



Australian  
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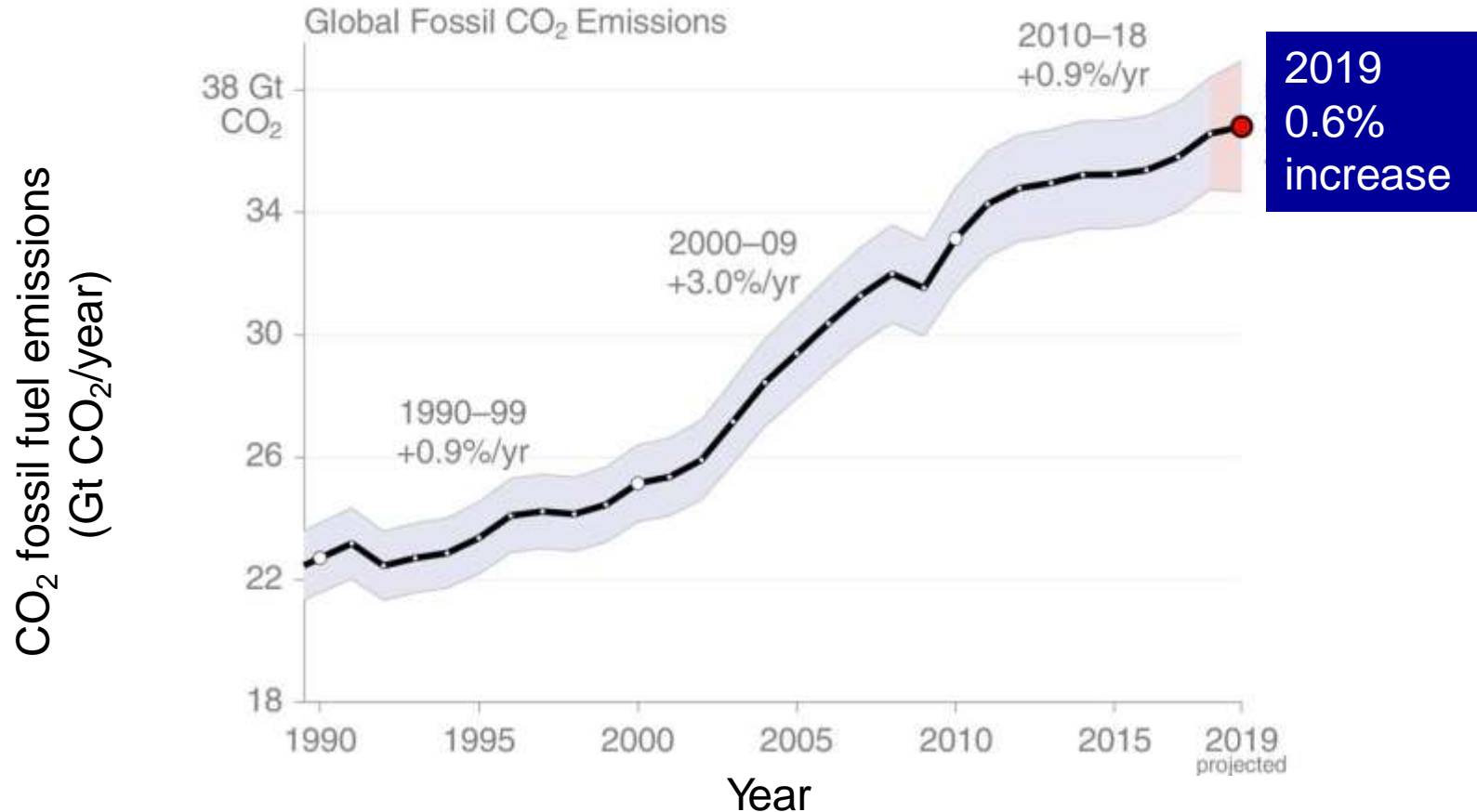
# Our changing climate: the past to the future



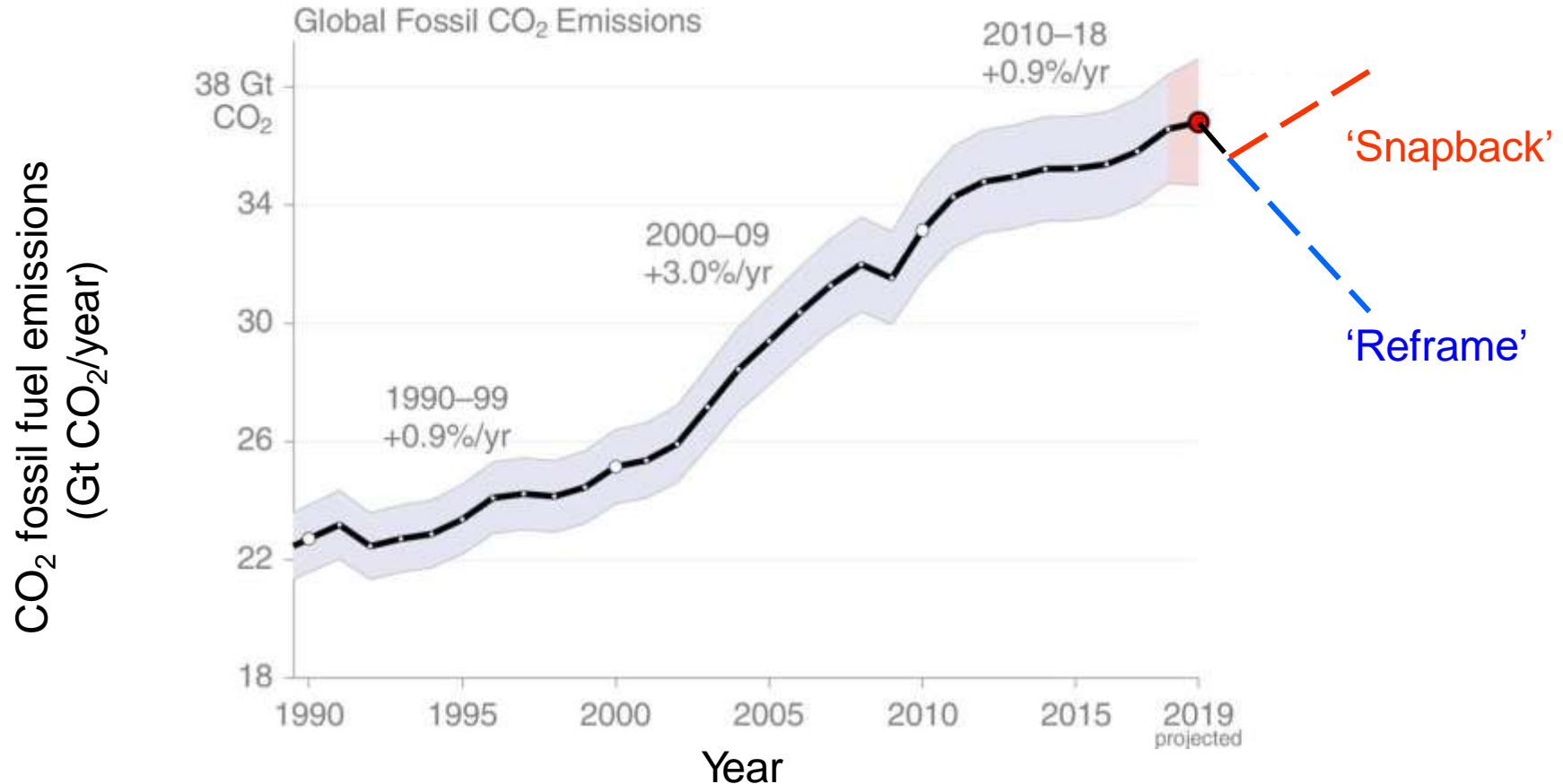
Professor Mark Howden  
ANU Climate Change Institute Vice  
Chair, IPCC Working Group II

[@ProfMarkHowden](#)

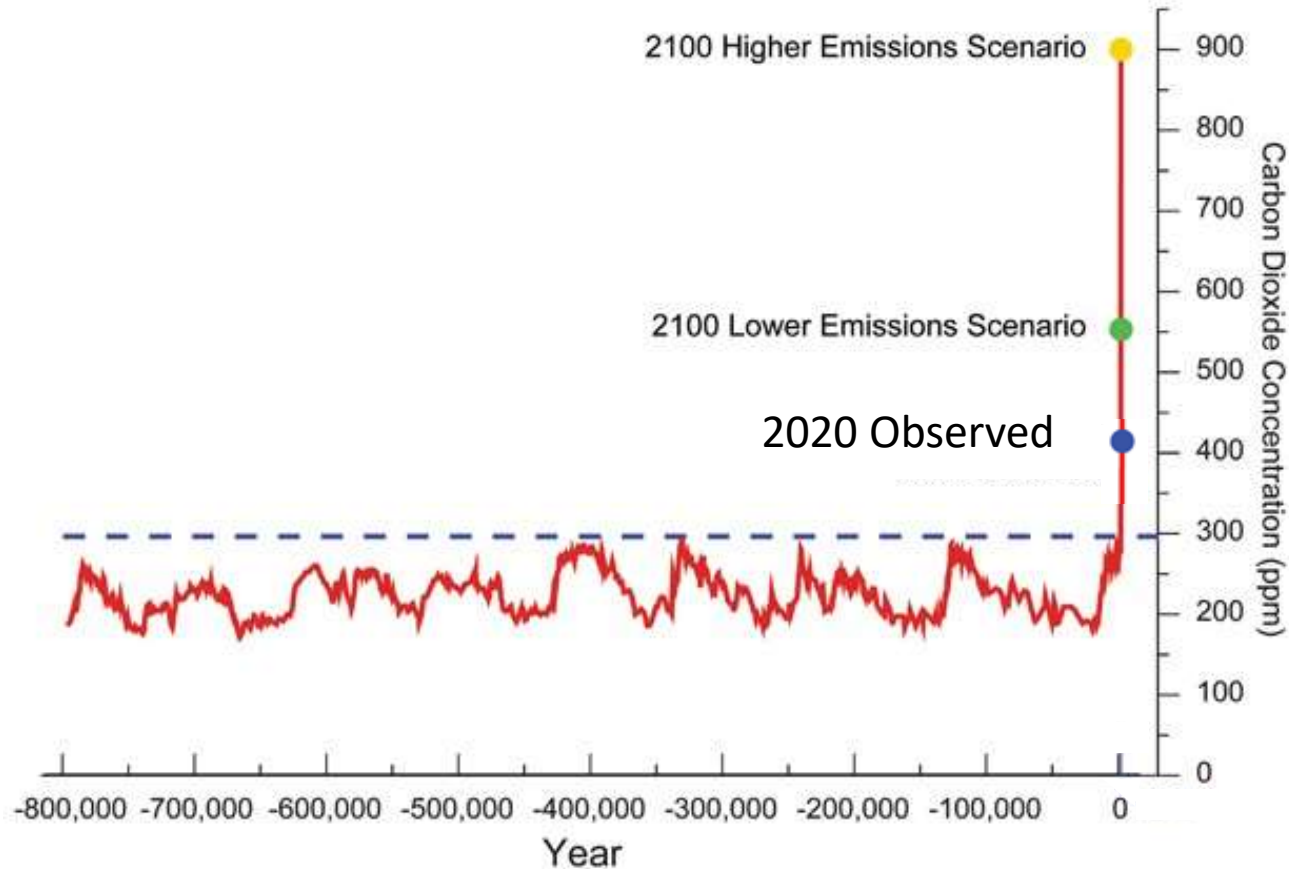
# CO<sub>2</sub> emission rising again: record levels



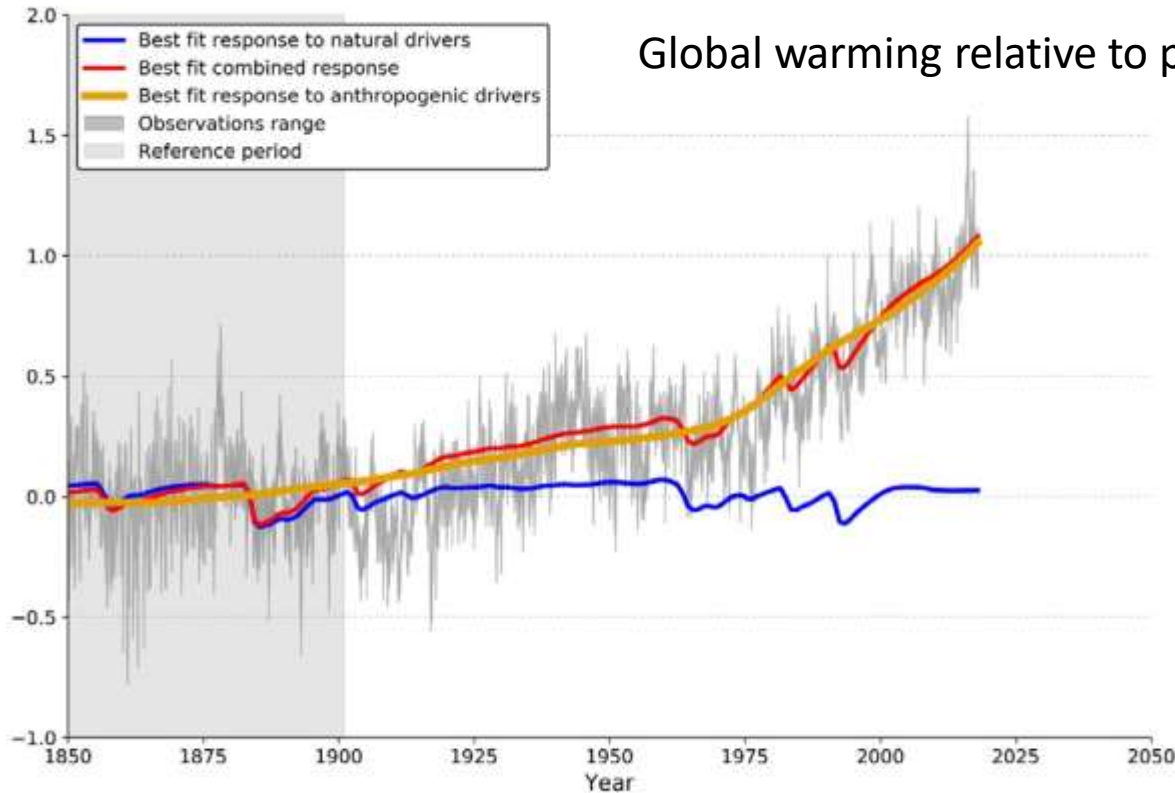
# CO<sub>2</sub> emission rising again: COVID-19



# Atmospheric CO<sub>2</sub>: outside the past envelope



Temperature relative to 1850-1900 (°C)



- Temperature already up 1°C globally
- Already up 1.5°C over land
- May get to 1.5°C as soon as 2026
- Less than 1 in 100 000 chance this is *not* due to humans

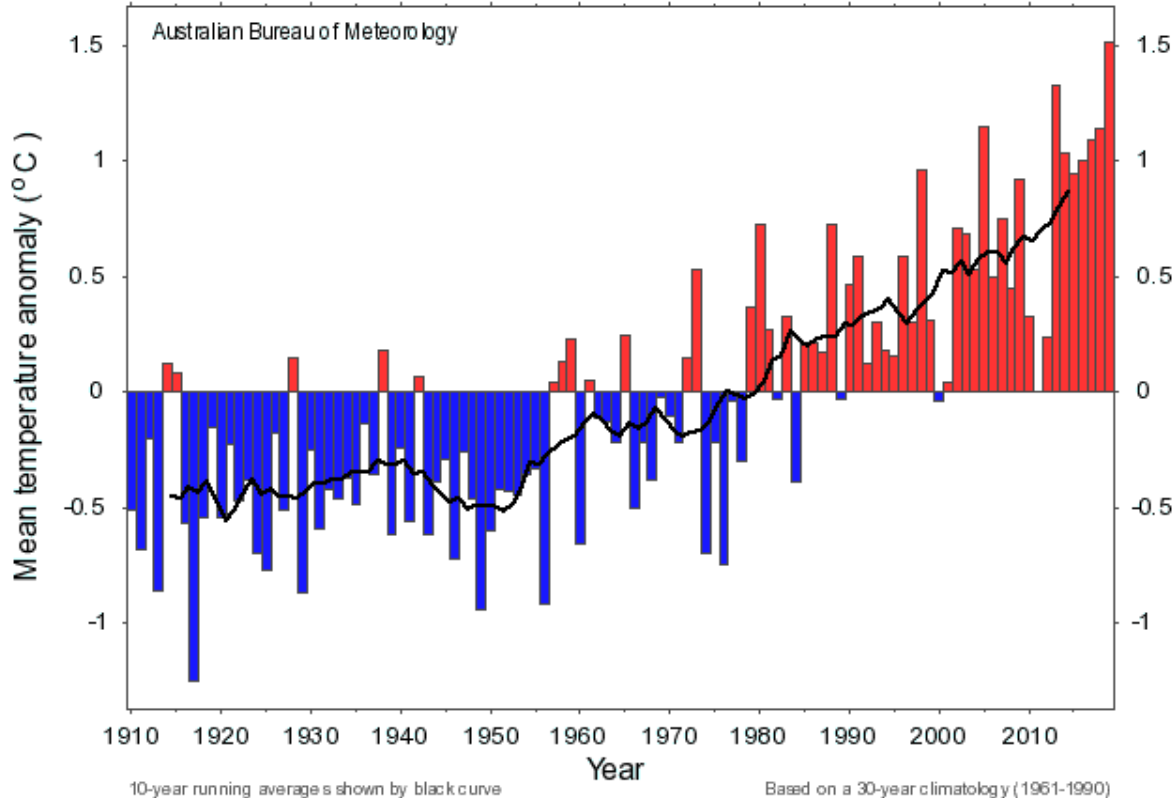


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# Temperature variability increasing

# Australia: record temperatures

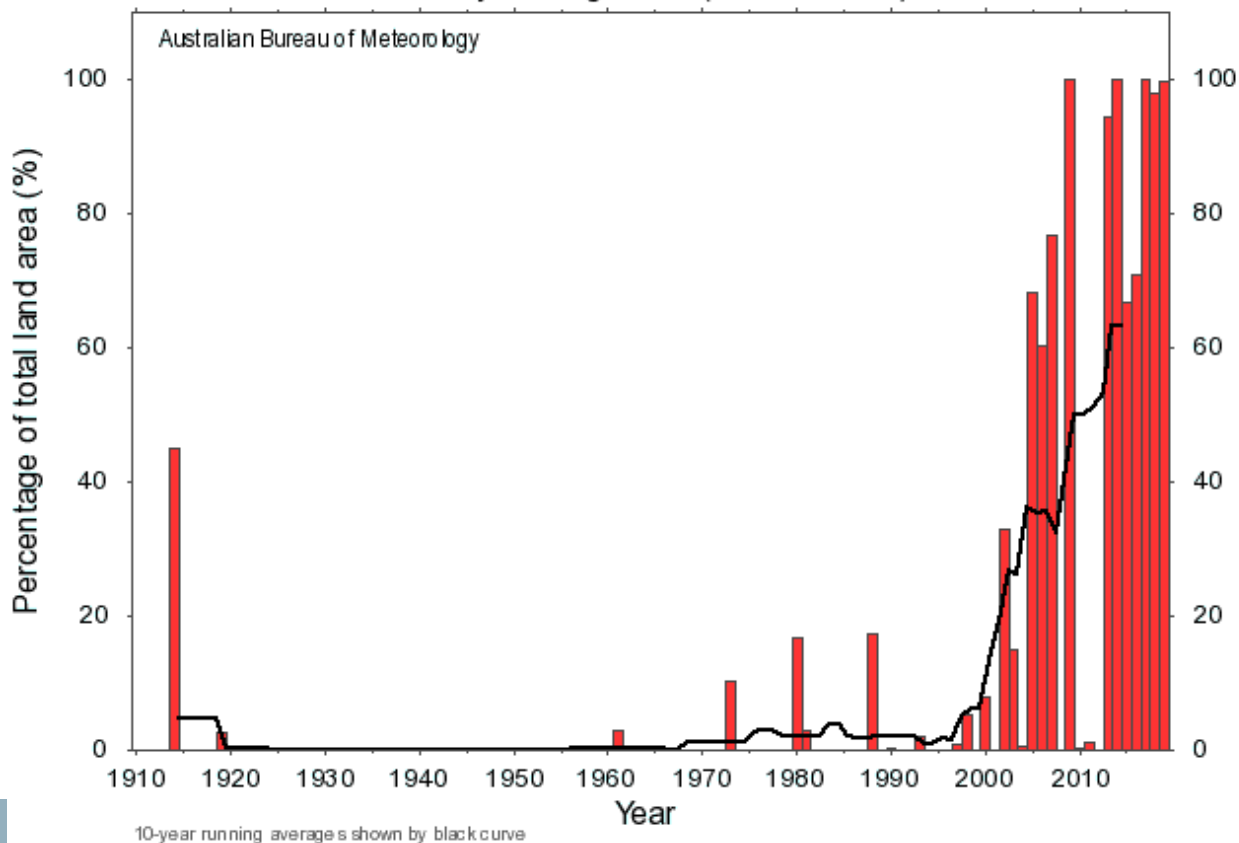
Annual mean temperature anomaly  
Australia (1910 to 2019)



- Hottest year (+1.52°C) especially daytime temperatures
- Hottest summer
- Heatwaves in several months
- Hottest day record beaten on two successive days: 40.9°C and then 41.9°C

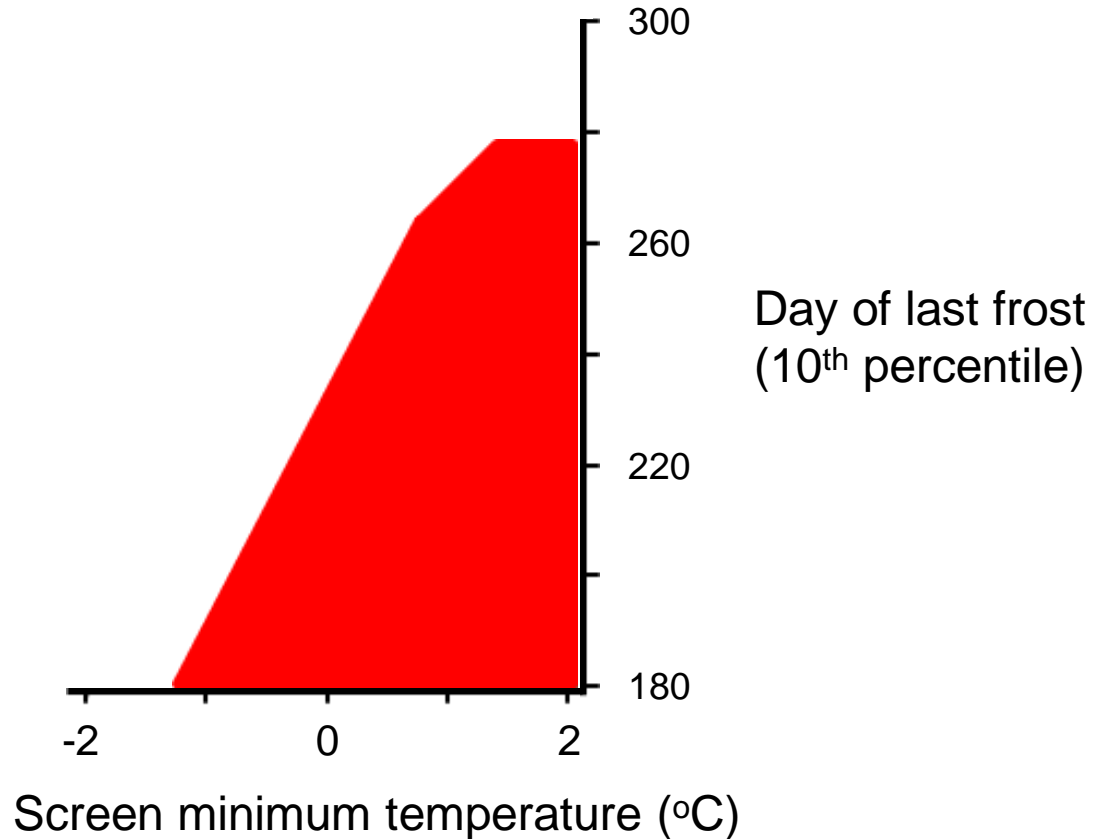
# Extremes almost everywhere, all the time

Annual mean temperature percentage area in decile 10  
Murray Darling Basin (1910 to 2019)

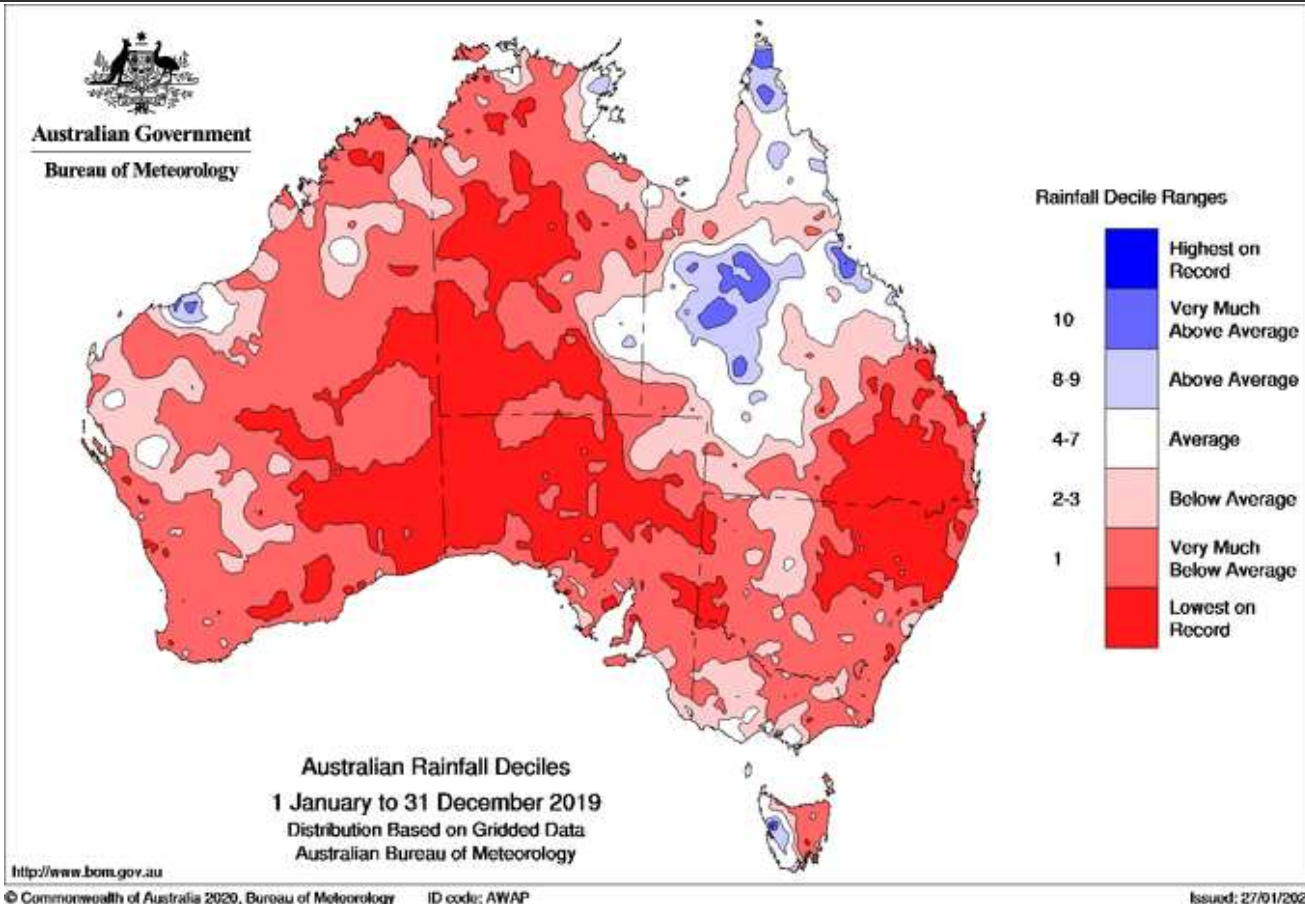




# Frost risk increasing in SE Australia

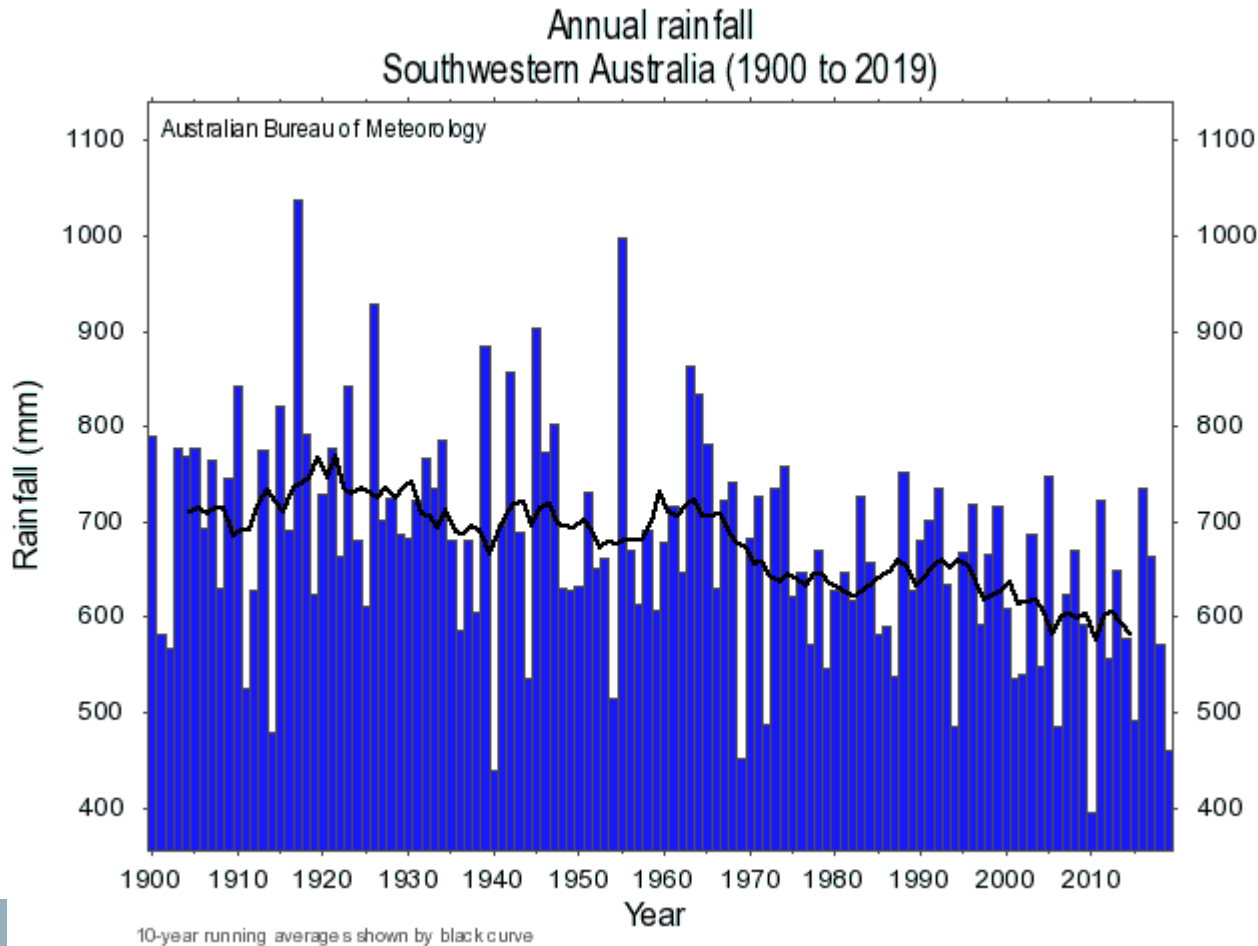


# Australian rainfall: record dry



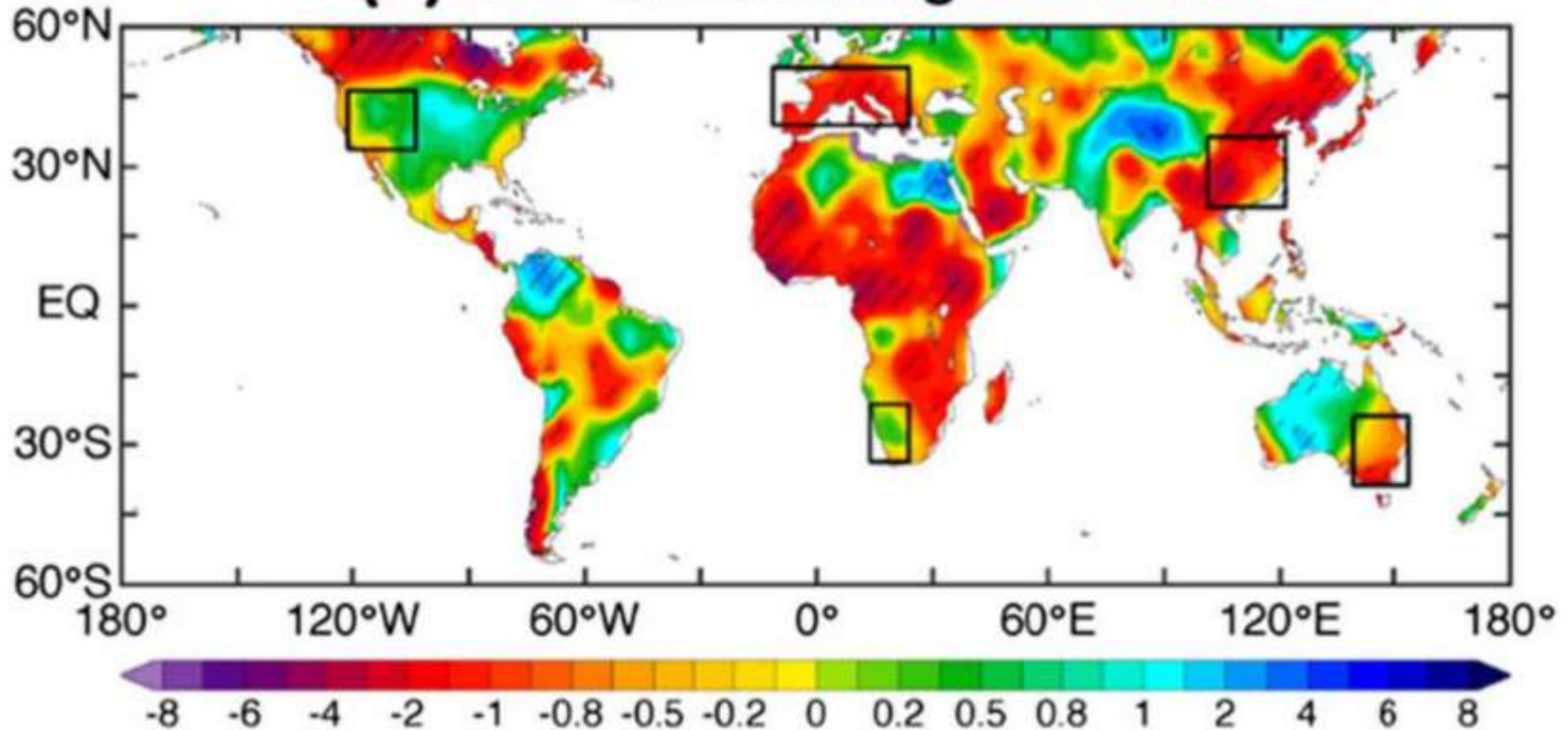
- Driest year on record (277.6mm)
- Record positive Indian Ocean Dipole event
- Many places worst drought on record
- Towns and rivers running dry, massive fish kills
- But also record rains and severe floods

# Drying trends in the SW and SE

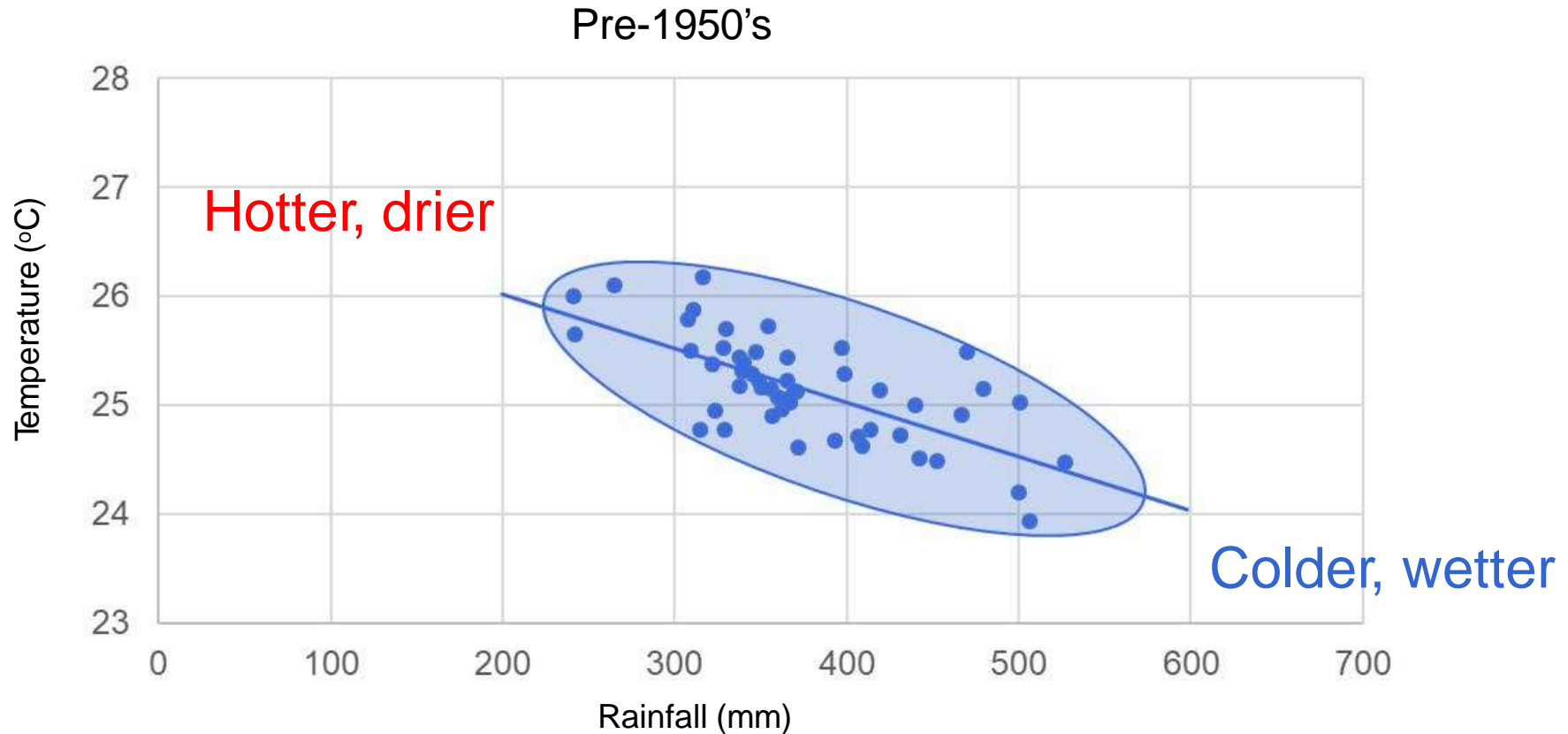


# Droughts: increasing in many regions

**(a) Obs. Trend during 1950-2014**

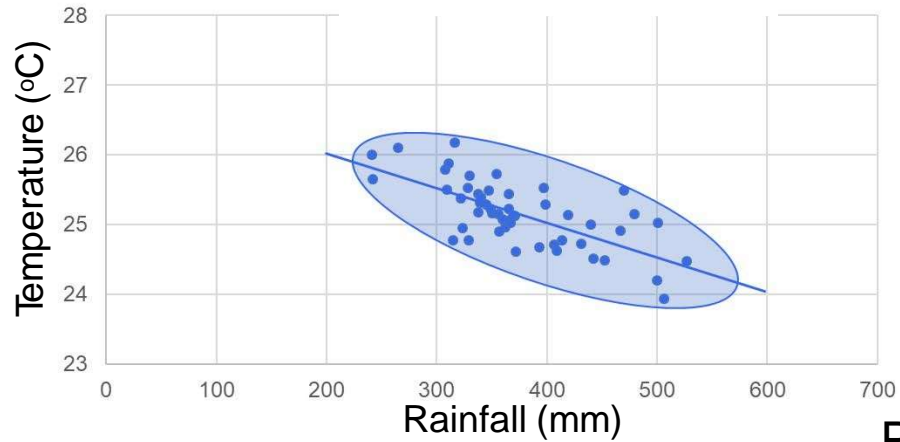


# The rainfall-temperature operating envelope

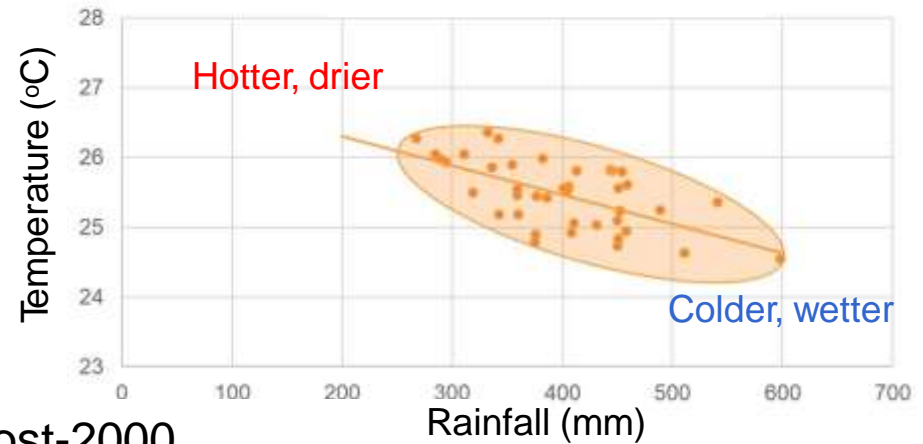


# Rainfall-temperature operating envelopes

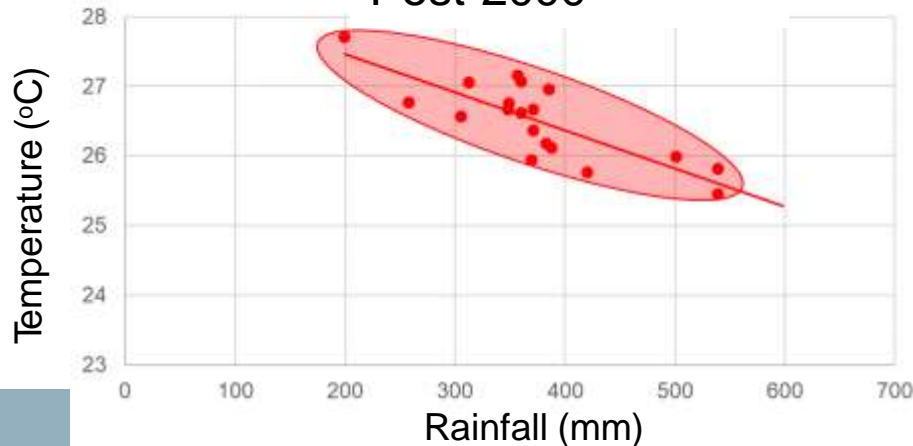
Pre-1950's



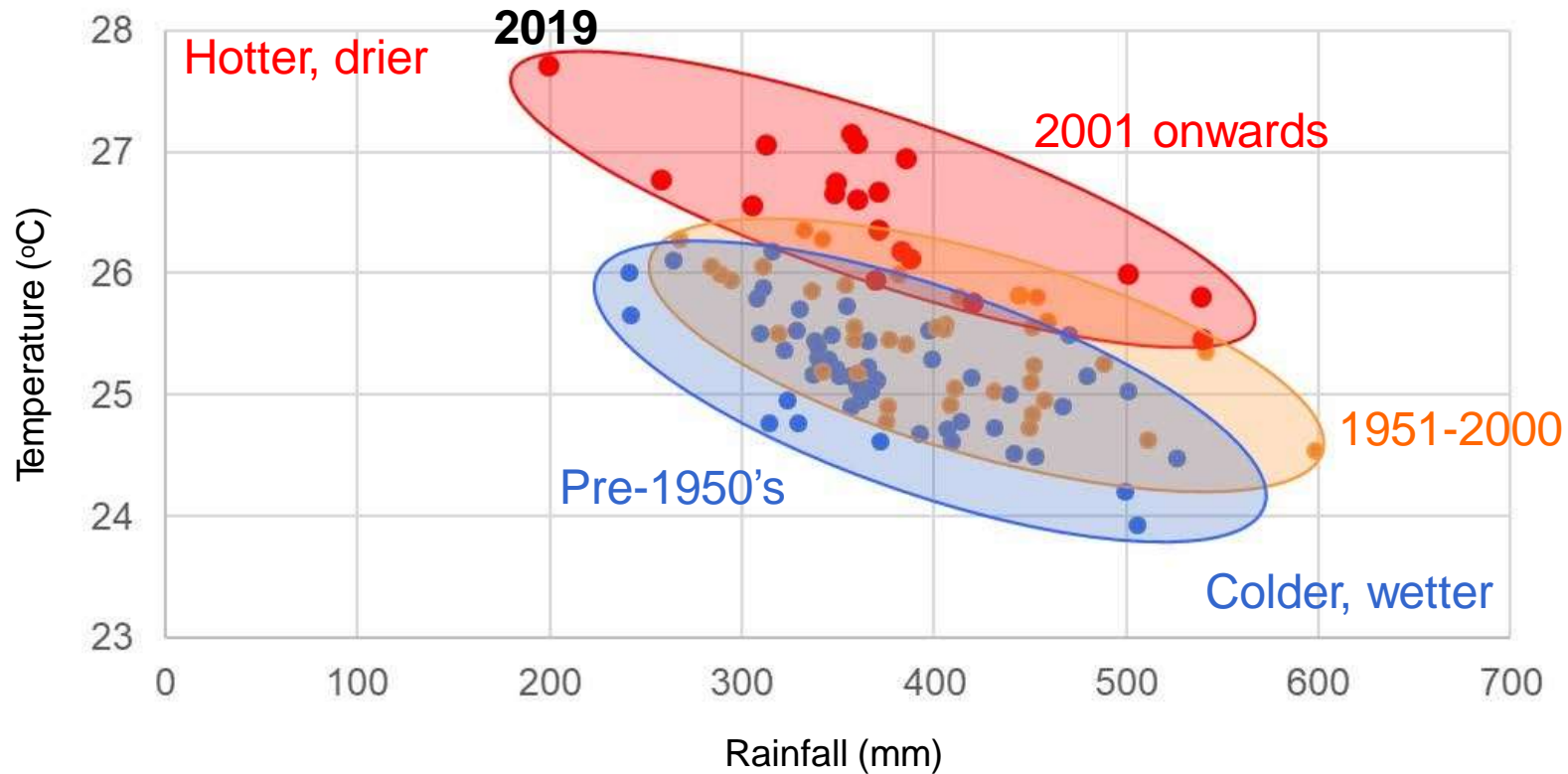
1951-2000



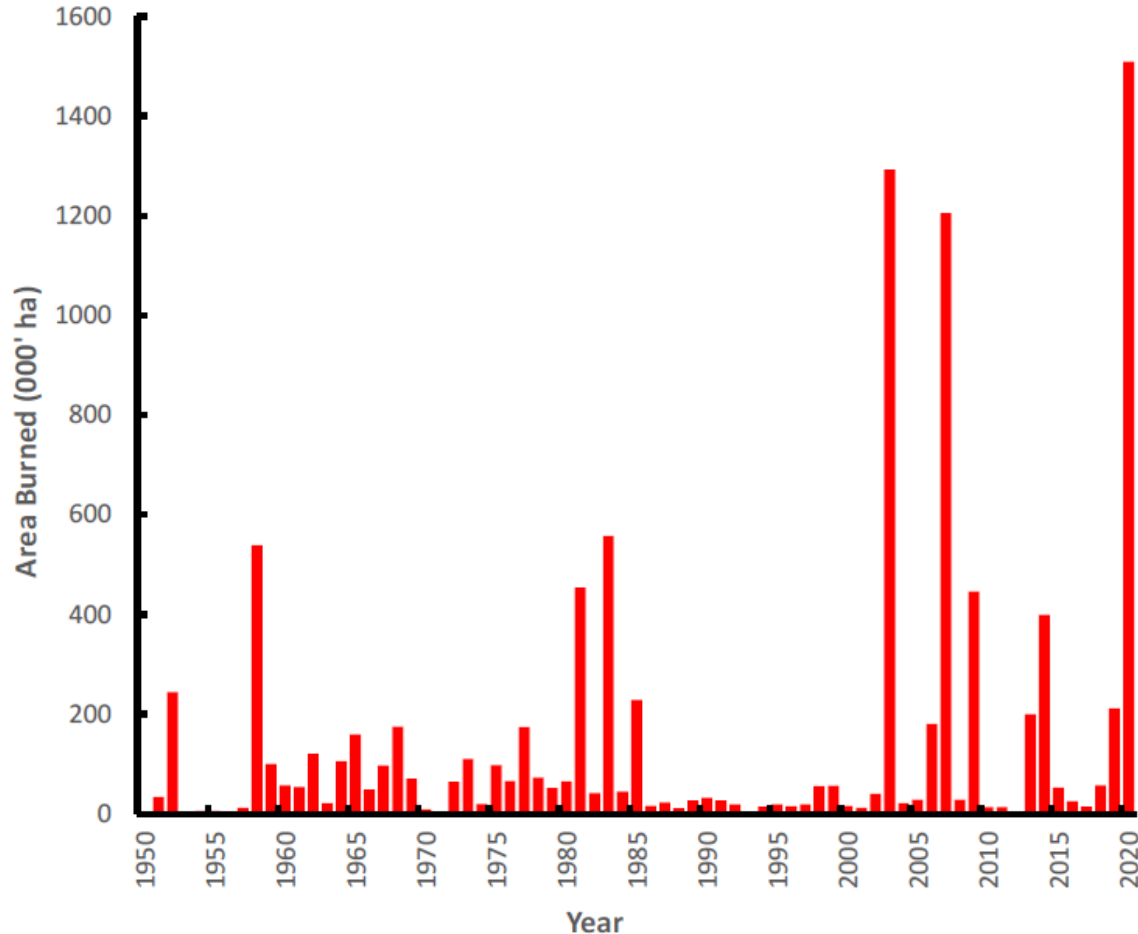
Post-2000



# A changed operating environment



# Fire risk is increasing

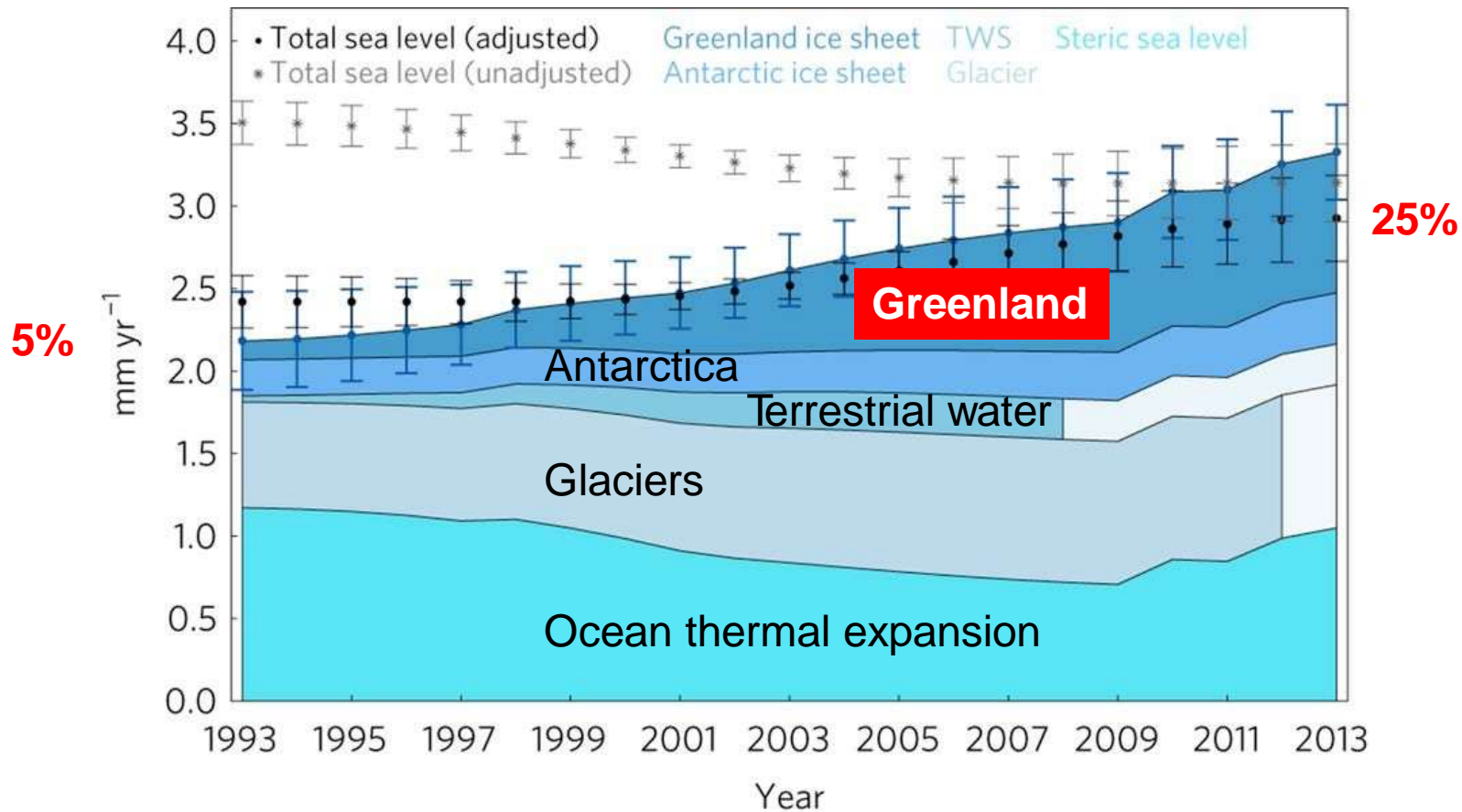


- Fire season has extended
- Fire intensity and frequency have increased
- Days of high fire danger have increased
- Affected area has increased
- Control burning opportunities reduced

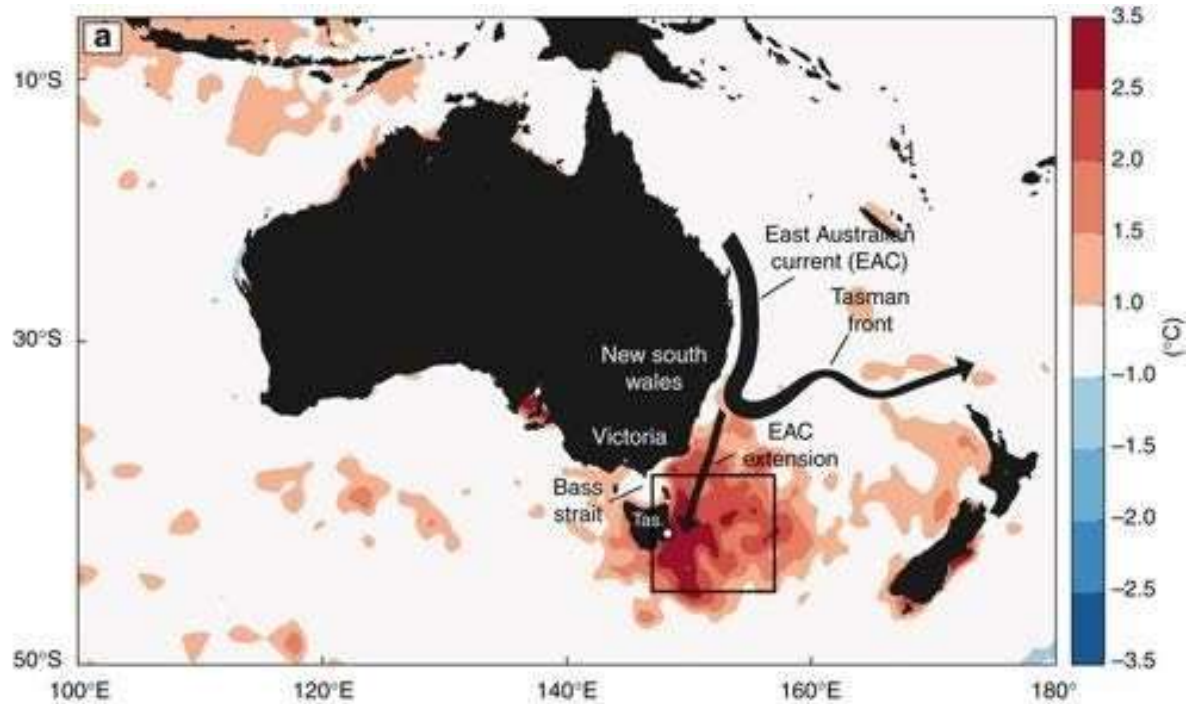




# Sea level rise: accelerating unexpectedly

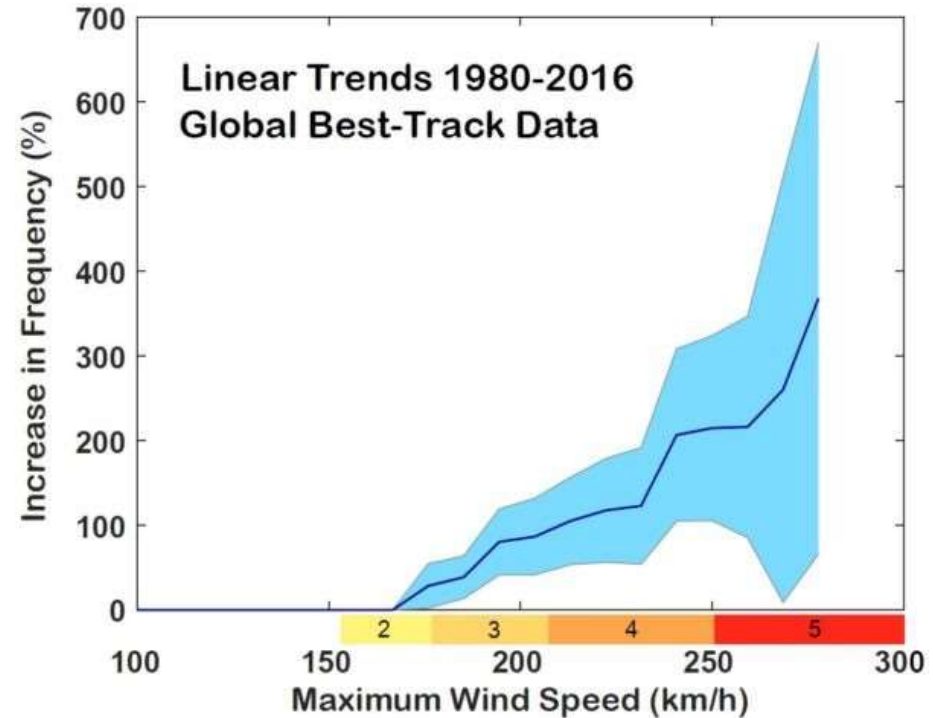
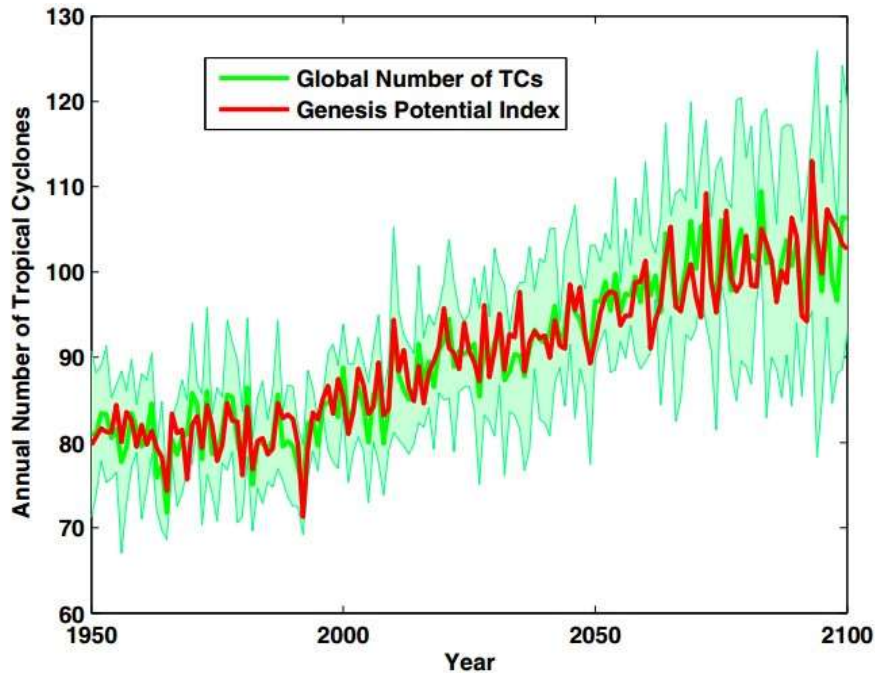


# Marine systems affected as well



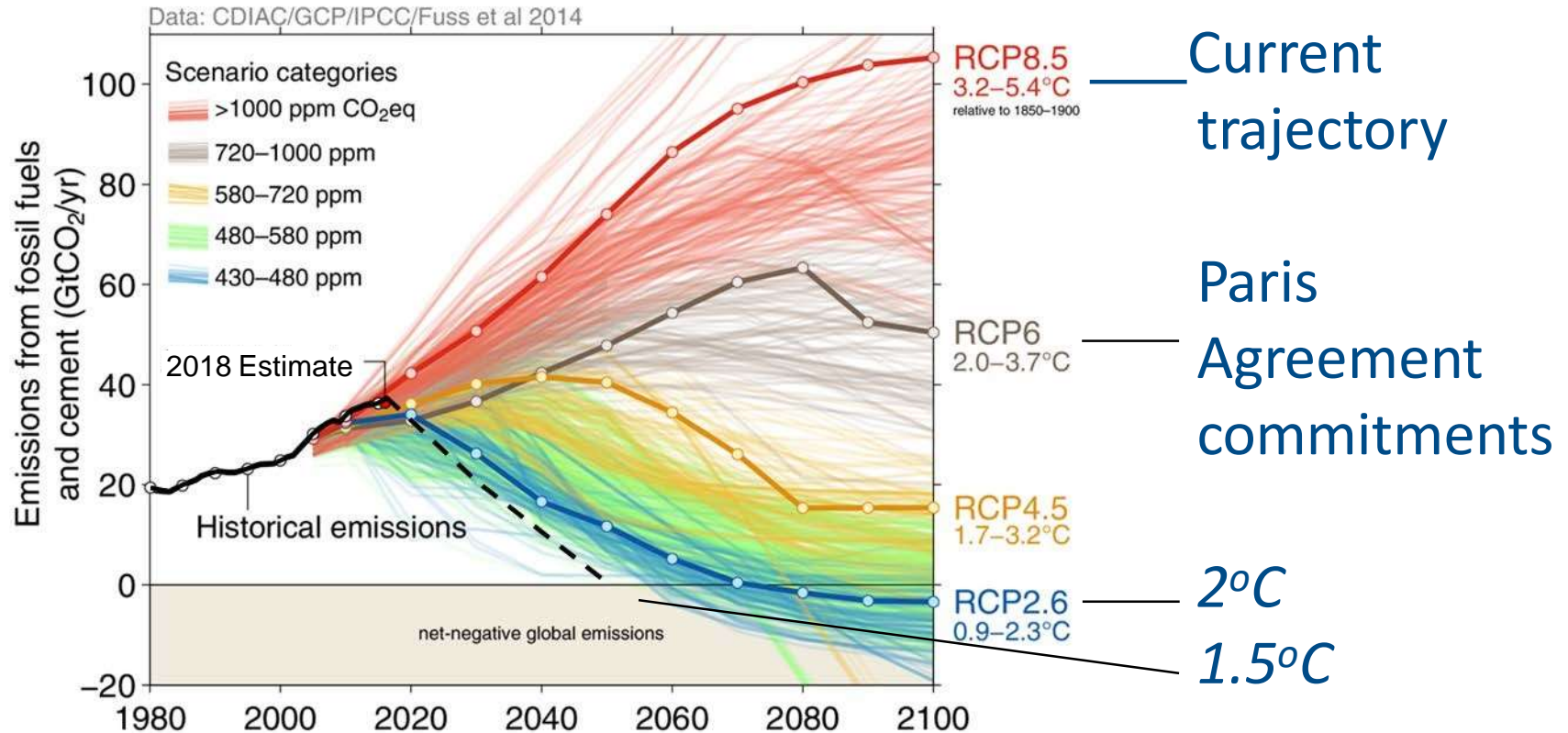
- Long-spined sea urchin
- Pacific Oyster Mortality Syndrome
- Predatory crabs and seastars
- Various plants, invertebrates and bivalves

# Tropical cyclone risk increasing



- Poleward migration – expanding the area affected

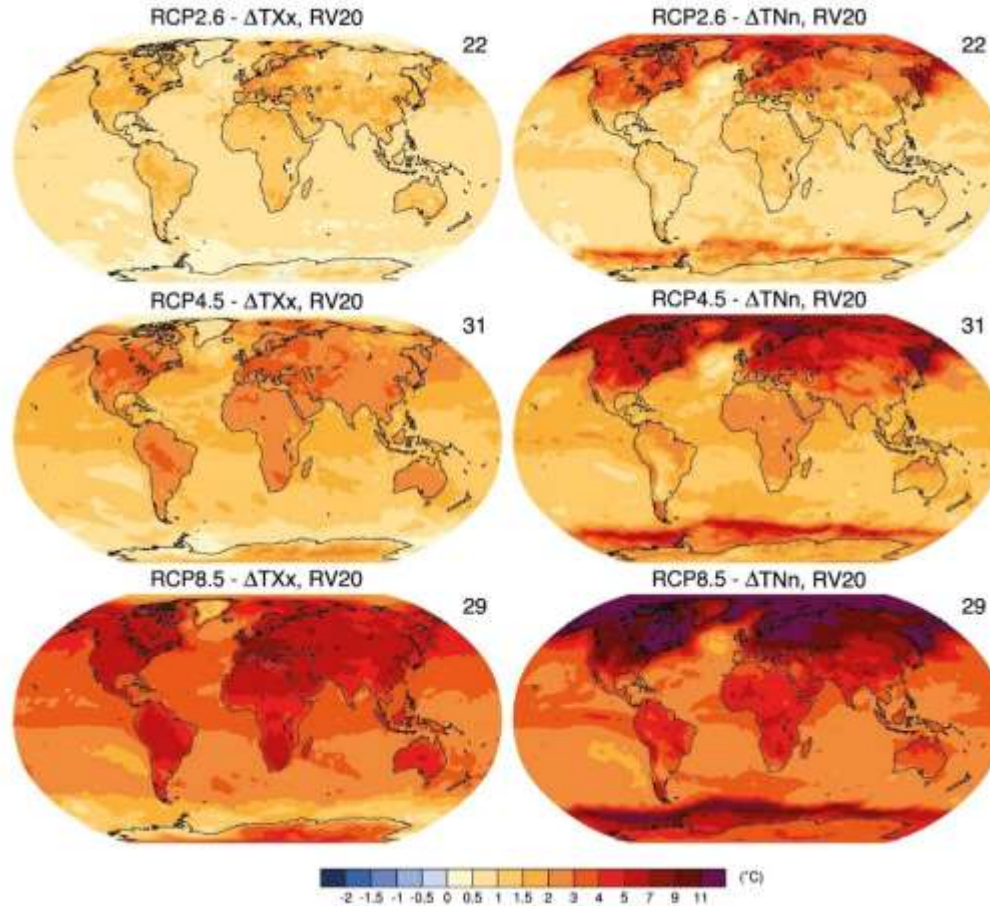
# Choices about our future





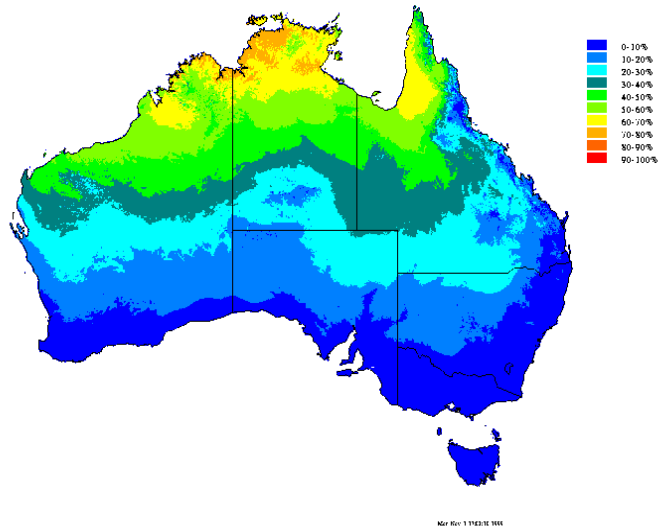
# Temperature projections

Daily surface air temperature 20 year return value change (2081-2100)

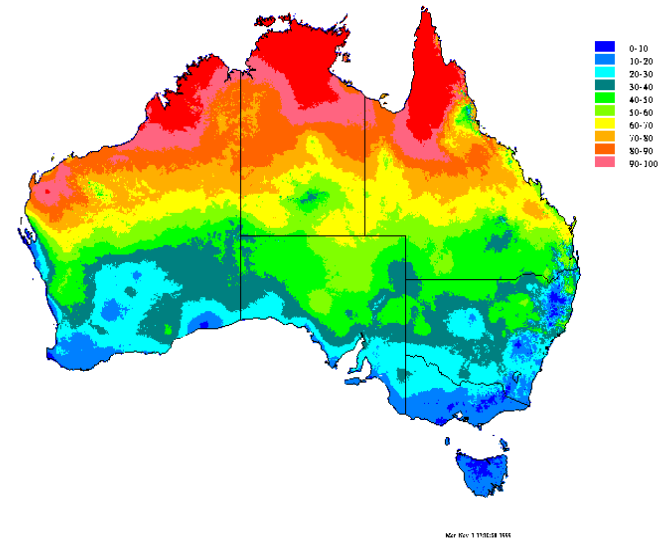


# Changes in heat stress frequency

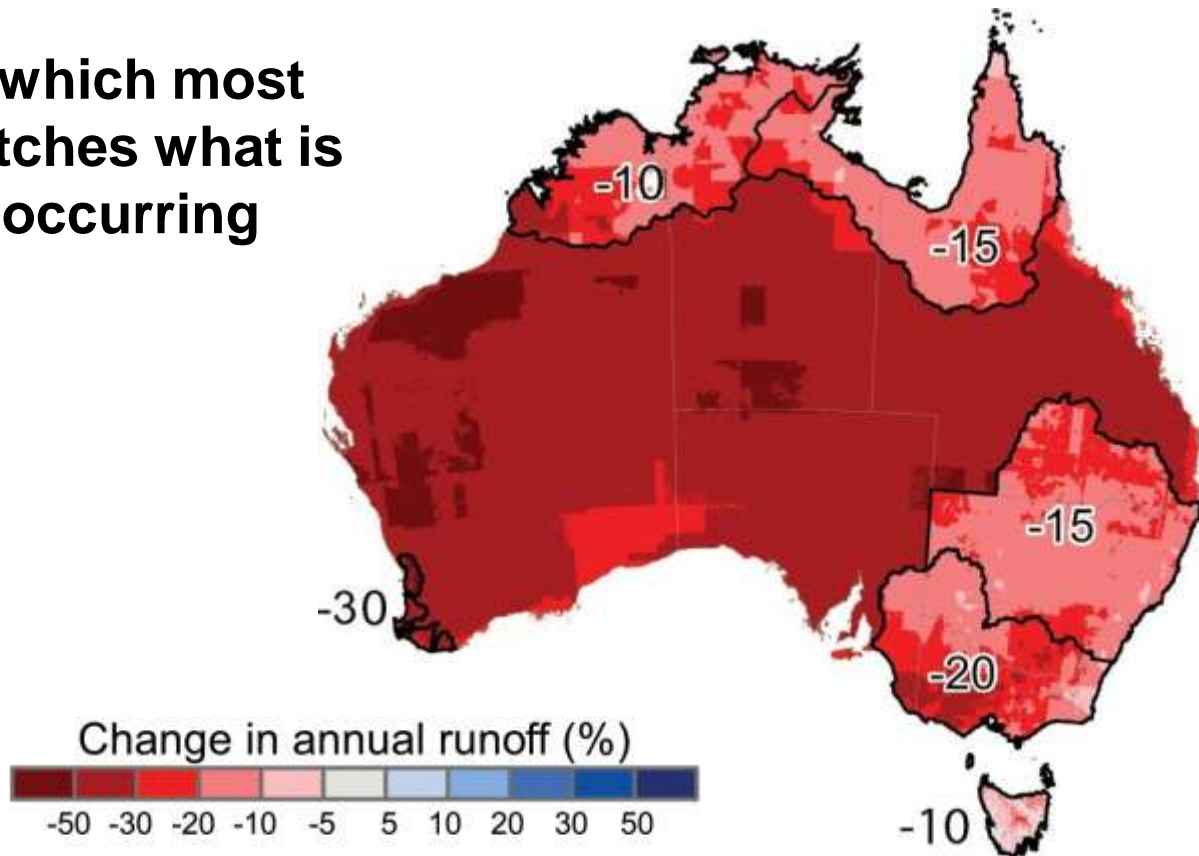
## Current heat stress



## Heat stress 2.7°C warmer



**Scenario which most closely matches what is already occurring**



# Fires risk is likely to increase

- Fire danger a function of:
  - Drought
  - High temperatures (especially daytime)
  - Strong winds
  - Dry air
- All are likely to increase with climate change

**Australia fires: The huge economic cost of Australia's bushfires**

By **Tim McDonald**  
BBC News

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*Every half a degree matters  
Every year matters  
Every choice matters*

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