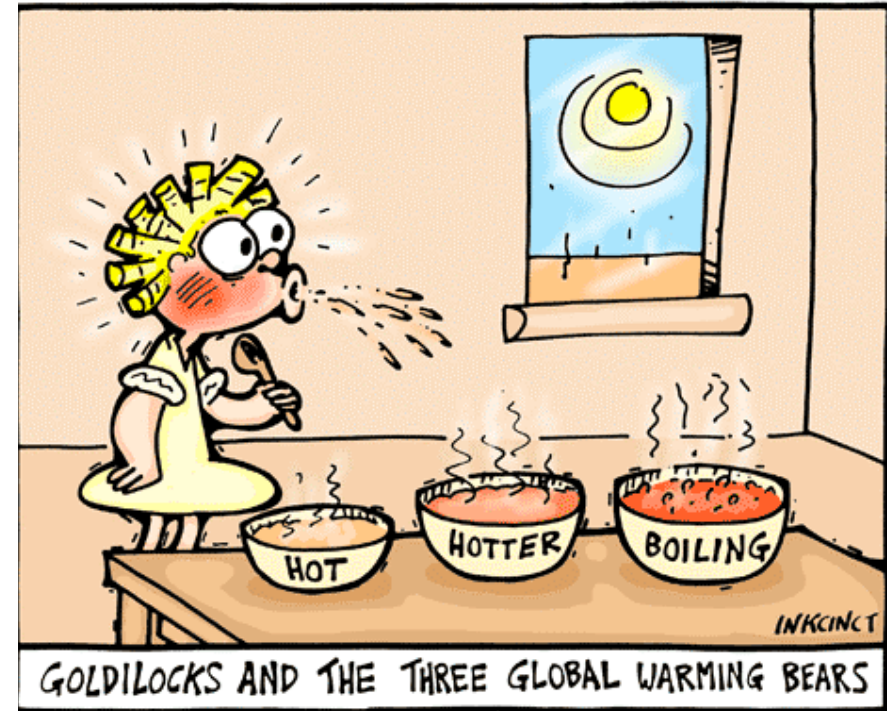
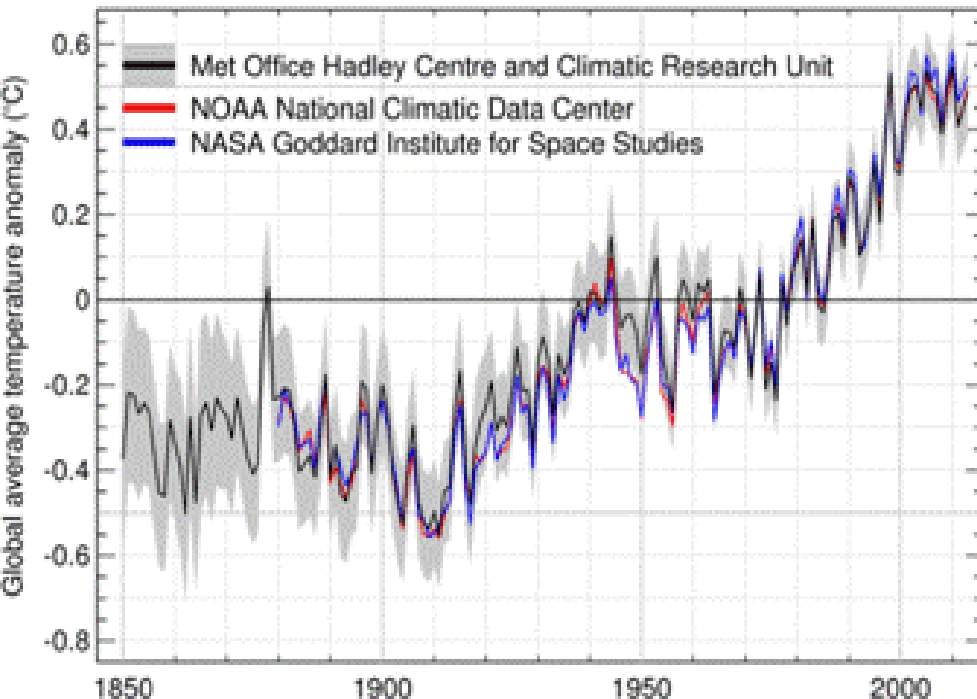


How will climate change impact Melbourne's East?

Professor David Karoly

School of Earth Sciences, University of Melbourne



Outline

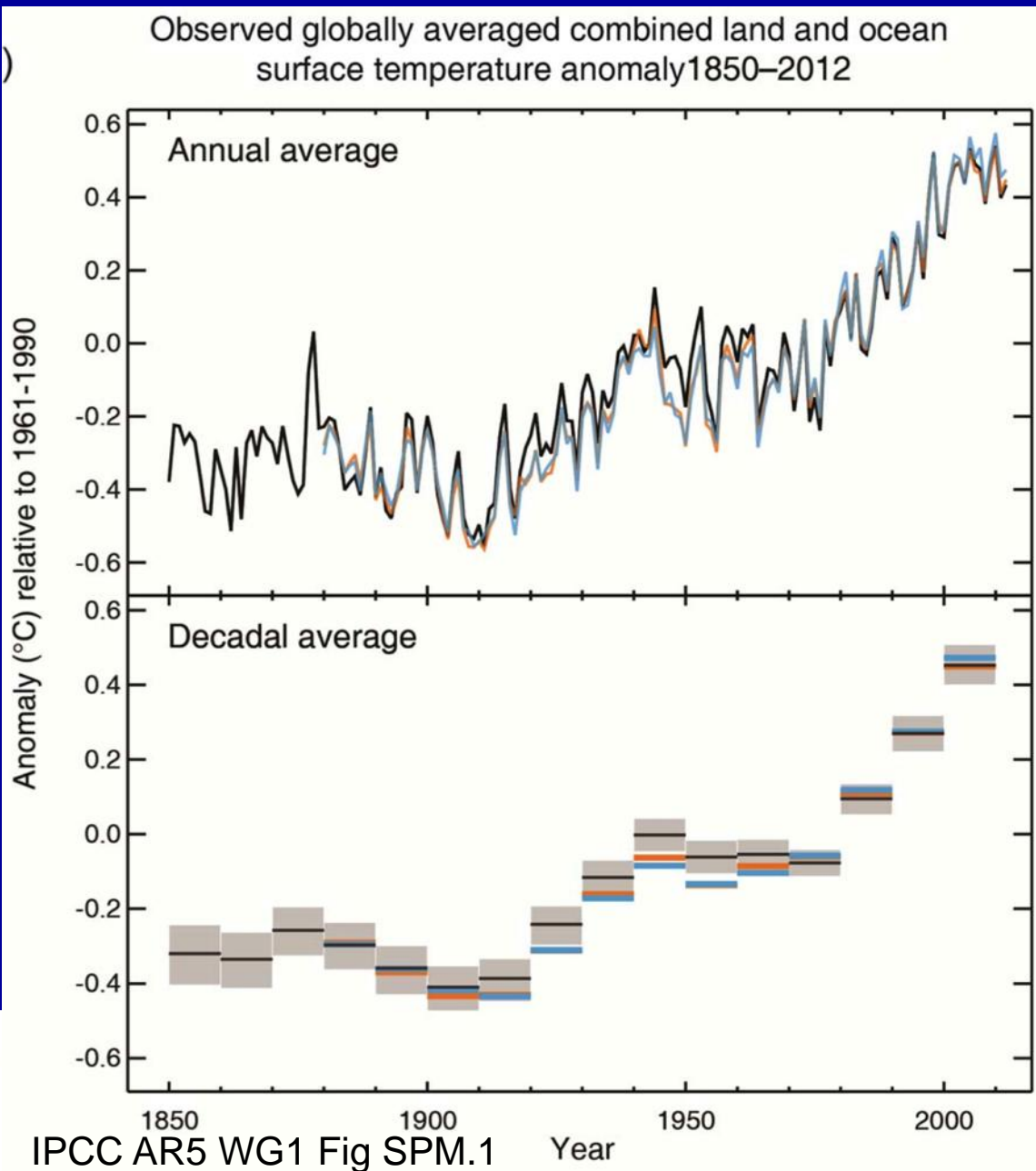
- The latest assessment of climate change science - IPCC 2013
- Implications for Melbourne's eastern suburbs
- Implications for greenhouse gas emission reduction targets globally and for Australia

References

IPCC AR5 Climate Change 2013: The Physical Science Basis

Bureau of Met & CSIRO State of the Climate 2014

Observed changes

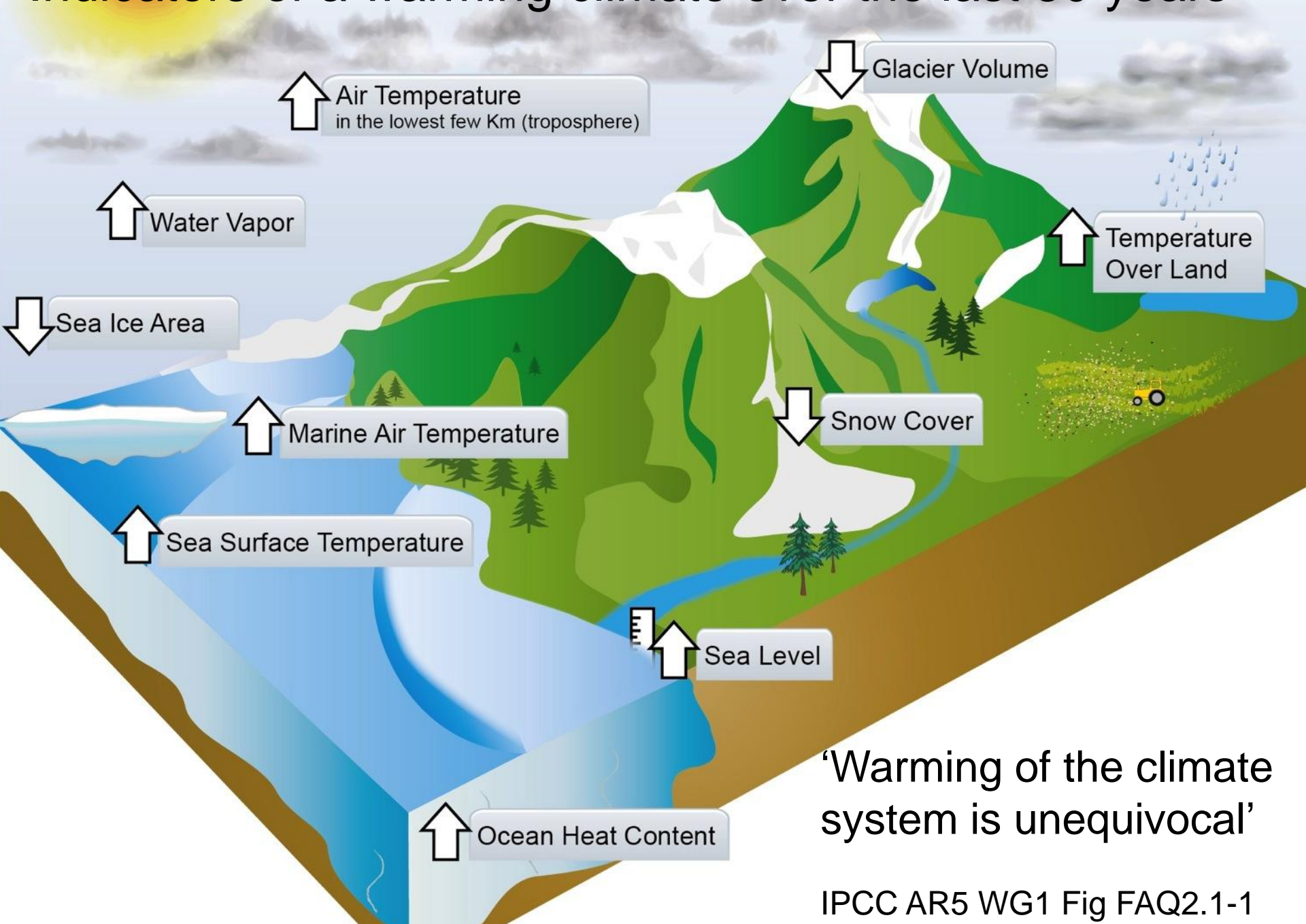


‘Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia.’

‘Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850’ (IPCC 2013)



Indicators of a warming climate over the last 50 years



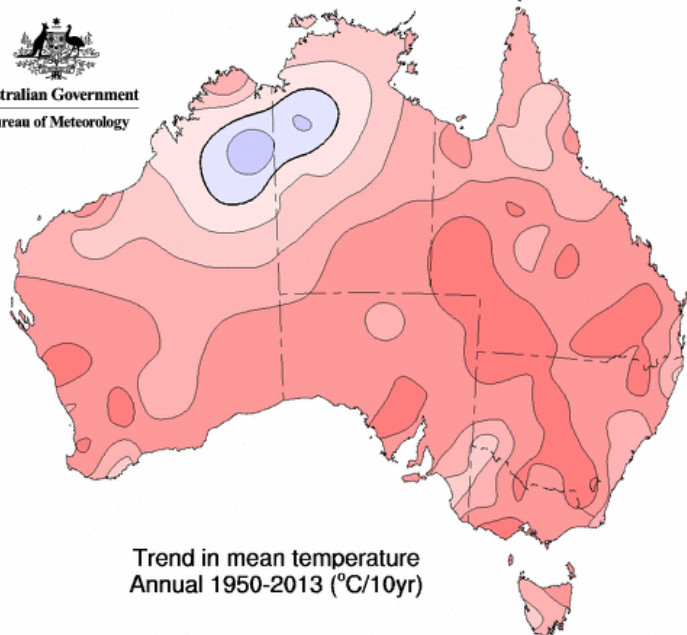
‘Warming of the climate system is unequivocal’

IPCC AR5 WG1 Fig FAQ2.1-1

Trends in Australian climate



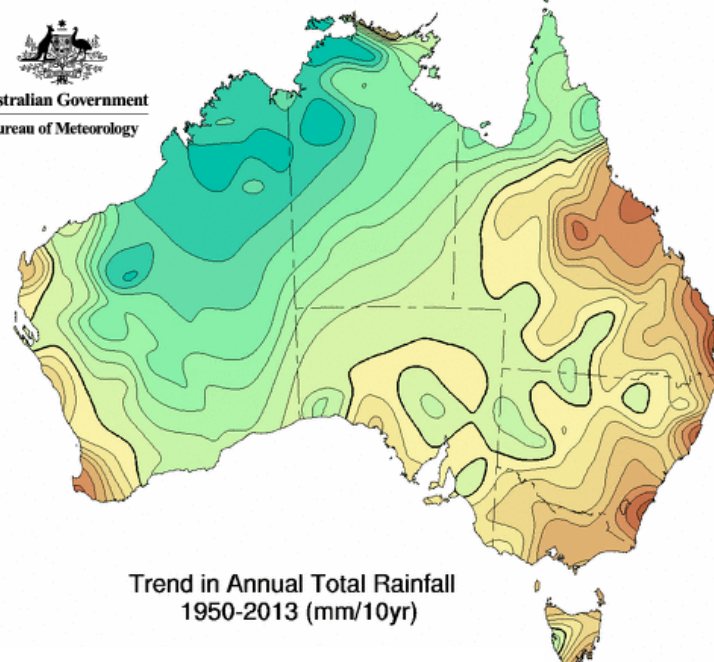
Australian Government
Bureau of Meteorology



Trend in mean temperature
Annual 1950-2013 ($^{\circ}\text{C}/10\text{yr}$)

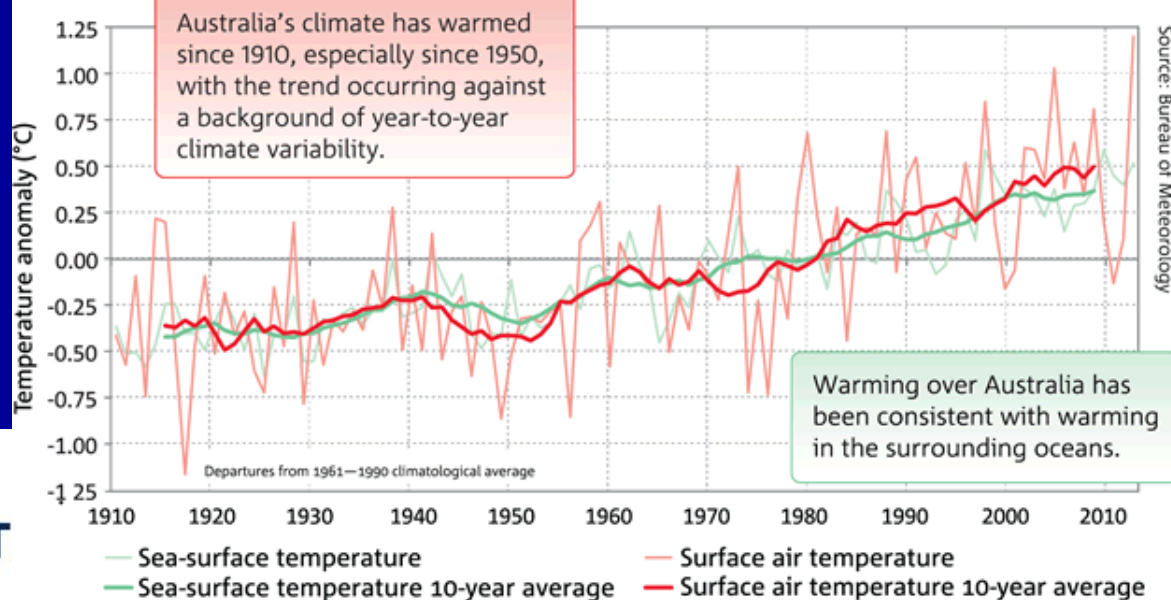


Australian Government
Bureau of Meteorology



Trend in Annual Total Rainfall
1950-2013 ($\text{mm}/10\text{yr}$)

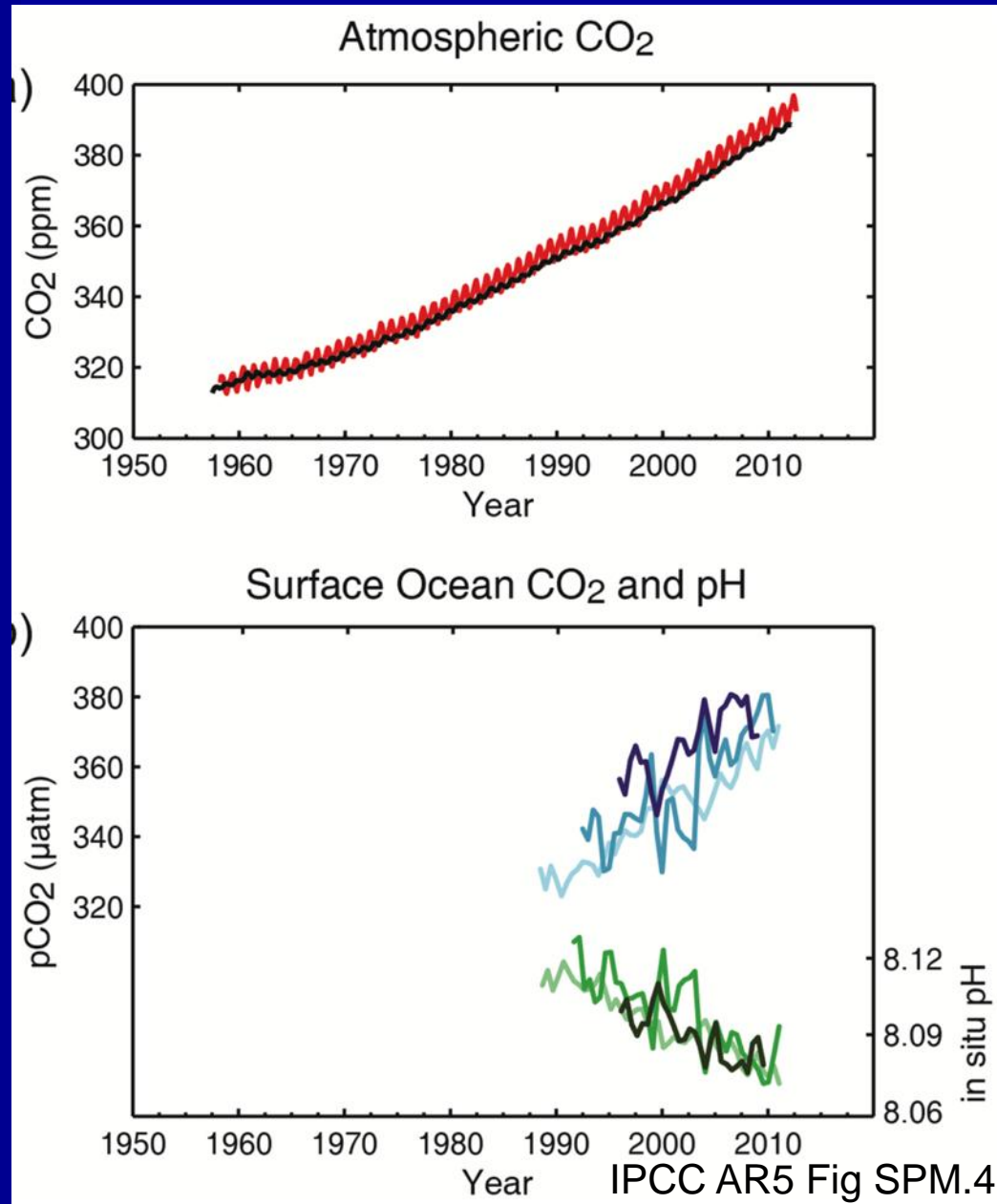
Commonwealth of Australia 2014, Australian Bureau of Meteorology



Issue: 07/15

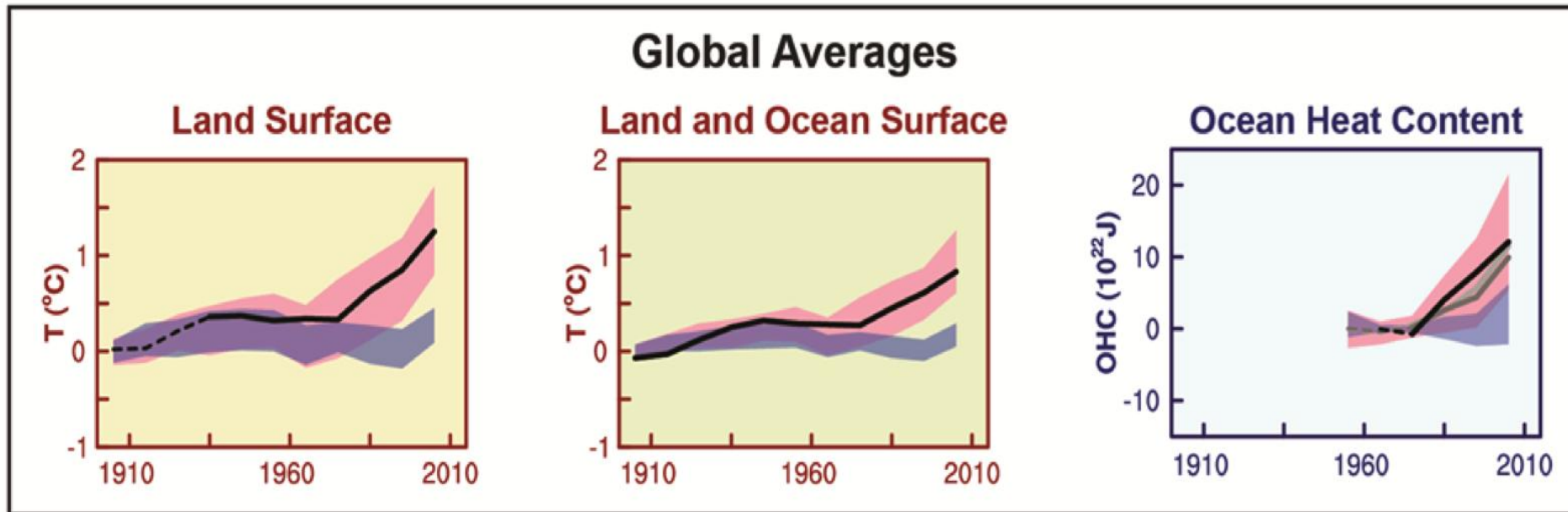
Observed changes

‘The atmospheric concentrations of carbon dioxide (CO_2), methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. CO_2 concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification ’ (IPCC 2013)



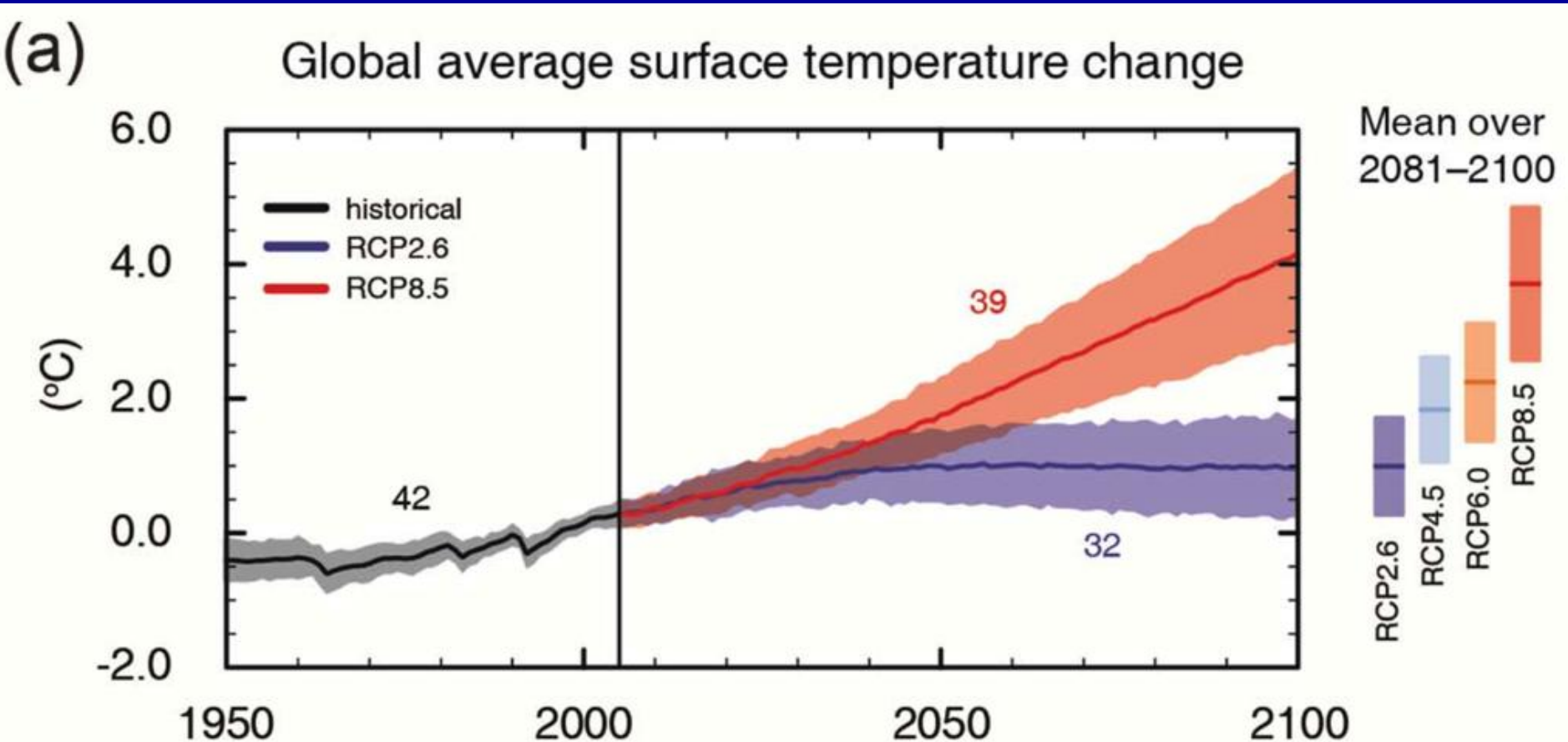
Causes of change

‘It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century.’ (IPCC 2013)



Projected changes

‘Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.’ (IPCC 2013)



Projected changes

- It is *virtually certain* that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales as global mean temperatures increase.
- Extreme precipitation events over most of the mid-latitude land masses and over wet tropical regions will *very likely* become more intense and more frequent by the end of this century, as global mean surface temperature increases. (IPCC 2013)

Future climate change in Melbourne

	Present day	2070 low emissions	2070 high emissions
Ann mean temp	15.6°C	1.4°C (1.0 to 2.0°C)	2.8°C (1.9 to 3.8°C)
Summer rainfall	155 mm	-2% (-17 to +14%)	-4% (-30 to +27%)
Winter rainfall	153 mm	-7% (-17 to +3%)	-12% (-30 to +5%)
Days over 35C	9	14 (12 to 17)	20 (15 to 26)
Rain days		-10% (-28 to -2%)	-19% (-54 to -4%)

From www.climatechange.vic.gov.au/regional-projections

Future climate change in Melbourne

	1980-99	2030	2004-13 observed
Ann mean temp	15.6°C	0.9°C (0.6 to 1.2°C)	0.9°C
Summer rainfall	155 mm	-1% (-11 to +9%)	+4%
Winter rainfall	153 mm	-4% (-10 to +2%)	-12%
Days over 35C	9	11 (10 to 13)	12

From www.climatechange.vic.gov.au/regional-projections

What would our changed climate be like?

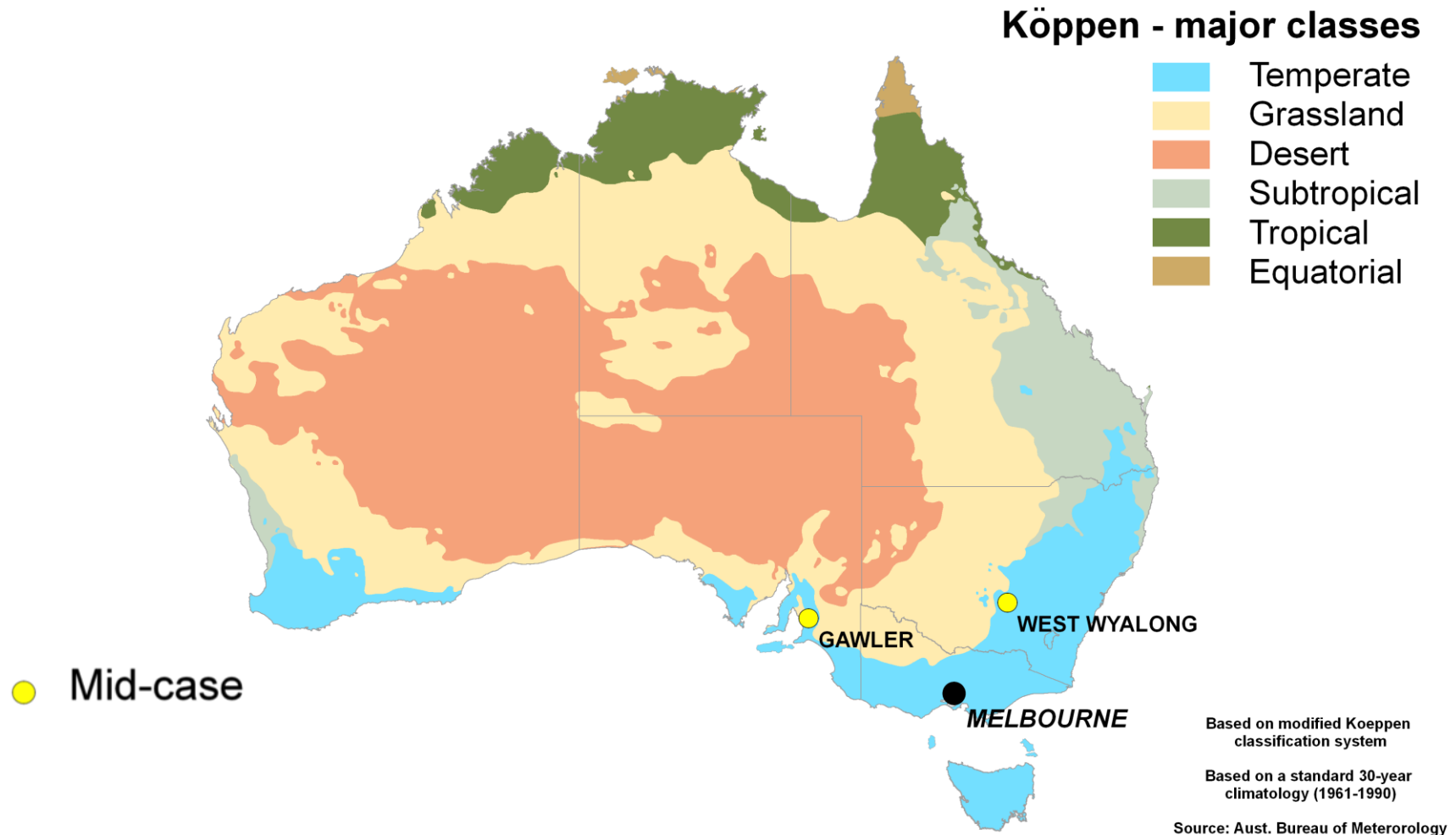
For a number of sites in Australia, we sought analogues for their 4C global warming climate amongst existing climates

This was done based on annual maximum temperature and rainfall (with tolerances $\pm 1.0^{\circ}\text{C}$ and $\pm 15\%$)

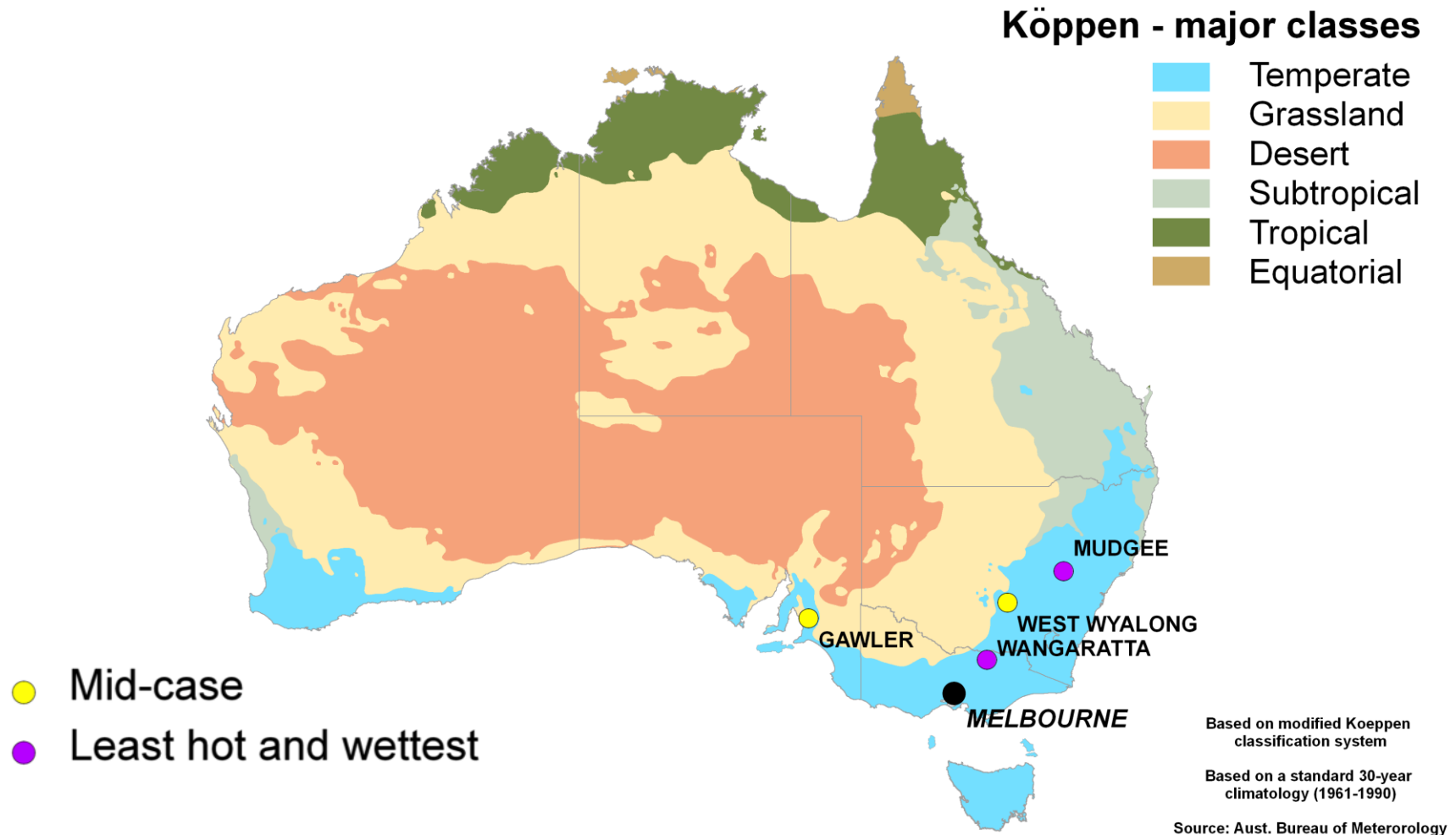
Three cases were considered

- *Least hot and wettest (10 and 90 percentiles resp. of temperature and rainfall)*
- *Mid case (50 percentiles of temperature and rainfall)*
- *Hottest and driest (90 and 10 percentiles resp. of temperature and rainfall)*

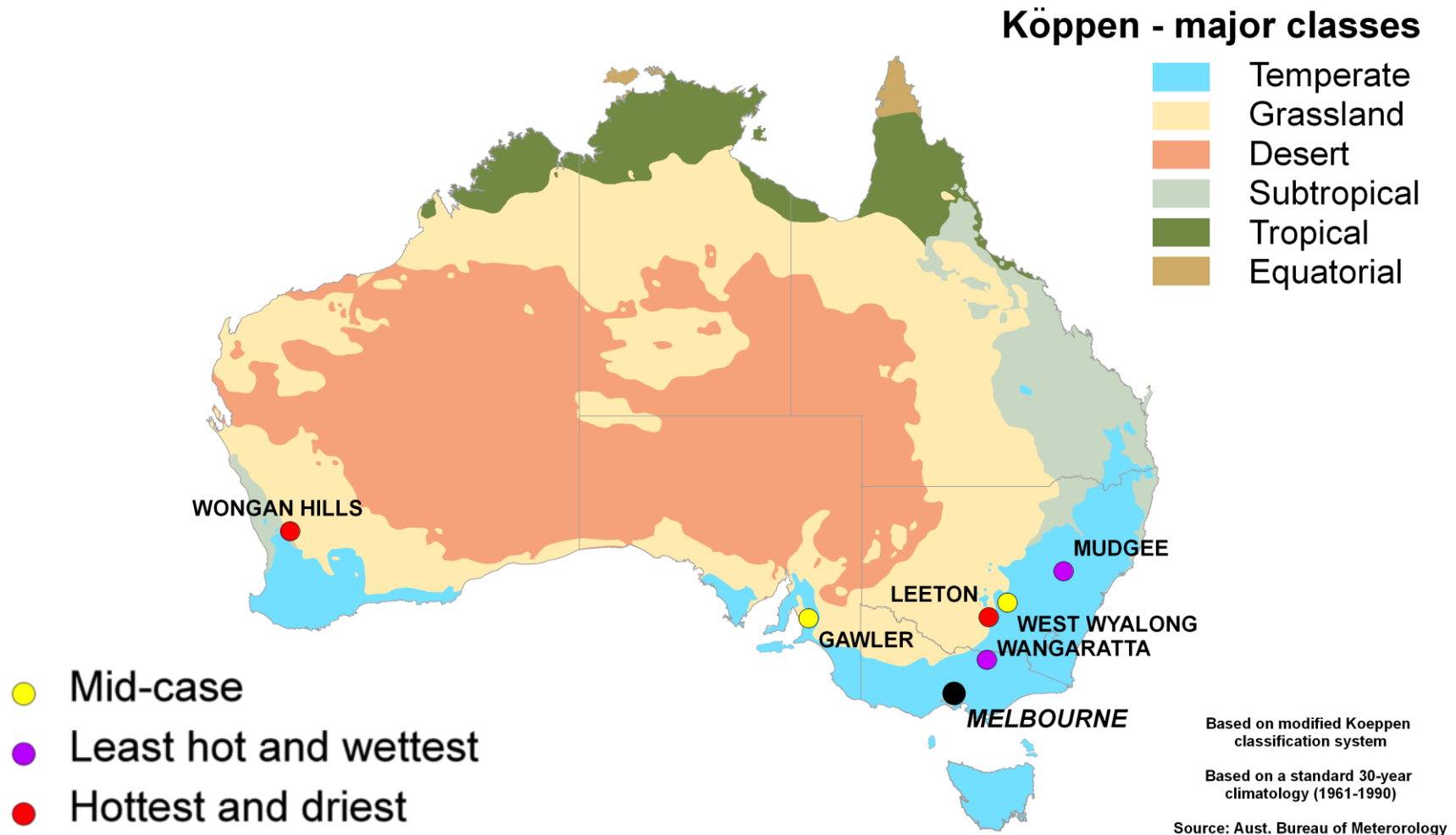
Melbourne: Mid-case



Melbourne: Least hot and wettest



Melbourne: Hottest and driest



CLIMATE CHANGE RISKS TO VICTORIA

Irrigated agriculture across the Murray Darling Basin could decline by up to

70%
by 2050.



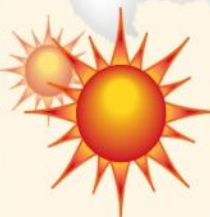
Rainfall has decreased and is expected to decrease further across Victoria



Declines in **snow cover** are expected to continue



Average number of **hot days** over 35°C in Melbourne could **double** by 2070



Dangerous bushfire weather has increased and is expected to increase further



The Gippsland Lakes is one of Australia's most vulnerable regions to **sea-level rise**



Stream flow into Melbourne's catchments expected to **decline 10%** by 2030



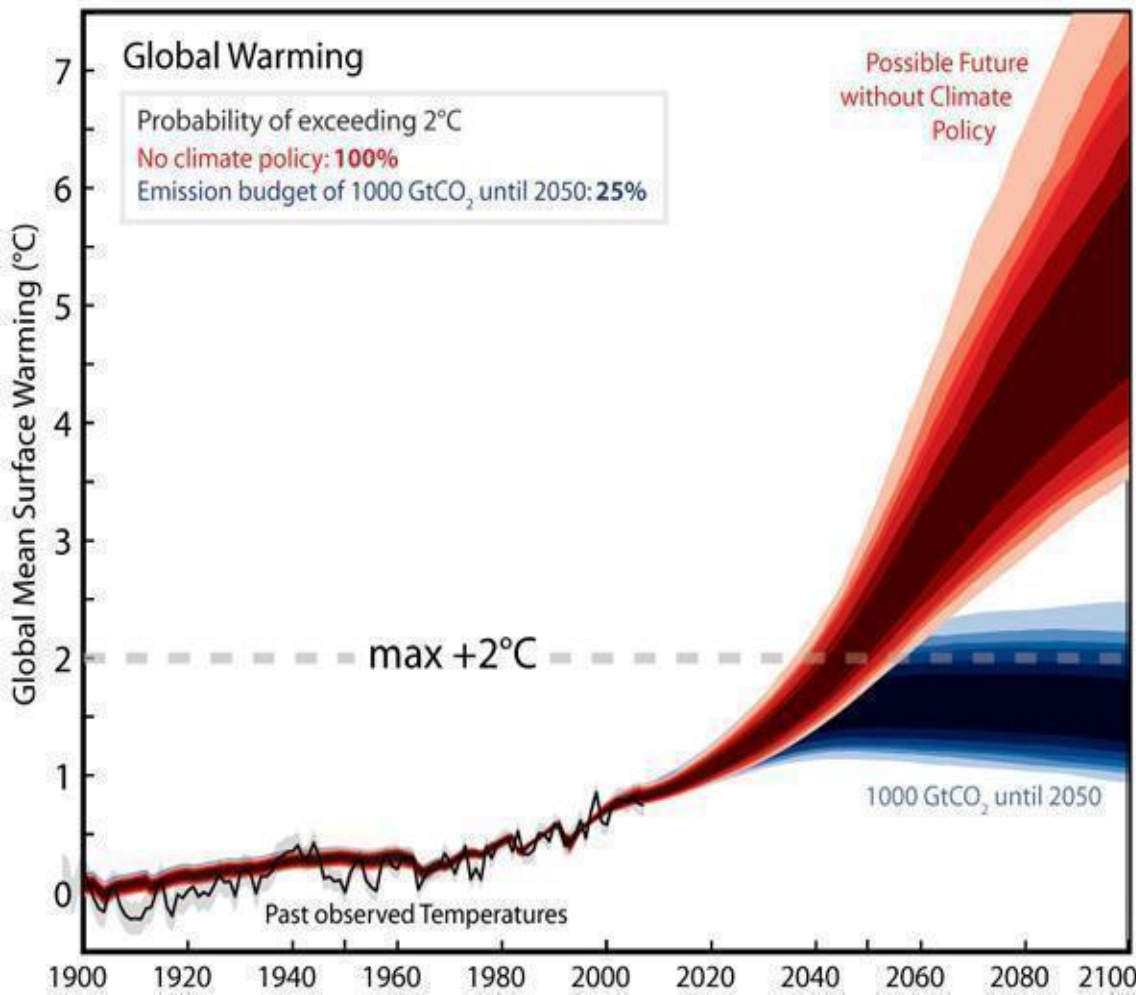
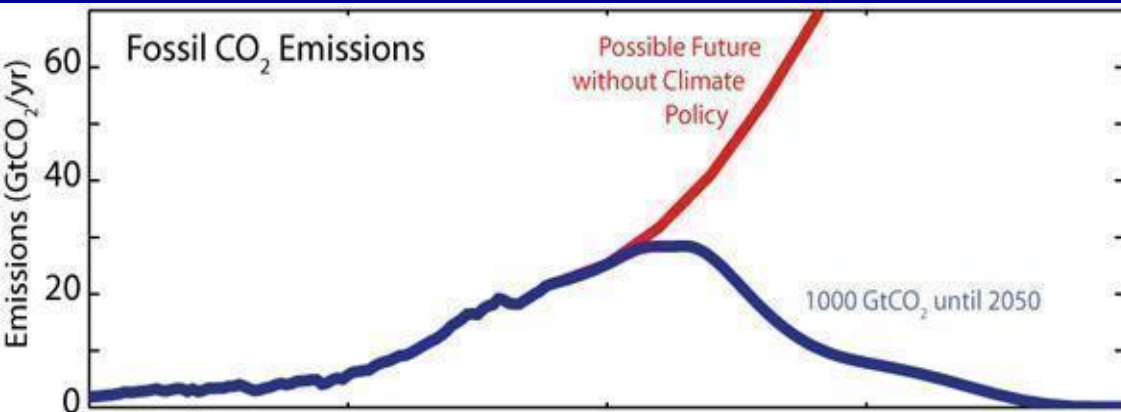
27,600-44,500 residential buildings at risk from 1.1m sea-level rise



Find out more: www.climatecommission.gov.au



CLIMATE
COMMISSION



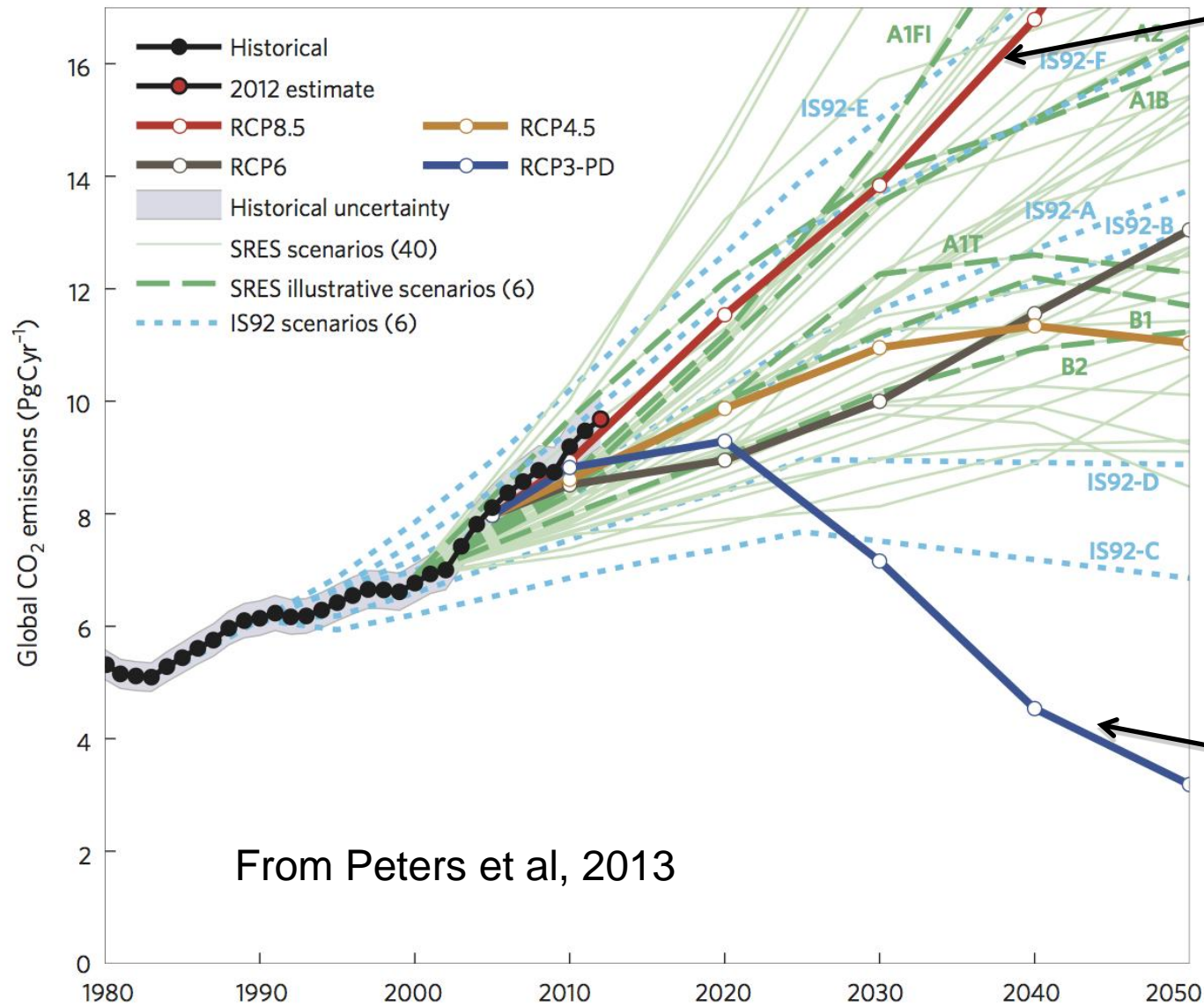
Budget approach

Cumulative emissions allowed for 25% risk of exceeding 2°C

- Equal per capita emissions allowance
- Global budget of 1000Gt CO₂ until 2050
- For world population of 7G, 140 t CO₂ per capita budget until 2050
- For Aust emissions of 20 t CO₂ per person from fossil fuels, budget is used in 7 years

Fig 5.1, *The Science of Climate Change*, AAS 2010

Global CO₂ emissions from fossil fuels and industry



BAU, Warming
in 2100 >4C

Warming in
2100 ~2C

The Critical Decade: Key messages (2013)

Australian Climate Commission

- Our understanding of the climate system has continued to strengthen.
- We are already seeing the social, economic and environmental consequences of a changing climate. Many of the risks scientists warned us about in the past are now happening.
- The changing climate poses substantial risks for health, property, infrastructure, agriculture and natural ecosystems.
- Three years into the Critical Decade it is clear: substantial progress is being made globally to reduce emissions. However, far more will need to be done to stabilise the climate.
- Most of the available fossil fuels cannot be burnt if we are to stabilise the climate this century.

From www.nicholsoncartoons.com.au

