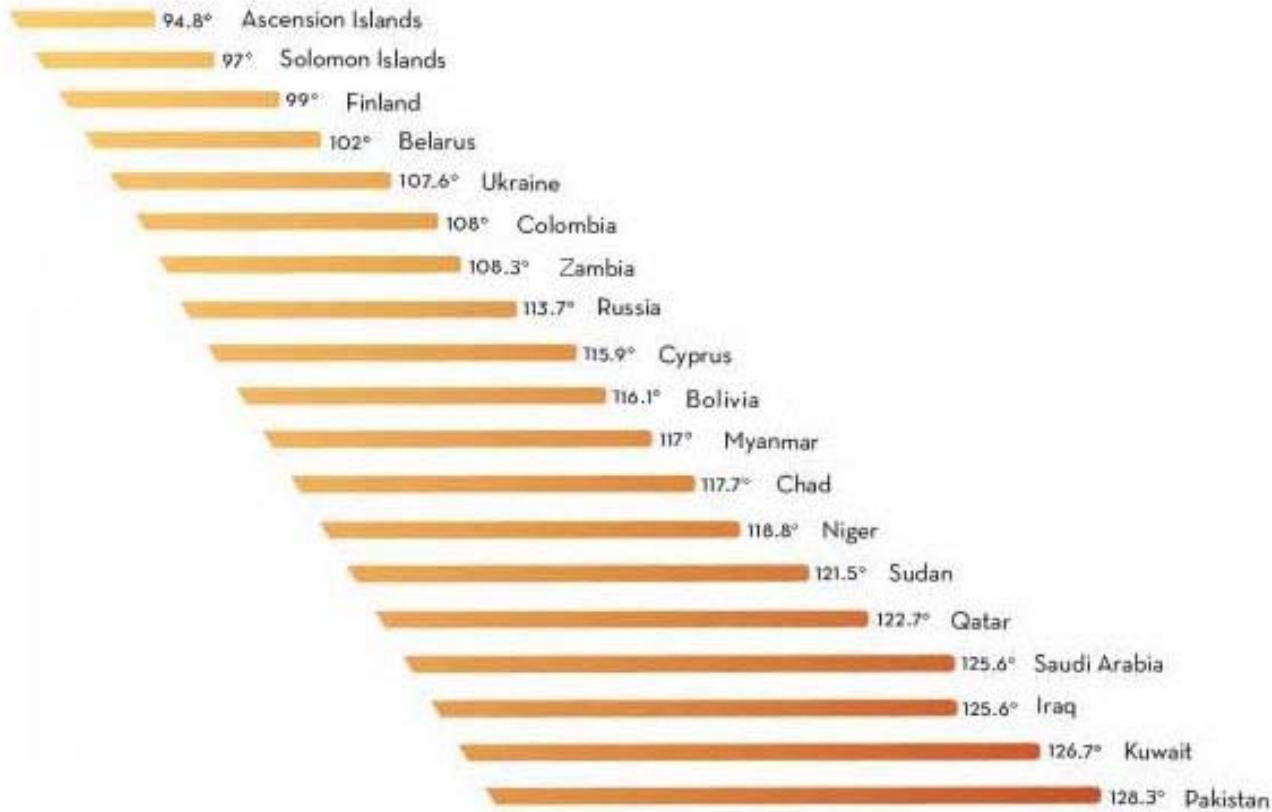


There is a trend in record heat
events for Australia.

More sites recorded highest
daily maximum temperatures
in 2009 than in any other year

A Record Number of Record Heatwaves

COUNTRIES THAT SET NEW RECORD HIGHS IN 2010



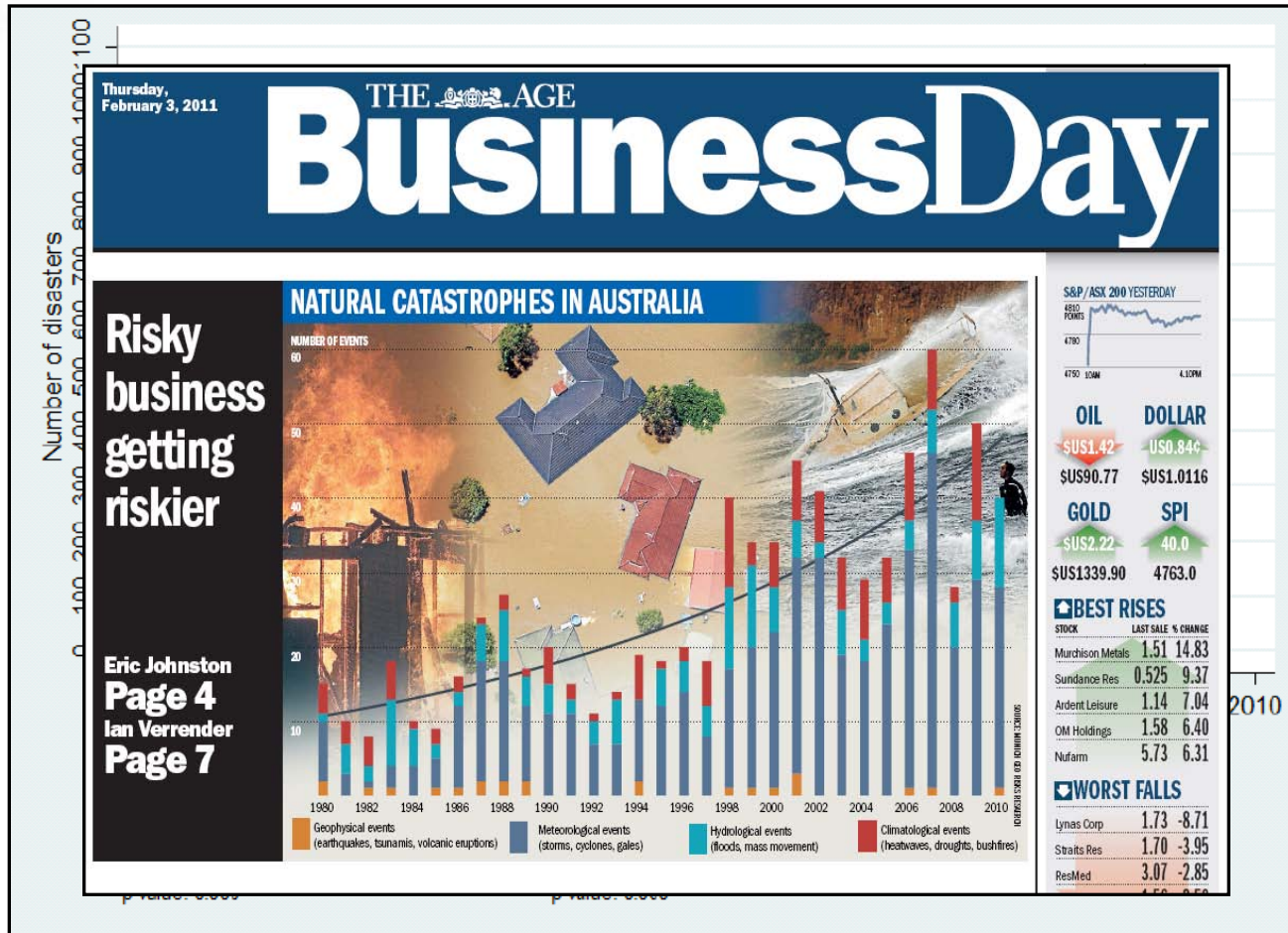
ALL TEMPERATURES IN DEGREES F

SOURCE: WEATHER UNDERGROUND/JEFF MASTERS

In 2010 - 19 countries set highest temperatures on record.

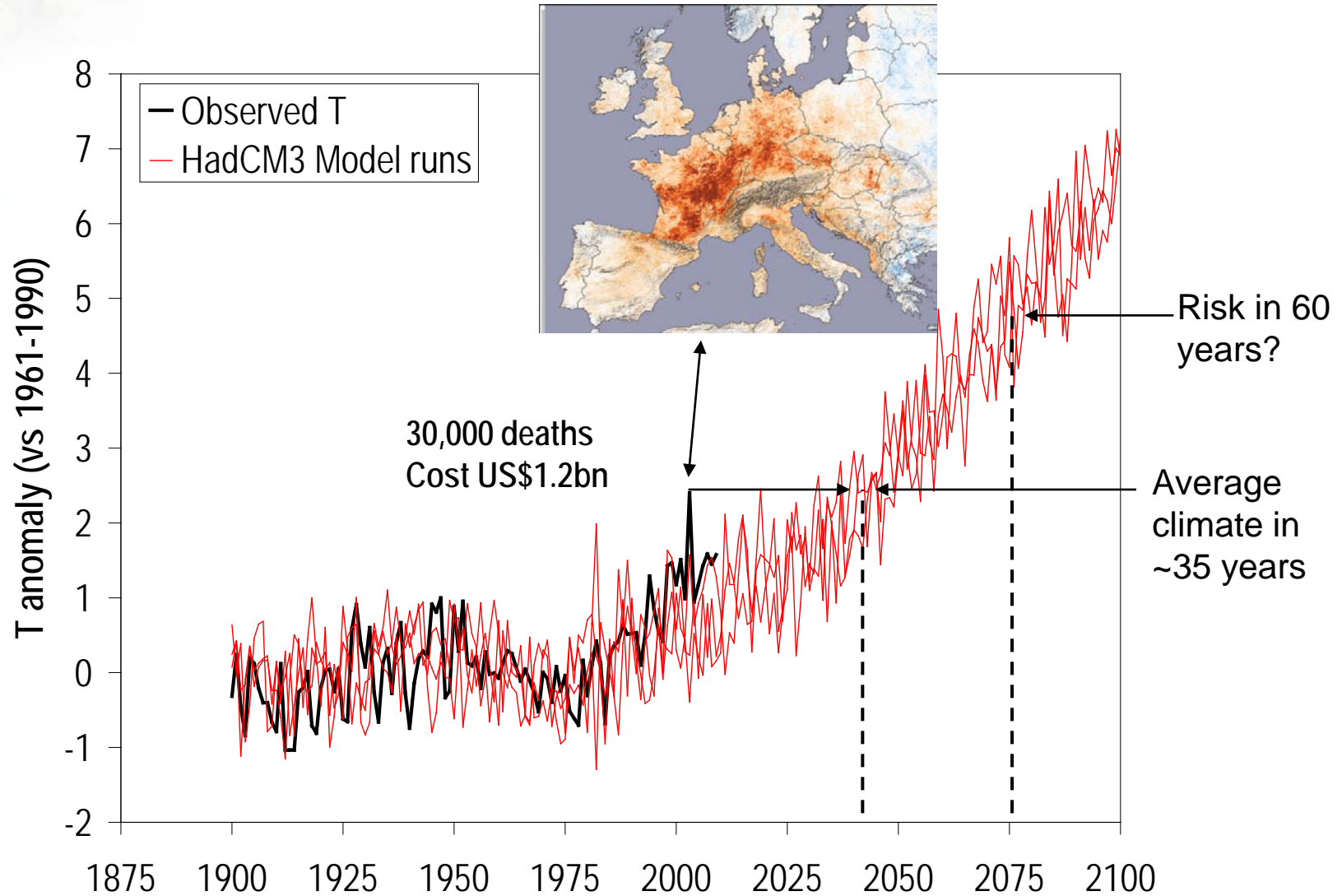
1 country set coldest temperatures on record.

Are Global Weather & Climate *Disasters* Escalating?



Count of weather disasters suggests so – from Munich Re (Neumayer and Barthel 2011)

Consider the European Heat Wave of August 2003 Observed Temp. 10W-40E, 10N-50N

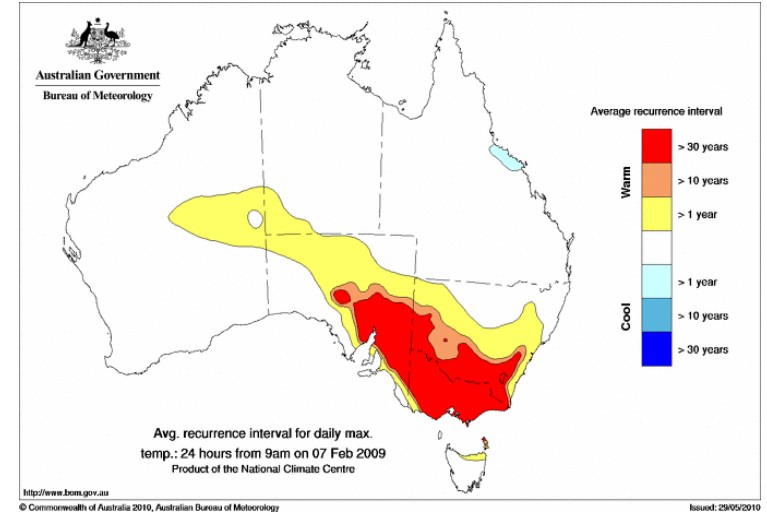
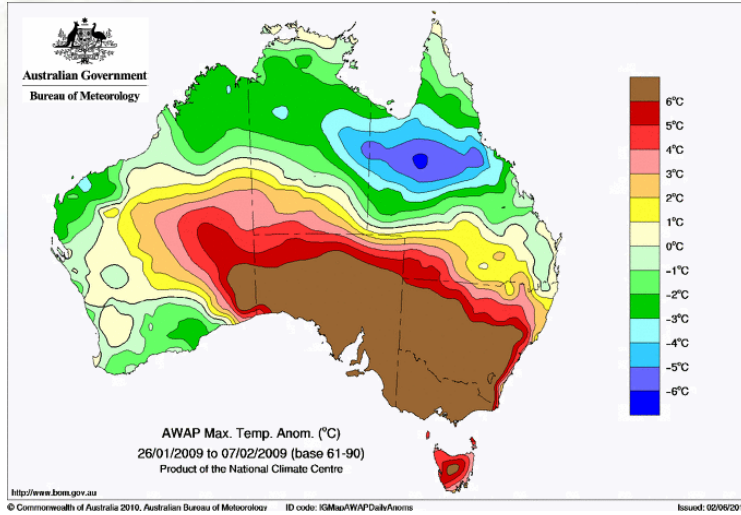


Case Study- Black Saturday Heatwave and Bushfires

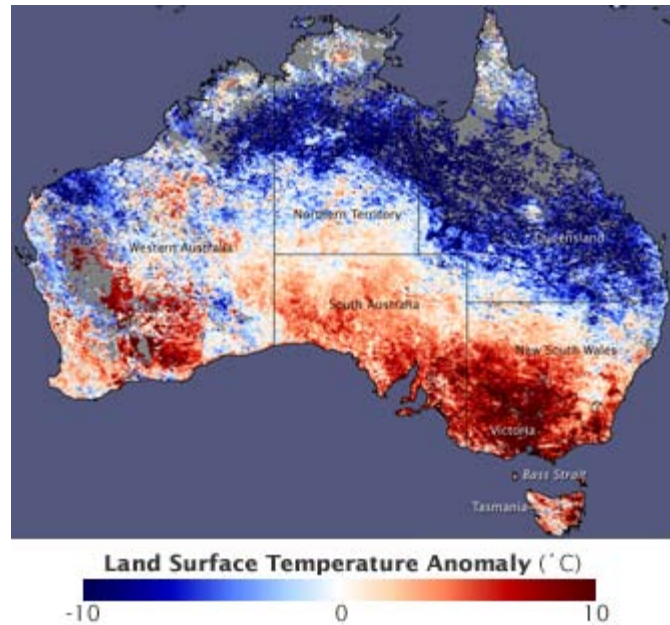
- Record heatwave across south-eastern Australia
- Severe and prolonged drought
- Record daytime maximum temperatures.
- Record Fire Danger Black Saturday – 173 deaths, 414 serious injuries. Insured cost of ~\$1 billion.



"Black Saturday" Heat Wave



Temperatures more than six degrees above normal- with a record number of locations recording highest on record maximums

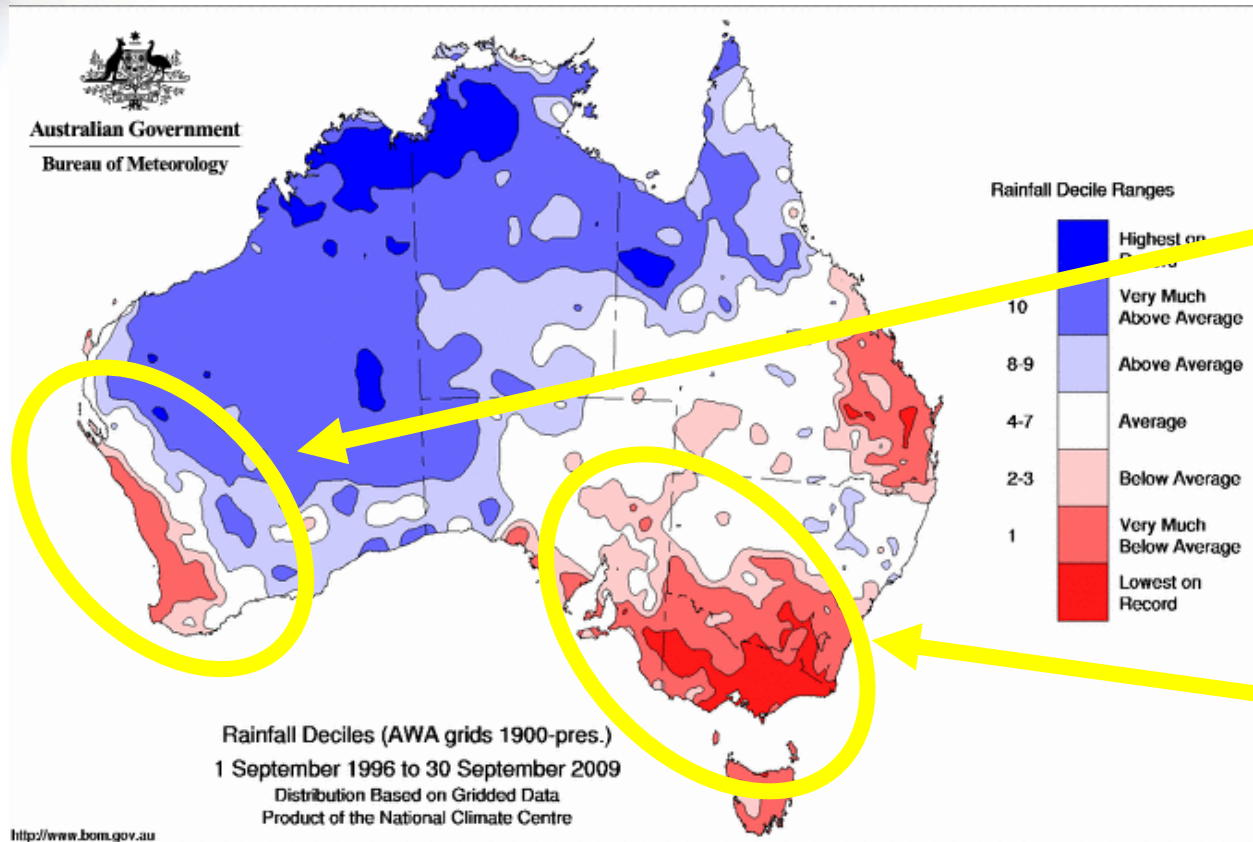


Once in a century event?

Heatwaves are extending in duration but not necessarily frequency across southern Australia

Severe and prolonged drought

Drying trend over southern Australia has possible links to climate change

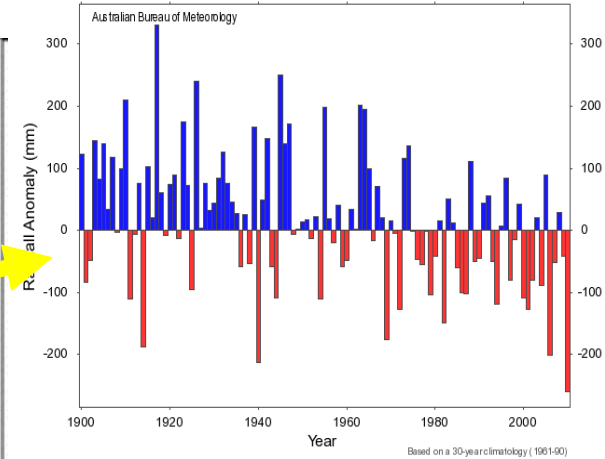


<http://www.bom.gov.au>

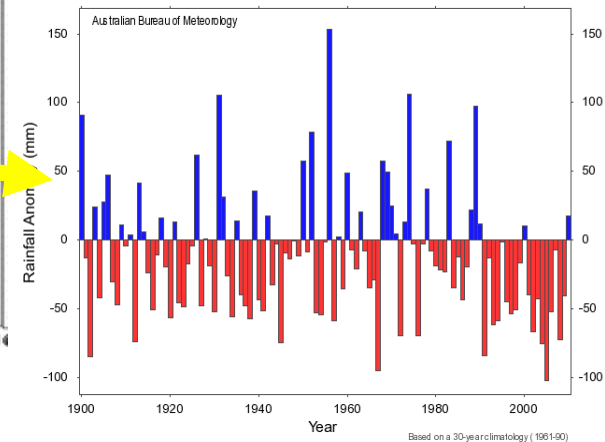
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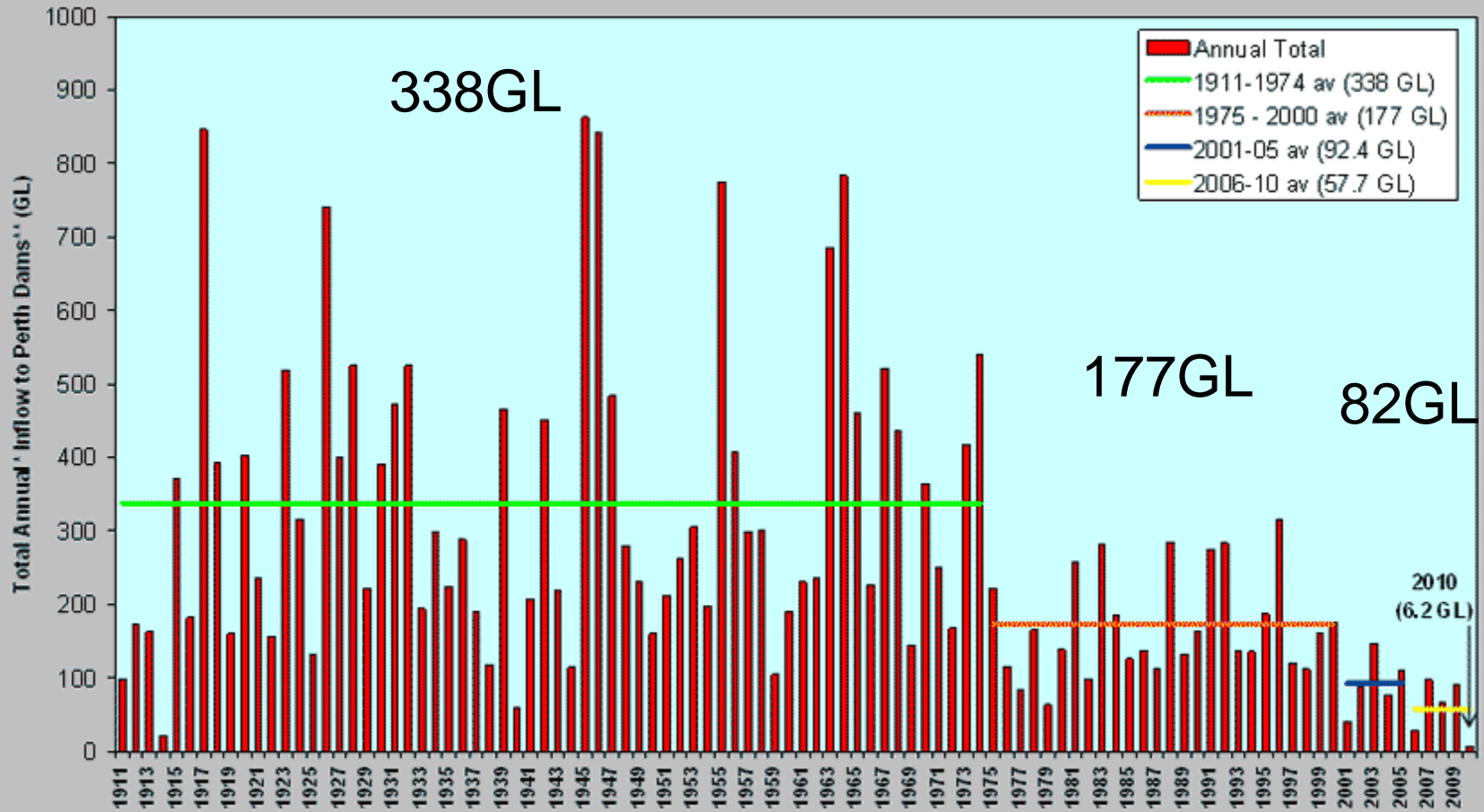
Southern Wet Season Rainfall Anomaly - Southwestern Australia



Autumn Rainfall Anomaly - Southeastern Australia



Drying has led to record low streamflow and water storage

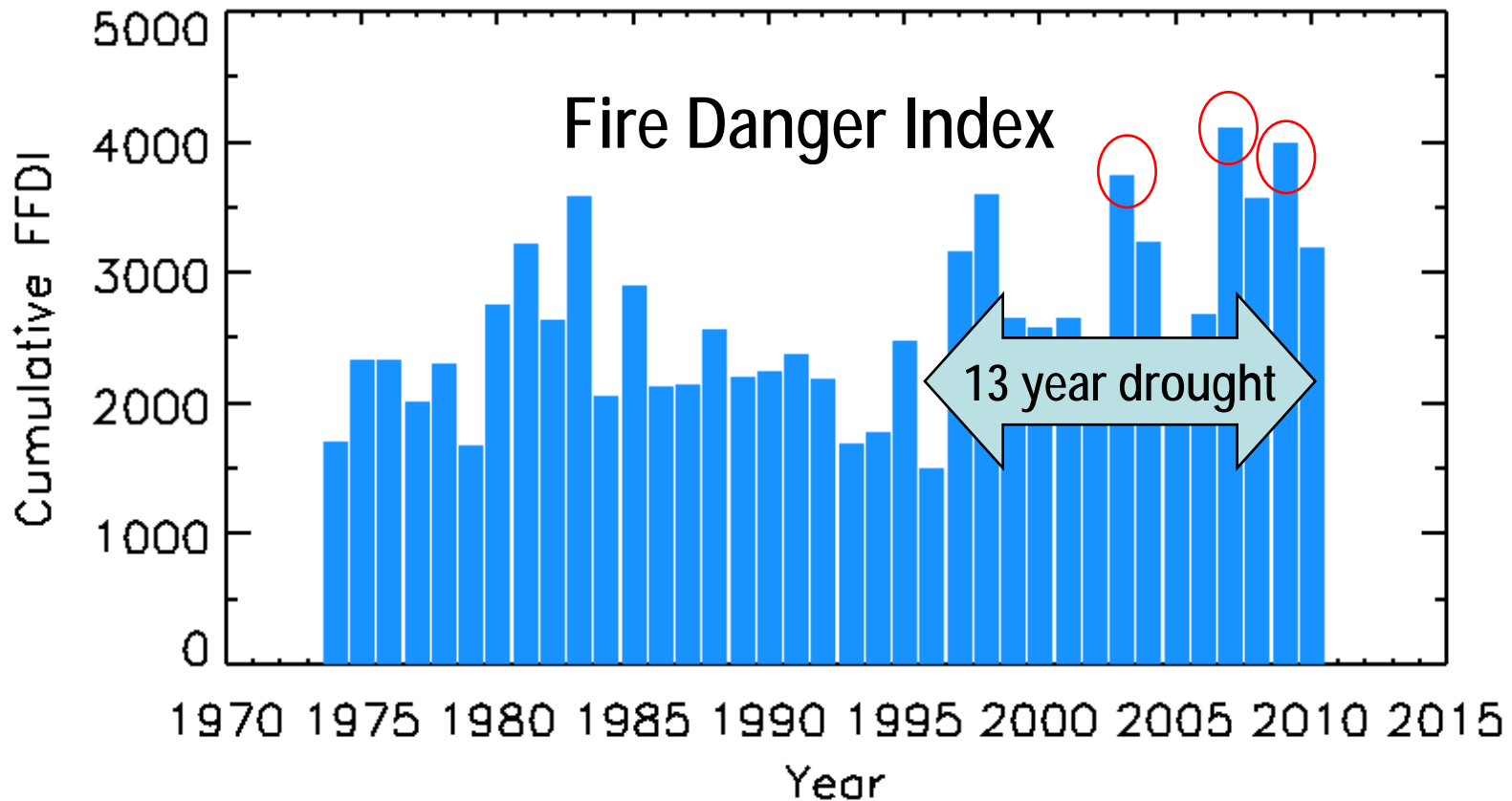


Notes: * year is taken as May to April and labelled year is start (winter) of year
** Inflow is simulated based on Perth dams in 2001 i.e. excluding Stirling, Samson & Wokalup

Collapse of Perth streamflow as a result of warming and drying

From: http://www.watercorporation.com.au/D/dams_streamflow.cfm

Prolonged Droughts and Higher Temperature = High Fire Danger



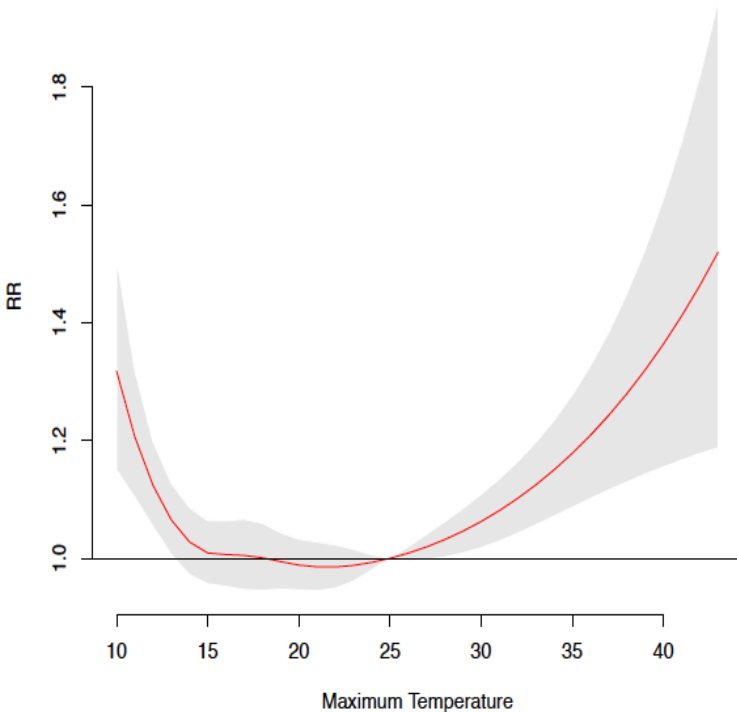
Clear impact of warming and recent long-drought on fire danger in Central Victoria
(Melbourne Airport)

Small Shifts can have Large Effects:

Case Study: Black Saturday, Melbourne 2009

Mortality versus Maximum Temperature

Overall effect of temperature over 30 days of lag



46.4°C

173 Deaths
from
Bushfires,
414 Injured.

374 Deaths
from
Extreme
Heat

Key findings of the Chief Health Officer's report on the January 2009 heatwave

- 25 per cent increase in the metropolitan Ambulance Victoria total emergency cases and a 46 per cent increase over the three hottest days
- 34-fold increase in metropolitan Ambulance Victoria cases with direct heat-related conditions (61 per cent in those 75 years and older)
- 12 per cent increase in emergency department presentations, with a greater proportion of acutely ill patients and a 37 per cent increase in those 75 years and older
- eight-fold increase in direct heat-related emergency department presentations (46 per cent in those aged 75 years and older)
- an almost three-fold increase in patients dead on arrival (69 per cent being 75 years and older) at emergency departments
- 374 additional deaths over what would be expected, which was a 62 per cent increase in total all-cause mortality
- the greatest number of deaths occurred in those 75 years or older.

Case Study- Heavy Rainfall and Flooding- 2010-2011 La Nina Event

- Record warm ocean temperatures
- Record rainfall and humidity
- Record extreme rainfall
- Major flooding across northern and eastern Australia
- Large and powerful tropical cyclone
- Queensland flooding 2010/11. Total insurance claims \$2 billion

Mackenzie River

Rockhampton

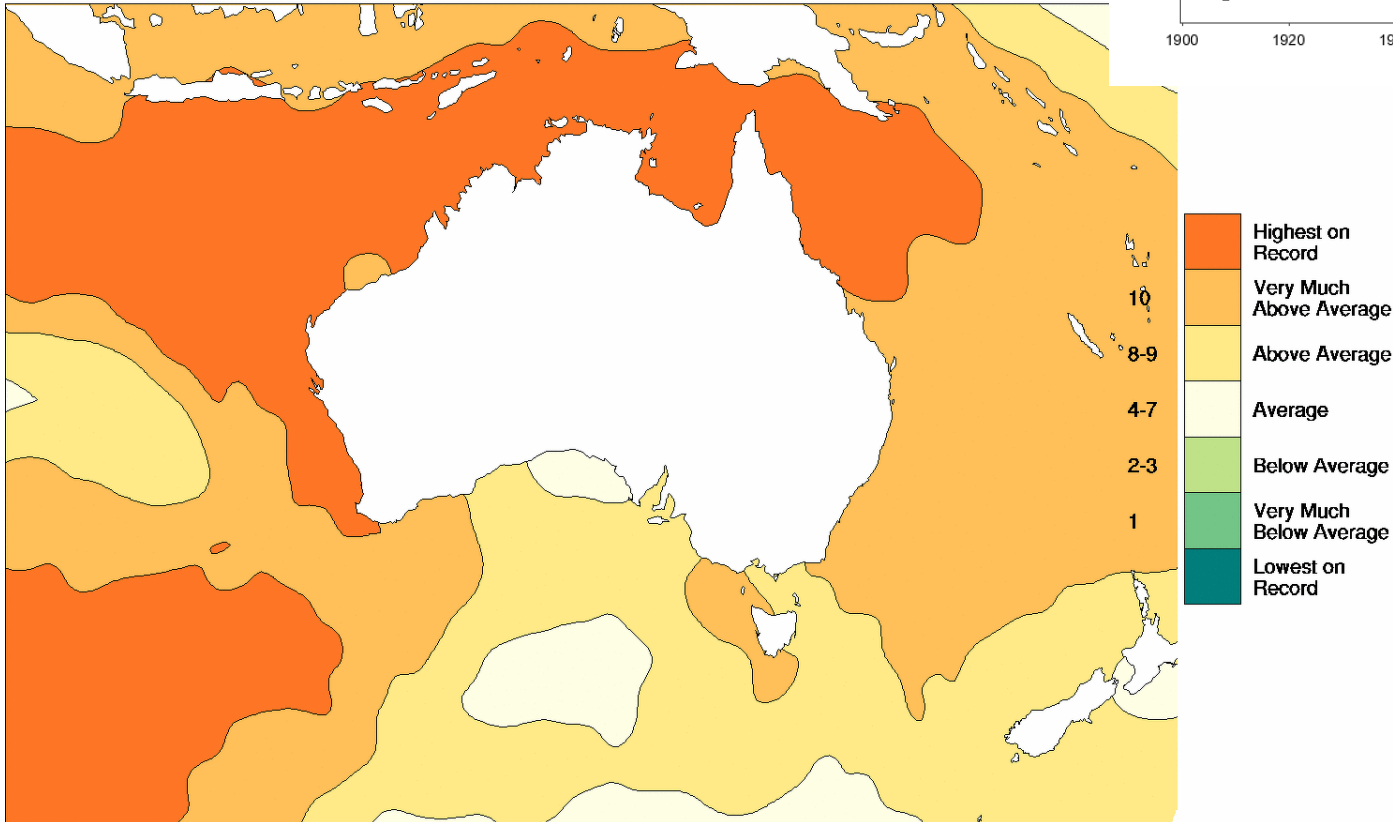
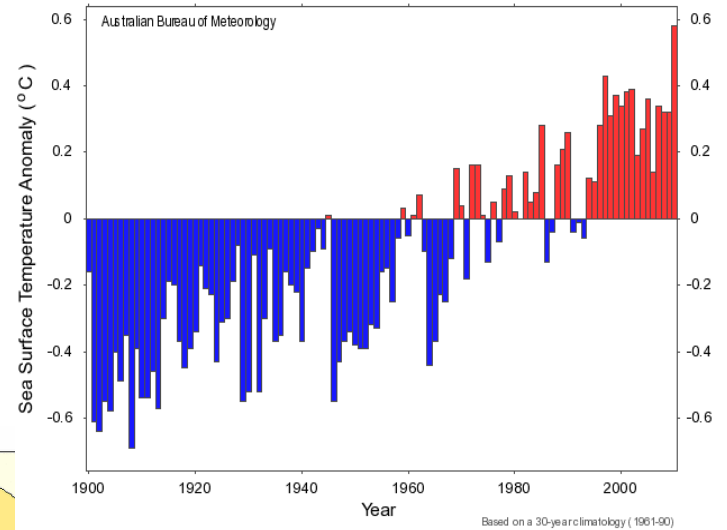
Coral Sea

20 km



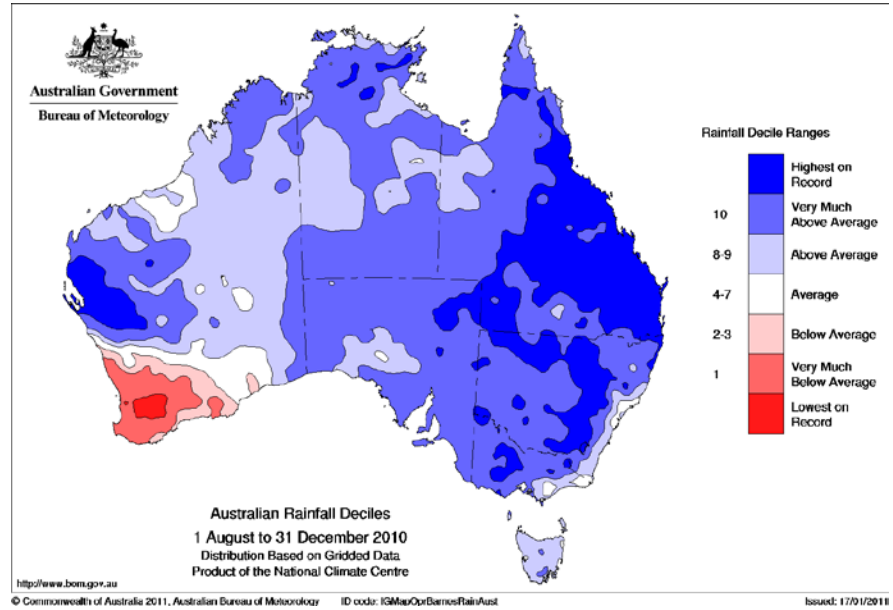
Tropical sea surface temperature was the highest on record for the second half of 2010

December Sea Surface Temperature Anomaly - Australian Region

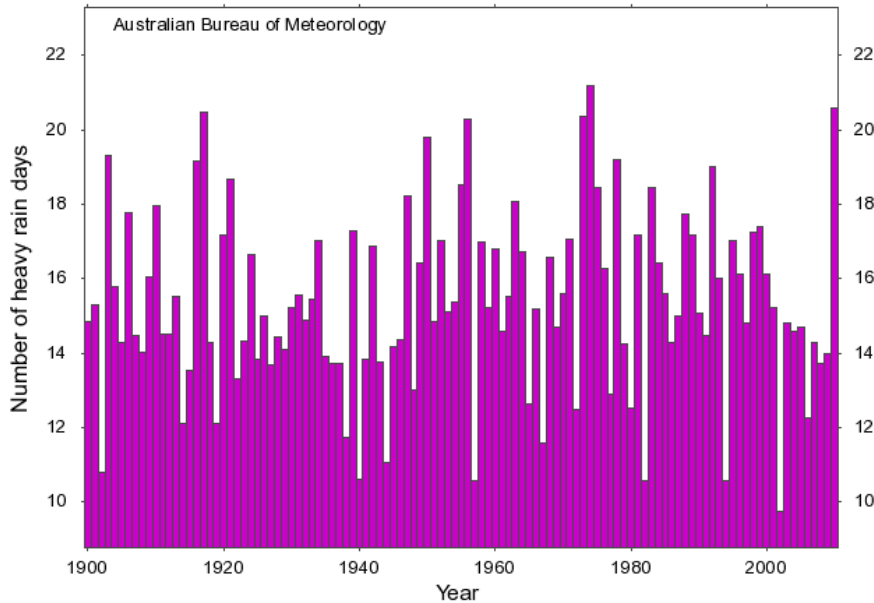


Sep-Dec 2010 Rainfall Deciles

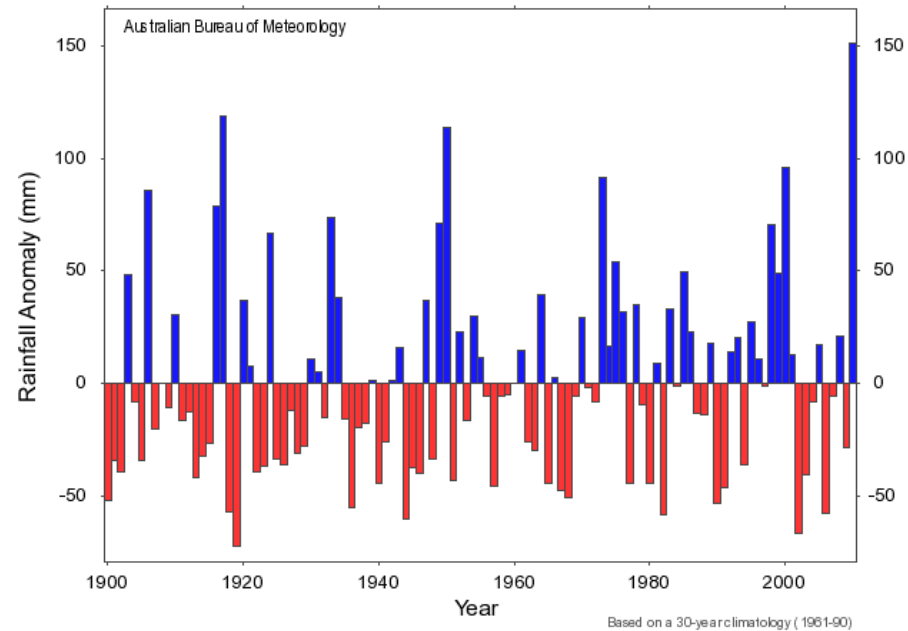
Extreme Rainfall in 2010/2011



Average number of heavy rain days



Spring Rainfall Anomaly - Eastern Australia



Extreme Rainfall

Darwin- wettest day (367.6mm); wettest week and wettest month in February.

Carnarvon- Flooding mid December

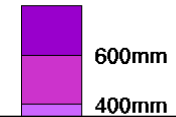
Tropical Cyclone Yasi

Double average rainfall around Brisbane for Spring and Summer

South-west WA. Driest year on record. Periods of extreme heat.

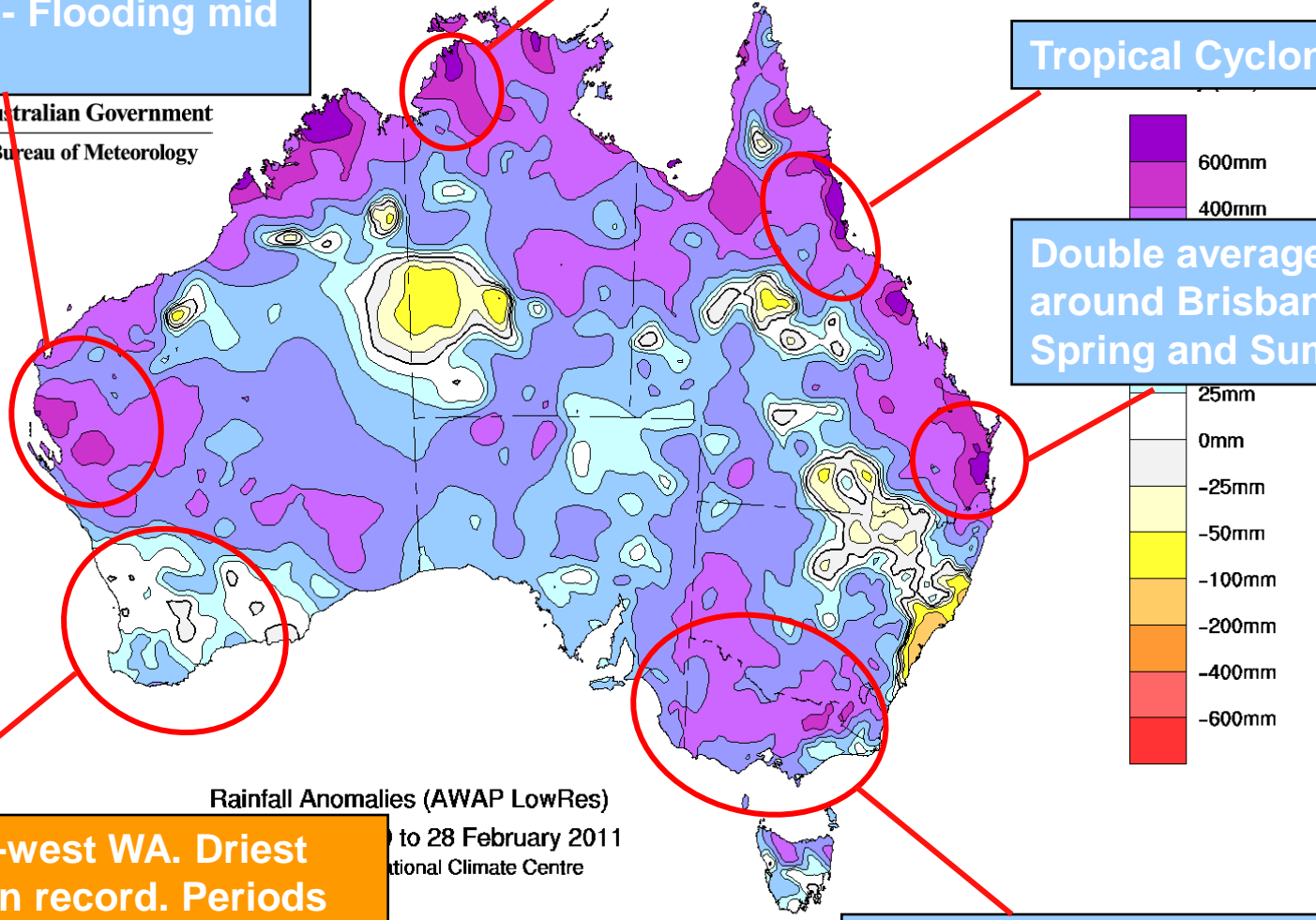
Victoria; Flooding Sep, Oct, Dec, Jan, Feb

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Rainfall Anomalies (AWAP LowRes)
to 28 February 2011
National Climate Centre

rology ID code: IGMMapAWAPAnomalies



Thank You

