Australian National University

Global Climate Update

Overview: It keeps on getting worse than we thought

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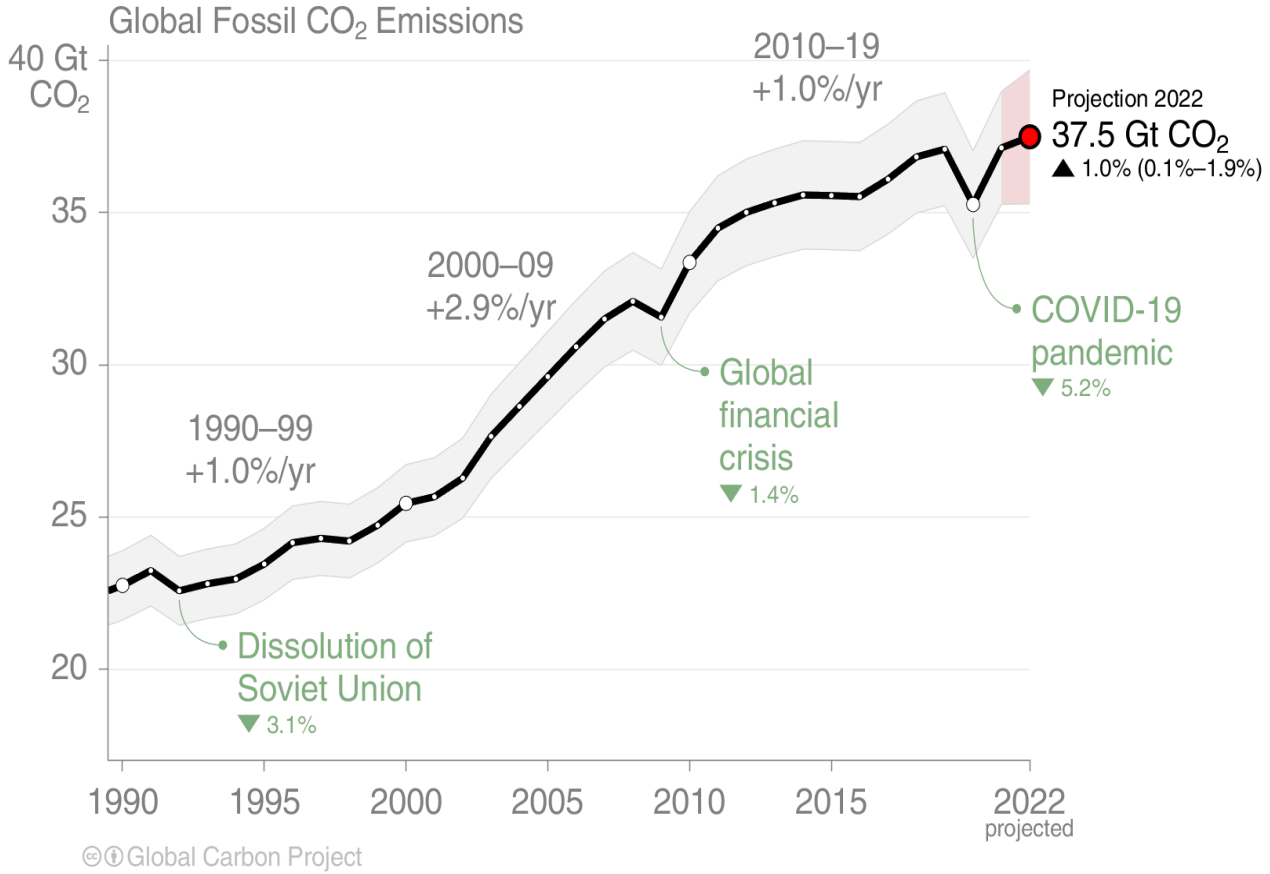
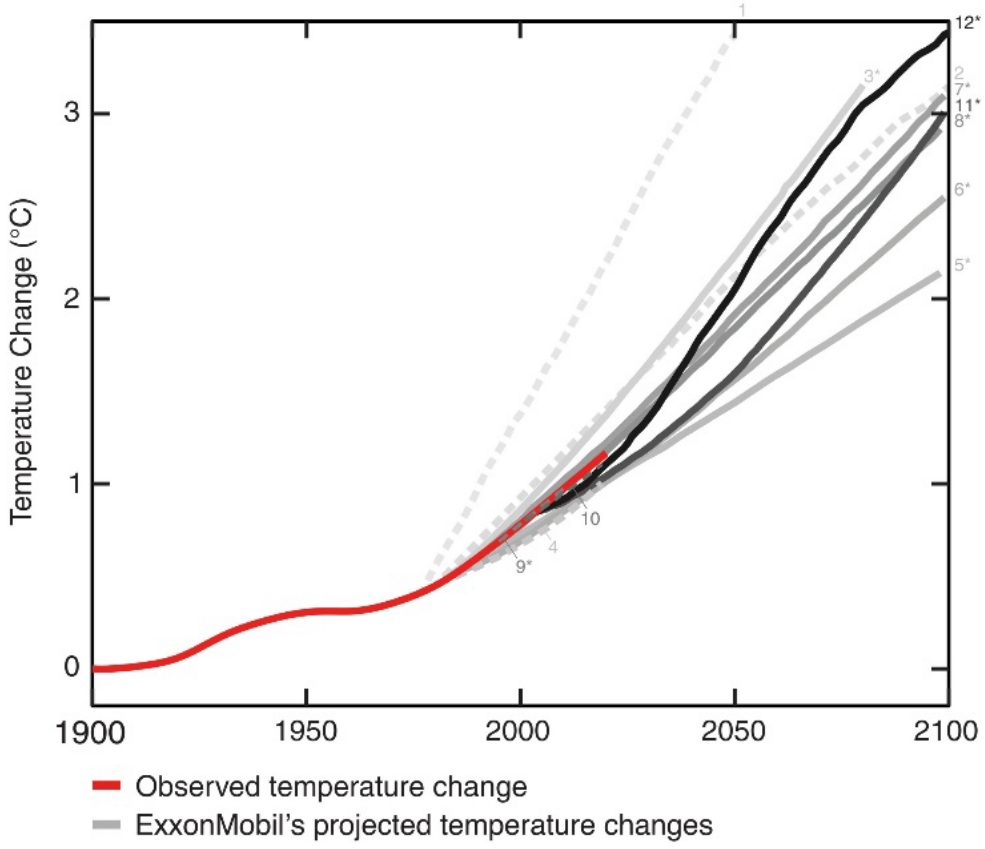
CO_2 emissions increasing (again)



- Record CO_2 concentrations
- Record levels of methane, nitrous oxide and other GHGs

Global Carbon Project 2022; Friedlingstein et al. 2022; IPCC 2021

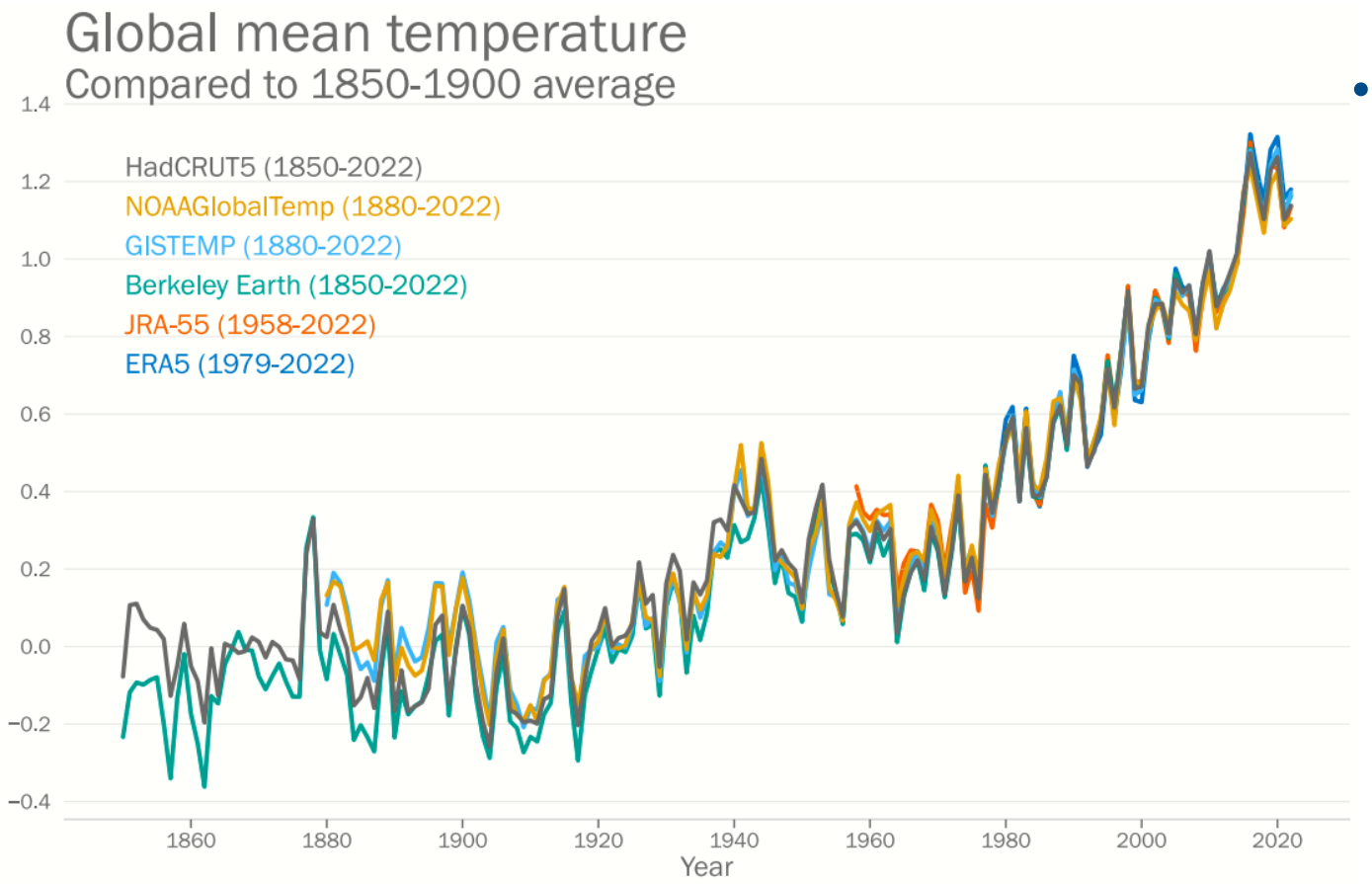
Early Exxon reports got global warming right



- Skilful and accurate projections of how CO_2 emissions would warm the earth were made up to 45 years ago
- Robust carbon budgets were also constructed
- A story of persistent misinformation

Supran et al. 2023

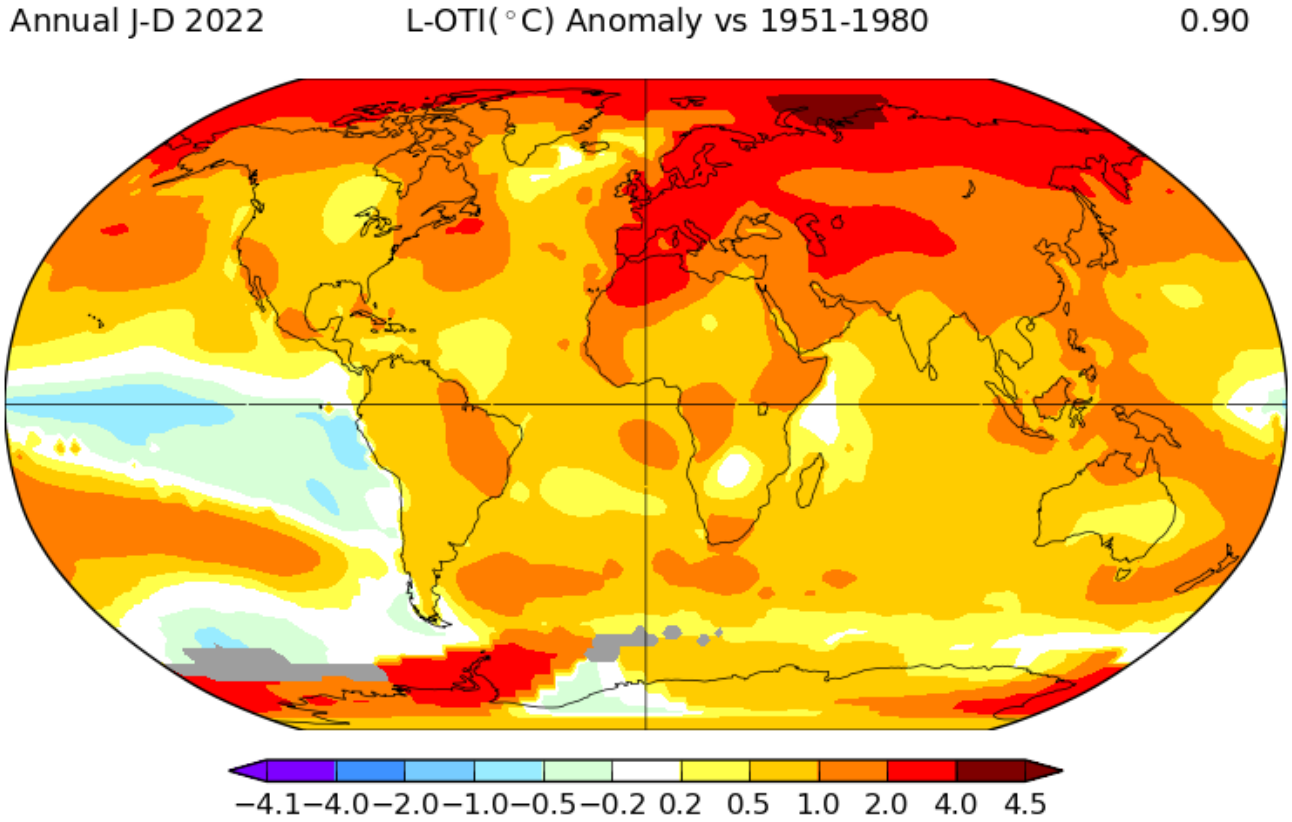
Globally – very warm



- Likely warmest year on record this year or next due to emerging El Niño

WMO 2022

High temperatures widespread

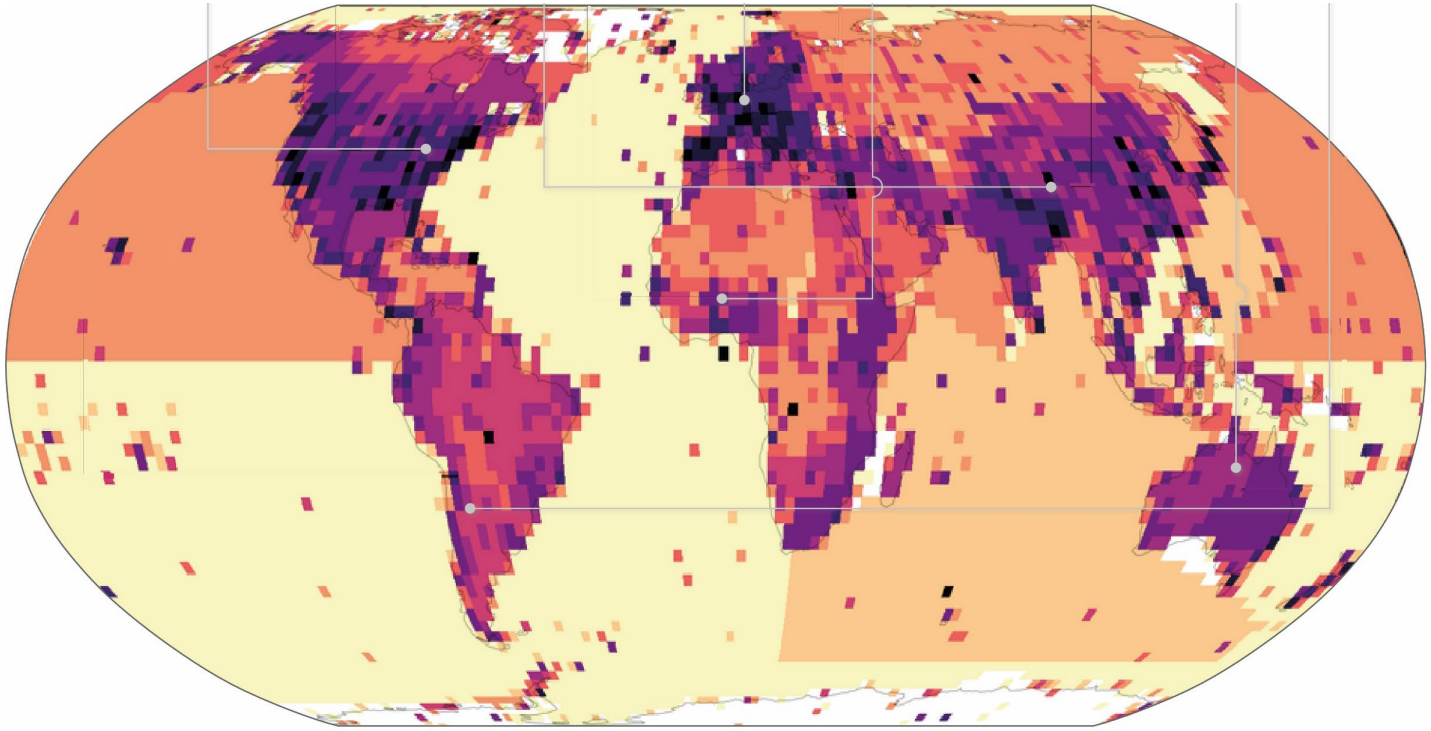


- Warmest year on record in 28 countries – where 850M people live
- Extreme heatwaves in Europe, China, south Asia etc
- Marine heatwaves too

NASA 2023

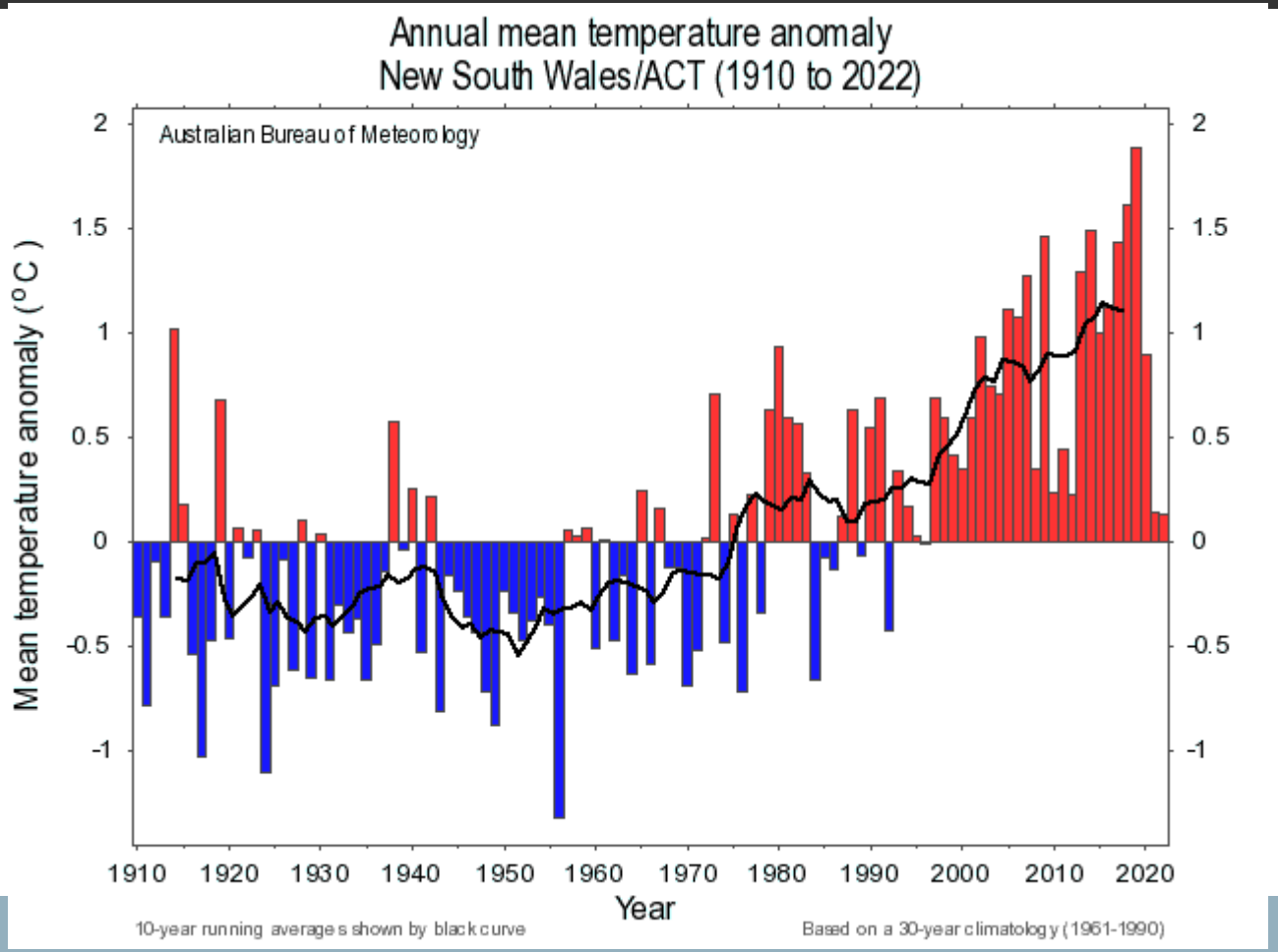
Australian National University

Climate change: evidence of impacts



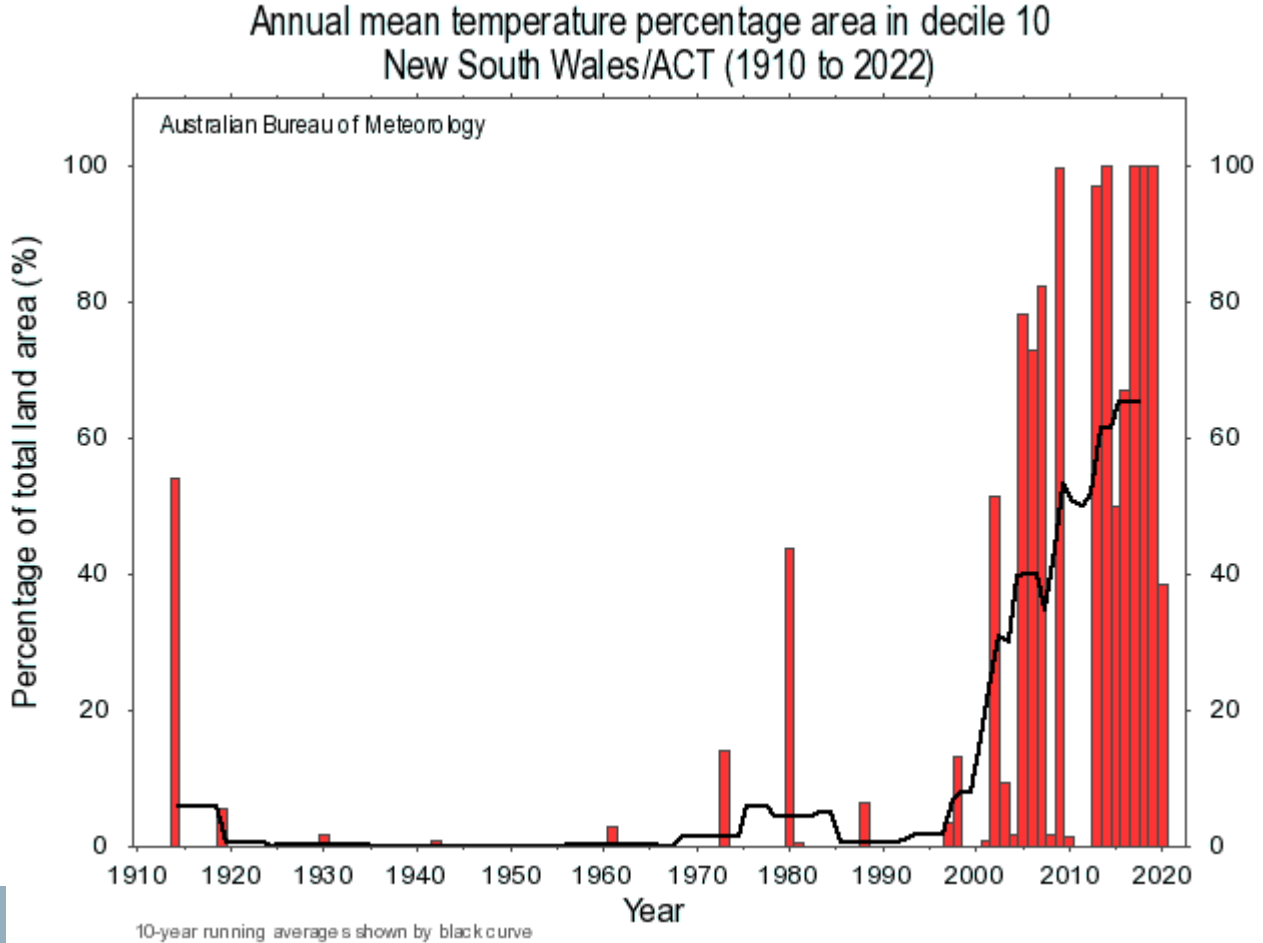
IPCC 2022

Australia: record temperatures



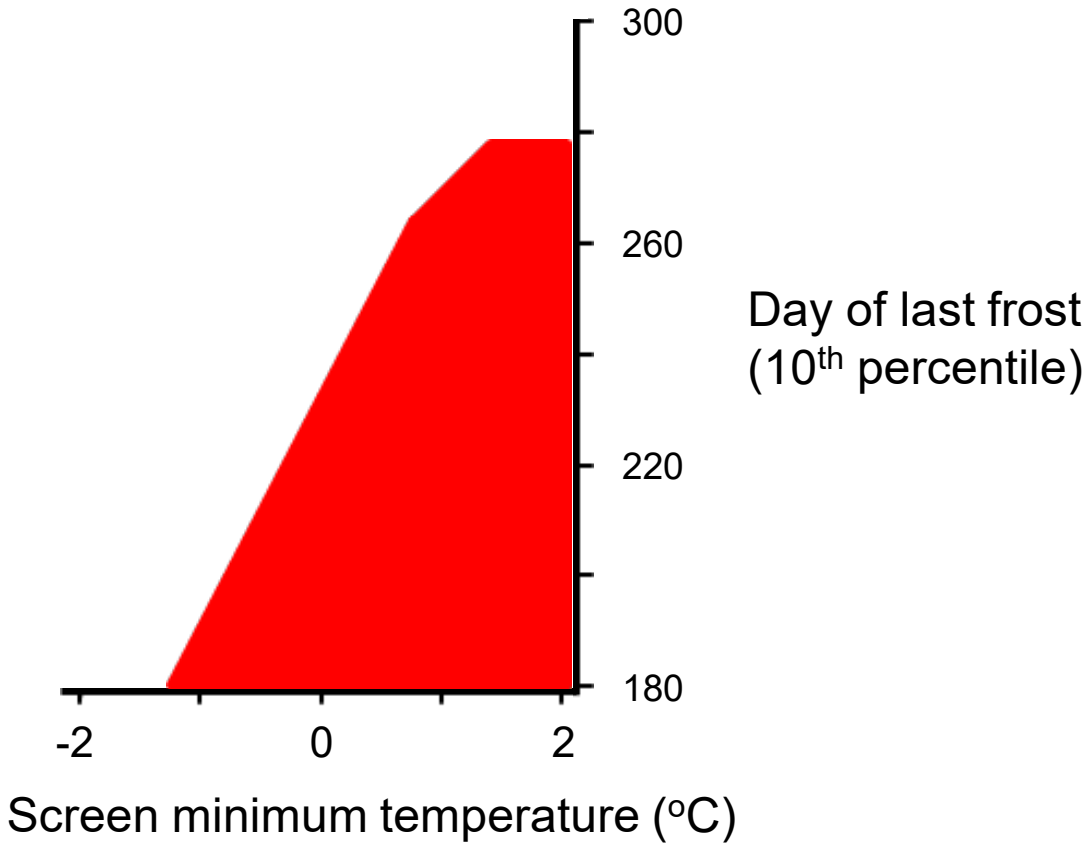
BoM 2023

Extremes almost everywhere, all the time



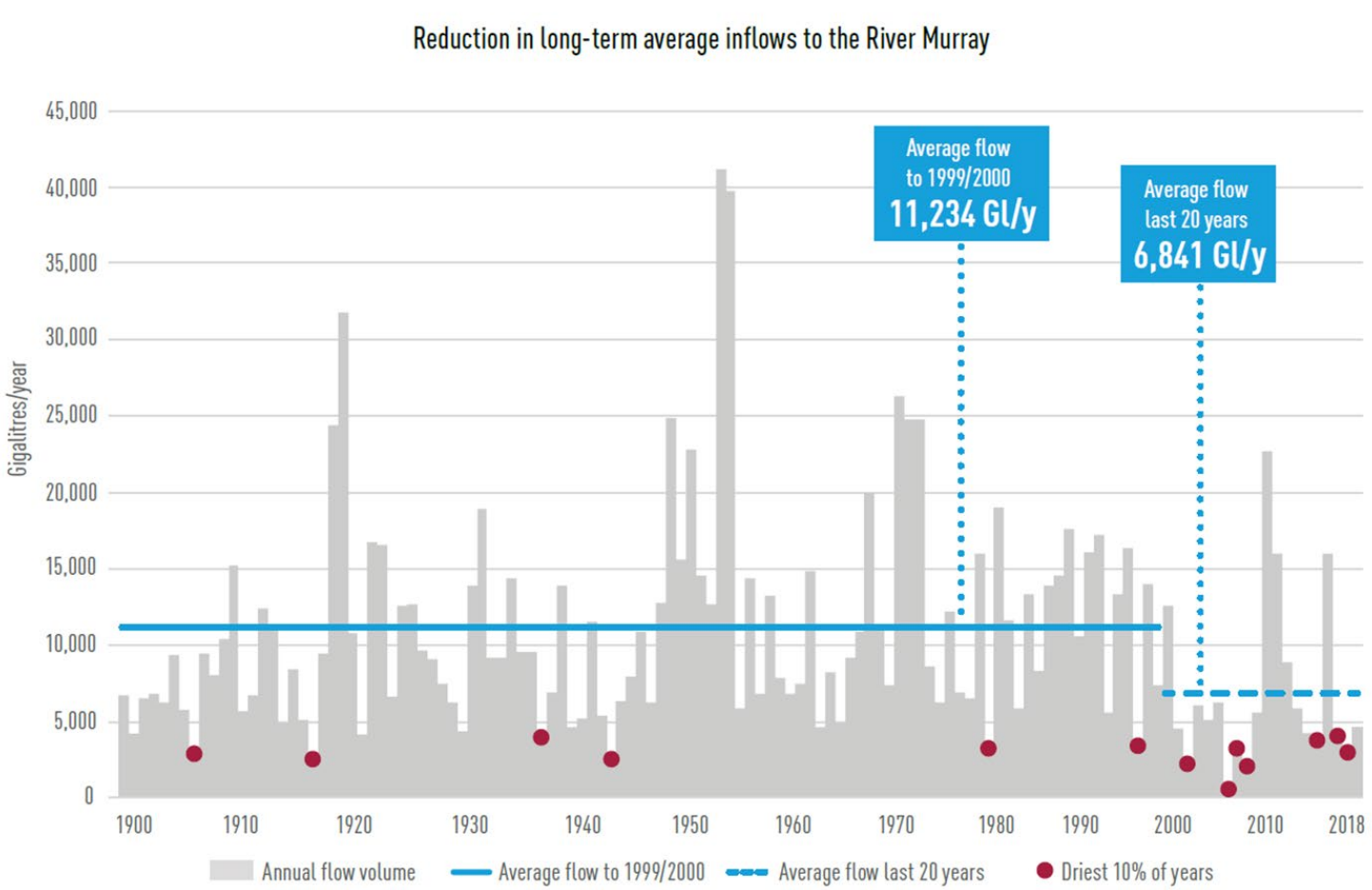
BoM 2023

Frost risk increasing in SE Australia



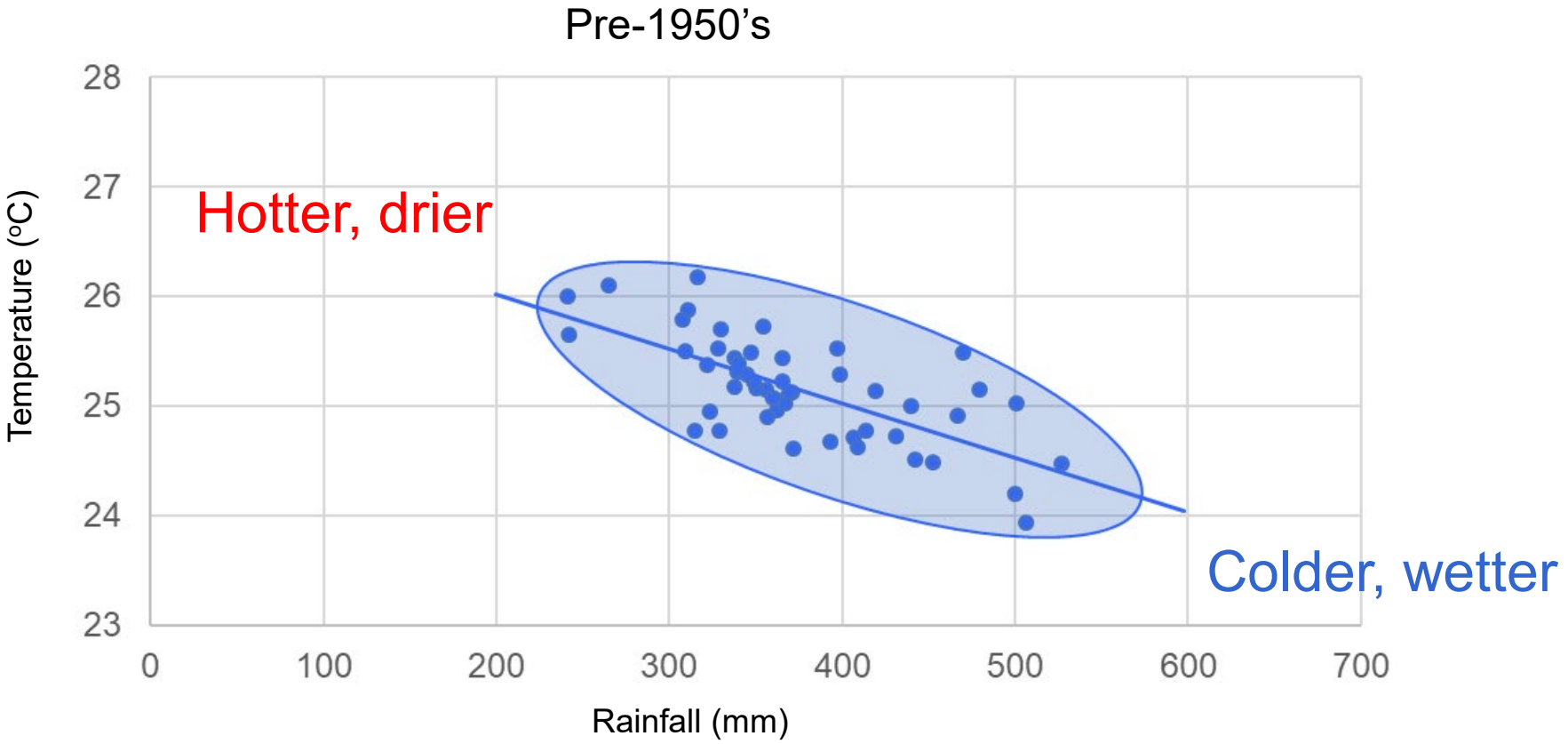
Crimp et al. 2016

Murray River flows: historical



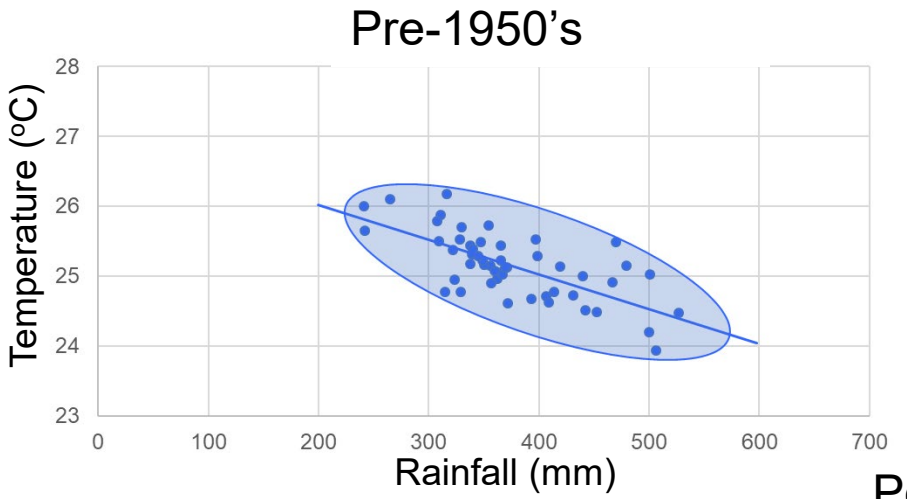
MDBA 2020

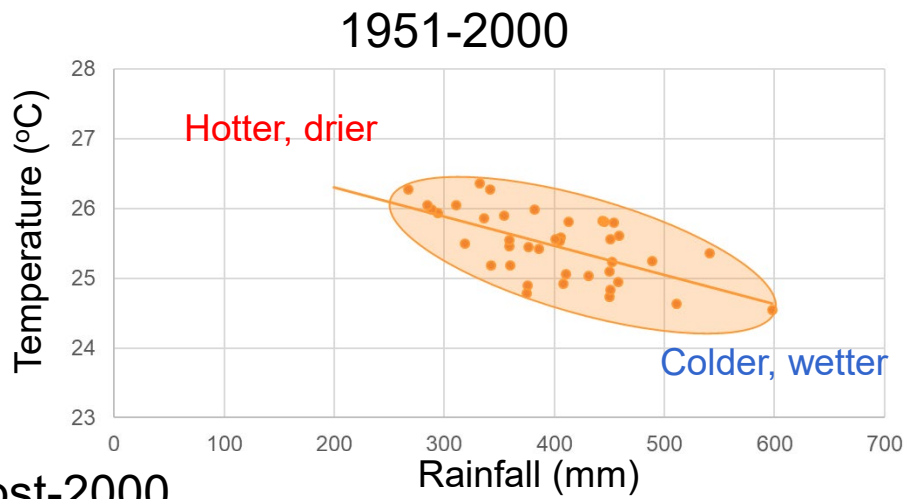
The rainfall-temperature operating envelope

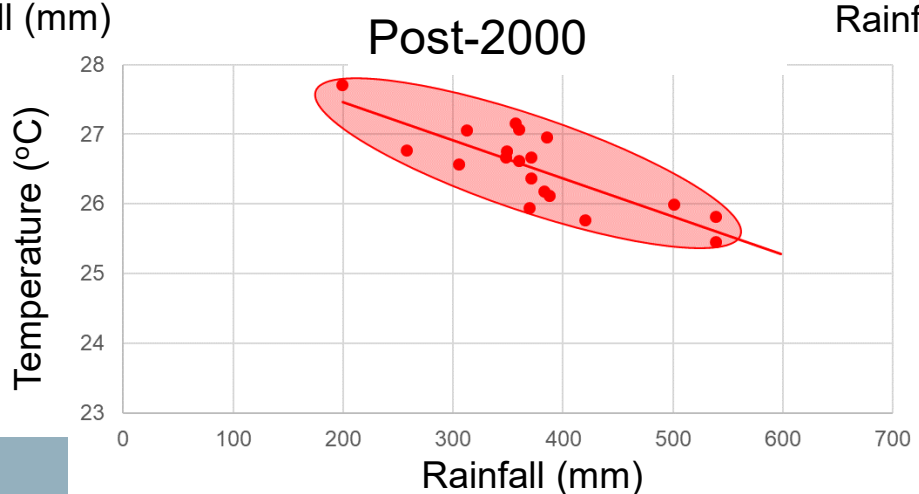


Analysis: Howden 2020. BoM data

Rainfall-temperature operating envelopes

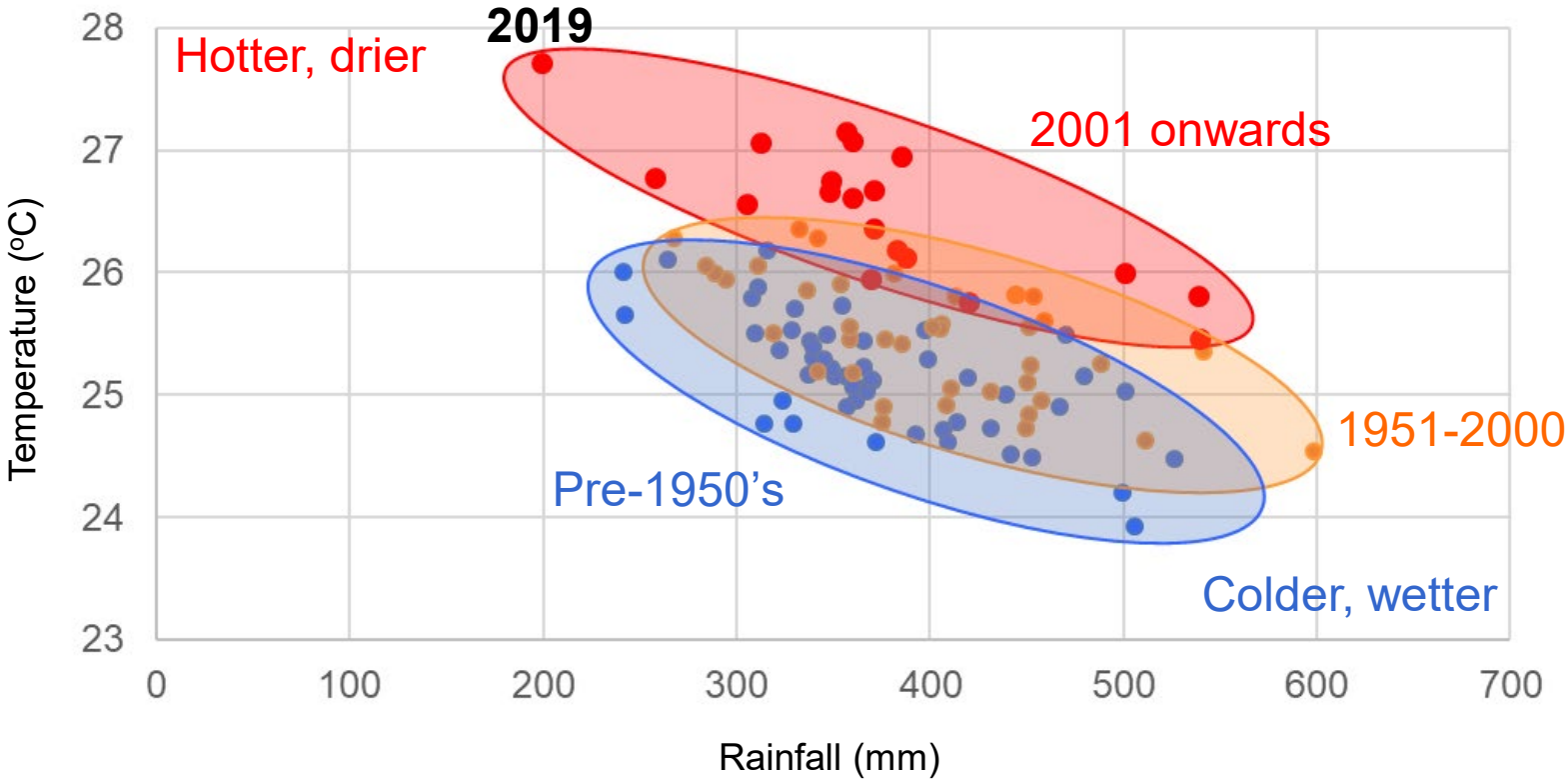






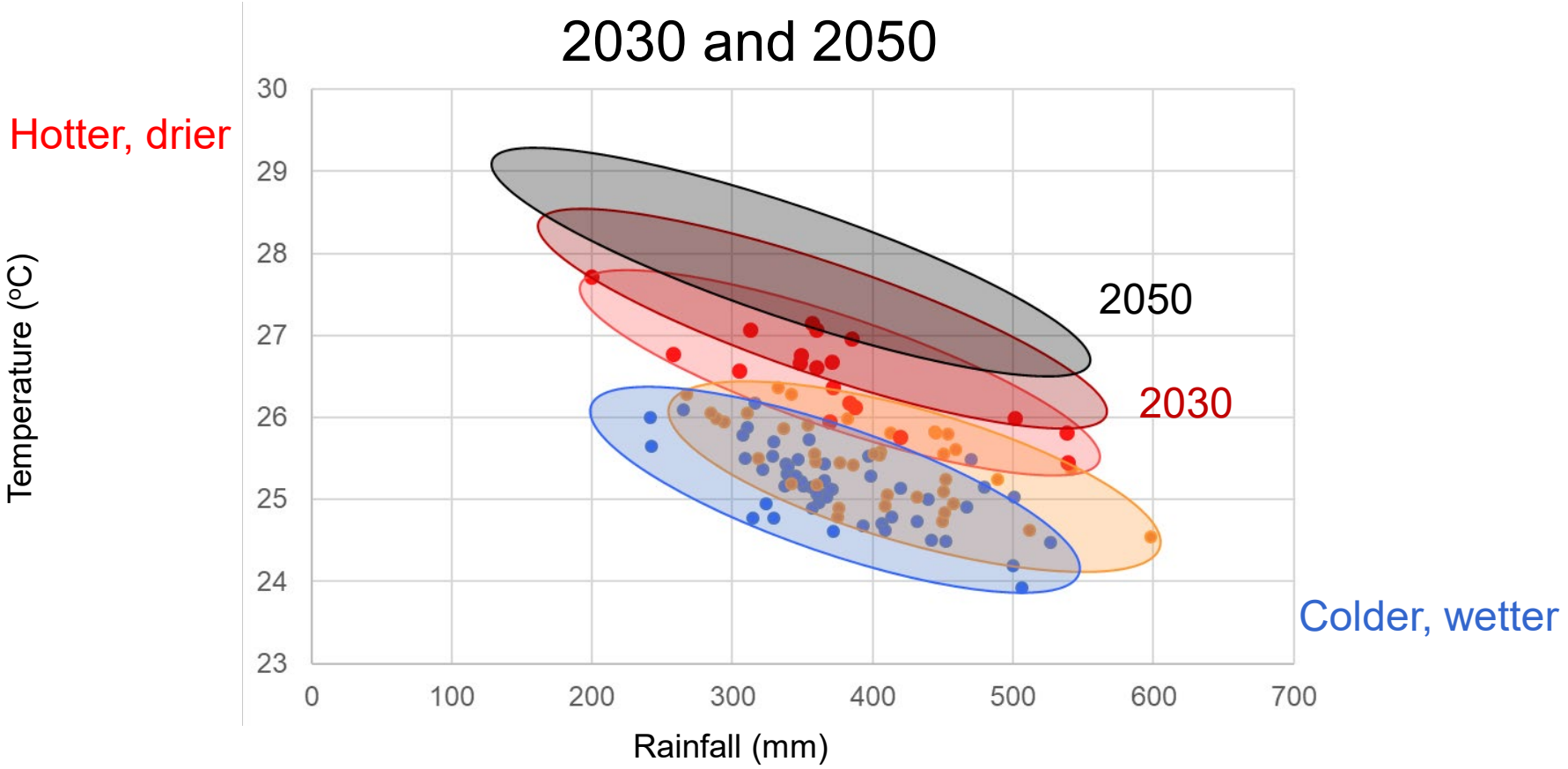
Howden 2020. BoM data

A changed operating environment



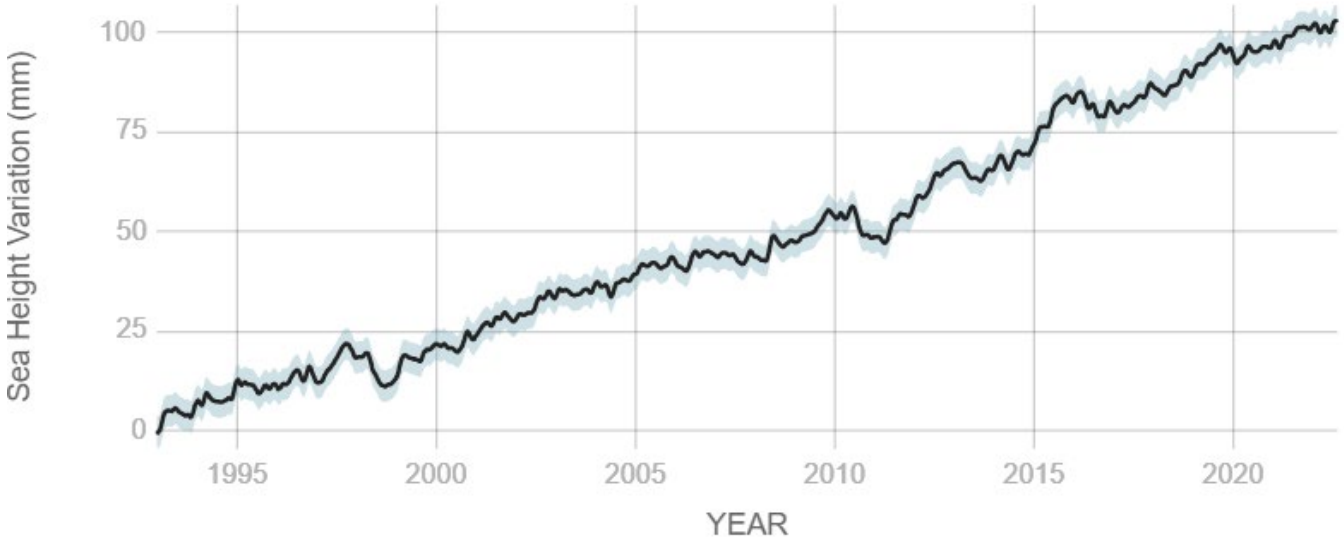
Analysis: Howden 2020. BoM data

Further changes in operating environments



Analysis: Howden 2021. BoM data; IPCC 2018

Sea levels keep getting higher

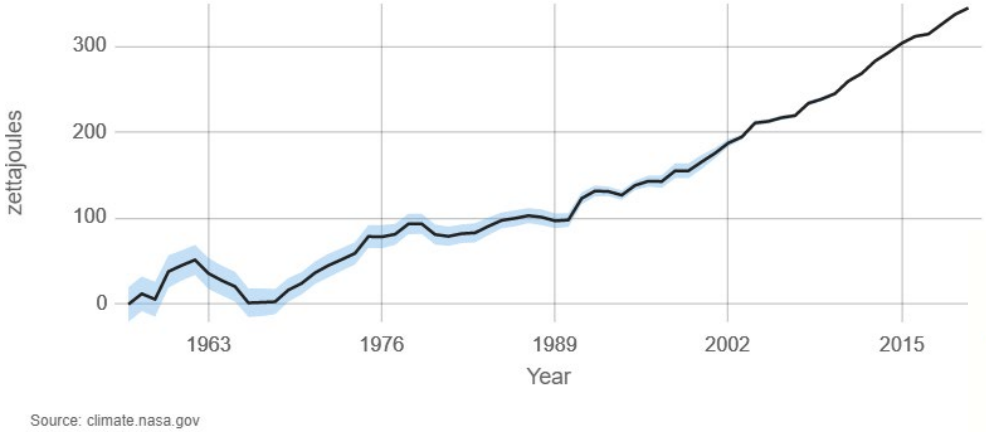


Source: climate.nasa.gov

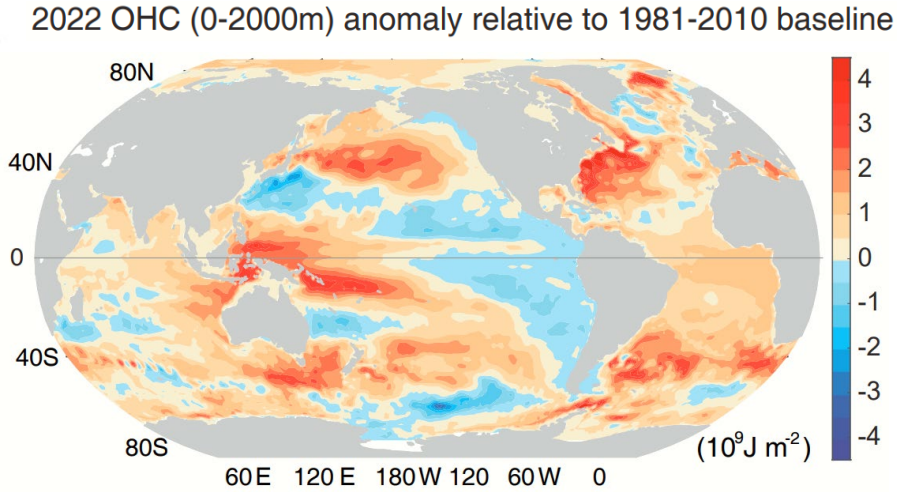
- Rose by about 4.0mm last year

NASA 2022; IPCC 2021

Seas keep getting hotter



Source: climate.nasa.gov



- Acceleration of ocean currents and increased stratification
- Record low Antarctic sea ice extent

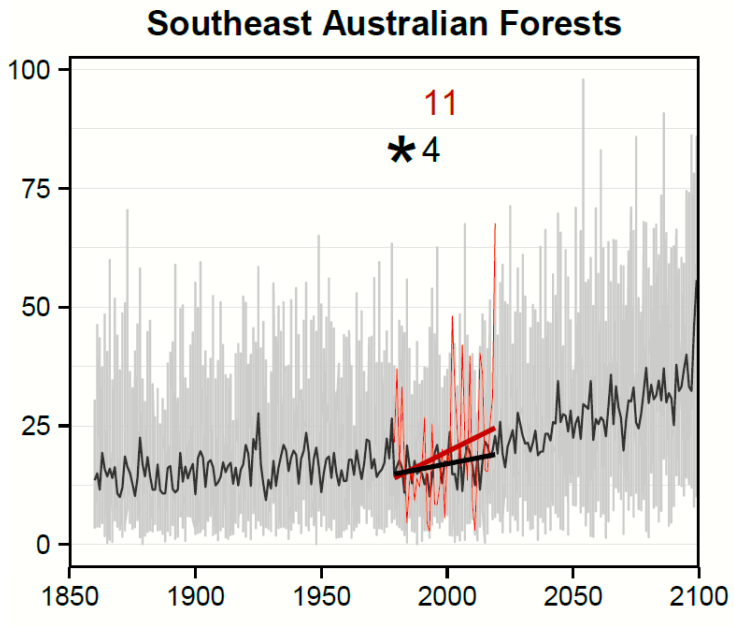
NASA 2023, Cheng et al. 2023, Xie et al. 2022, Shijian et al. 2020

Systemic under-estimation of risk

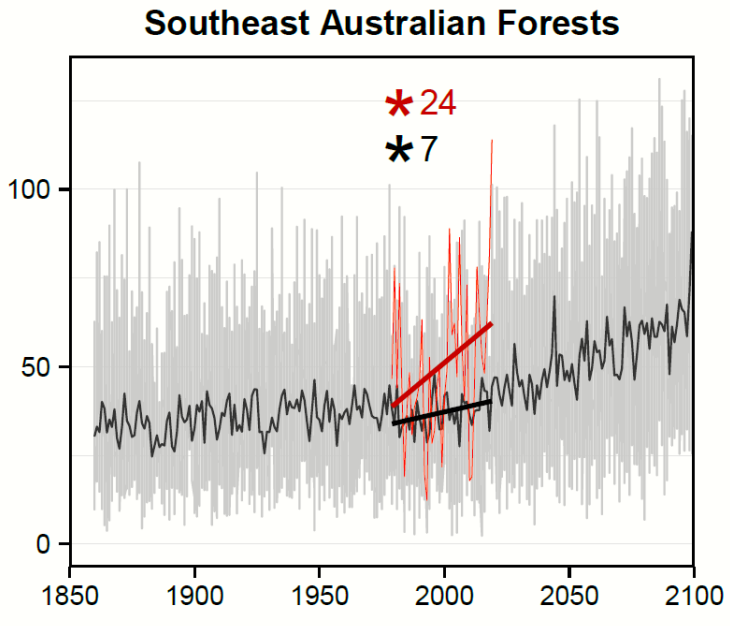
- Ice sheets and sea level rise
- Agriculture and food security
- Water-related issues
- Heatwaves
- Biodiversity
- Fire

Past and future fire changes

Fire Weather index

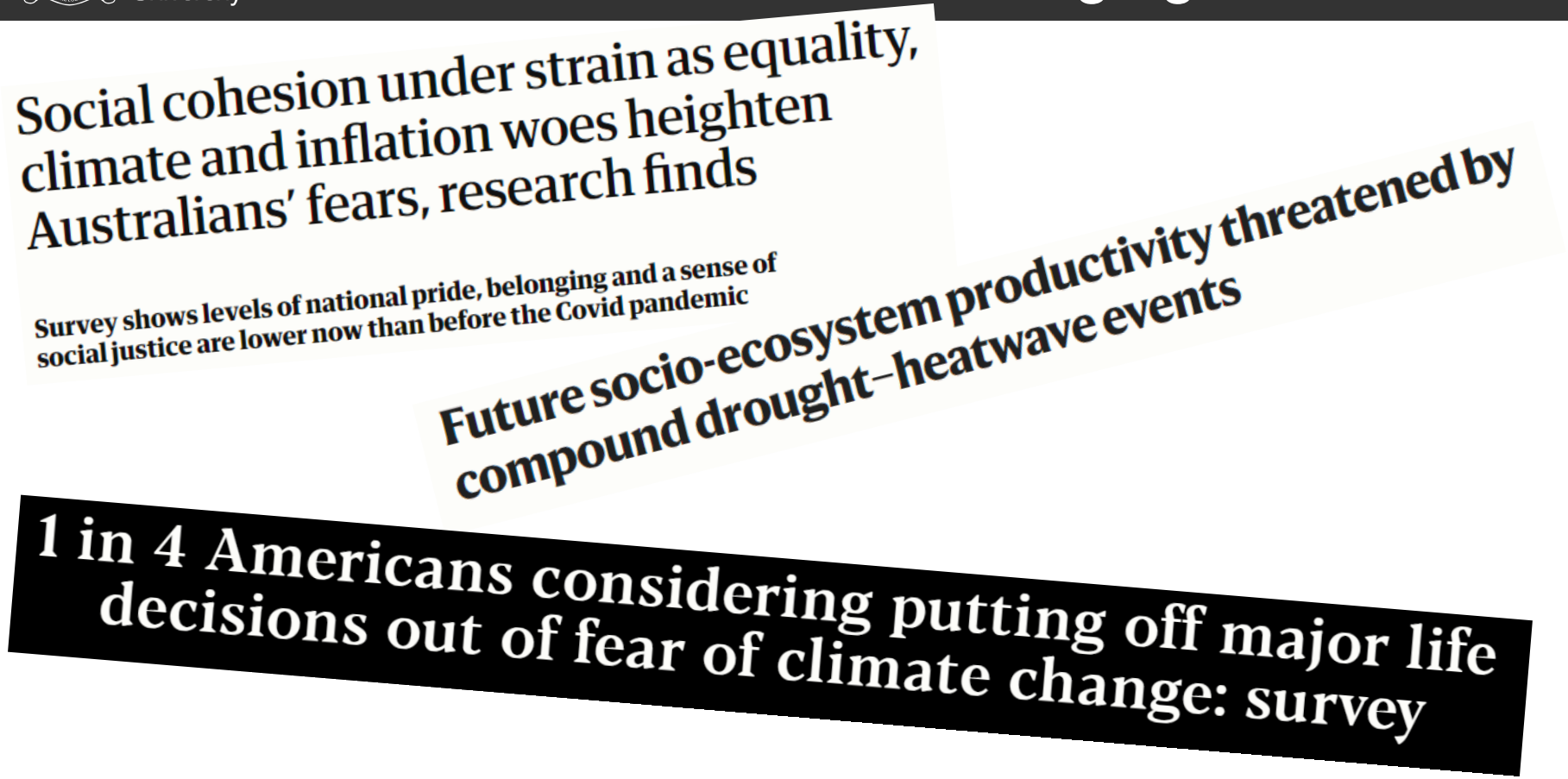


Fire Weather season length



Jones et al. 2022, Cai et al. 2022

Societal stresses are emerging



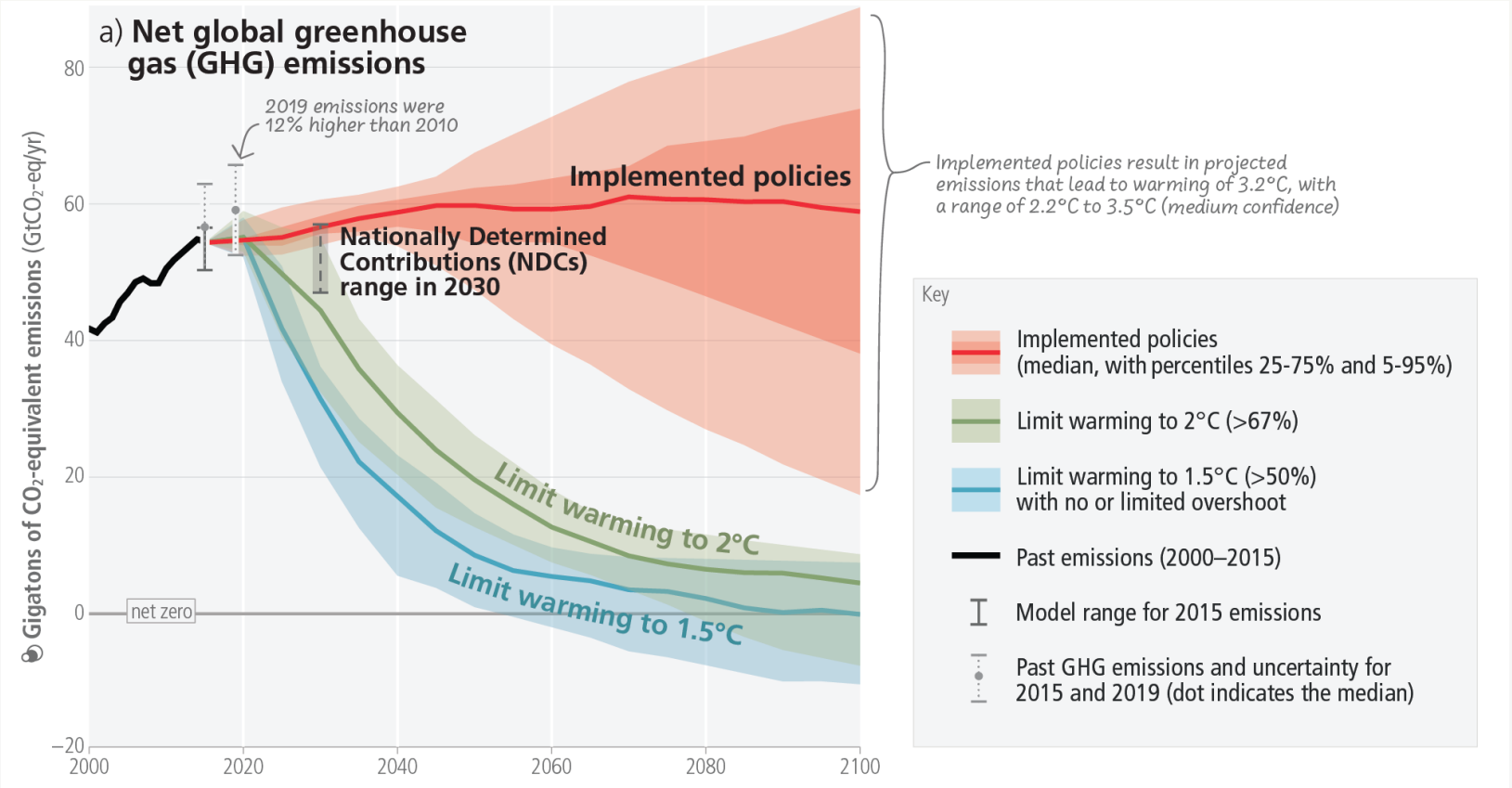
Social cohesion under strain as equality, climate and inflation woes heighten Australians' fears, research finds

Survey shows levels of national pride, belonging and a sense of social justice are lower now than before the Covid pandemic

Future socio-ecosystem productivity threatened by compound drought–heatwave events

1 in 4 Americans considering putting off major life decisions out of fear of climate change: survey

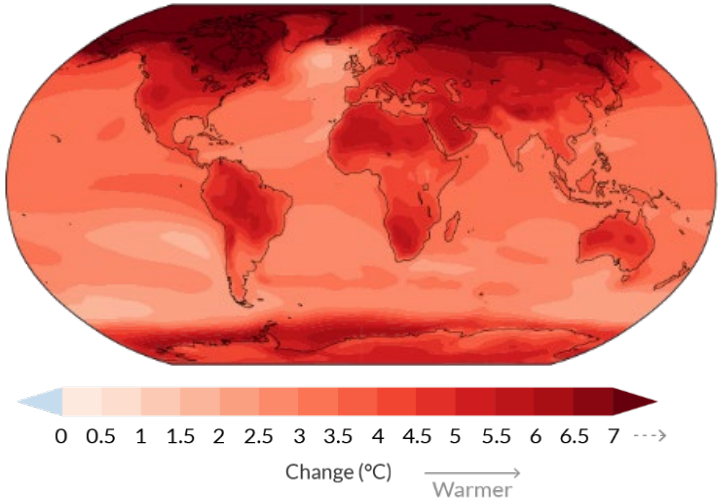
Deep, rapid and sustained emission reductions



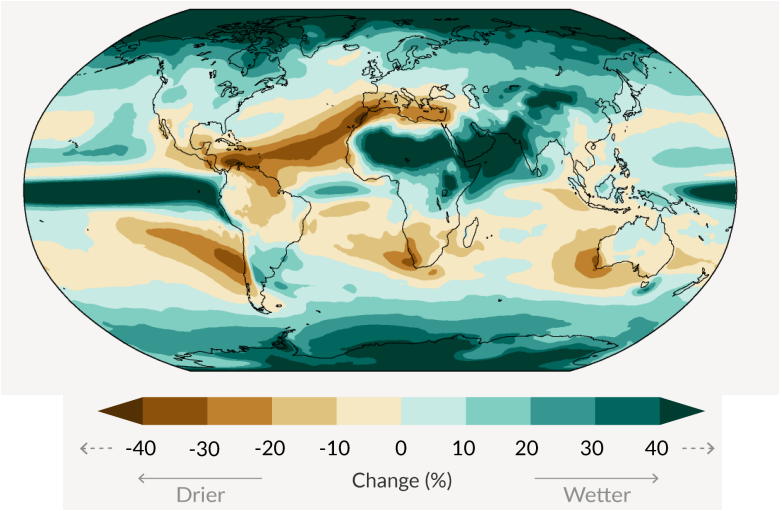
IPCC 2022

Changed rainfall, temperature & water

Temperature (4°C scenario)



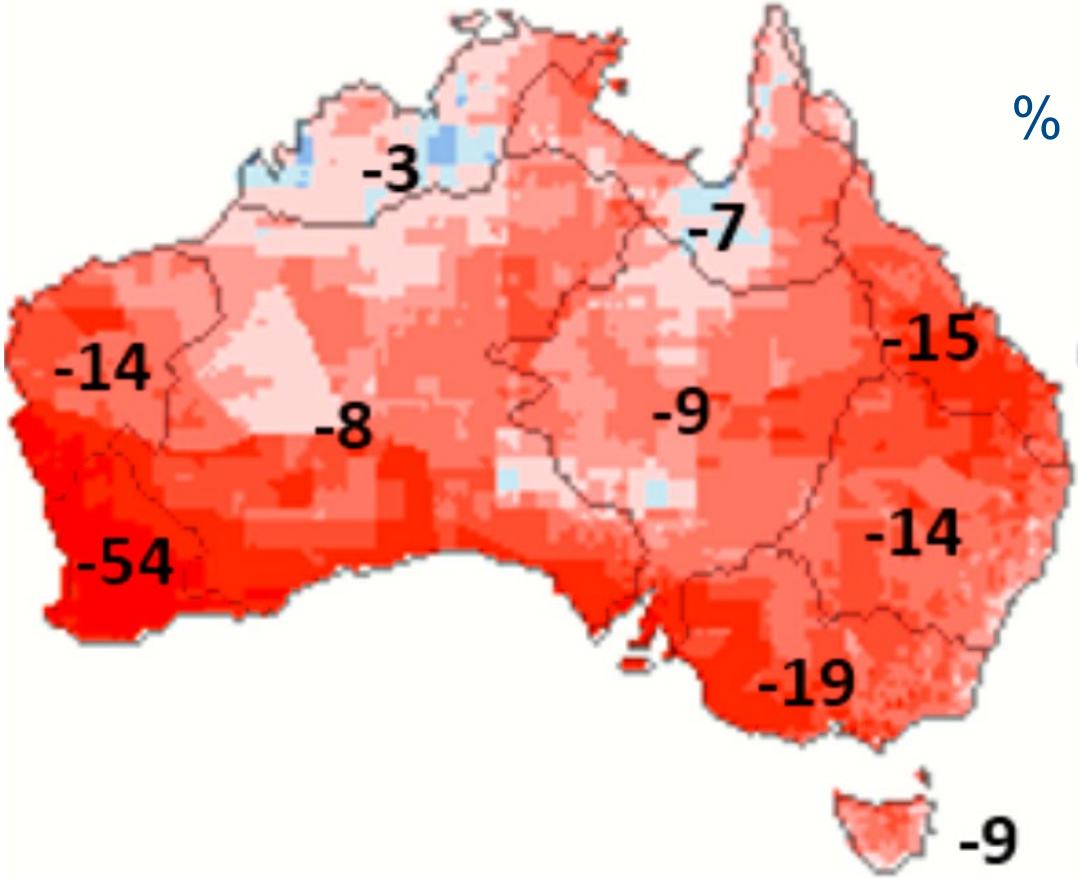
Rainfall at 4°C



- Crop and pasture growth, quality and variability
- Heat stress (livestock and humans)
- Extreme events (including fire, heat waves, drought, storms and cyclones)
- Demand-side changes

IPCC 2021

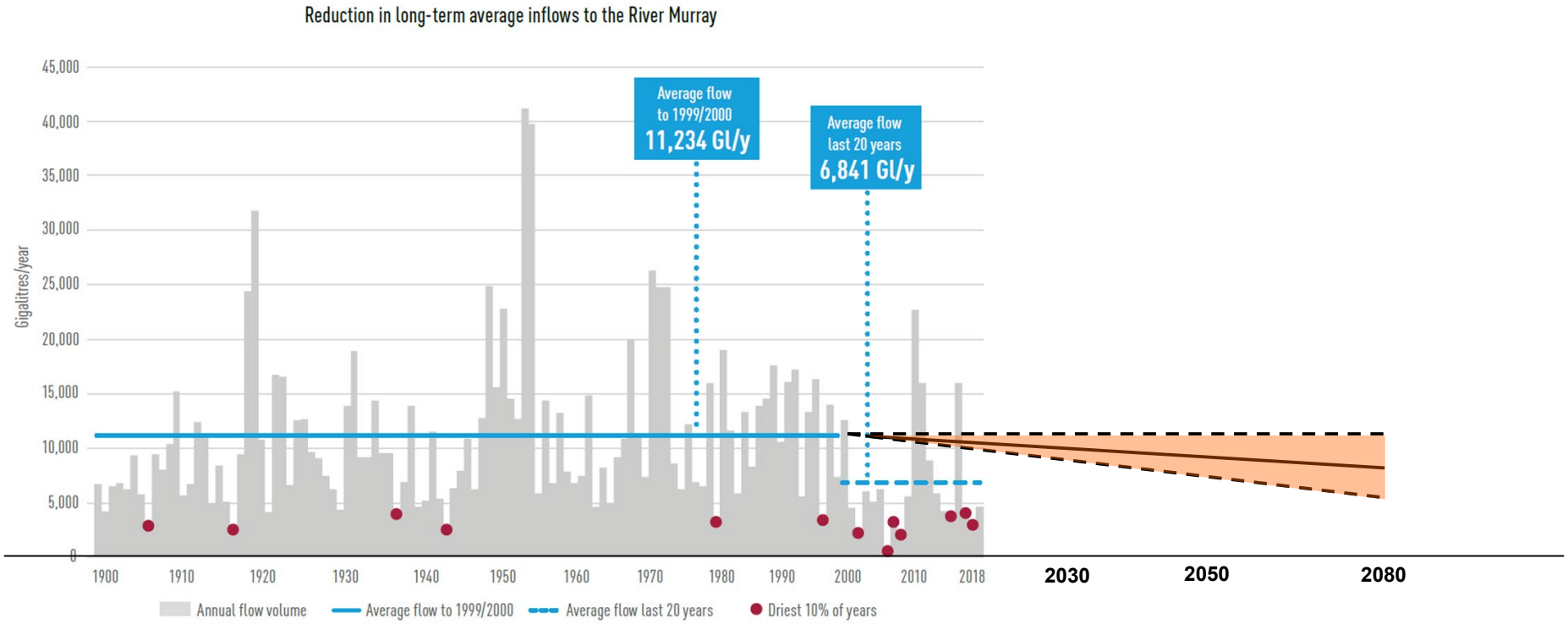
In the future, water resources more limited



% change in runoff per ^{o}C

IPCC 2022

MDB flows: historical and projected



MDBA 2020; CSIRO 2021

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We can take action !

- 18 countries have achieved a steady decrease in emissions consistent with limiting warming to 2°C
- Zero emissions targets have been adopted by at least 826 cities and 103 regions
- Policy packages better understood, costs falling
- Many emission-reduction options, often bringing other benefits (sometimes trade-offs), but implementation/financing needs ramping up
- Options for 50% emissions by 2030 identified at cost <US$100/t
  - half of this at cost <US$20/t
- Many adaptations well understood but not being actioned

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Climate change is a bit like this …

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Thankyou

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Every half a degree matters
Every year matters
Every choice matters

Howden and Colvin 2018