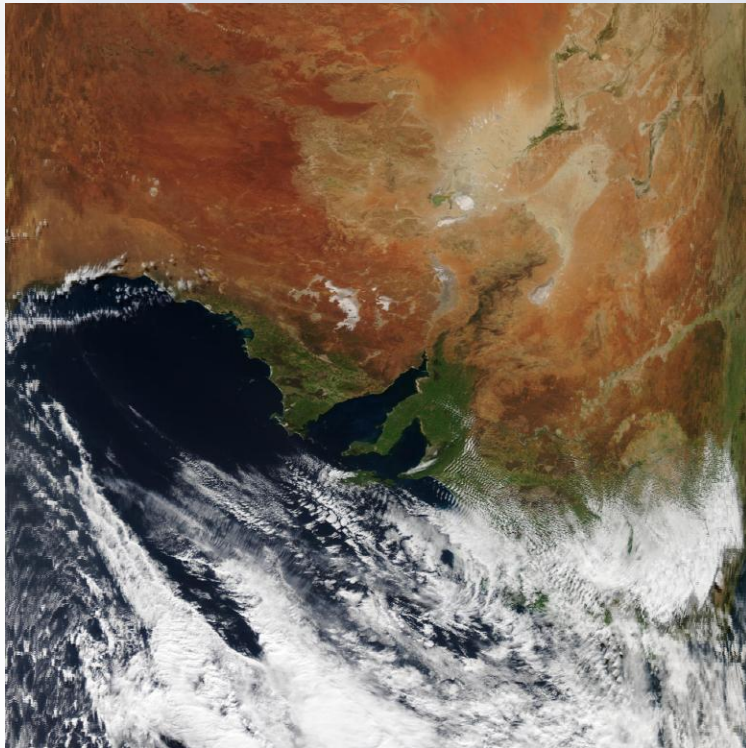




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Climate change and the Limestone coast wine region



Darren Ray

Senior Meteorologist/Climatologist

South Australian Regional Climate Services
Centre

Bureau of Meteorology

d.ray@bom.gov.au

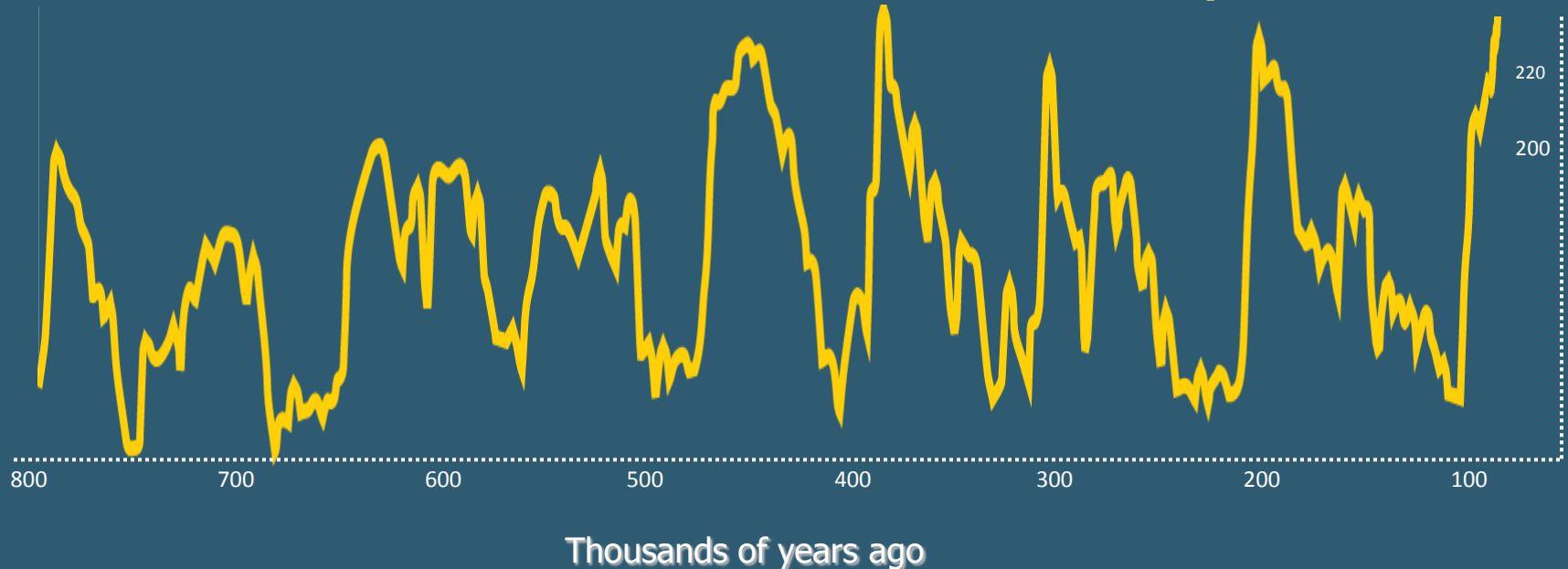
Outline

- Climate change science
- Observed trends and changes impacting viticulture
 - globally to locally
- Sources of information about climate change
- Forecasting information for climate change adaptation

Atmospheric CO₂ concentrations reached 400 parts per million in 2013

We have put a large pulse of greenhouse gases into the atmosphere over a short period

Carbon dioxide concentrations over the last 800,000 years





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What are those higher levels of greenhouse gases doing?

Less heat is being measured escaping to space by satellites



More heat is being measured coming back to the surface...
2.3 watts/square metre

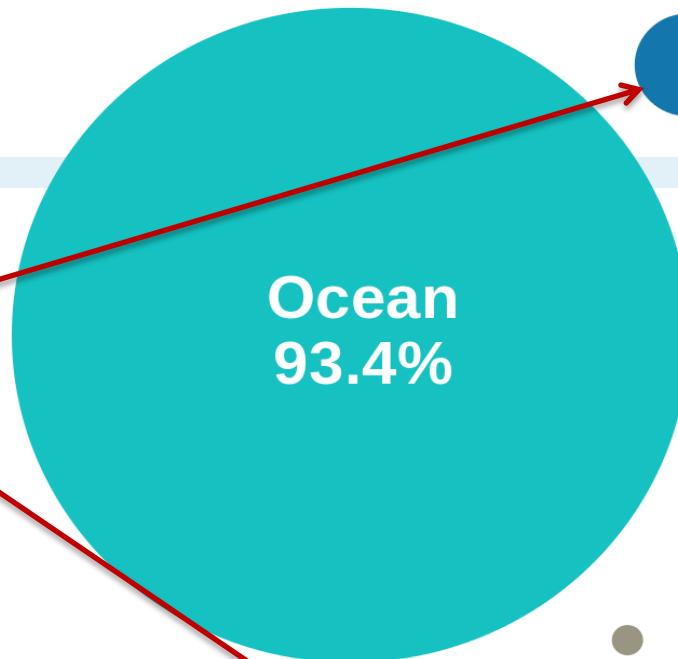


The amount of extra heat being trapped in the Earth climate system is equivalent to 4 Hiroshima bombs per second



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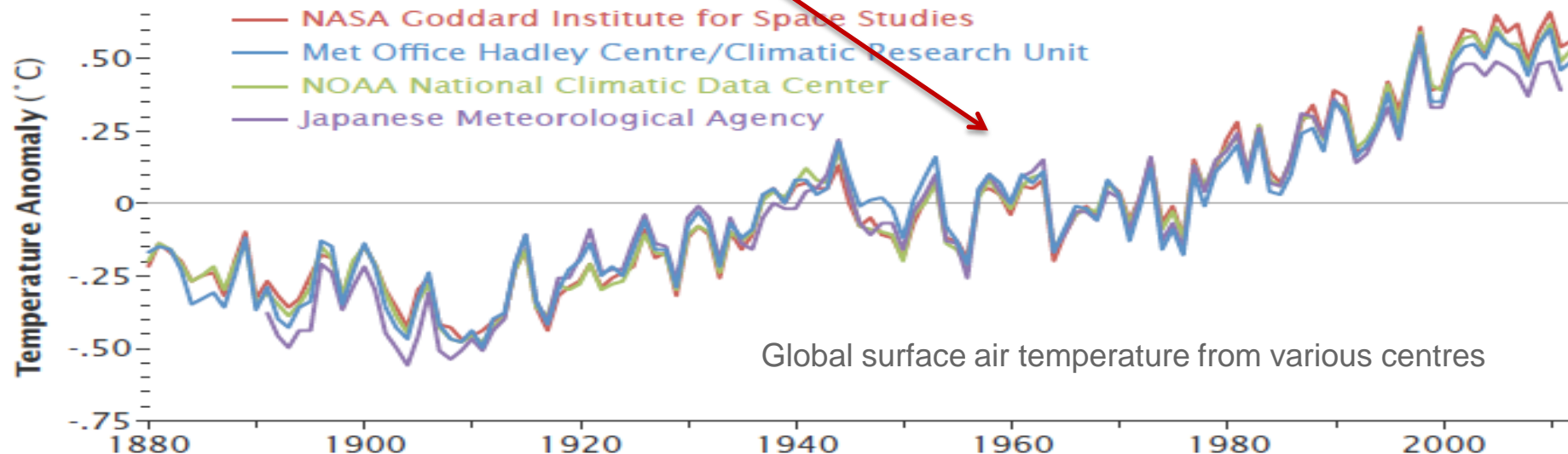
Where is global warming going?



- Atmosphere 2.3%
- Continents 2.1%
- Glaciers/ice caps 0.9%
- Arctic sea ice 0.8%
- Greenland Ice Sheet 0.2%
- Antarctic Ice Sheet 0.2%

The amount of trapped heat that ends up being measured in surface air temperature

2014 is very likely to be the new hottest year on record globally

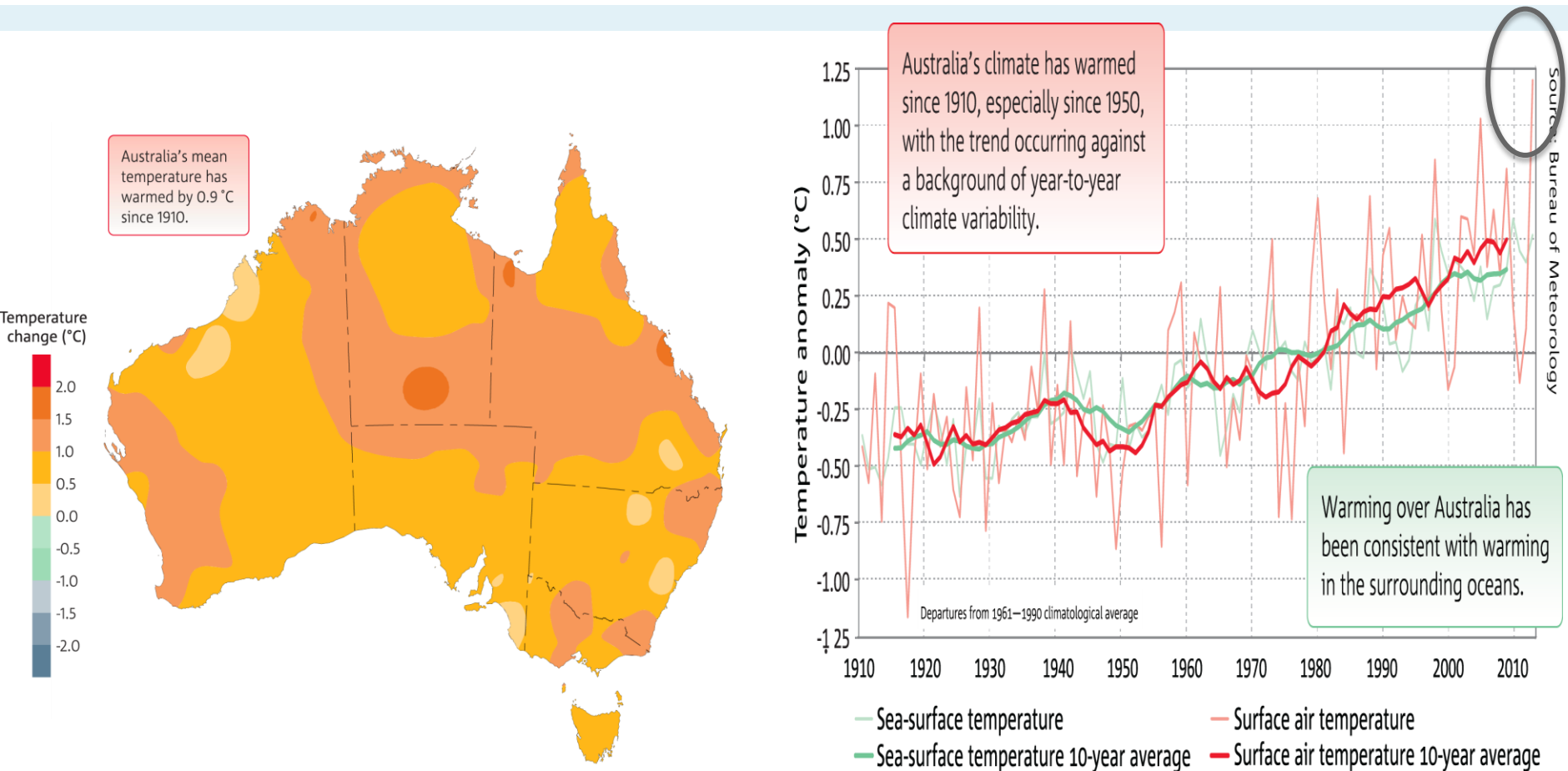




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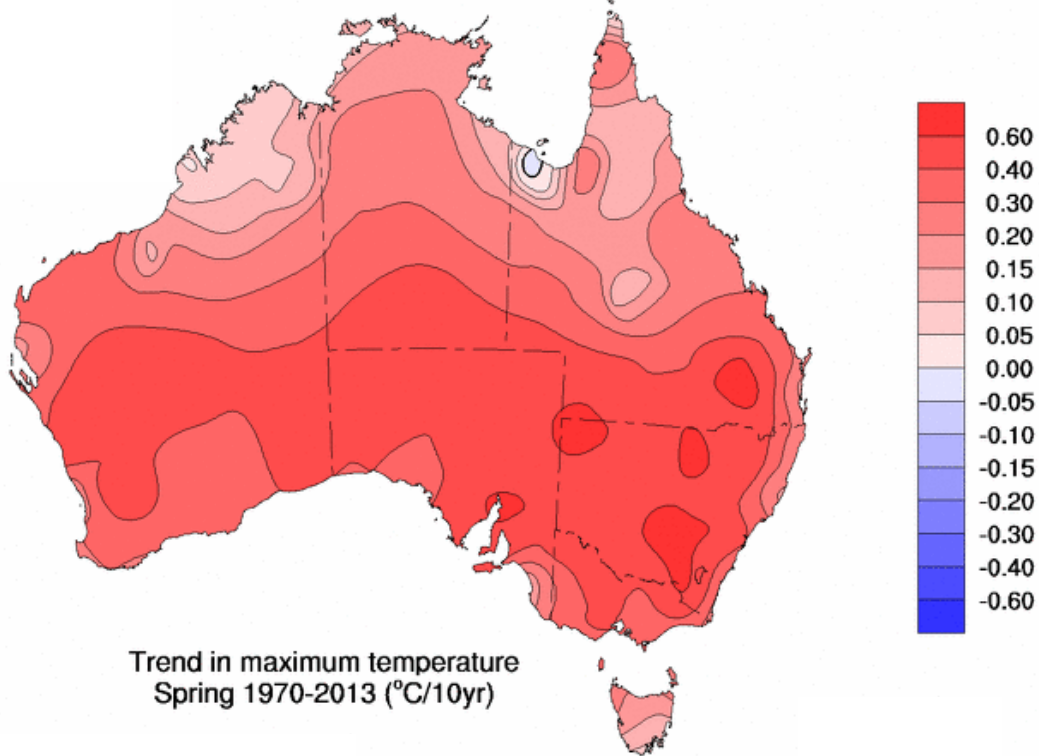
Bureau of Meteorology

Australia is warming, on land and in the oceans



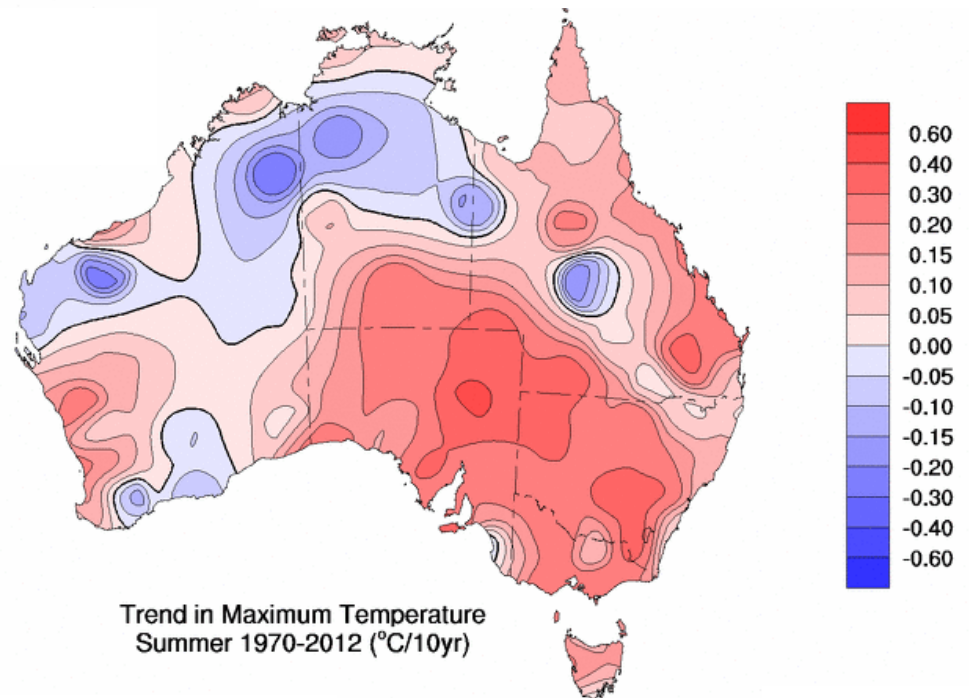
2013 was hottest year on record for Australia and South Australia

Climate trends and changes

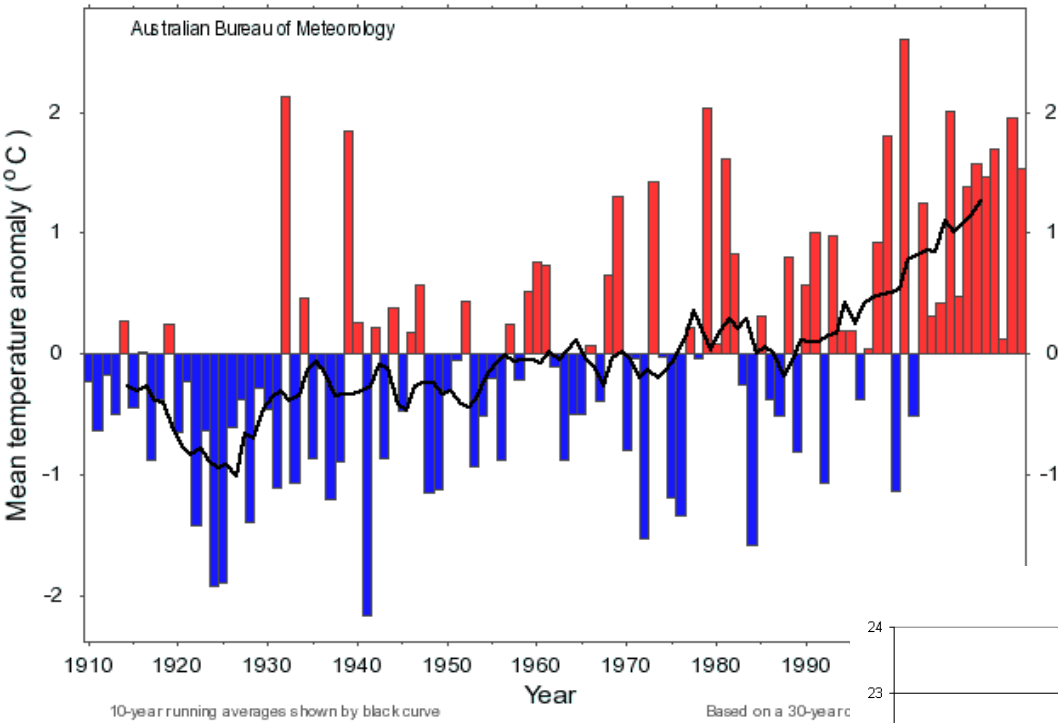


Warming by ~ 1.0°C,
particularly at night and in
spring

Earlier bud burst and
flowering resulting in
earlier harvests in late
summer

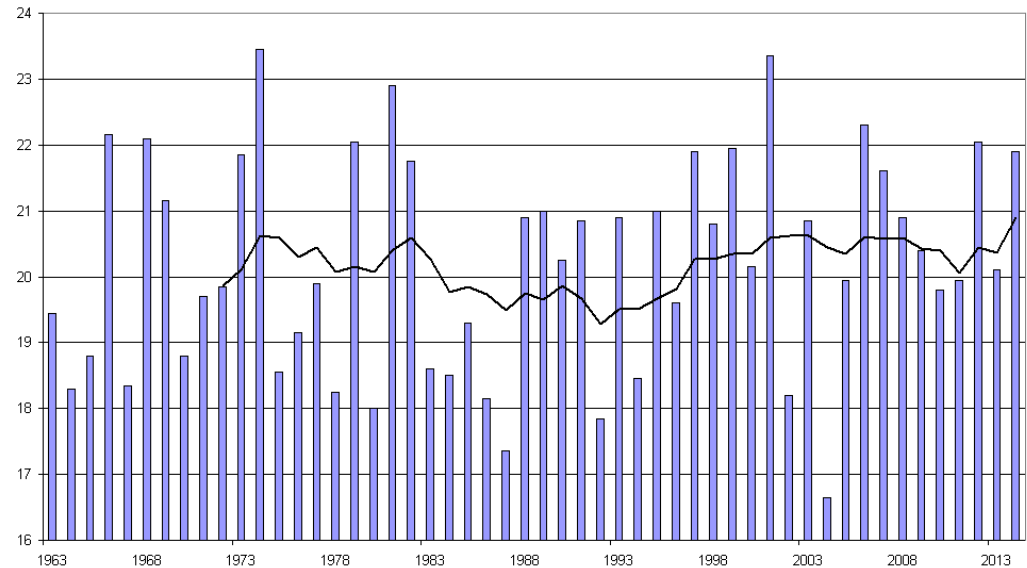


January mean temperature anomaly - Southern Australia (1910-2014)



Mean January Temperature

Mean January Temperature - Naracoorte





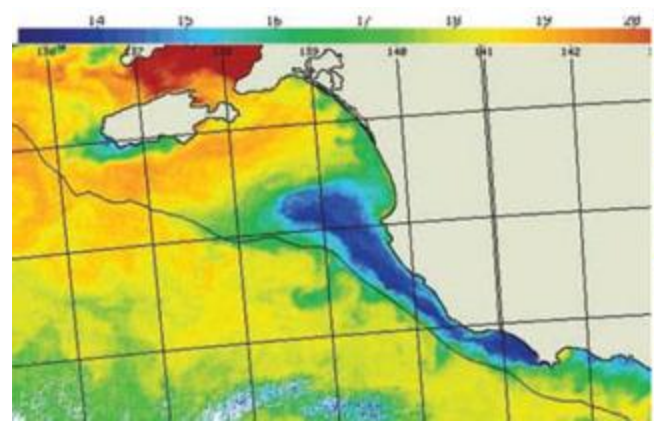
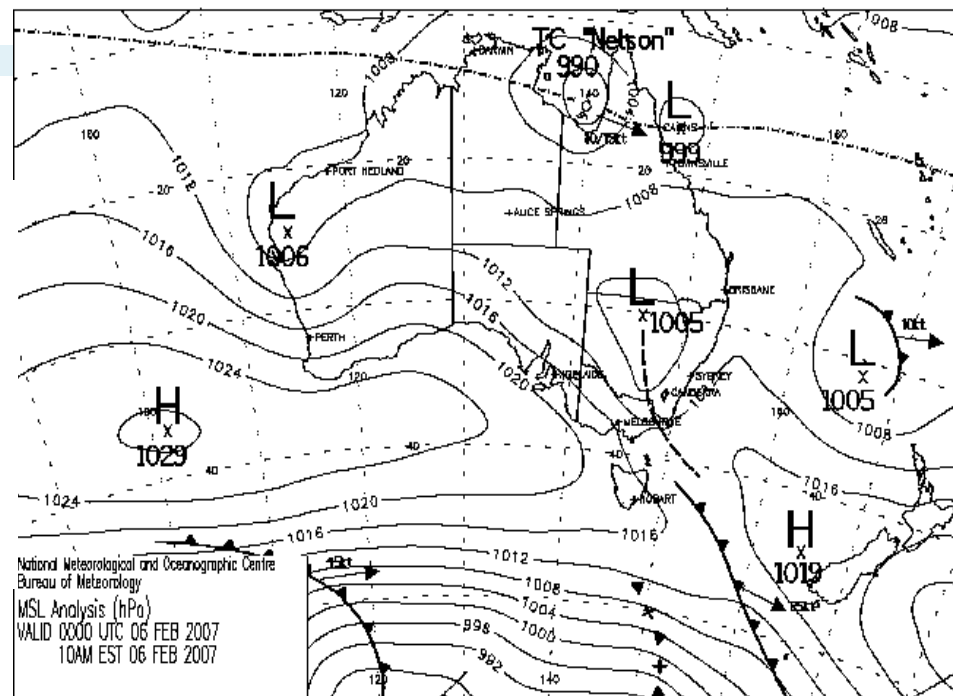
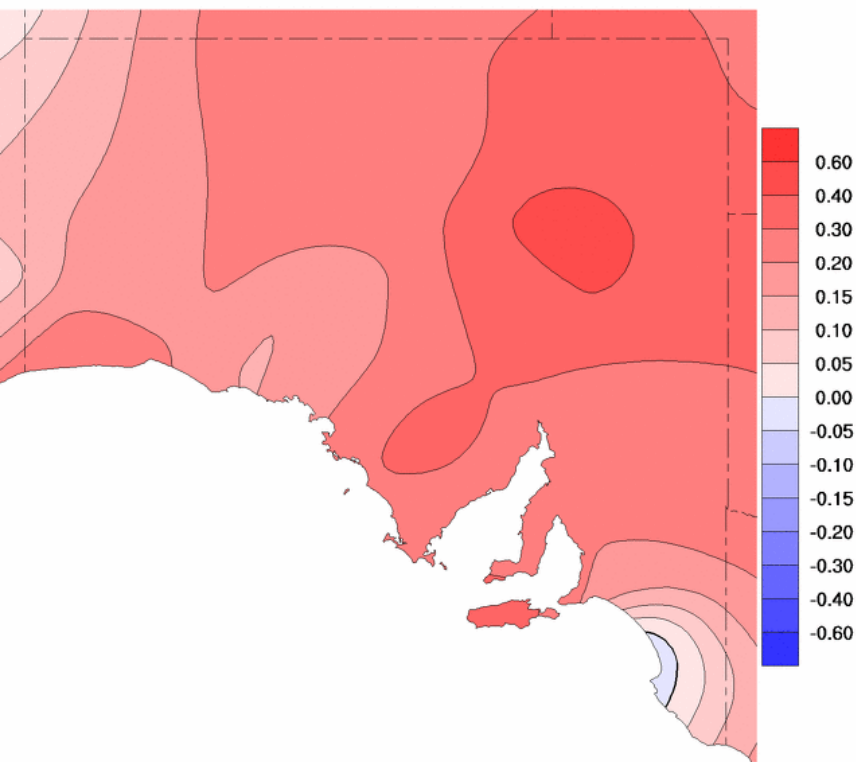
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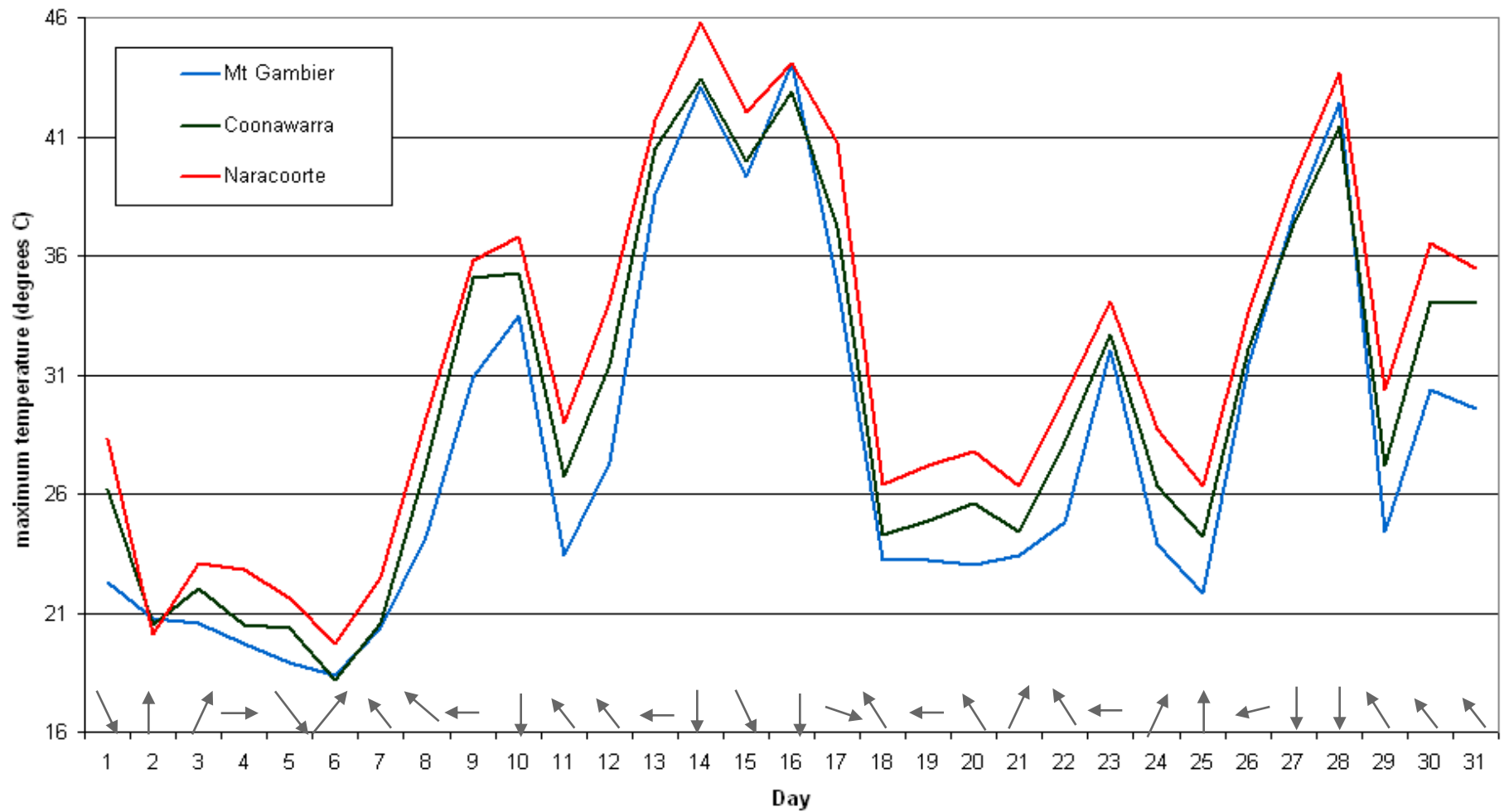
What's going on?

Trend in Maximum Temperature

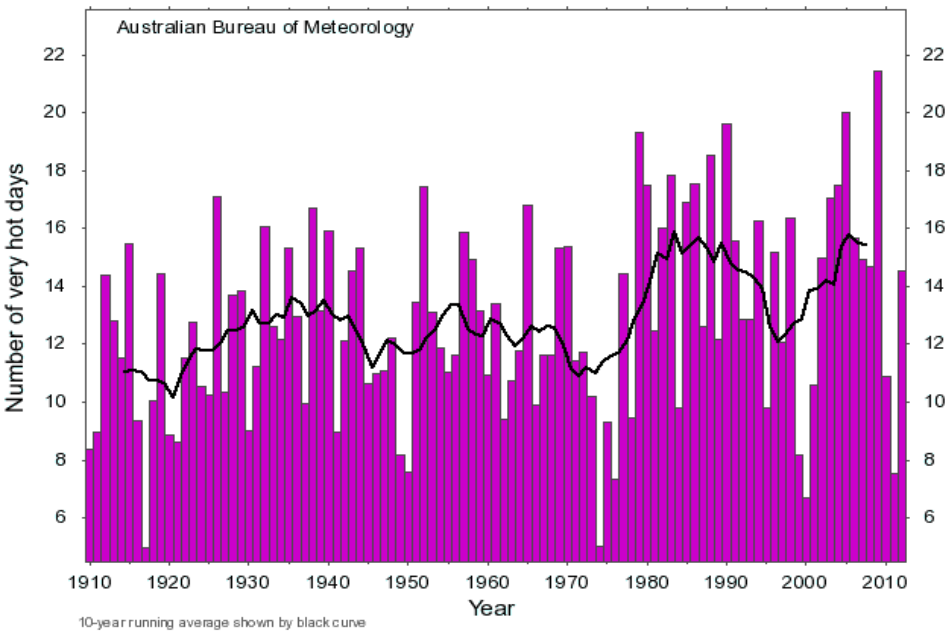
Summer 1970-2012 ($^{\circ}\text{C}/10\text{yr}$)



January 2014 daily maximum temperatures



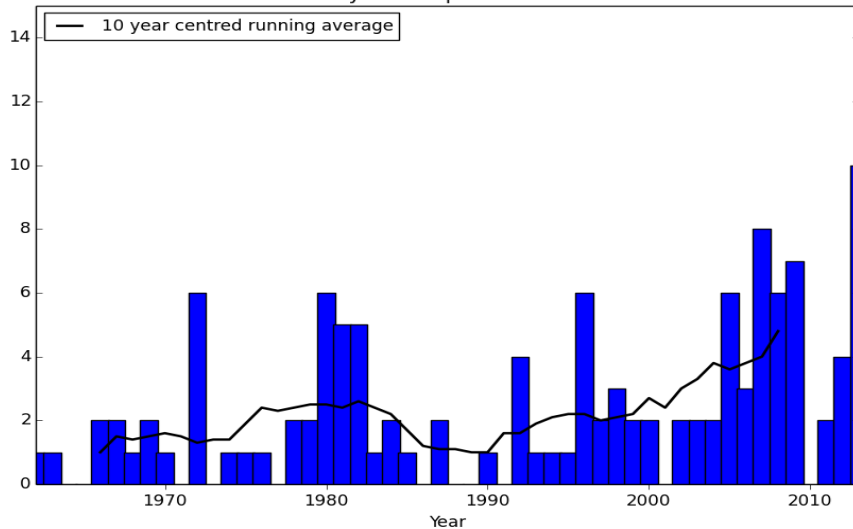
Average number of very hot days (1910-2012)



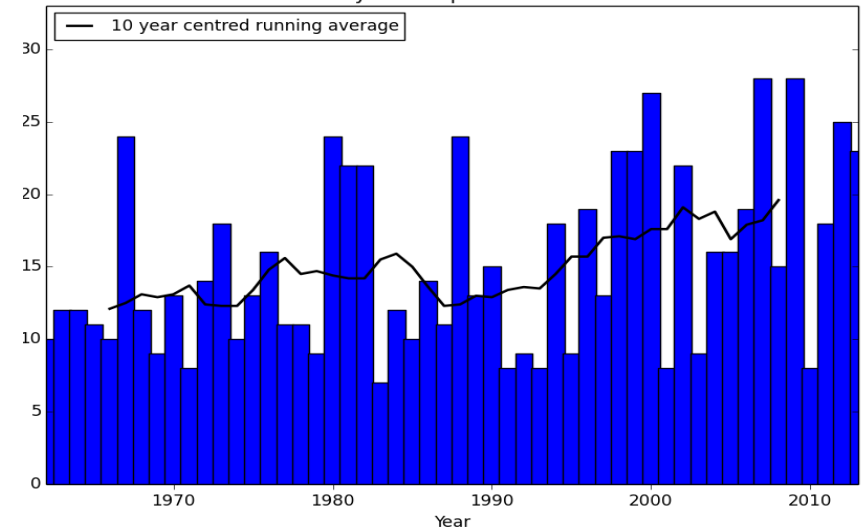
Australian extreme temperatures

About a 2-3 x increase in extreme days

No. of days >40C per FY: Naracoorte



No. of days >35C per FY: Naracoorte



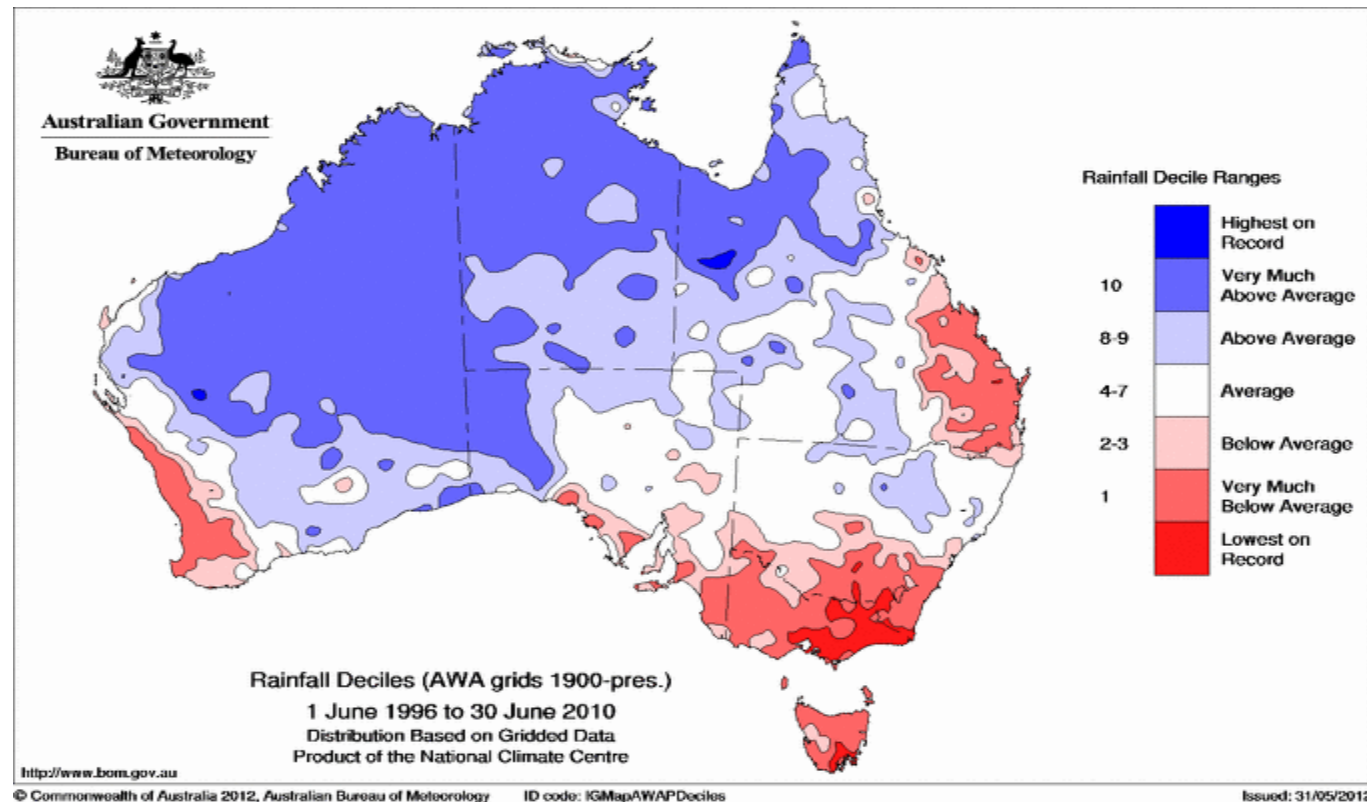


Australian Government

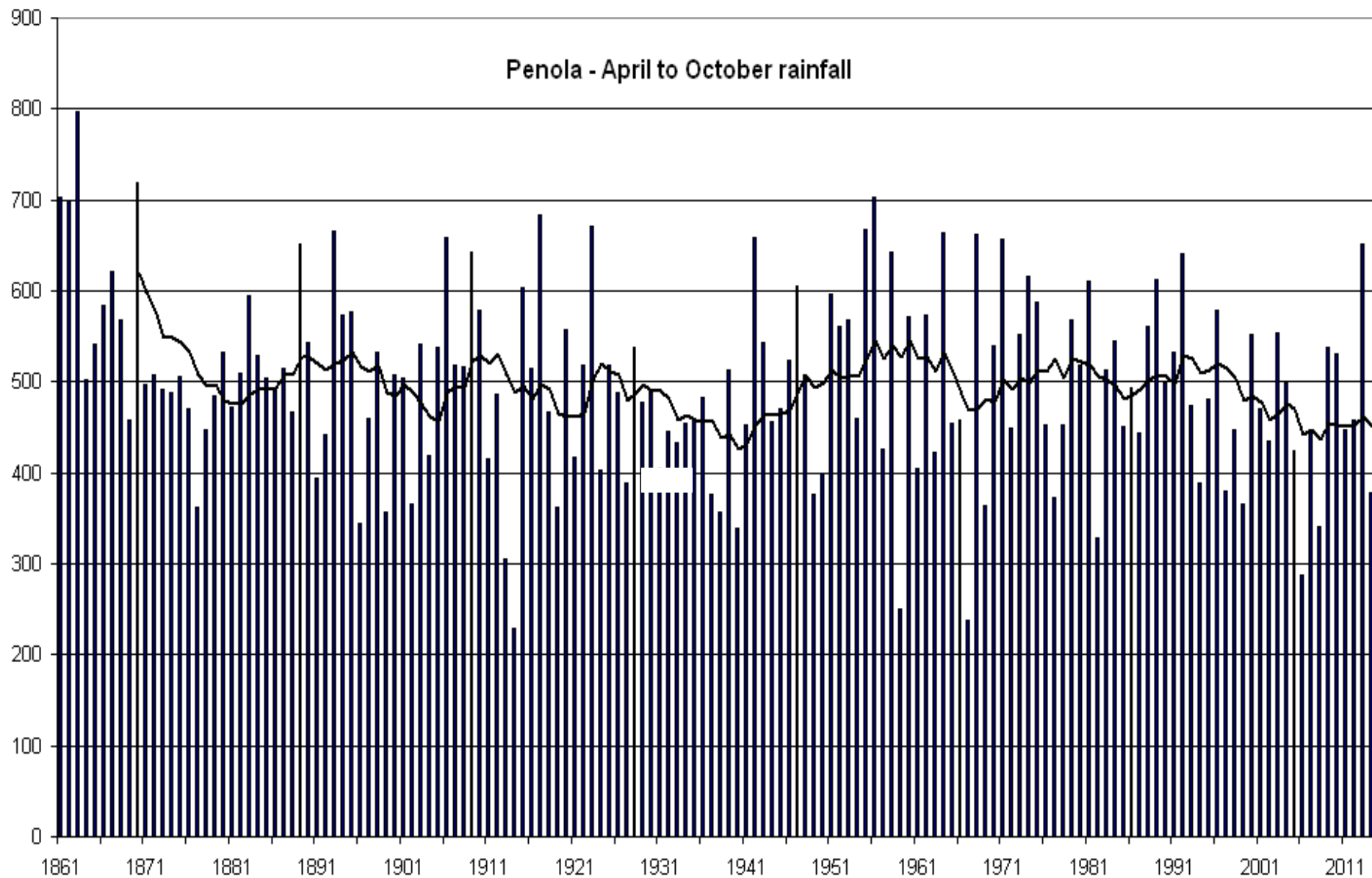
Bureau of Meteorology

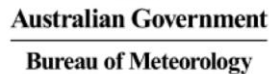
Changes in weather patterns

Decreased April
to October
rainfall

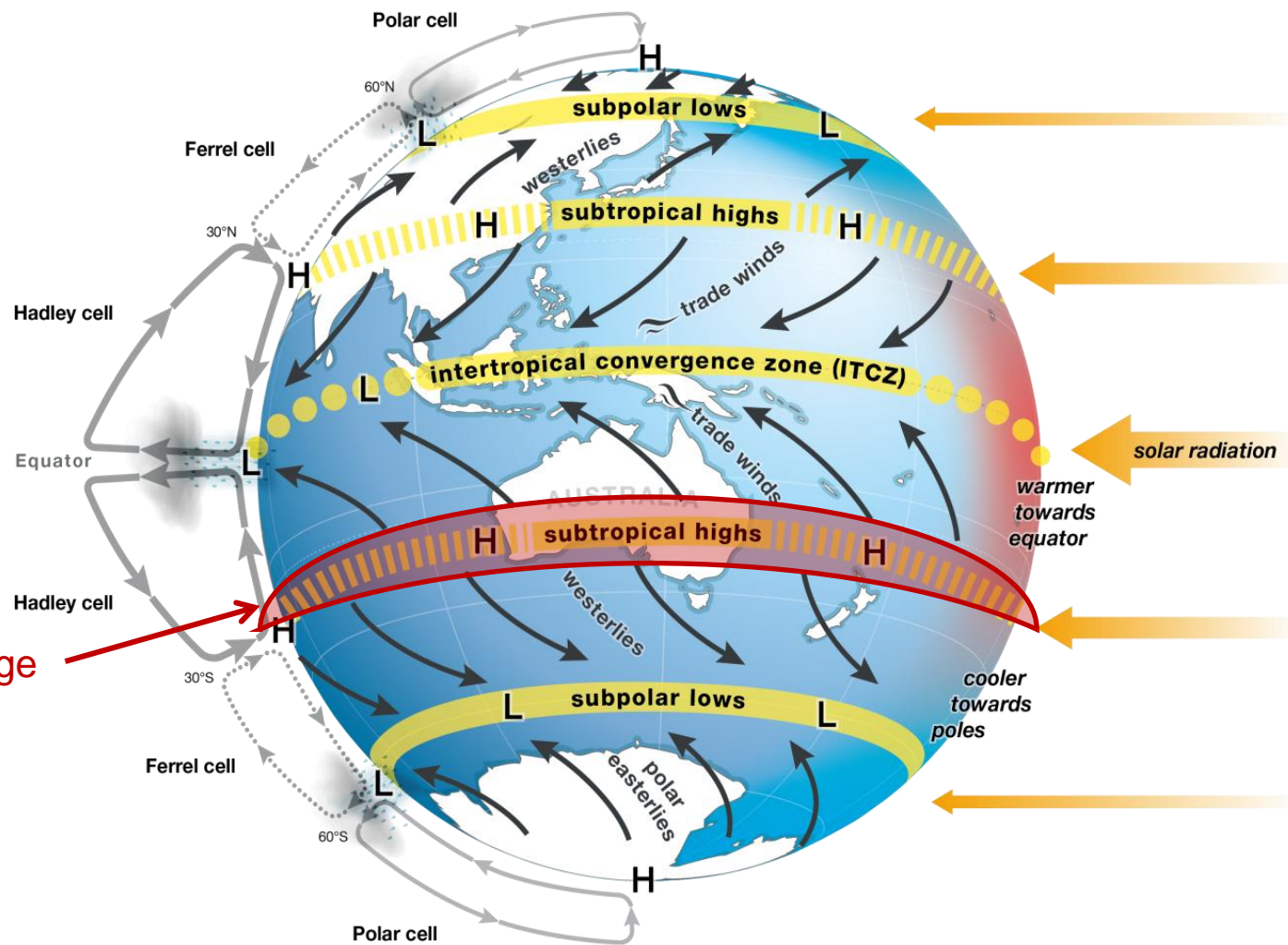


Penola - April to October rainfall





Sub-tropical ridge

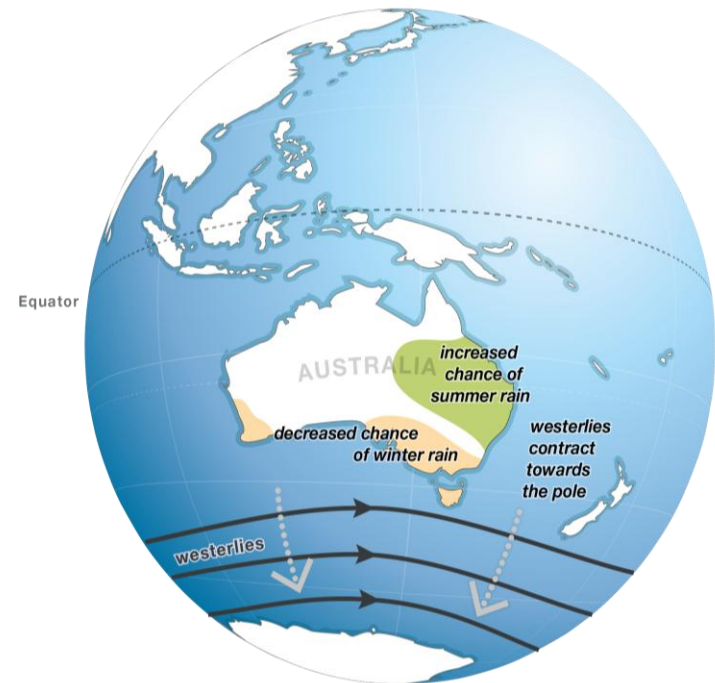
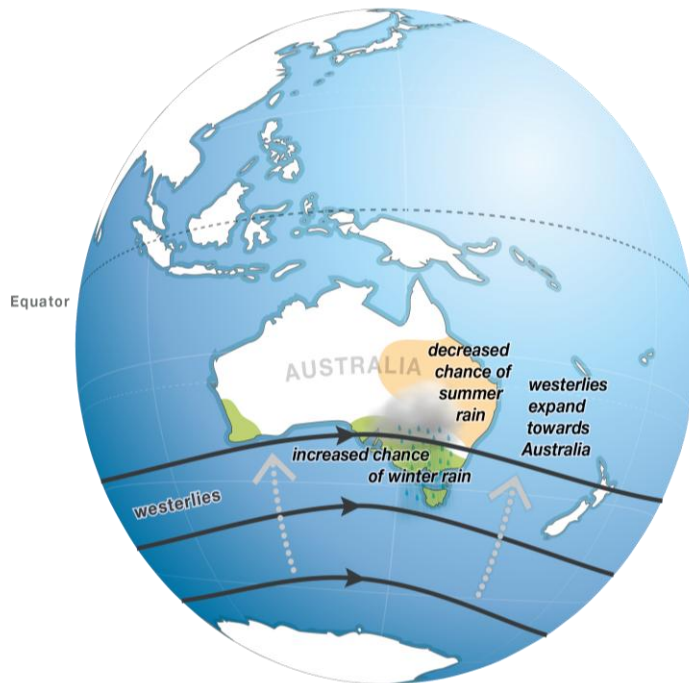




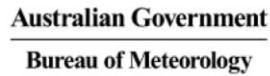
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Southern Annular Mode

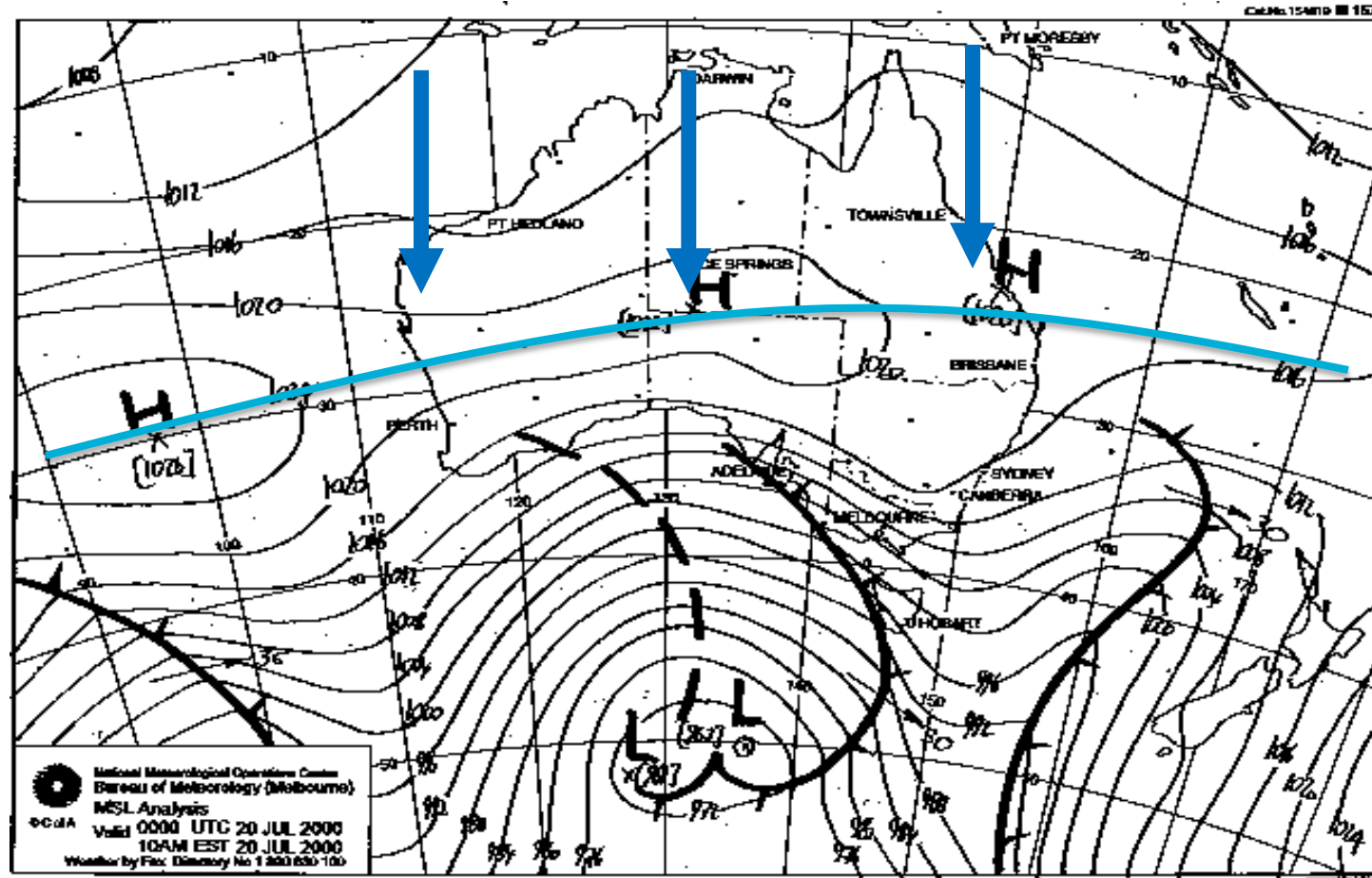


A measure of how contracted the westerly winds are around Antarctica



Not from natural variability

Strong April-June drying trend





Australian Government

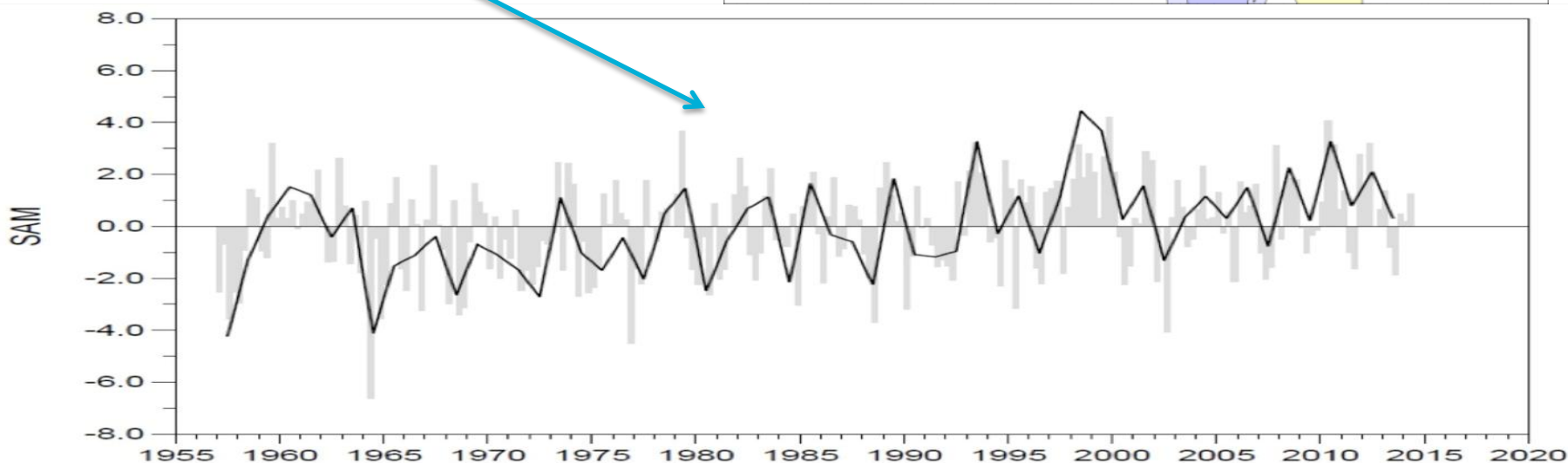
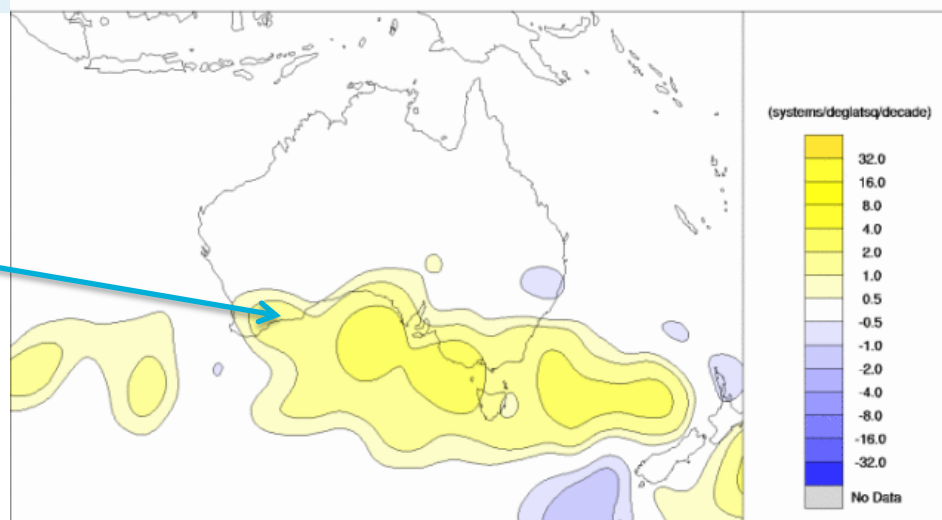
Bureau of Meteorology

Changes in weather patterns

Stronger sub-tropical ridge
over southern Australia

and SAM is trending upwards

Trend in Autumn Anti-Cyclone Density 1970-2009

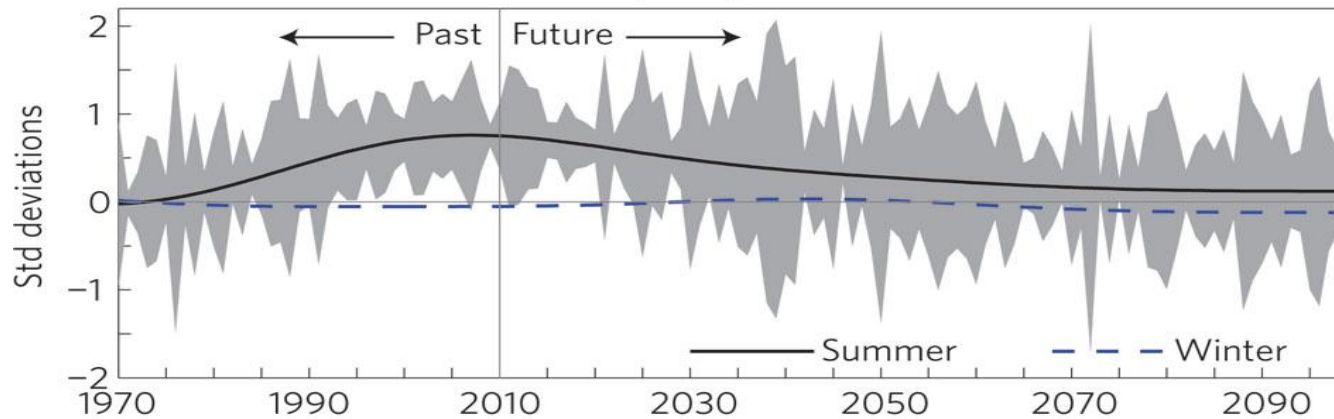




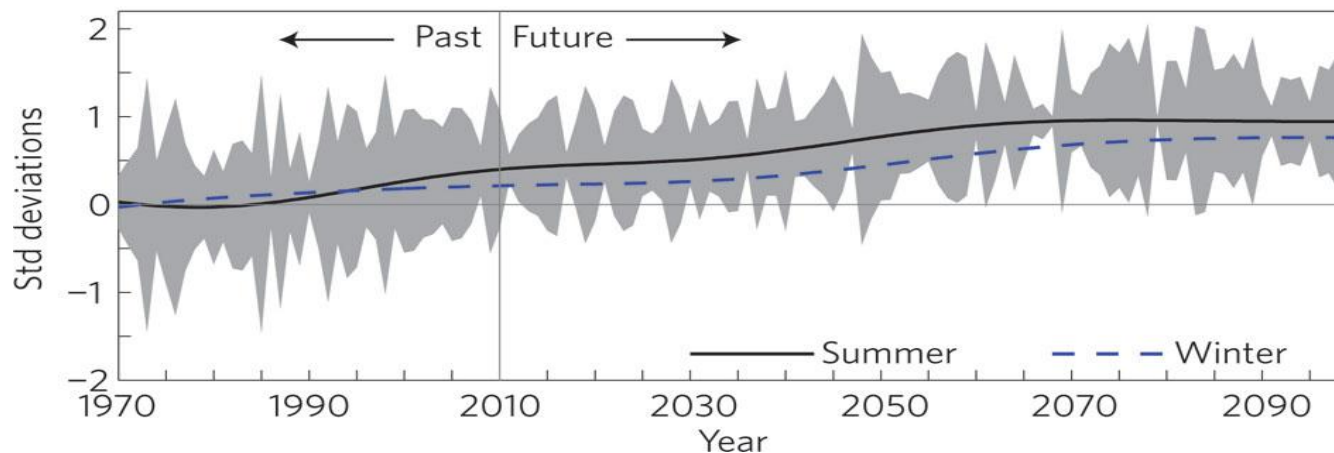
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SAM observations and projections

Ozone-depleting substances



Greenhouse gases



Has
implications
for SE coast
weather
patterns and
rainfall

Impacts
Antarctic sea
ice

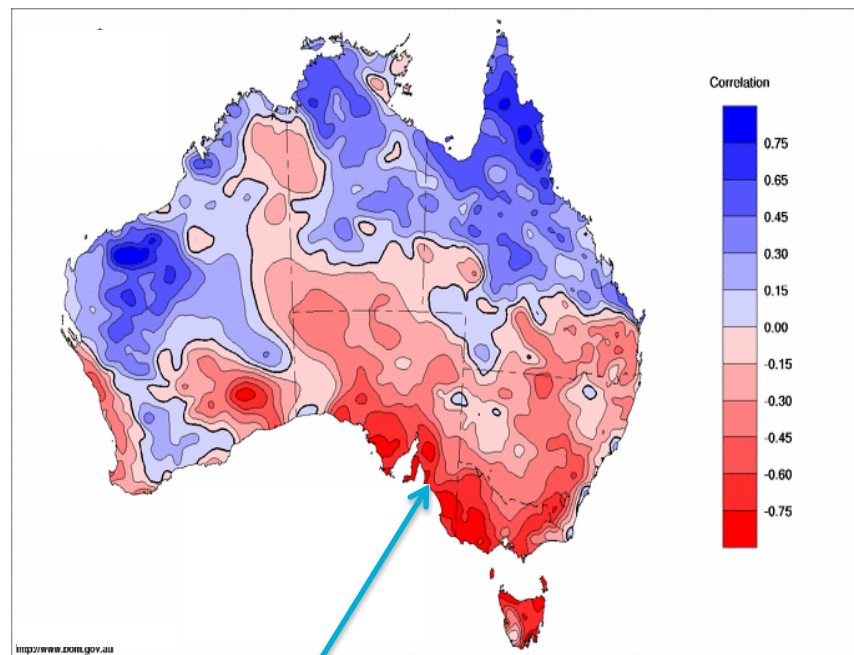


Australian Government

Bureau of Meteorology

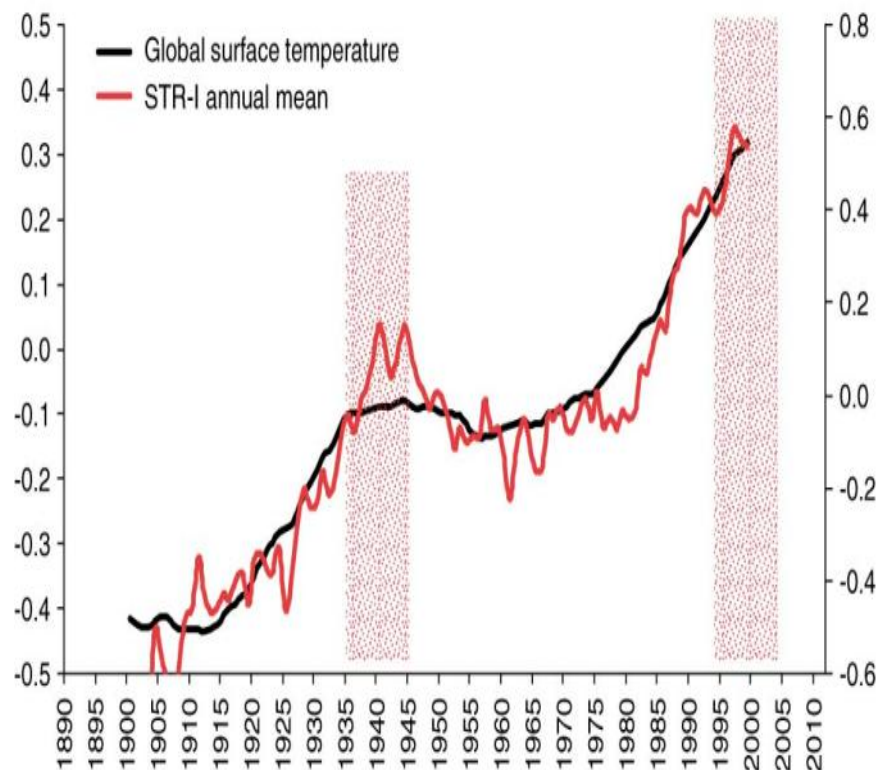
Changes in weather circulation patterns

The strength of high pressure weather patterns is strongly related to April to October rainfall



Correlation between rainfall and
sub-tropical ridge intensity

and to global temperature...

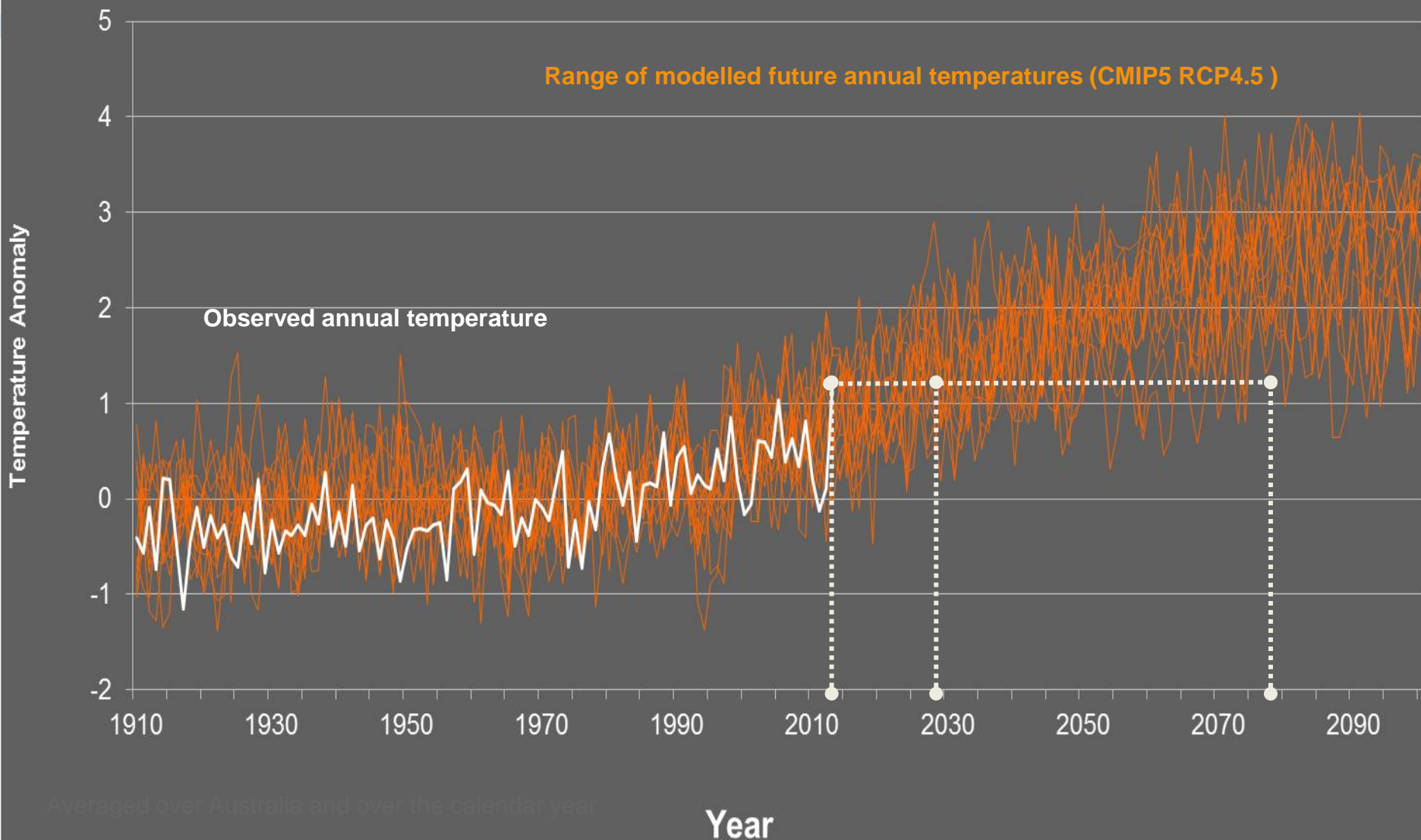




Australian Government

Bureau of Meteorology

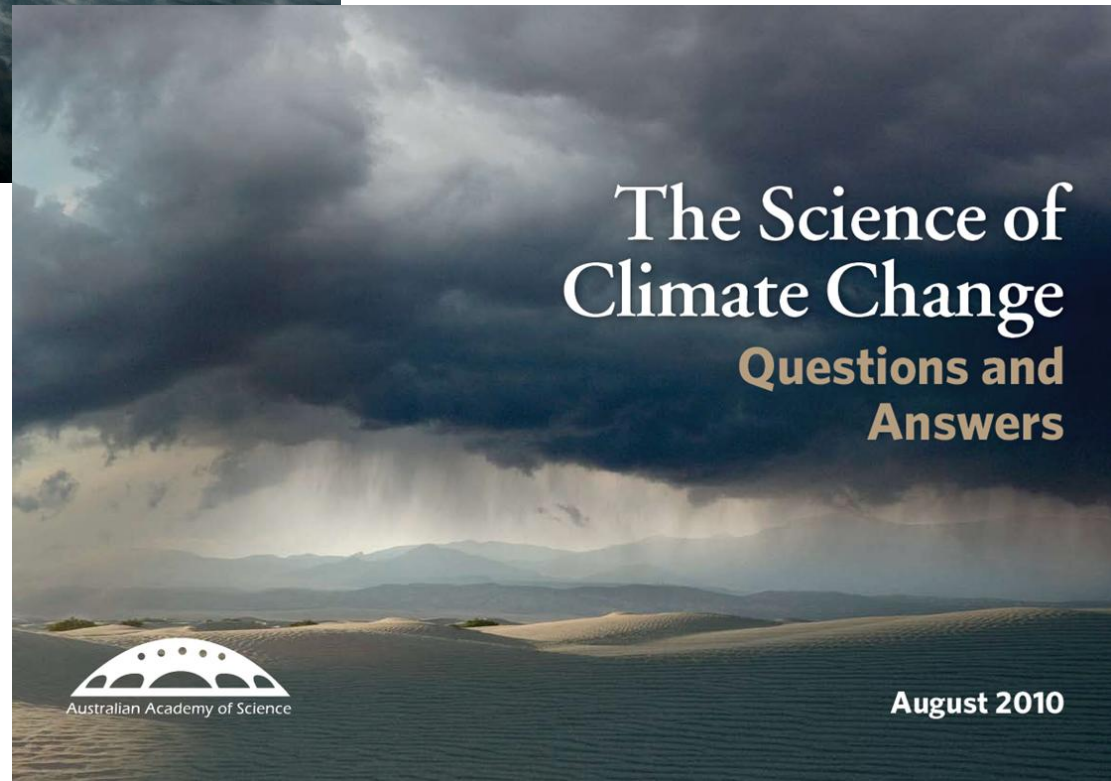
Australia's future is very likely to be hotter





Useful reports

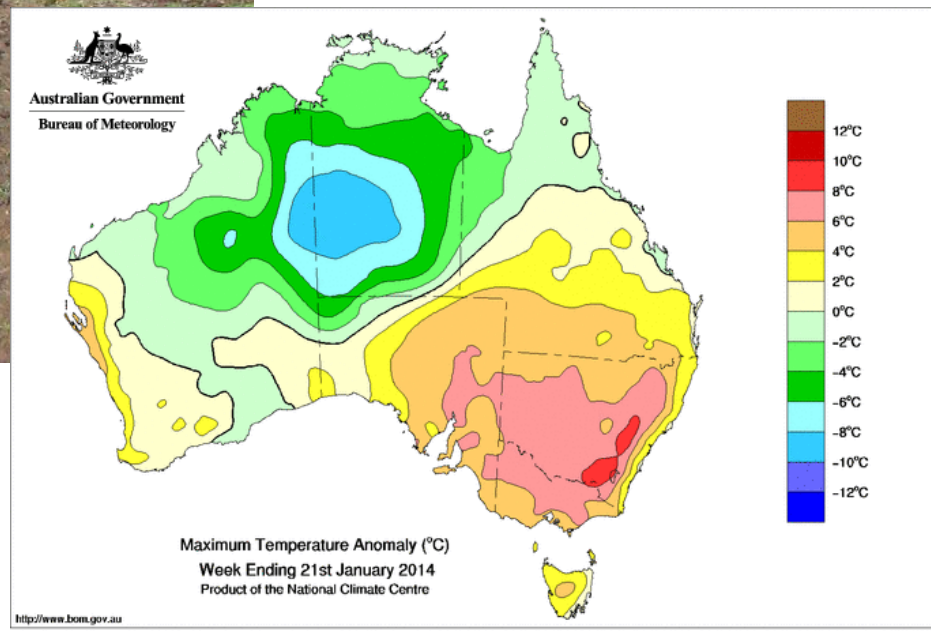
Australian Academy of Science climate change science
update (August 2010)

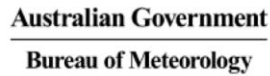




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Forecast information for climate change adaptation



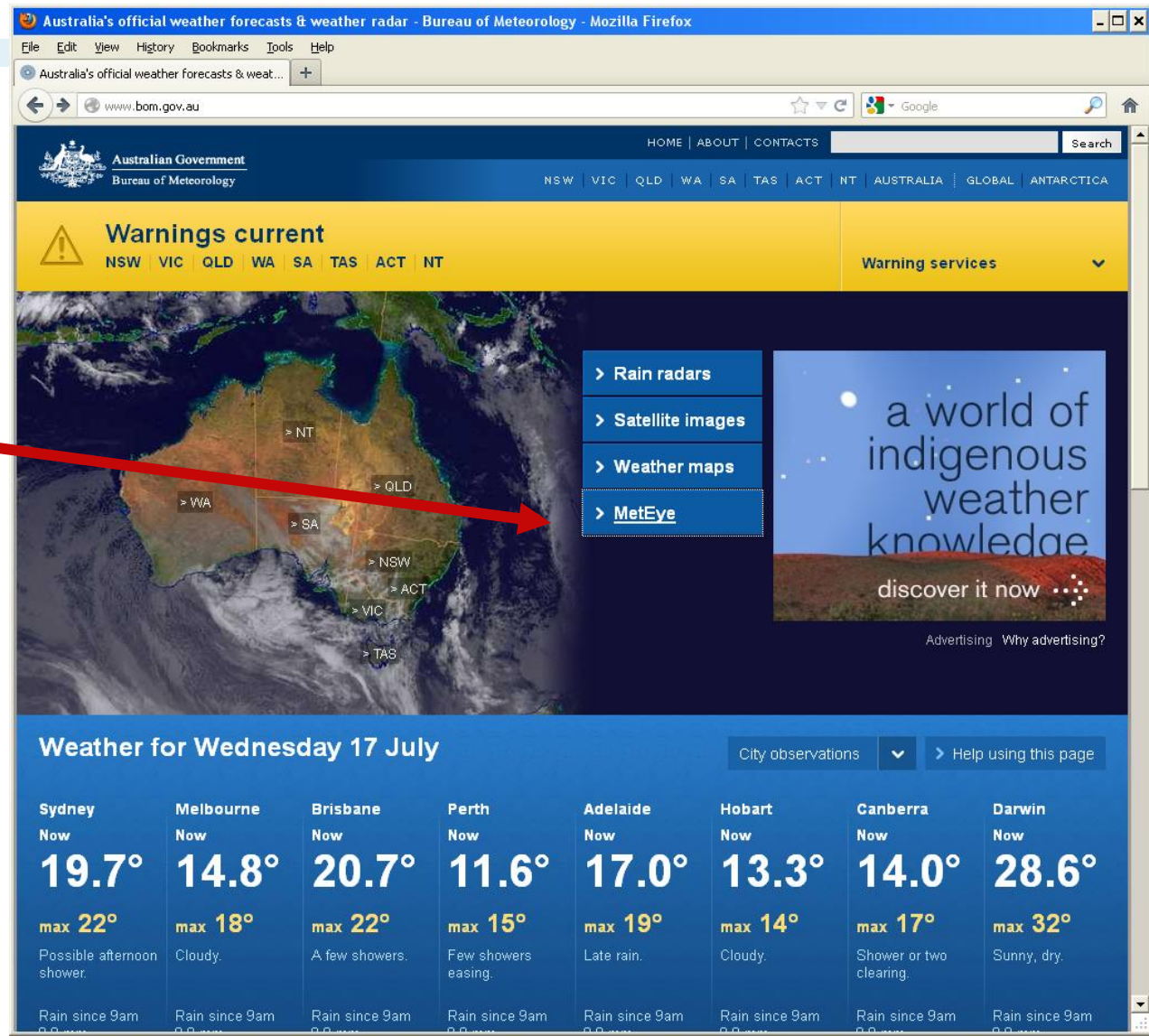


- 7 day forecasts across all of SA on a 6km grid

- Now available through MetEye

- MetEye - your eye on the environment, bringing BoM observations and forecasts together in one place.

www.bom.gov.au





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MetEye

The Next Generation forecasting system allows more information out 7 days ahead for a point or as maps/grids

Key features:

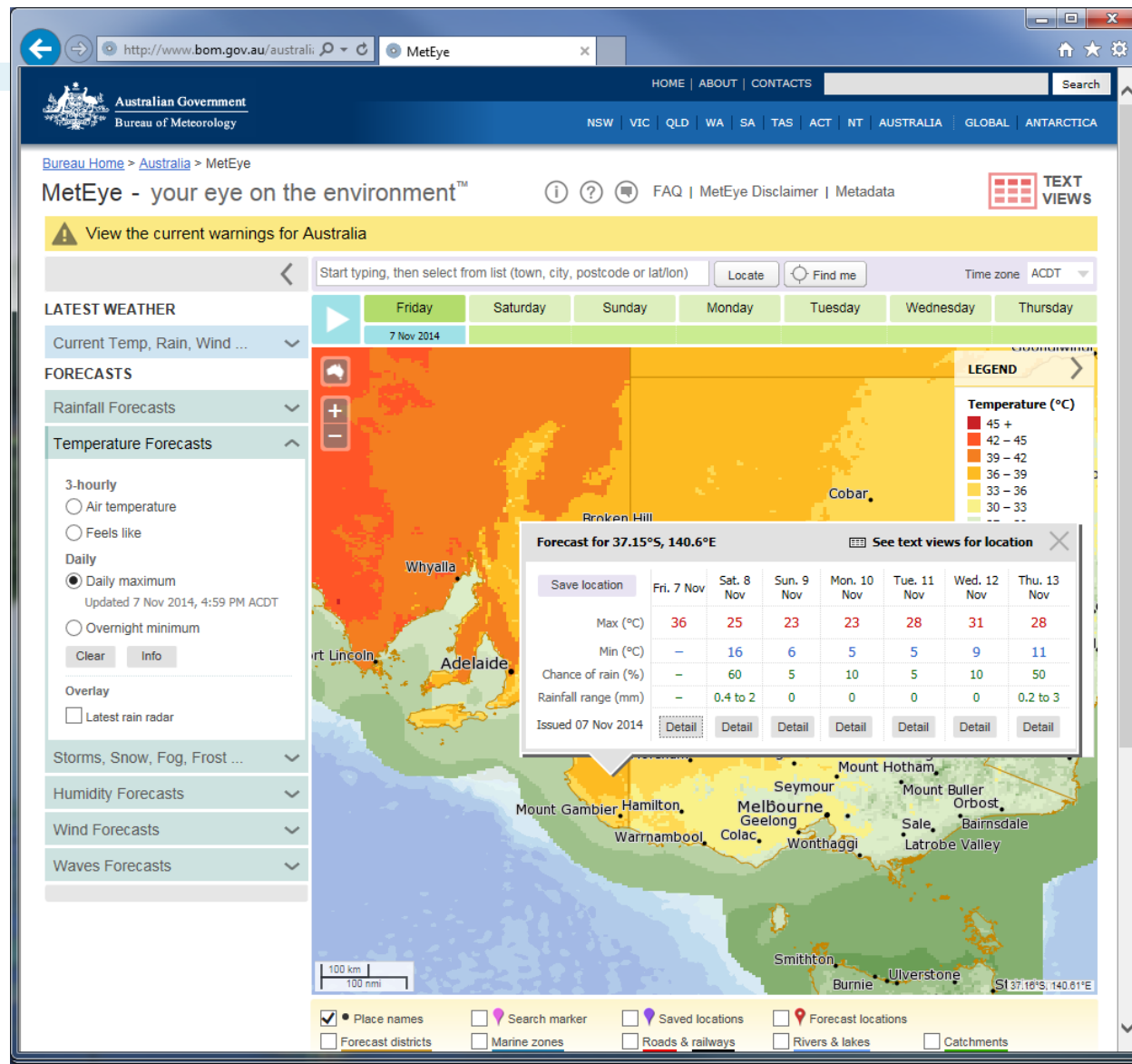
GIS enabled data

Zoom/pan

Multiple forecast element overlay & marine (waves)

Includes observations, radar, satellite overlays

Potential to add profiles such as Agriculture profile





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Evapotranspiration (Eto) data for irrigation

- Daily past Eto figures derived from BoM weather stations
- On our 'Agriculture' page from the BoM homepage
- 7 day forecast Eto is in development

The screenshot shows the Bureau of Meteorology website's 'Recent Evapotranspiration' page. The page includes a navigation menu on the left with options like Rainfall, Cloud, Temperature, Wind, Pressure, El Niño & La Niña, Humidity, Evapotranspiration, Sunshine, Forecasts & Observations, Climate Data Online, and Our Weather & Climate. The main content area displays 'Recent Evapotranspiration' for Mount Gambier Aero, with a table of daily calculations for November 2014. The table includes columns for Date, Evapotranspiration (mm), Rain (mm), Pan Evaporation (mm), Max Temp, Min Temp, Max Rel Hum, Min Rel Hum, Average 10m Wind Speed (m/sec), and Solar Radiation (MJ/sq m). The totals for the month are 37.3 mm for evapotranspiration, 5.2 mm for rain, and 38.6 mm for pan evaporation. A 'Monthly Archive' table is also present, showing links for each month from 2009 to 2014. The footer contains warnings, product code IDCKWCDEA0, and links to various services like Radar, Sat, Maps, National Weather Services, Aviation Weather Services, Careers, Sitemap, Feedback, and Freedom of Information.

Bureau Home > Water and the Land > Evapotranspiration > Recent Evapotranspiration

Recent Evapotranspiration

About evapotranspiration

These maps and tables provide daily reference evapotranspiration (ET_0) derived from automatic weather station records and satellite measurements. Monthly data is available via the location links in the tables for each state.

Map NSW Vic Qld WA SA Tas NT

Evapotranspiration Calculations

Mount Gambier Aero - November 2014 daily calculations

Date	Evapotranspiration (mm) 0000-2400	Rain (mm) 0900-0900	Pan Evaporation (mm) 0900-0900	Max Temp	Min Temp	Max Rel Hum (%)	Min Rel Hum (%)	Average 10m Wind Speed (m/sec)	Solar Radiation (MJ/sq m)
31/10/2014	9.6	0.0	3.4	33.2	8.3	95	10	7.15	23.01
01/11/2014	3.6	3.8	10.2	14.4	8.9	95	43	8.75	18.98
02/11/2014	3.4	1.4	4.8	17.0	8.1	91	39	4.33	14.60
03/11/2014	5.6	0.0	3.6	24.7	3.4	99	18	3.83	23.87
04/11/2014	5.6	0.0	7.4	22.3	11.0	82	21	6.28	16.03
05/11/2014	4.5	0.0	4.0	19.1	5.2	91	35	3.98	26.52
06/11/2014	5.0	0.0	5.2	23.9	4.8	95	33	3.18	26.36
Totals:	37.3	5.2	38.6						

Monthly Archive

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Product Code: IDCKWCDEA0

WARNINGS

WATER | CLIMATE | ENVIRONMENT

Tropical Cyclones

Radar Sat Maps

Rainfall Forecasts

MetEye™

National Weather Services
Aviation Weather Services

RSS

Careers | Sitemap | Feedback

Freedom of Information



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BoM seasonal outlook information has just been re-vamped

- Interactive
- Grid point detail
- Monthly and seasonal outlooks





Australian Government
Bureau of Meteorology

POAMA

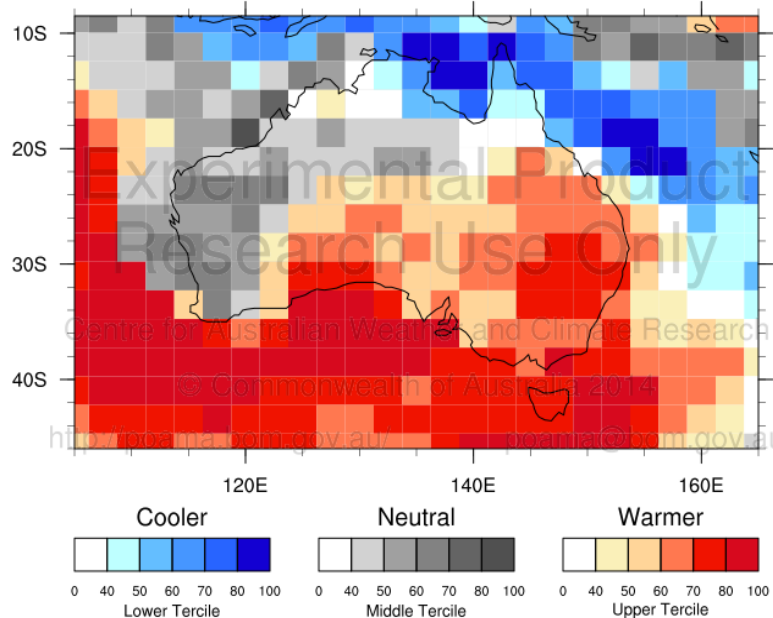
bridging the gap between the week ahead
and the season ahead

Maximum Temperature Tercile Probabilities

Region: Australia

Start Date: 2014-10-09

Period: (Week) 23/10/2014 to 29/10/2014



Climatology: years from 1981 to 2010 with mmdd = 1011

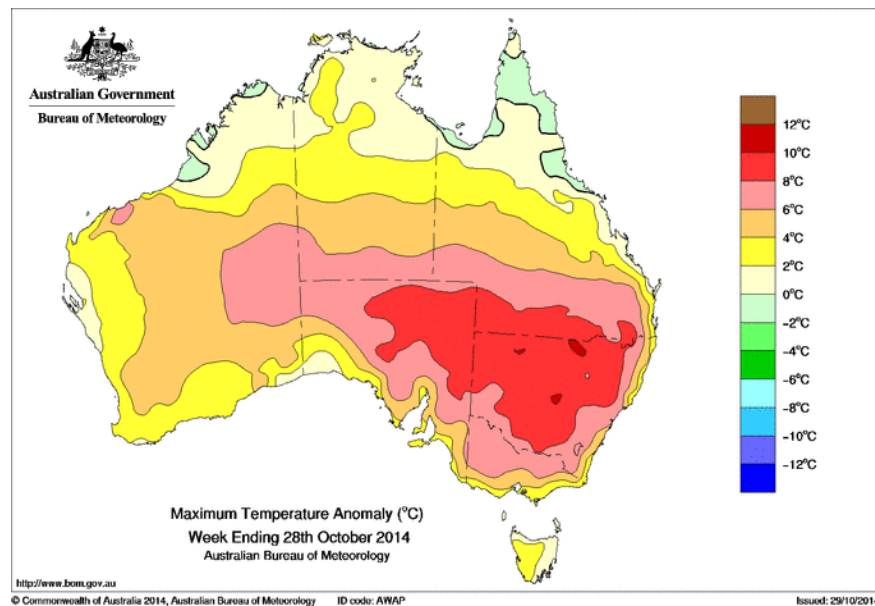
Created: 2014-10-10 15:32:31 +0000

Start Dates (DD/MM): Start Date List

Resource: wact_ / week

POAMA gives useful predictions of
heatwaves 2-6 weeks ahead

Maximum temperature



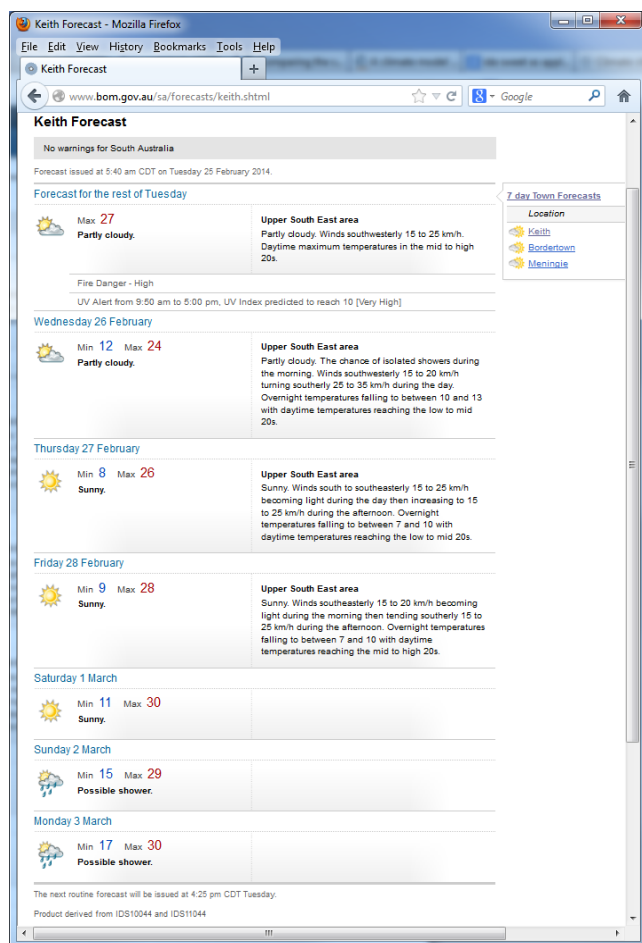
Observed daytime temperature anomaly



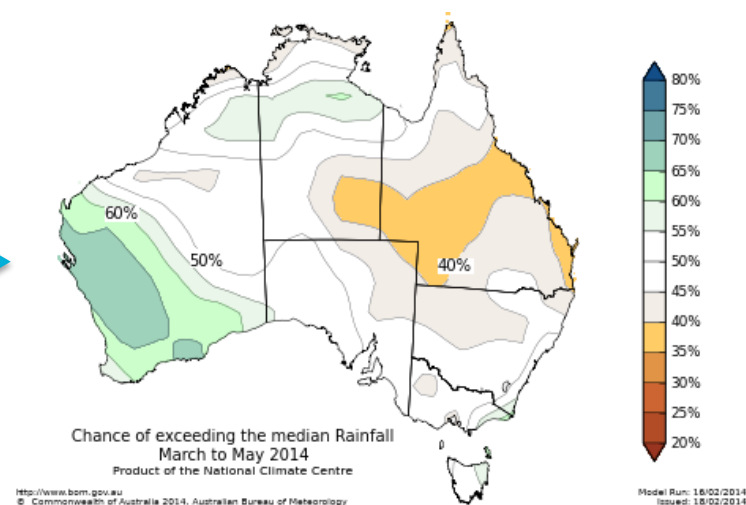
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Providing information across a range of timescales

7 day forecasts



3 month block seasonal outlook



BoM is moving toward more specific products across a range of timescales



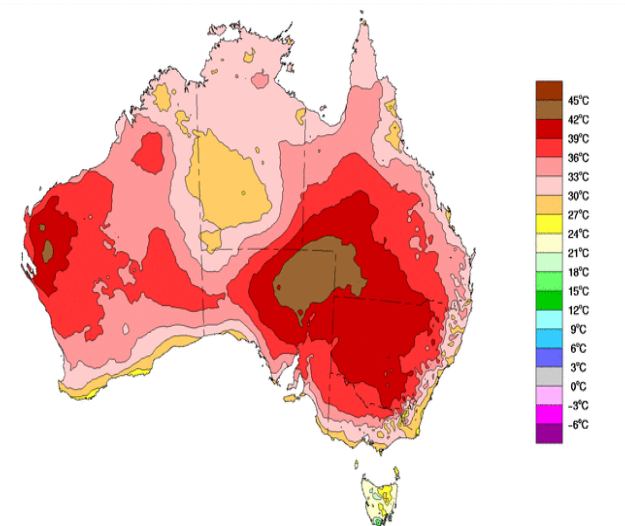
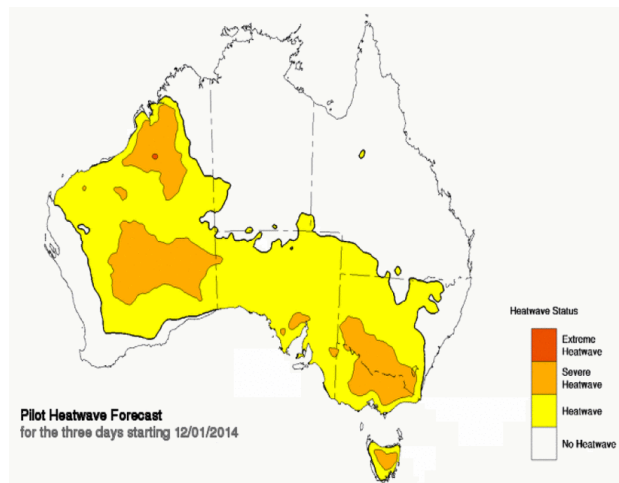
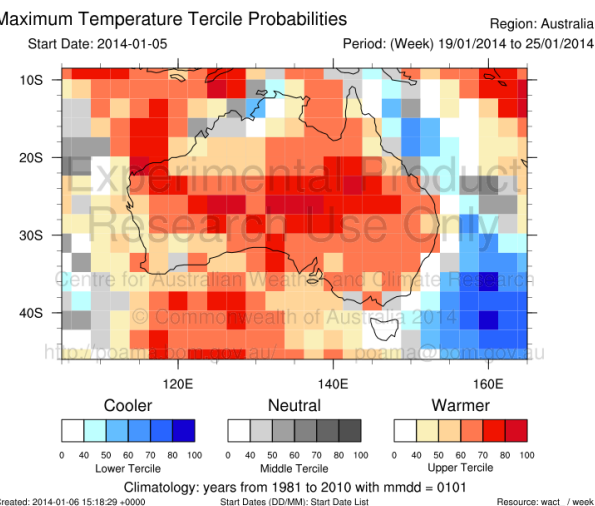
Australian Government
Bureau of Meteorology

Predicting extremes – BoM pilot heatwave warning service

POAMA outlook 5th January 2014 for third week of January

Pilot heatwave forecast

Observed Temperatures
Week ending 21 January 2014





Australian Government

Bureau of Meteorology

Summarising...

- There is direct evidence of the impact of increasing ghg's
- Seeing temperature increases globally, nationally and locally, and increased heat extremes
- Weather patterns are changing –MJT?,
- Improved forecasting across timescales allows climate change adaptation
- Reducing emissions as much as possible is a smart way to go



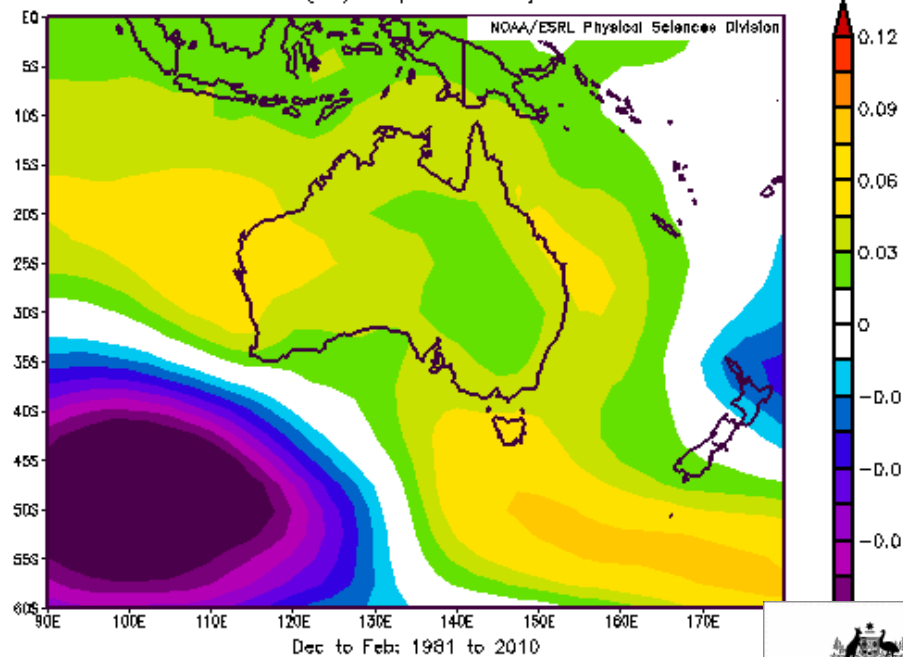
Australian Government

Bureau of Meteorology

Thank you

d.ray@bom.gov.au

NCEP/NCAR Reanalysis
Sea Level Pressure (mb) Composite Anomaly 1981–2010 climo



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Bureau of Meteorology

