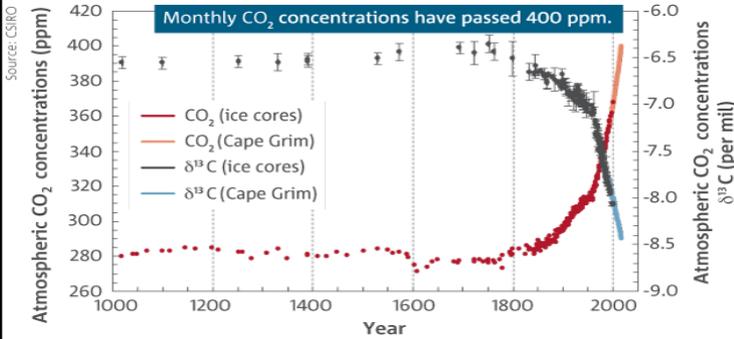


## Need to manage risks associated with

- physical risks due to climate change, and
- transition to a zero carbon economy

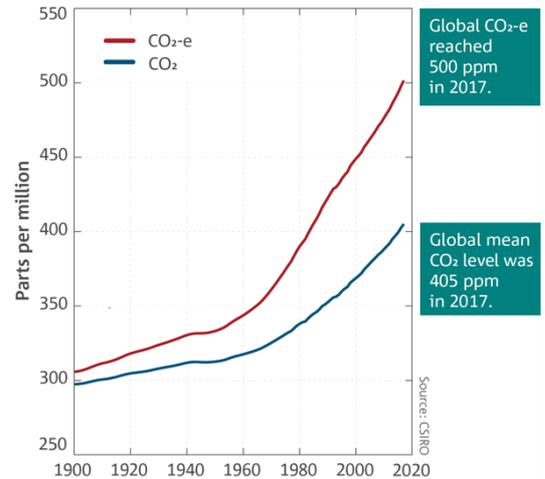
- Introduction to climate change
- Global climate update
- Climate change in Victoria
- Global emissions and Australian emission projections
- United in Science report to UN climate summit, Sept 2019

## Observed global climate change: greenhouse gases



The decrease in the ratio of the carbon-13 isotope ( $\delta^{13}\text{C}$ ) that accompanies increasing  $\text{CO}_2$  trends show that the sources are fossil fuel and land-use change.

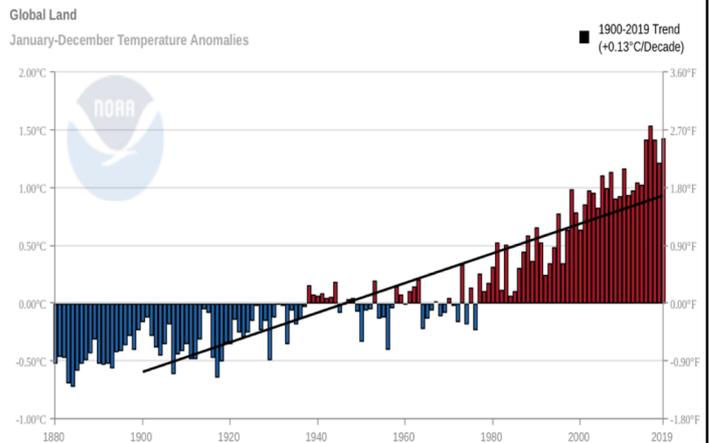
Other long-lived greenhouse gases, in addition to carbon dioxide, are major contributors to climate change.



SoC, 2016, 2018

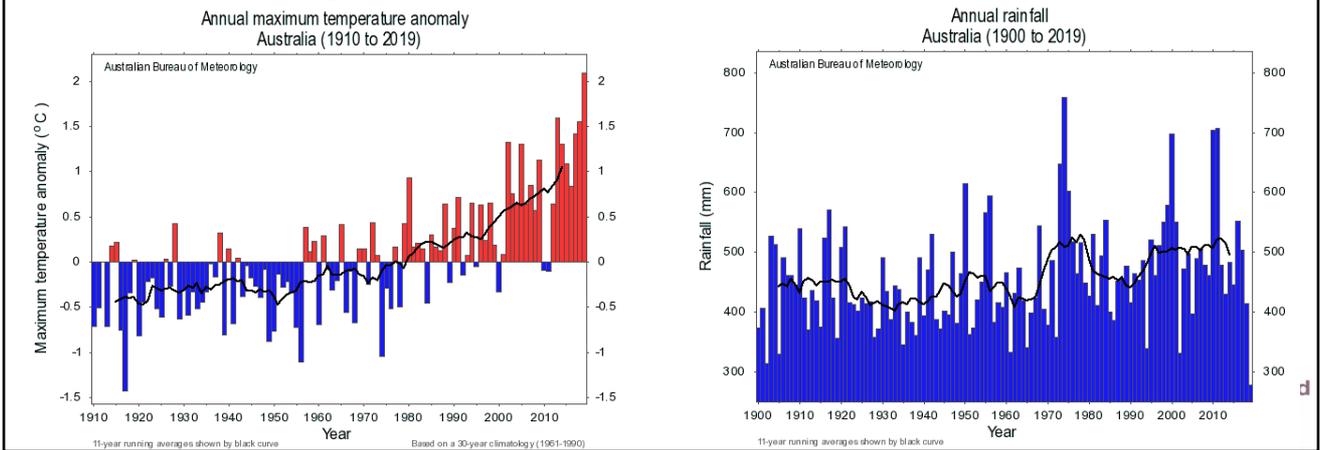
## IPCC Special report on Climate change and Land, 2019

- Since the pre-industrial period, the land surface air temperature has risen nearly twice (~1.7 times) as much as the global average temperature
- Climate change, including increases in frequency and intensity of extremes, has adversely impacted food security and terrestrial ecosystems as well as contributed to desertification and land degradation in many regions

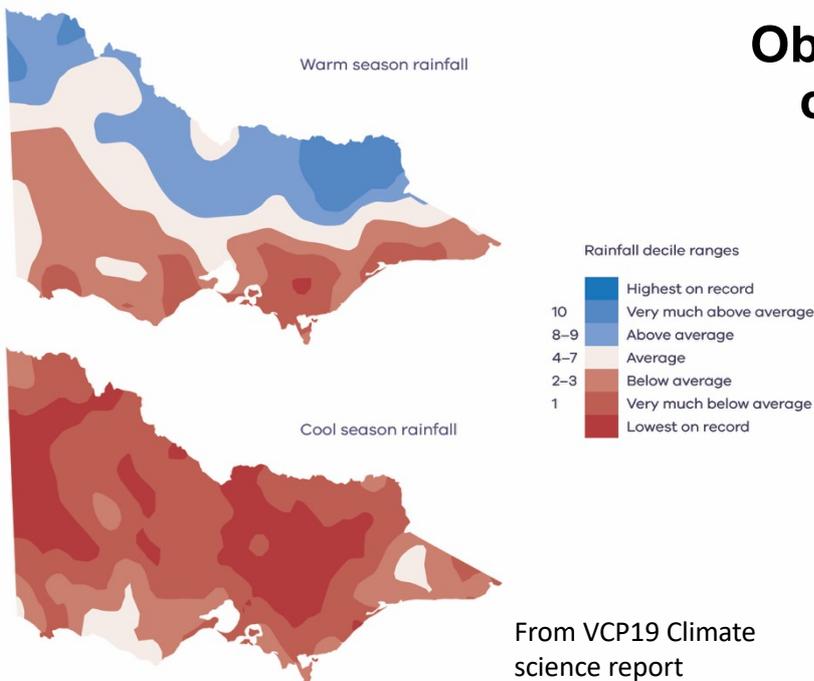


## Australian climate in 2019

- Record high annual maximum temperature across Australia due to climate change. Virtually impossible due to natural climate variations alone.
- Record low annual rainfall across Australia, mainly due to natural variations, not climate change.

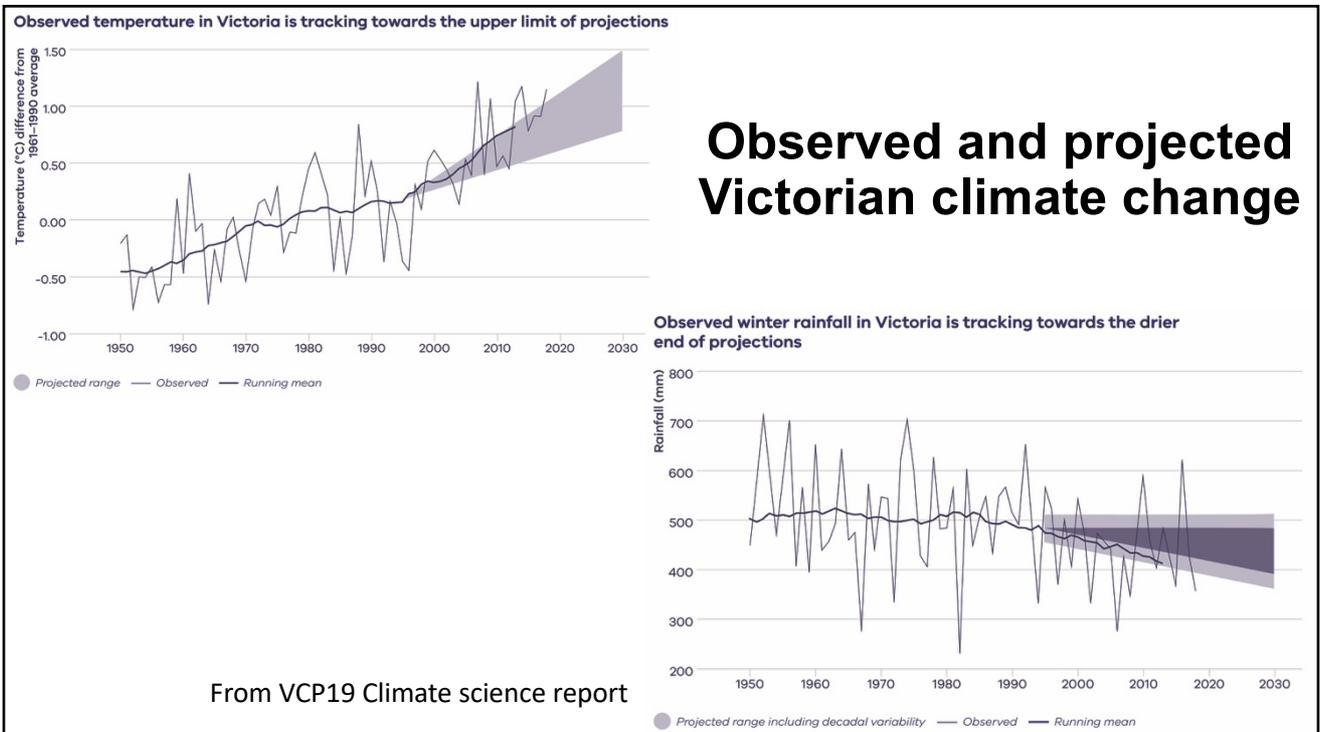
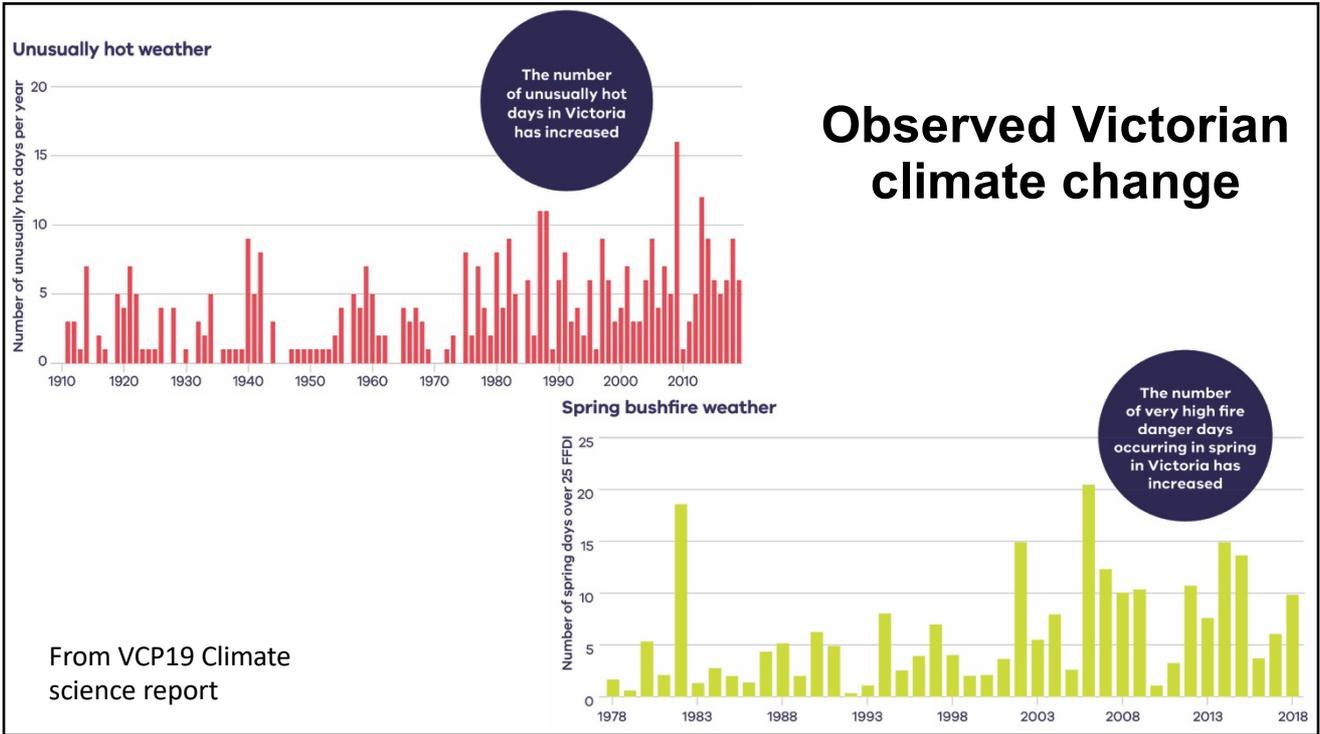


Observed rainfall change in Victoria for the last 30 years (1989–2018/19)

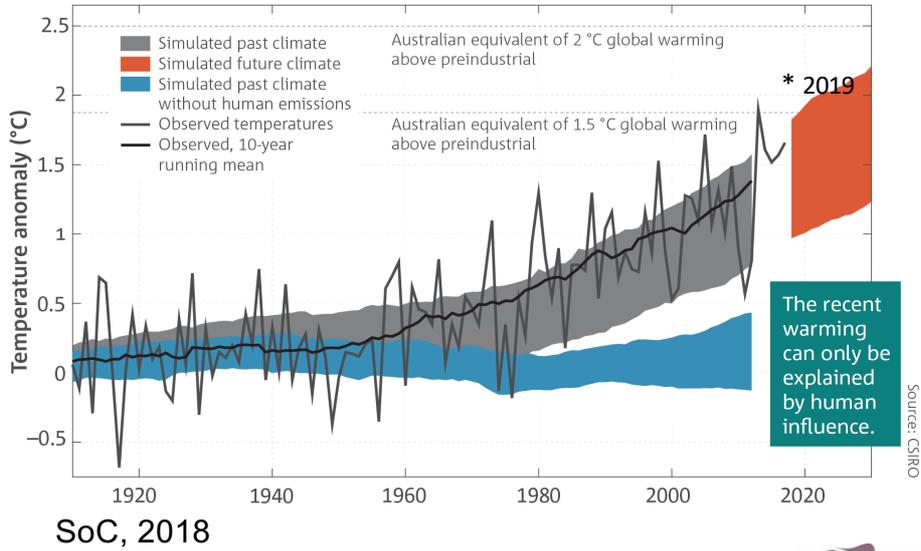


## Observed Victorian climate change





## Simulated temperature changes in Australia



Victoria is already experiencing the impacts of climate change:



**Decrease**  
in average rainfall



Temperature increase of just **over 1.0°C** since 1910



**Significant increase**  
in fire danger in spring

From VCP19 Climate science report

In the future Victoria can expect:

Average annual temperature increase up to **2.4°C**



Longer fire seasons, with up to **60% more very high fire danger days**



Melbourne's climate could be more like Wangaratta's



Double the number of **very hot days**



Decline in alpine snowfall of **35-75%**



Sea levels will rise by **around 24 cm**



Decline in **cool season rainfall**



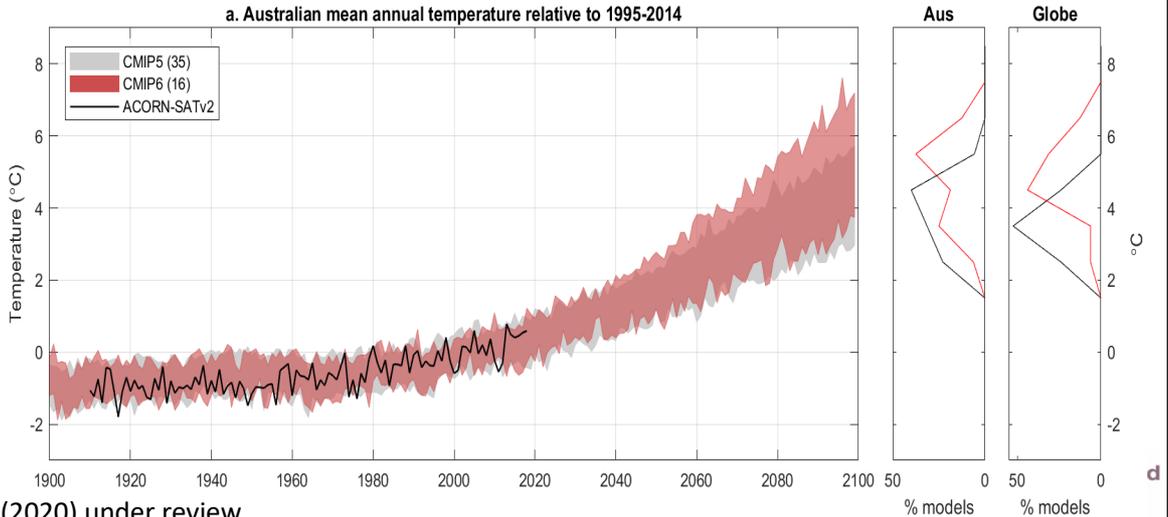
More intense **downpours**



By 2050s under high emissions, compared to 1986-2005

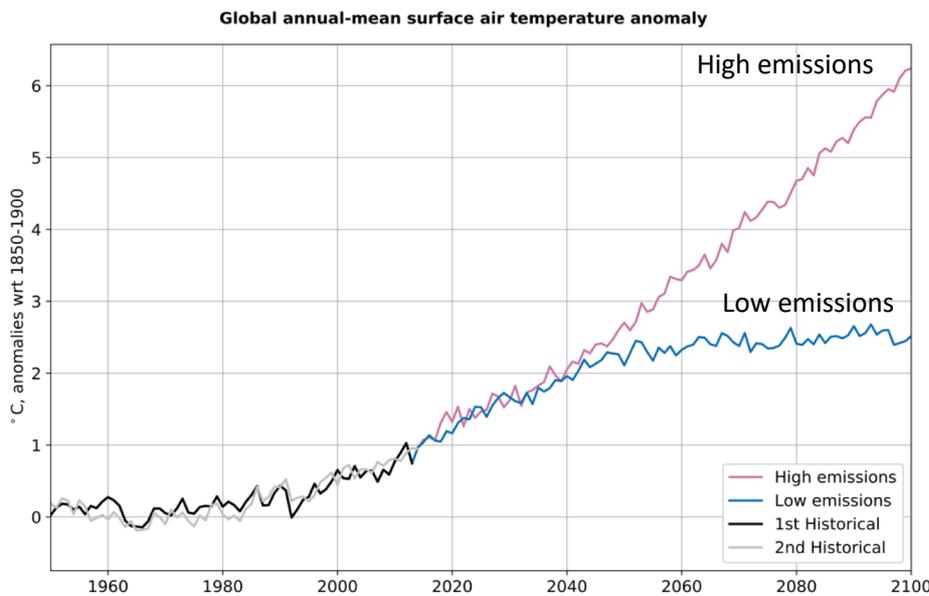
# New CMIP6 global climate model simulations

CMIP6 ScenarioMIP – some models have higher ECS, hotter!



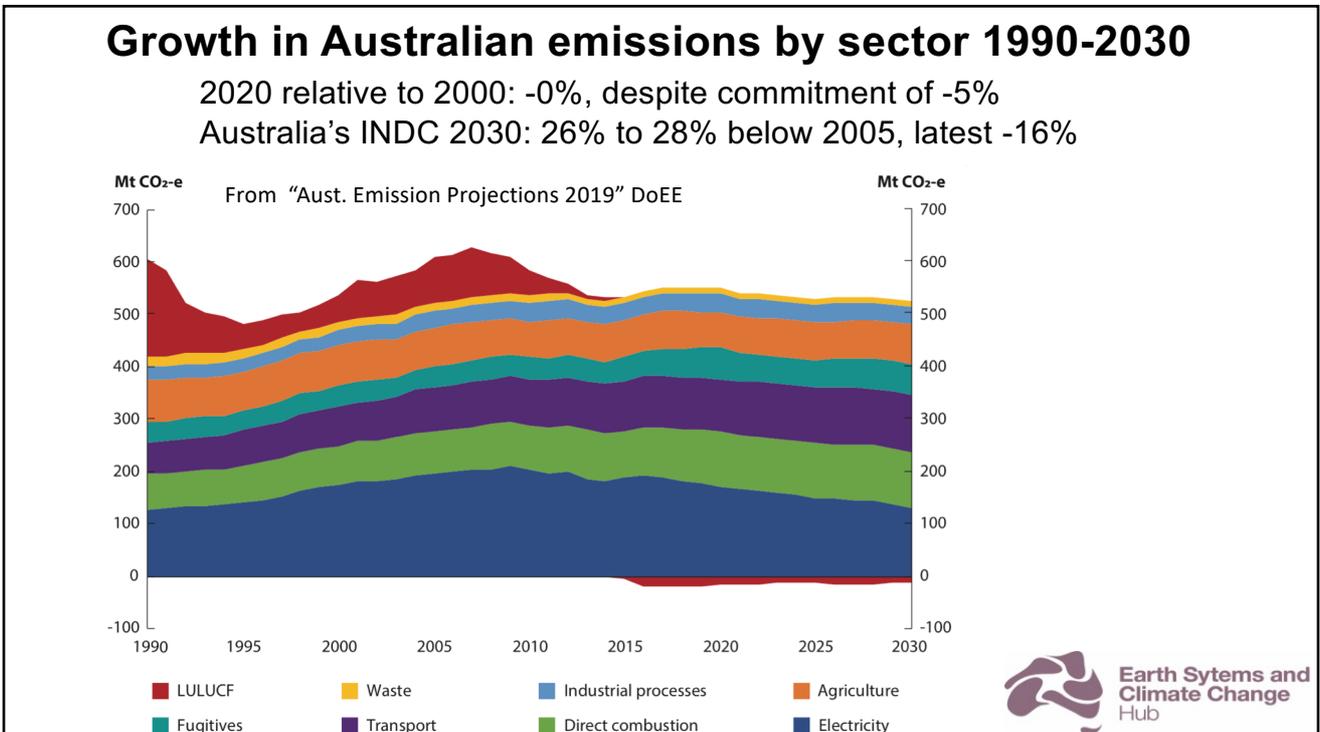
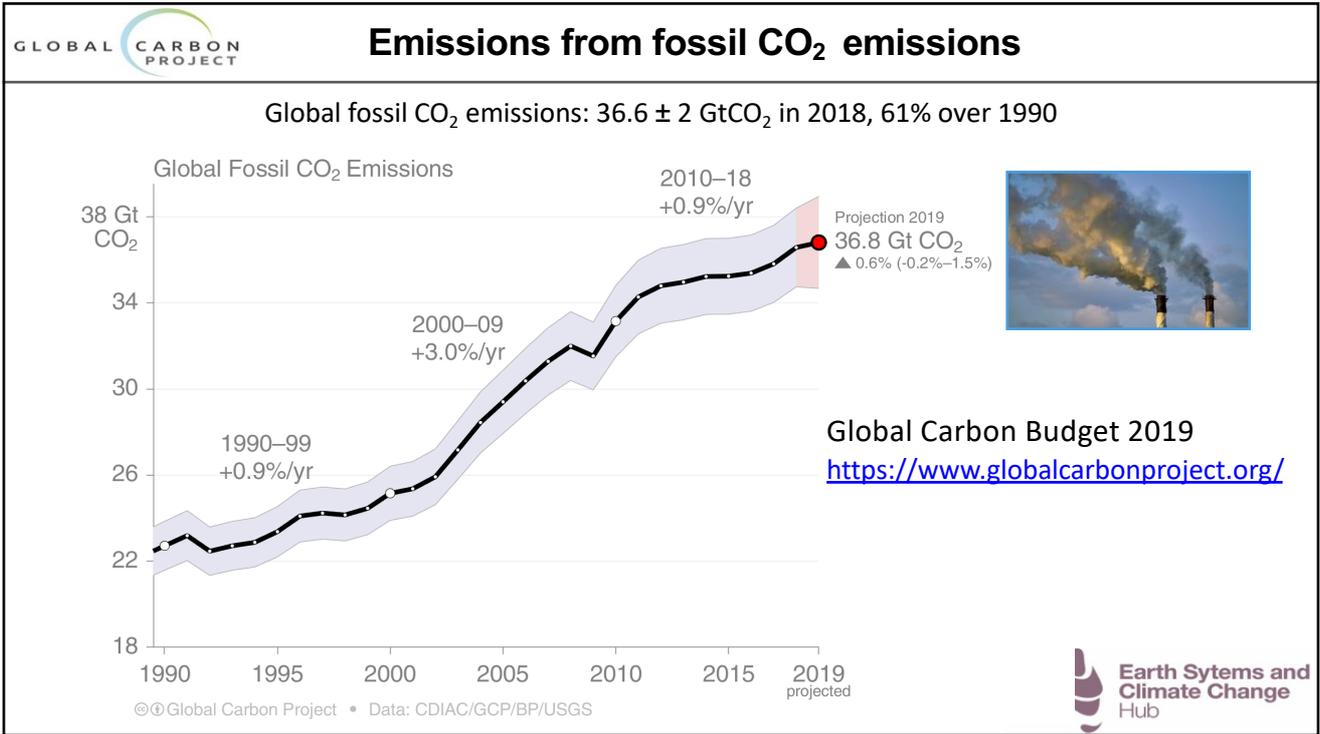
Grose et al (2020) under review

# New Australian global climate model simulations ACCESS



Global temperature changes relative to pre-industrial





**United in Science**  
report informing UN  
Climate Action Summit,  
Sept 2019

from WMO, UNEP,  
IPCC, GCP, Future  
Earth, GFCS



## Summary

- Climate change has already led to significant changes in climate risks and will continue to do so for the next 30-100 years or more
- Most confident projected changes are for increases in heat waves, severe fire weather and coastal flooding, less certainty in many other extremes
- Recent Special Reports from IPCC have confirmed faster rate of observed climate change and increasing impacts
- Much stronger global emission reductions are needed to limit global warming to well below 2 degrees above pre-industrial levels

## References

- Aust Academy of Science *The science of climate change: Questions and answers 2015* <https://www.science.org.au/climatechange>
- IPCC Special Report *The Ocean and Cryosphere in a Changing Climate*, 2019 <https://www.ipcc.ch/srocc/home/>
- IPCC Special Report *Climate Change and Land*, 2019 <https://www.ipcc.ch/report/srccl/>
- Global Carbon Project Carbon Budget 2019 [www.globalcarbonproject.org/](http://www.globalcarbonproject.org/)
- UN *United in Science*, 'Synthesis report latest climate science' UN Climate Action Summit, 2019 <https://www.ipcc.ch/2019/09/22/united-in-science-report-climate-summit/>
- CSIRO & Bur of Met State of the Climate 2018 <https://www.csiro.au/en/Showcase/state-of-the-climate>
- Victoria's Climate Science Report 2019 <https://www.climatechange.vic.gov.au/climate-science-report-2019>



National Environmental Science Programme



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The Earth Systems and Climate Change Hub is funded by the Australian Government's National Environmental Science Program, with co-investment from the following partner agencies



### **Climate change and the 2019 bushfires**

- Eastern Australia experienced unprecedented bushfires in spring and summer 2019 due to extended drought, heat waves and periods of strong winds
- Natural weather and climate variations (Indian Ocean Dipole, Antarctic vortex breakdown and stronger westerly winds over NSW) were the main cause of the extreme low rainfall and the extreme fire danger
- Climate change contributed to the extreme conditions through long-term increases in temperature and heat waves across Australia, and reduced rainfall in winter across southern Australia

