

Victoria's changing climate

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Team lead – Extended and long-range forecasting

Bureau of Meteorology

27/08/2021



Australian Government
Bureau of Meteorology

**KNOW YOUR WEATHER.
KNOW YOUR RISK.**

Changes in climate requiring adaptation



Increased frequency of large-scale heatwaves and record-high temperatures



Longer fire season with more extreme fire danger days



Prolonged high ocean temperatures



More time spent in drought



Greater proportion of rainfall from heavy rainfall events



Increased frequency of coastal storm surge inundation

occurring now

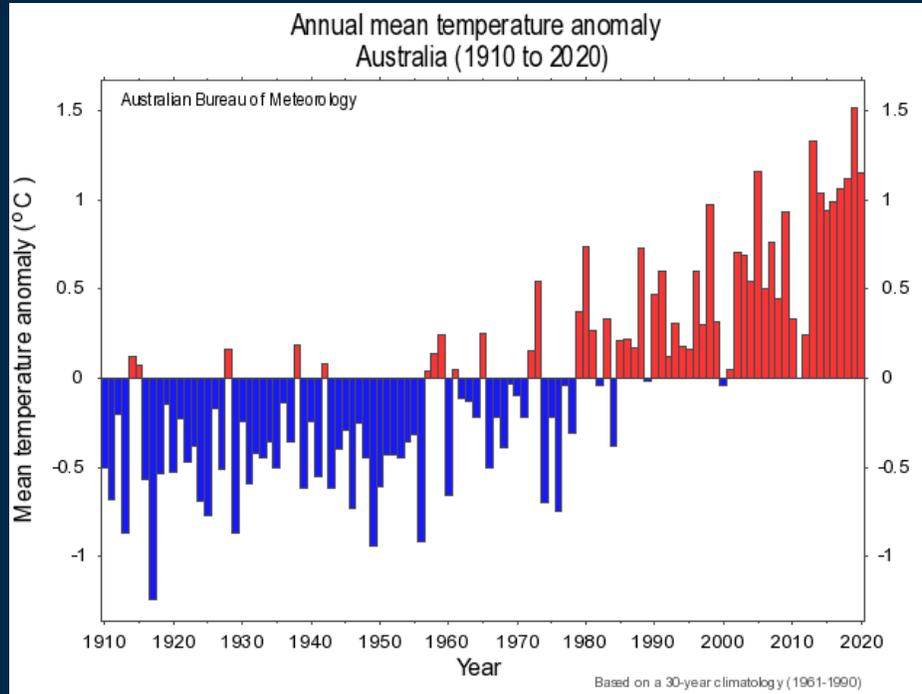


emerging threat

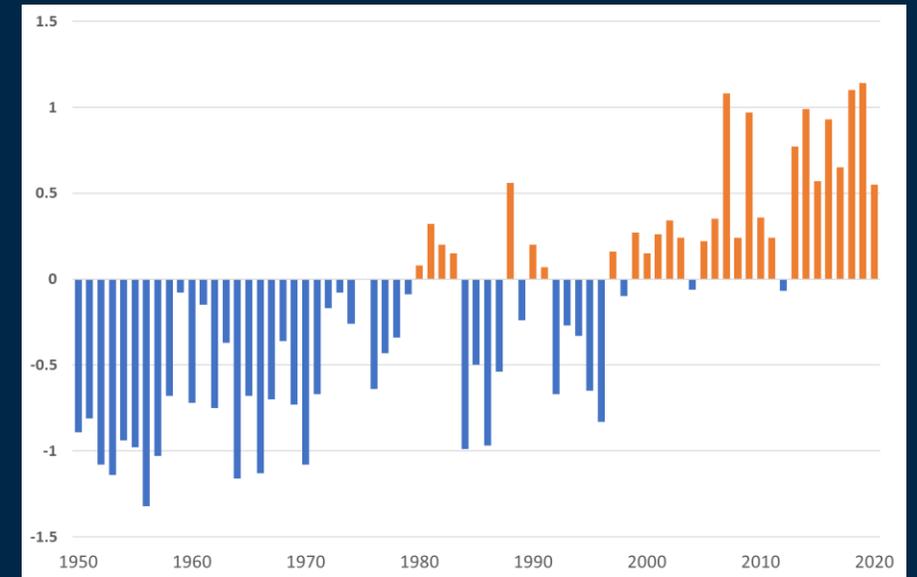


Australia's climate is naturally highly variable

- Clear warming trend in temperatures, but year-to-year variability
- Australia's climate has warmed by around 1.4 °C since 1910 leading to an increase in the frequency of extreme heat events.



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

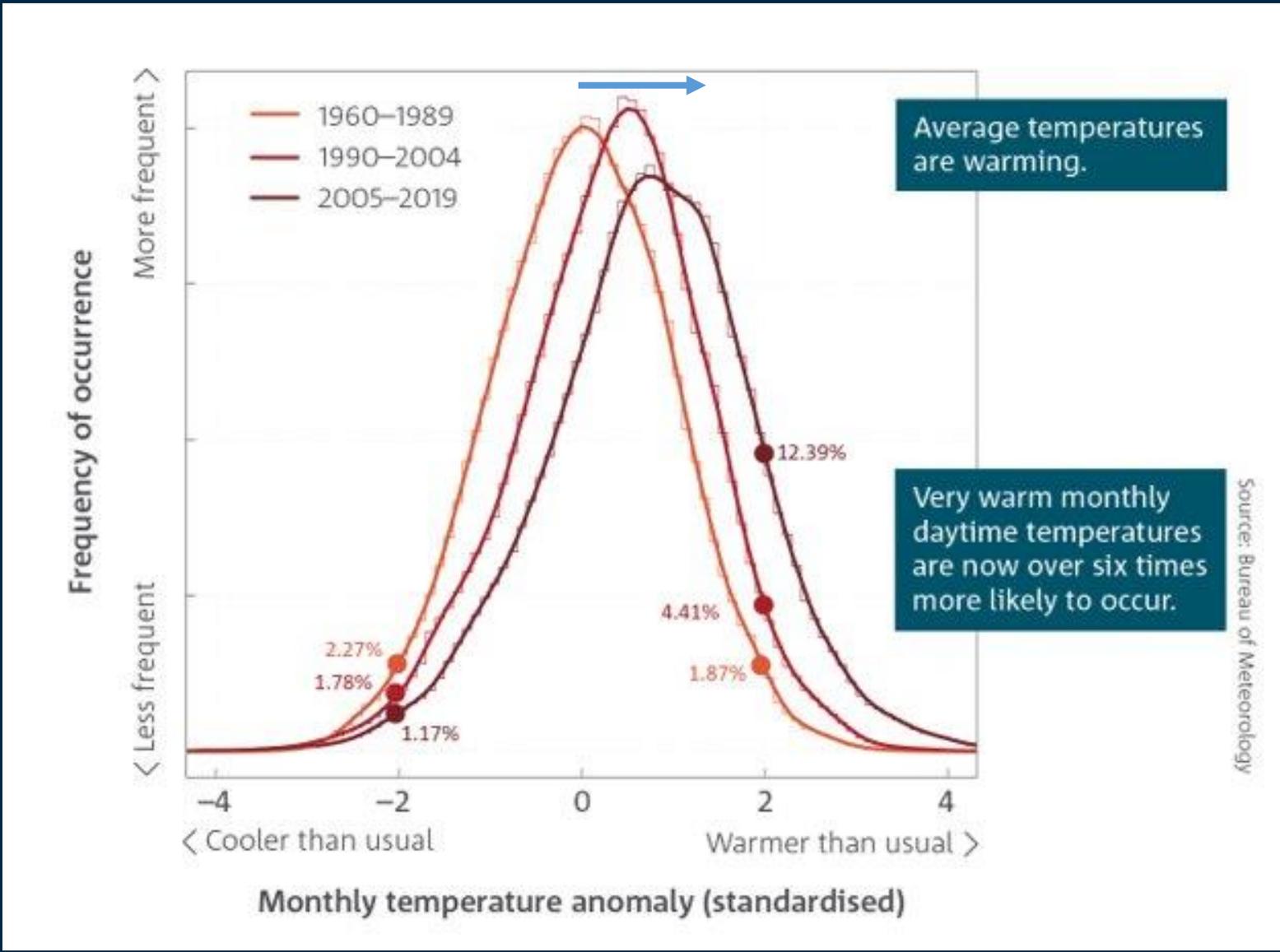


Northeast Victoria annual temperature anomalies 1950-2020



Why does 1 °C matter?

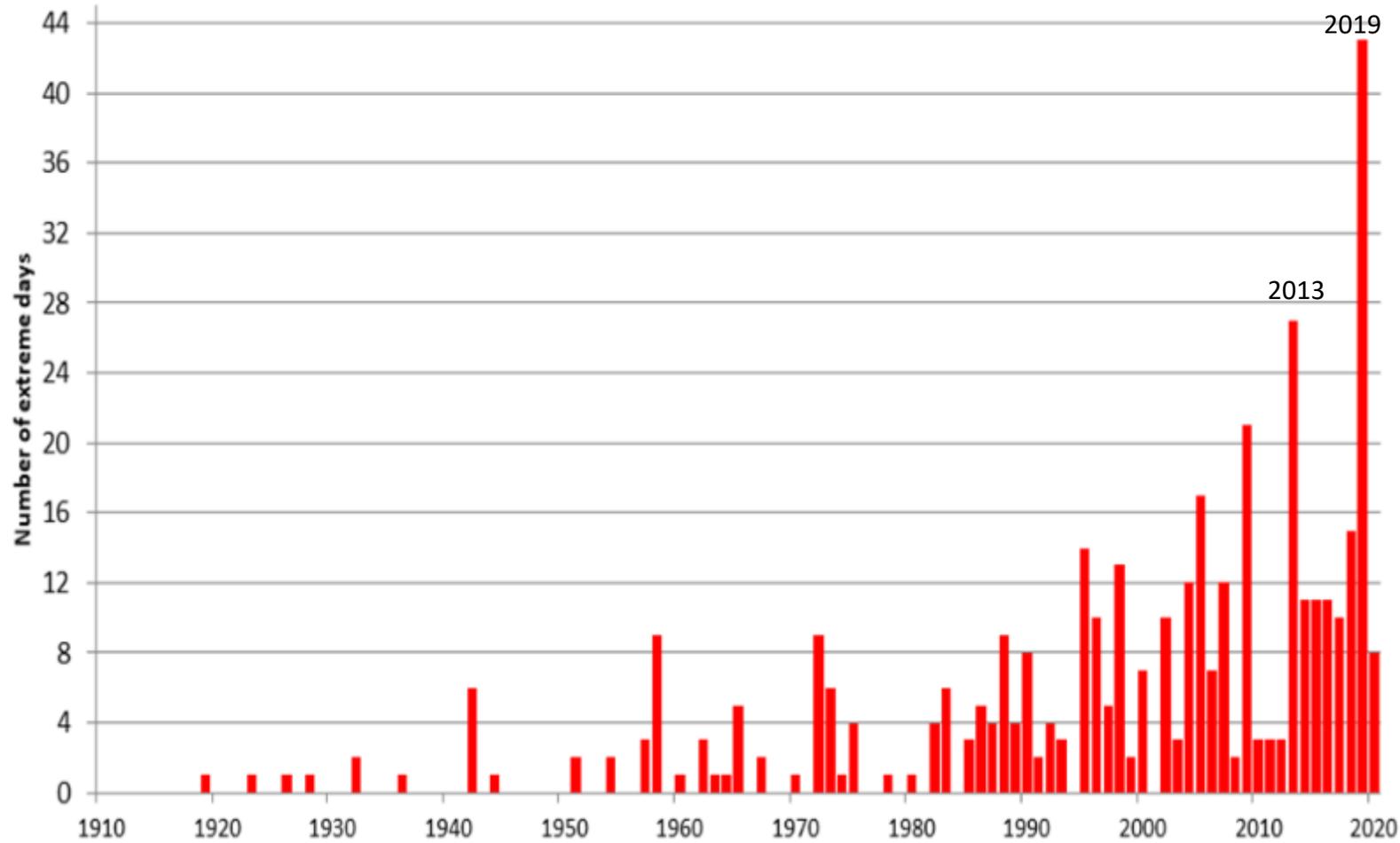
- A shift of over 1°C in the mean temperature means a large shift in the extremes





We are seeing more extreme heat events

Number of days each year where the Australian daily area-averaged mean temperature is extreme



Black Saturday 2009

Record-breaking heatwave across southeastern Australia

Melbourne late January 43.4, 44.3, 45.1°C...7th Feb: 46.4°C

January 2014

Four days 41°C and above in Melbourne

(42.8, 41.7, 43.9, 43.9°C)

Vic Heat health Plan reduces mortality and morbidity of the event

January 1908

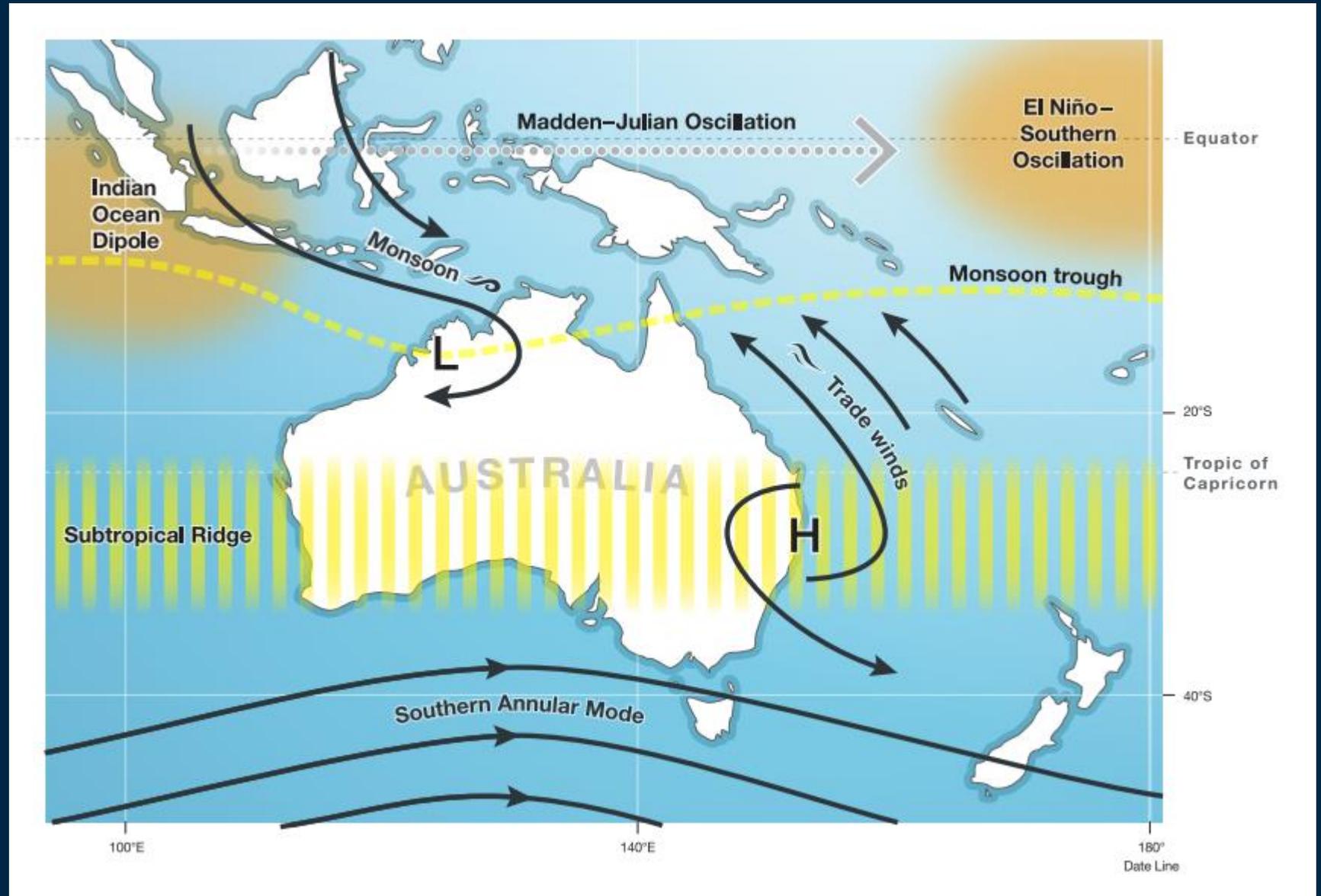
Five days 40°C and above in Melbourne (nearly six days: 39.9°C)

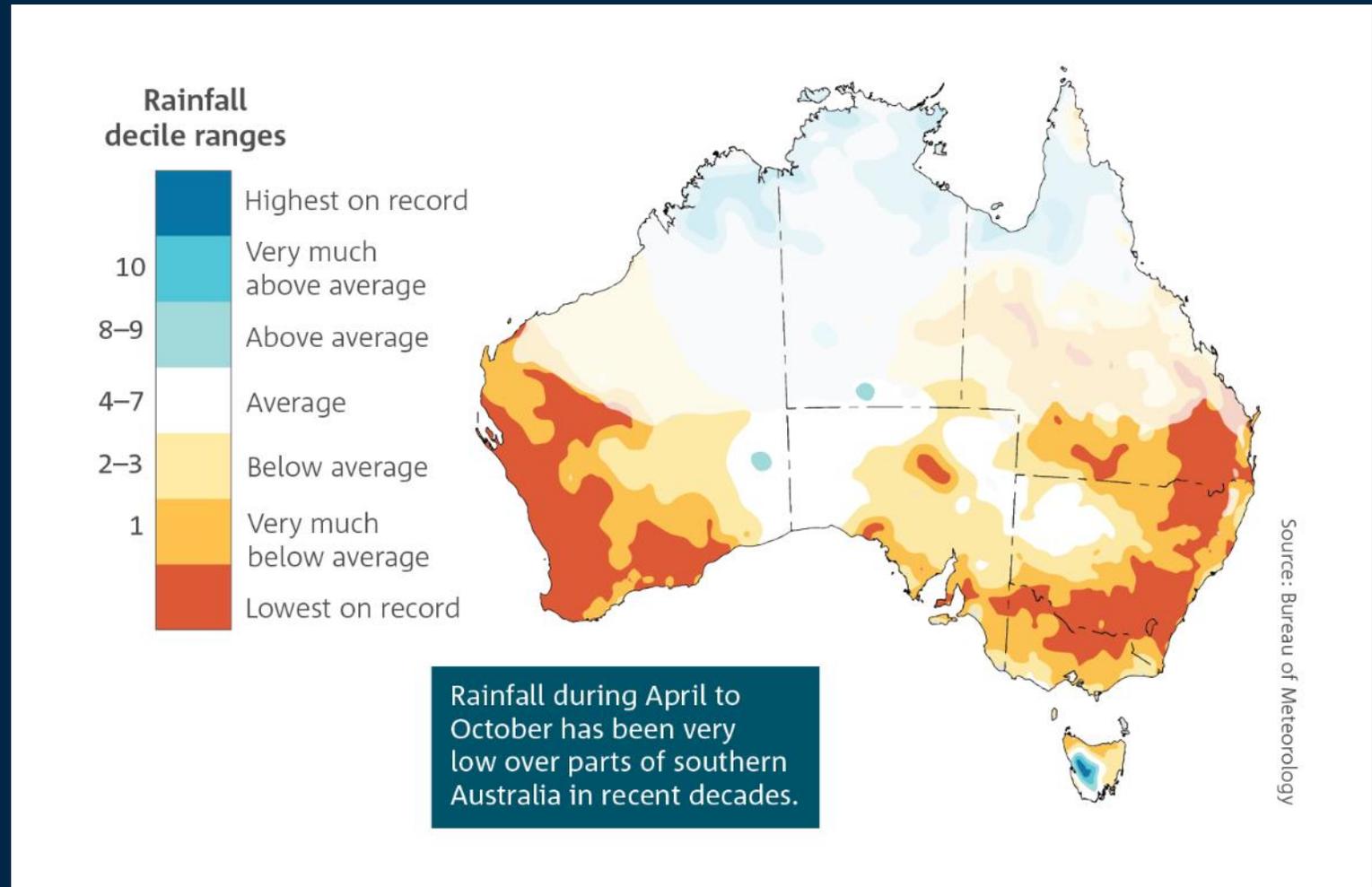
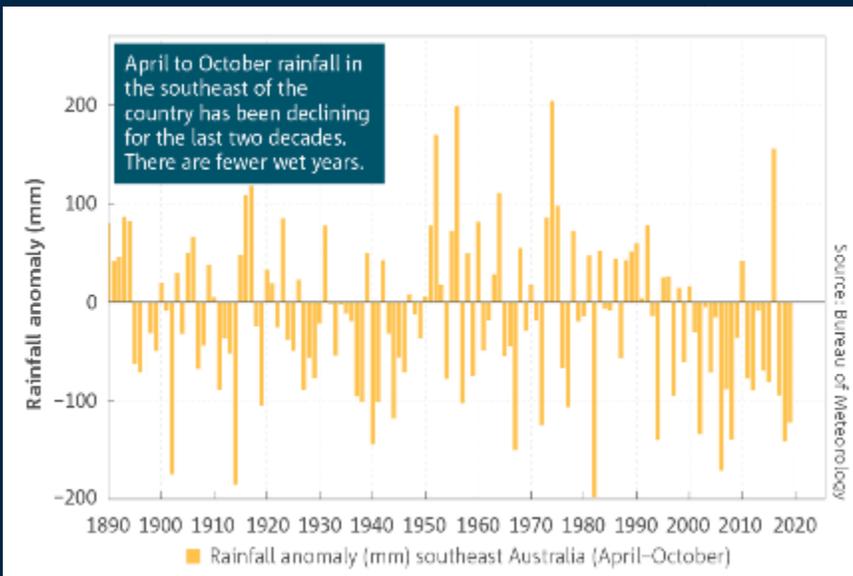
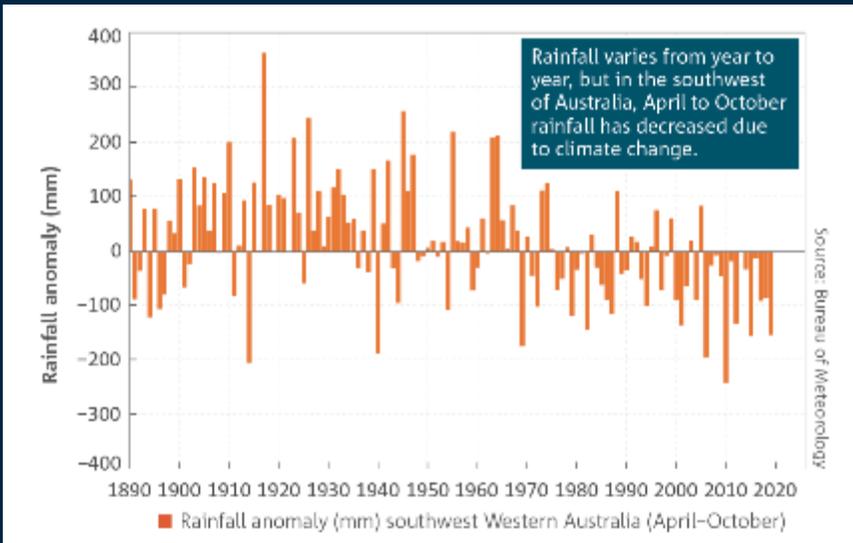
Peak 44.2°C



What is driving our climate?

- Climate change will affect Australian climate directly and by modifying the behaviour of other climate drivers.

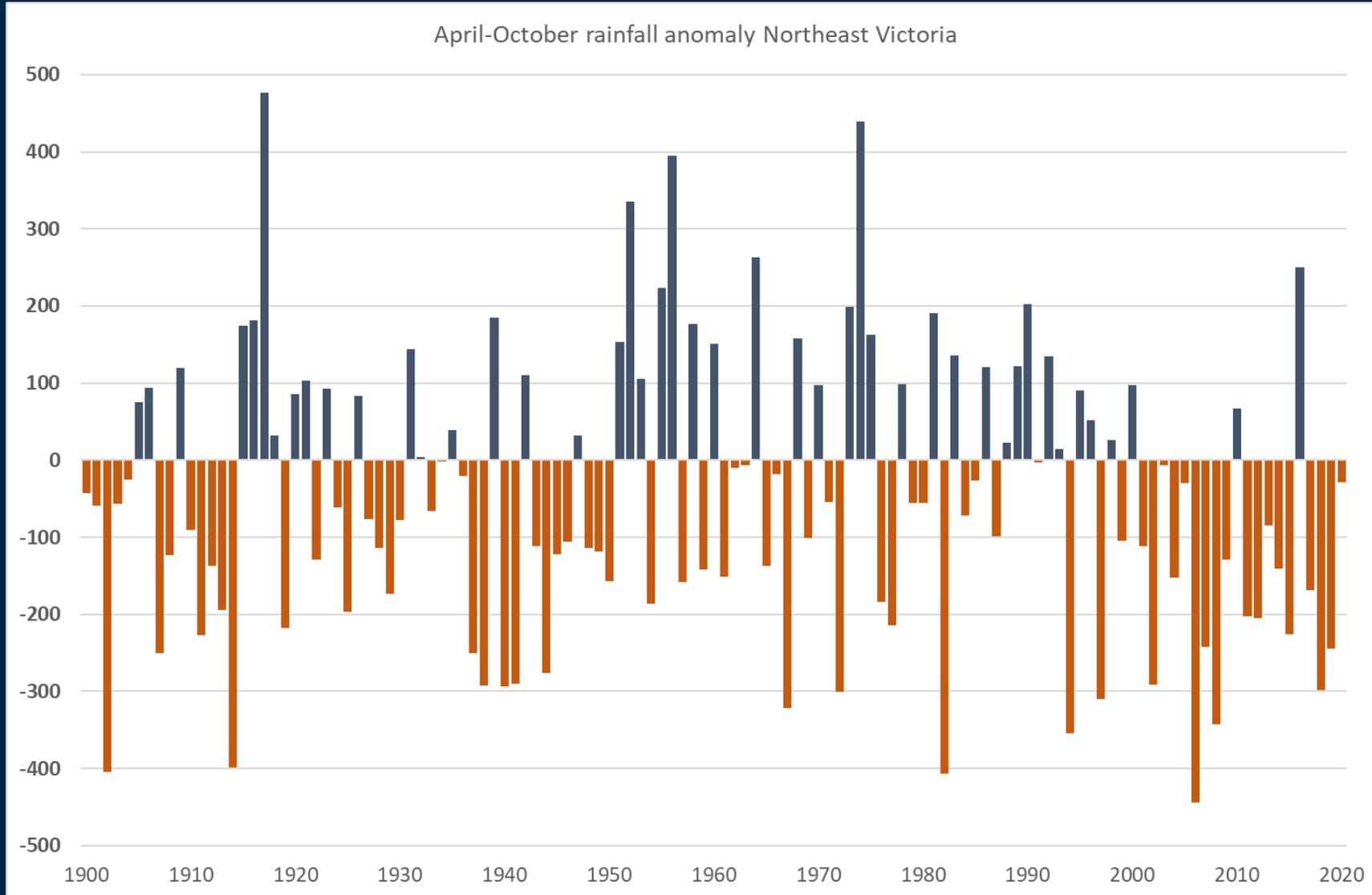






Decrease in rainfall over the April-October period

- Recent decades has seen fewer really wet years, still high year-to-year variability

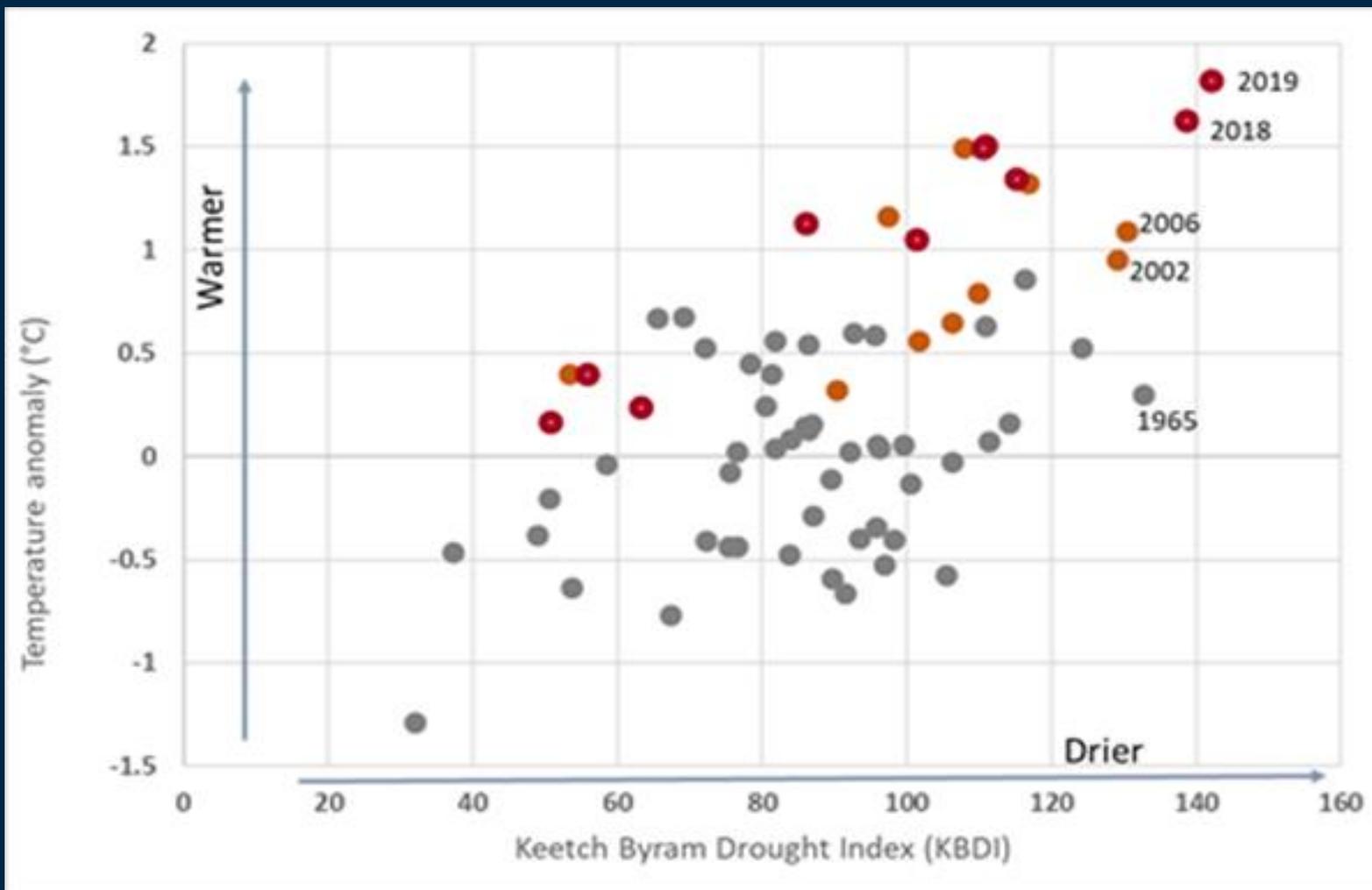


Average is 761 mm

Northeast Victoria April to October rainfall anomalies 1900-2020



Periods of dry are getting hotter



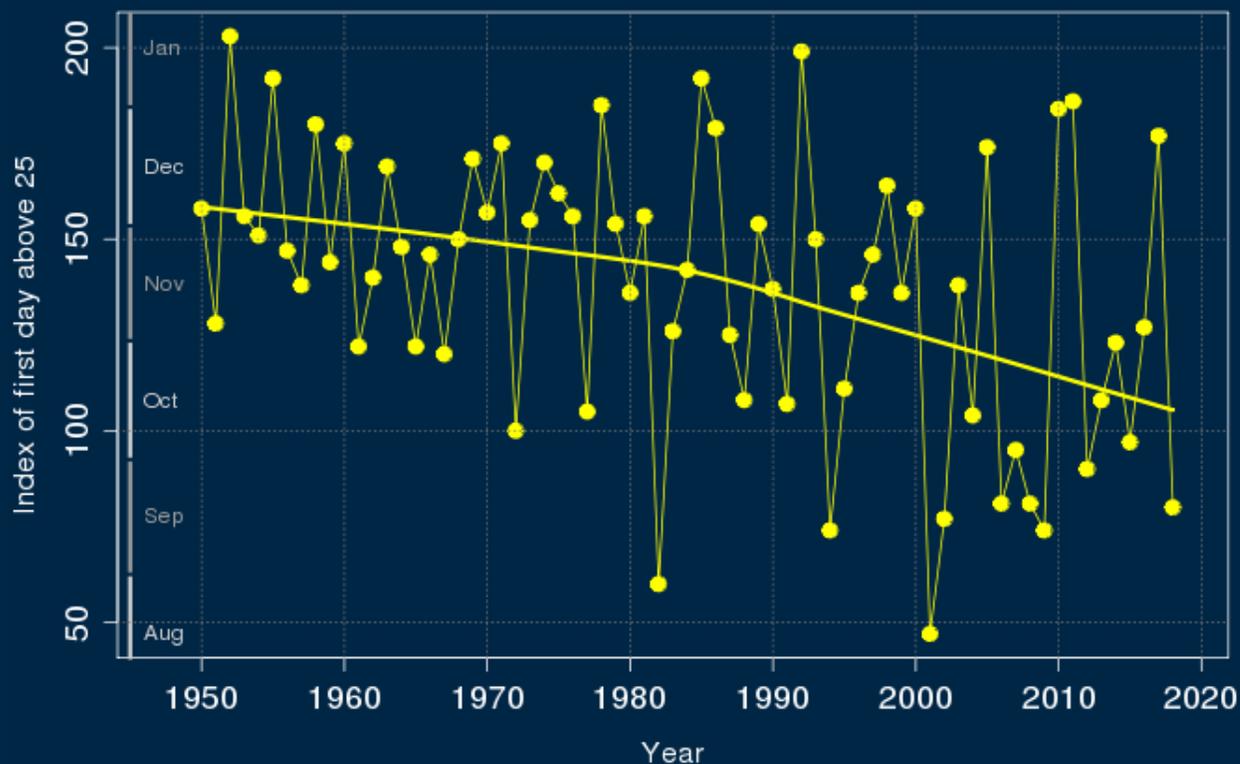
Drier conditions in the Murray-Darling Basin are now accompanied by warmer temperatures increasing the intensity and rapid onset of drought

Values of the Keetch-Byram Drought index (an indicator of dry conditions) plotted against temperature. Referenced in <http://www.bom.gov.au/state-of-the-climate>

Longer more intense fire seasons

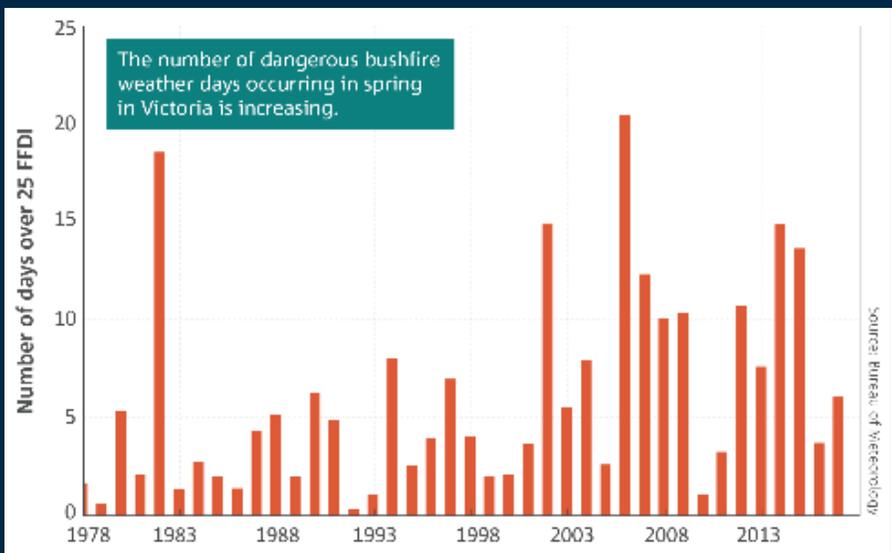
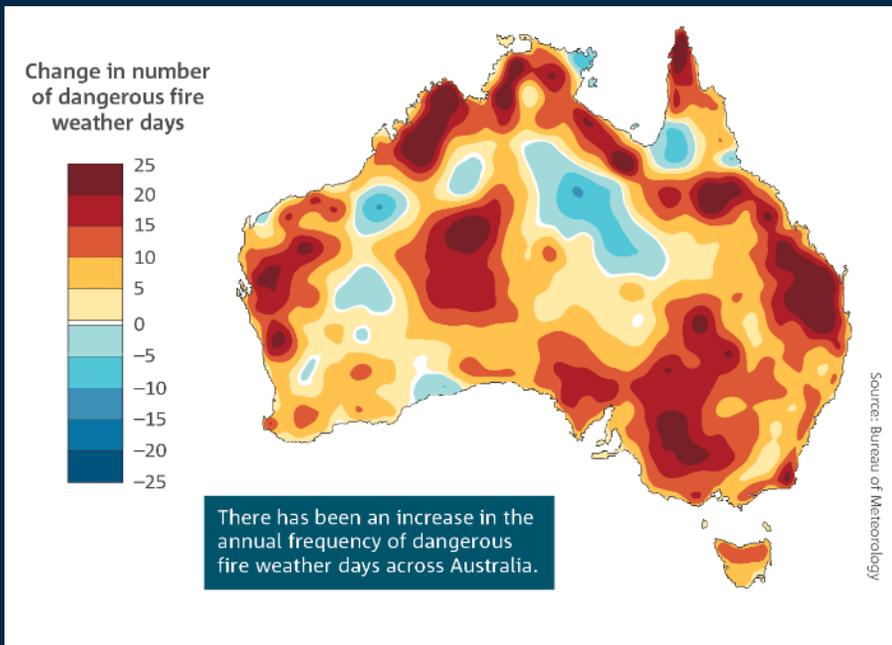
Earliest day with northeast Vic daily FFDI > 25

Change = -53.02



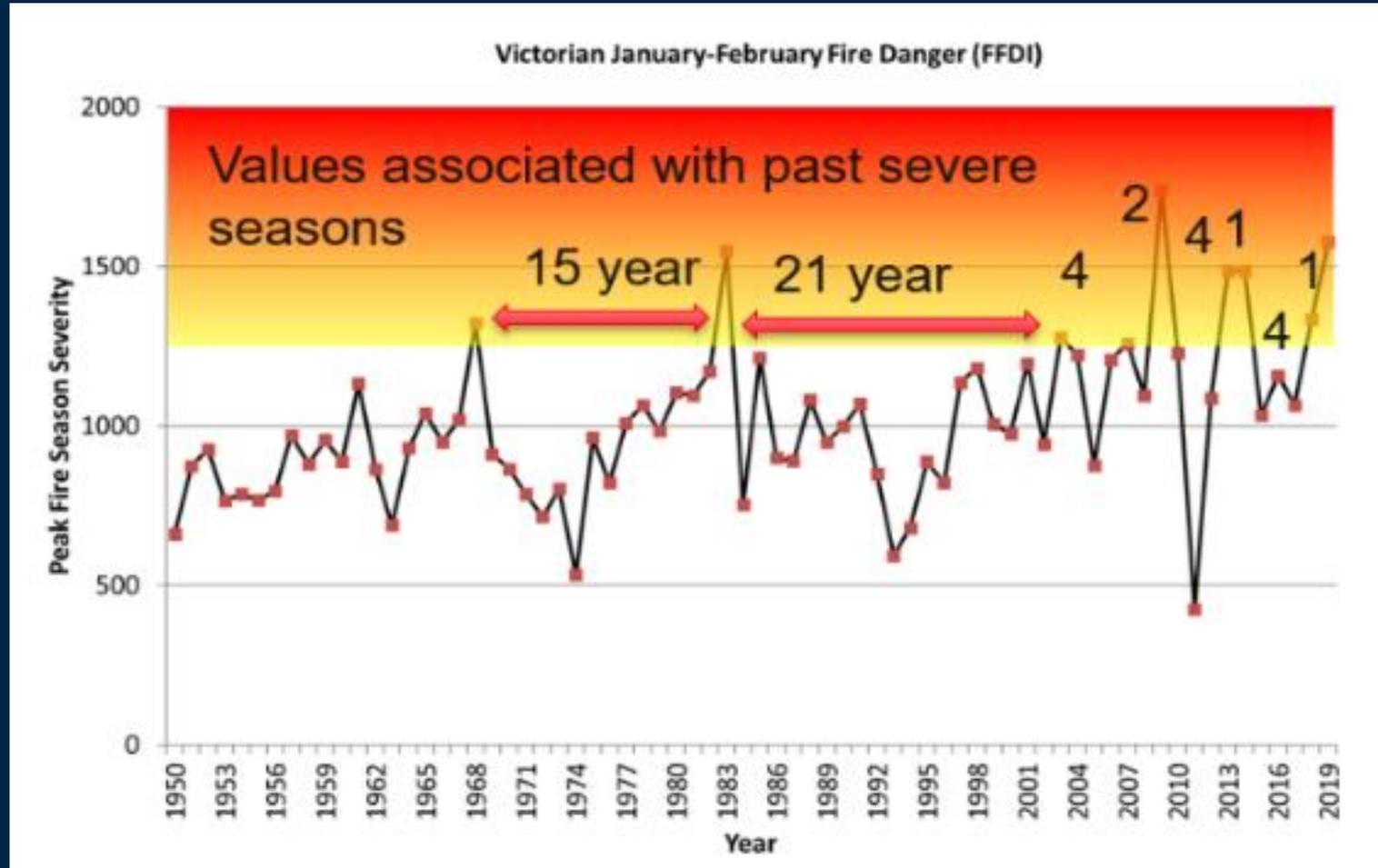
Data Reference: Dowdy (2018), *J. Applied Met. Climatol.*

<http://www.bom.gov.au/state-of-the-climate>





Victorian January-February fire danger: less recovery time between severe seasons





Fire behaviour is changing

Fire-generated thunderstorms can produce extremely dangerous fire behaviour, with strong, erratic winds and lightning.

- Thunderstorms that are initiated by bushfire smoke plumes have been observed more frequently in recent years than in previous decades.
- These fire-generated thunderstorms can produce extremely dangerous fire behaviour, including erratic changes in wind. They can also start new fires from burning embers and lightning far ahead of the fire front.
- In southern Australia, human-caused climate change is increasing some risk factors associated with fire-generated thunderstorms.

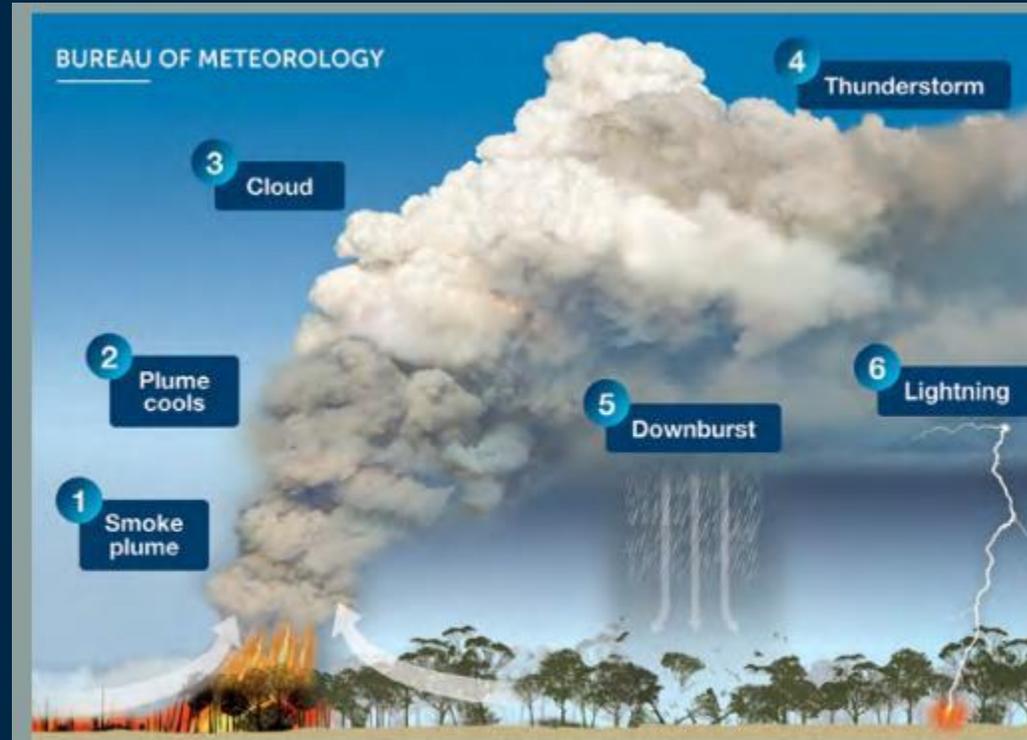


Figure 2: Pyrocumulonimbus cloud development.
Image: Australian Bureau of Meteorology

1. A plume of hot, turbulent air and smoke rises above a large area of intensely burning fire.
2. Cooler air mixes into the plume as it rises, causing it to broaden and cool.
3. When the plume rises high enough, lower atmospheric pressure causes further cooling and clouds form.
4. In the right environmental conditions (known as a weakly-stable atmosphere) a thunderstorm may develop.
5. Rain from the cloud sometimes evaporates as it falls and cools when it comes into contact with dry air, producing a downburst of wind.
6. Lightning may be produced and can ignite new fires far ahead of the fire front.

https://nespclimate.com.au/wp-content/uploads/2021/05/ESCC_Fire-Generated-Thunderstorms_Brochure.pdf



Goulburn Climate Projections 2019



Maximum and minimum daily temperatures will continue to increase over this century (very high confidence).



By the 2030s, increases in daily maximum temperature of 0.9 to 1.8°C (since the 1990s) are expected.



Rainfall will continue to be very variable over time, but over the long term it is expected to continue to decline in winter and spring (medium to high confidence), and autumn (low to medium confidence), but with some chance of little change.



Extreme rainfall events are expected to become more intense on average through the century (high confidence) but remain very variable in space and time.



By the 2050s, the climate of Shepparton could be more like the current climate of Griffith, NSW.

Ovens Murray Climate Projections 2019



Maximum and minimum daily temperatures will continue to increase over this century (very high confidence).



By the 2030s, increases in daily maximum temperature of 1.0 to 1.9°C (since the 1990s) are expected.



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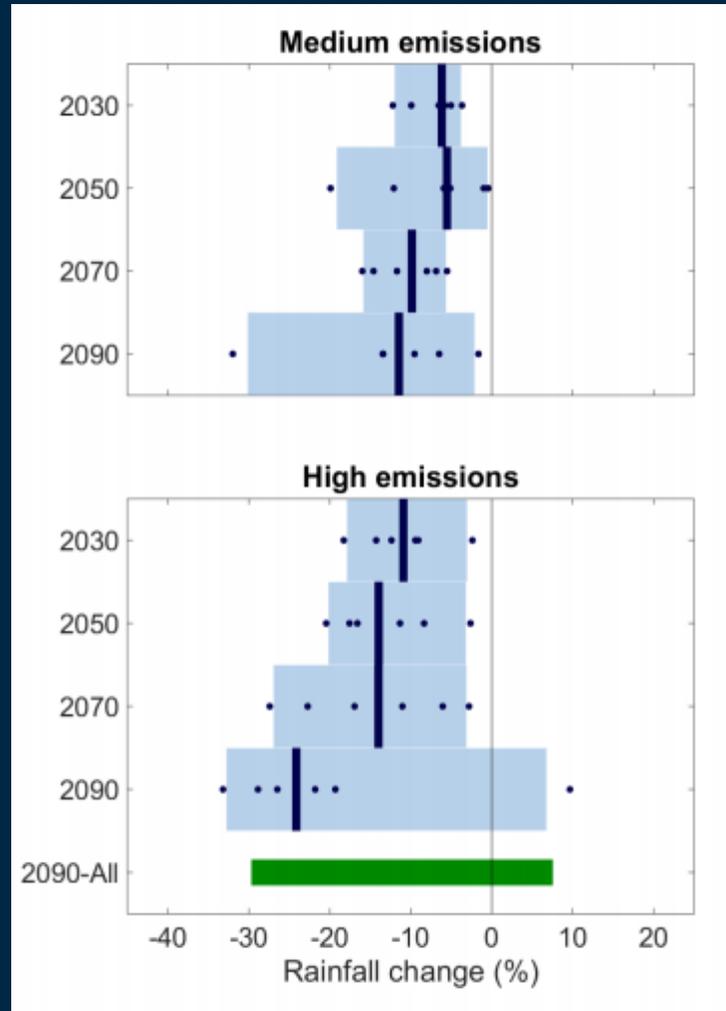
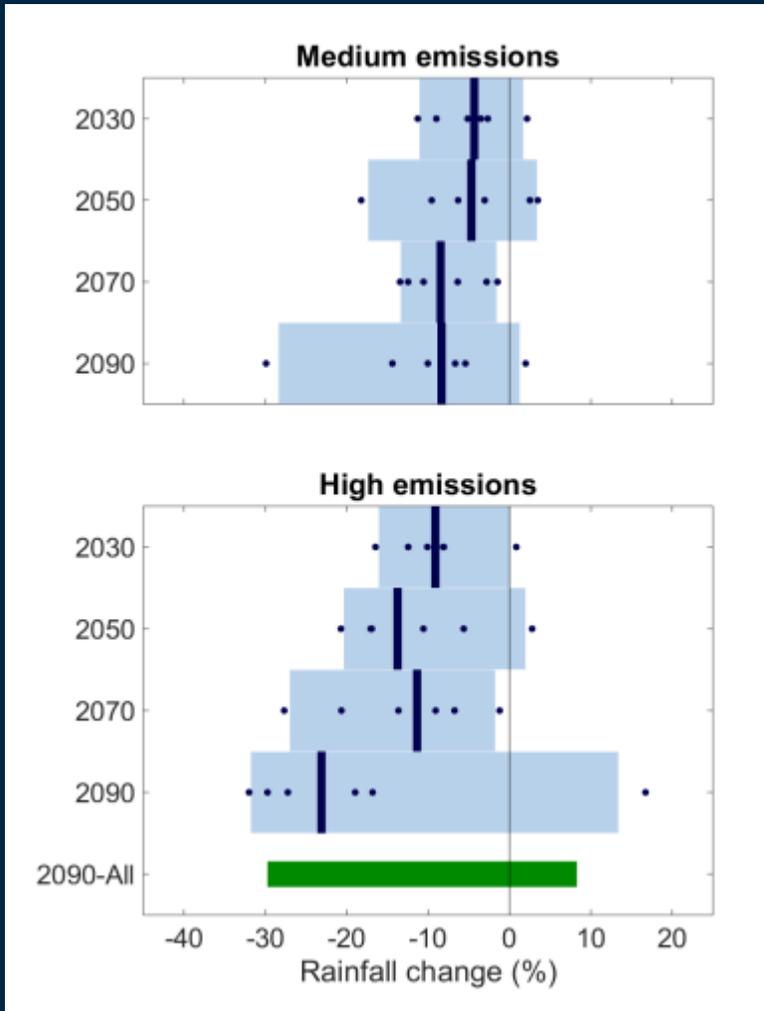


By the 2050s, the climate of Wodonga could be more like the current climate of Forbes, NSW.



More time spent in drought = more dry years and potentially very dry years

Projected **annual** rainfall – Goulburn region Projected **annual** rainfall – Ovens-Murray region

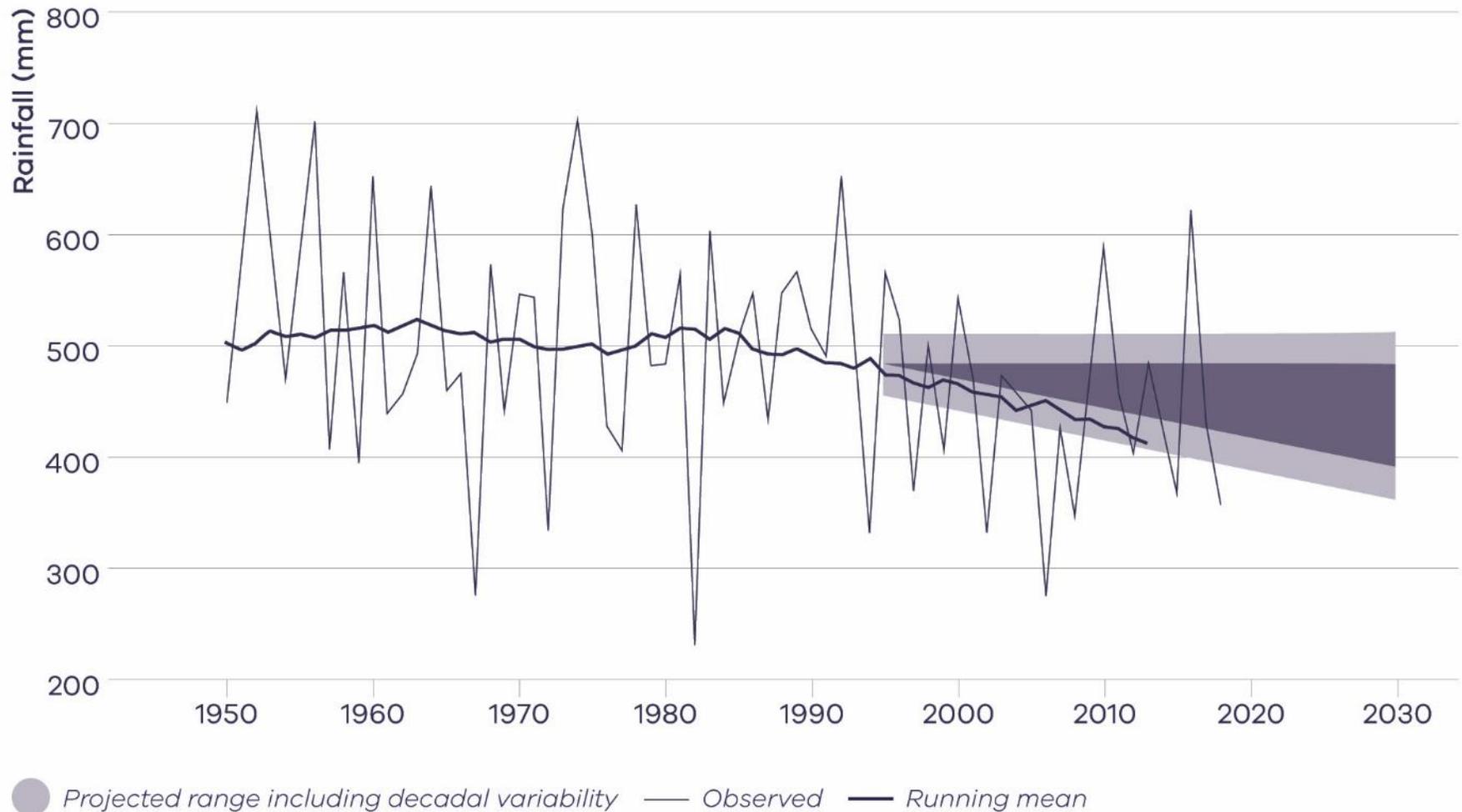


(Observed rainfall change for 2006-2019 April to October compared to the base period is already 19%!)



More time spent in drought = more dry years and potentially very dry years

Observed Apr-Oct rainfall in Victoria is tracking towards the drier end of projections





Australia's warming over the next decades is already set by historical greenhouse gas emissions (those already in the atmosphere)

Australian average temperature trends from different future global greenhouse gas emissions pathways

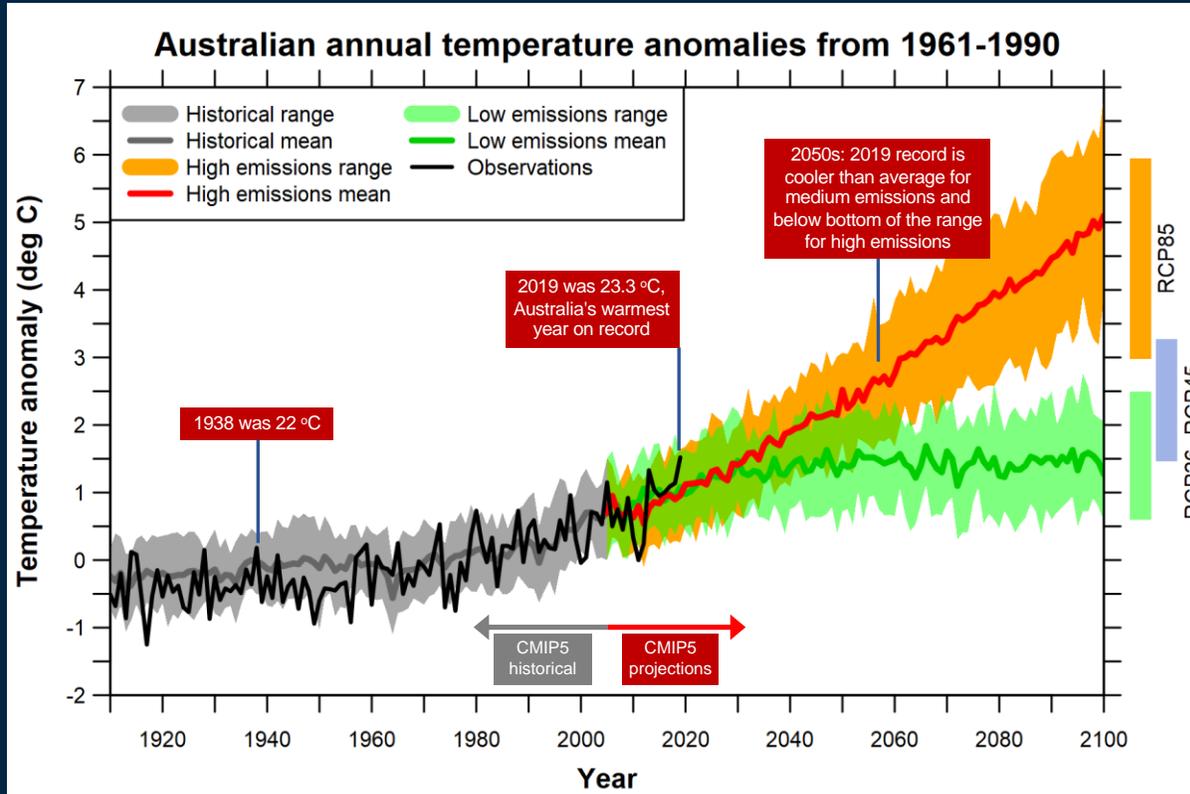
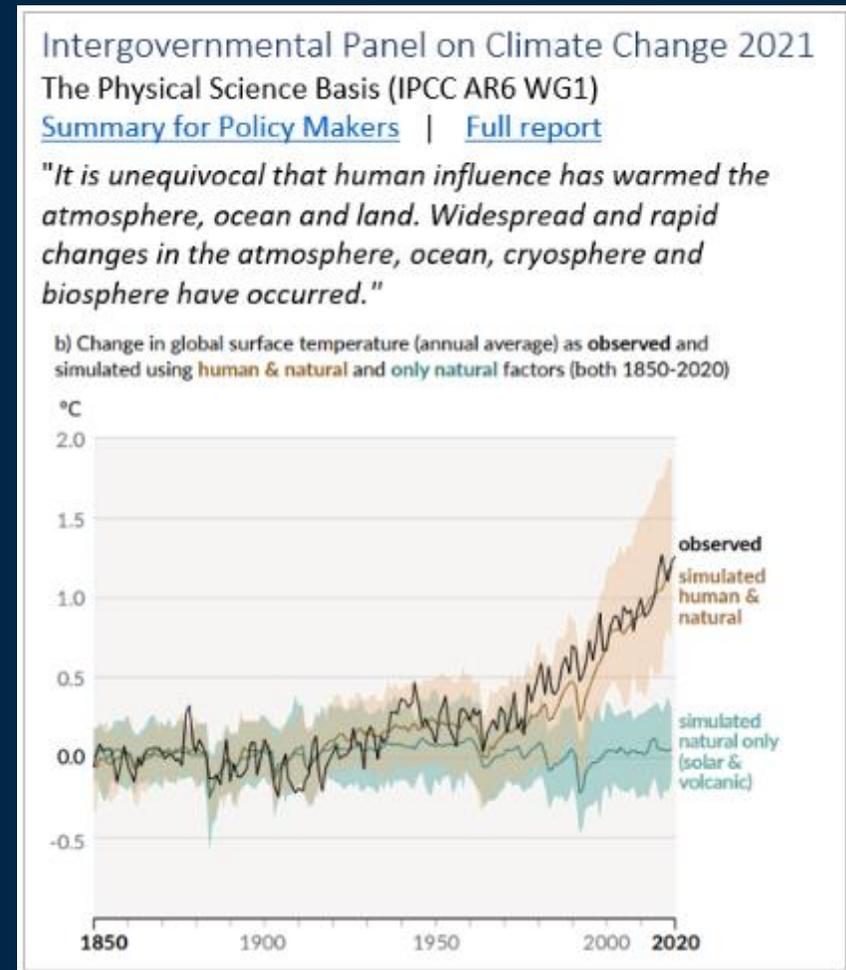


Figure provided by Simon Grainger modified from <http://www.bom.gov.au/state-of-the-climate/future-climate.shtml>





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Thanks

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