Climate Change 2014: Science, Risks and Responses

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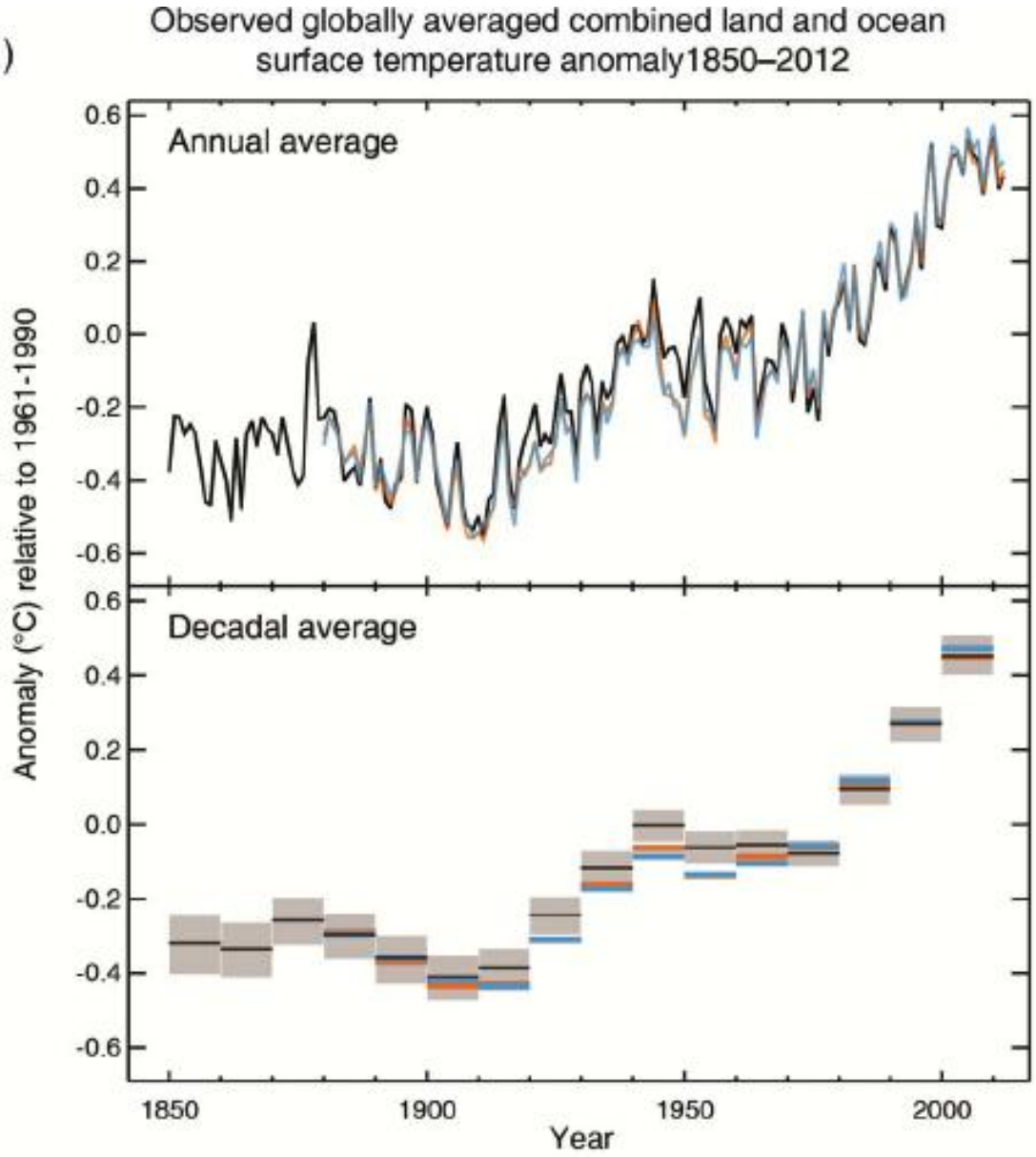
The Climate Council of Australia
The Australian National University

CLIMATE COUNCIL

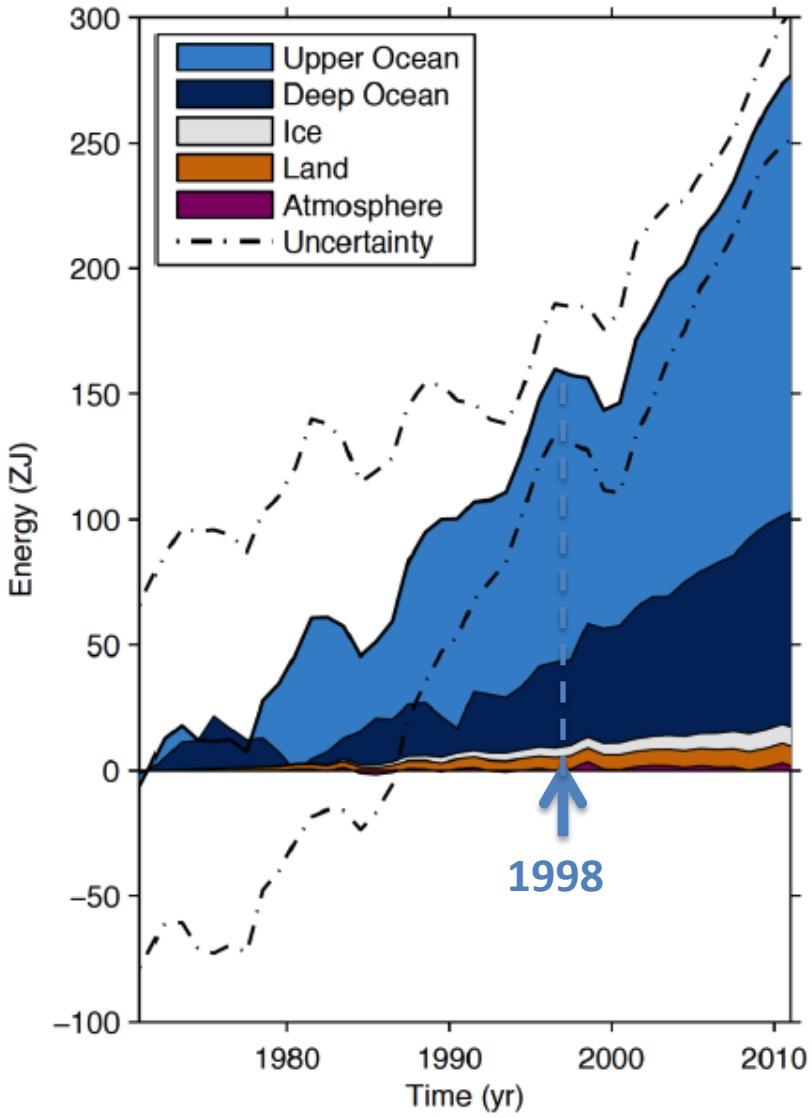
Outline of Talk

1. The climate system is being destabilised.
2. Human-driven greenhouse gas emissions are the primary cause.
3. The risks of a destabilised climate are serious and growing rapidly.
4. To stabilise the climate system, GHG emissions must be reduced rapidly and deeply.

The atmosphere is warming



Ocean warming accounts for 93% of the extra heat stored since 1971.



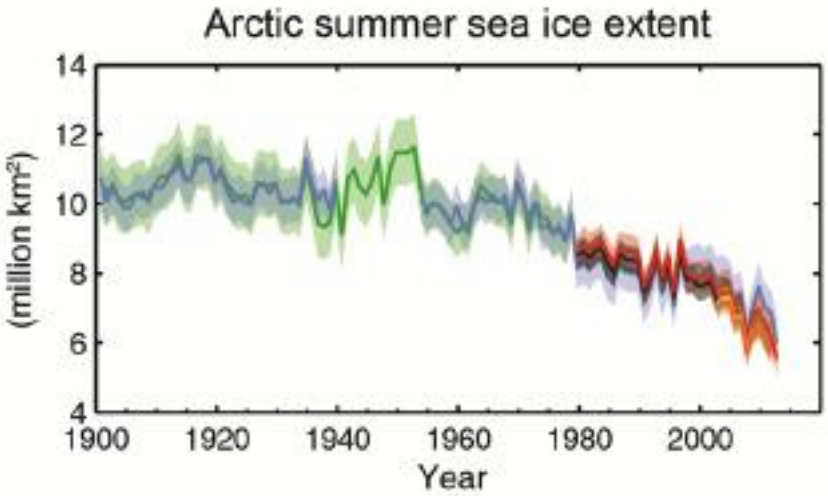
3% warming land

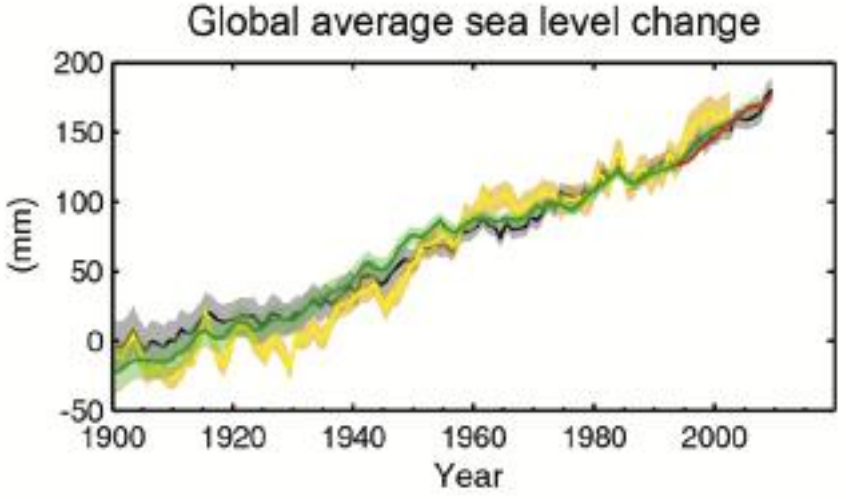
3% melting of ice (glaciers, ice sheets)

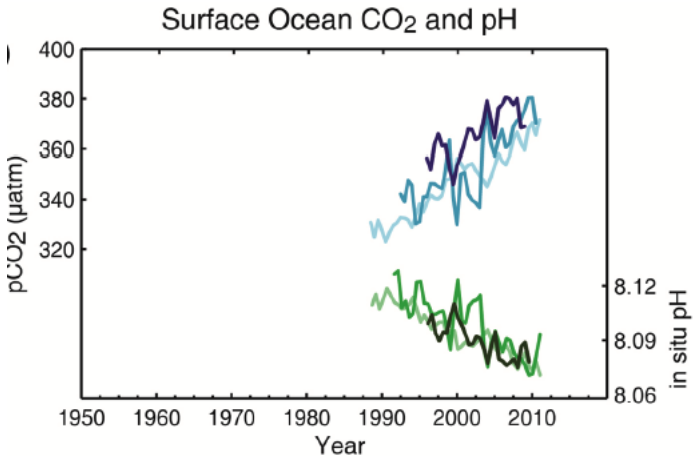
1% warming atmosphere

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Other changes in the climate system

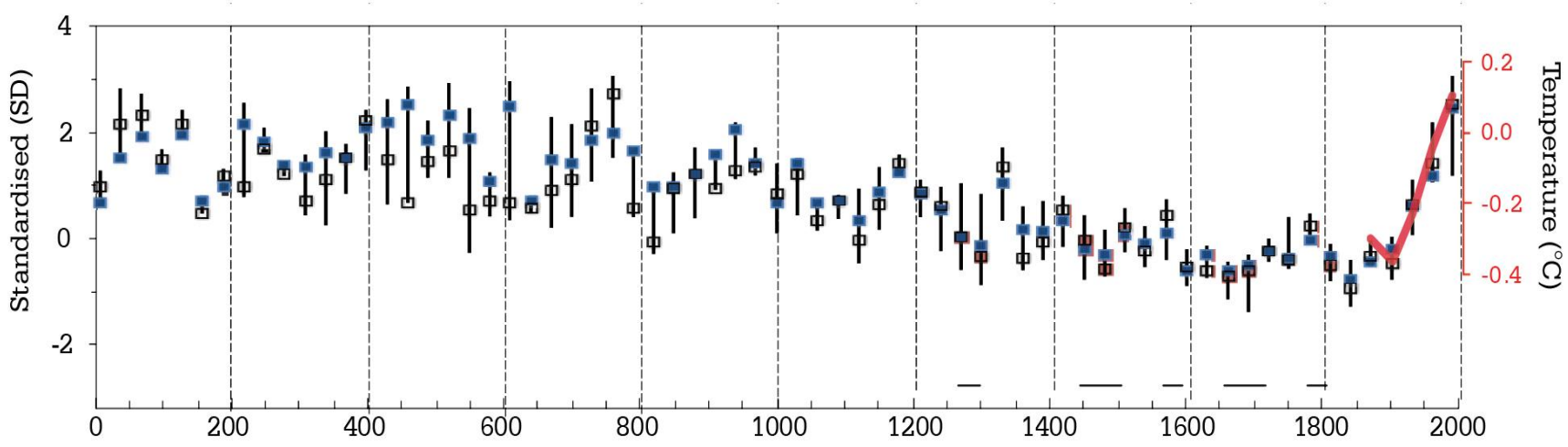






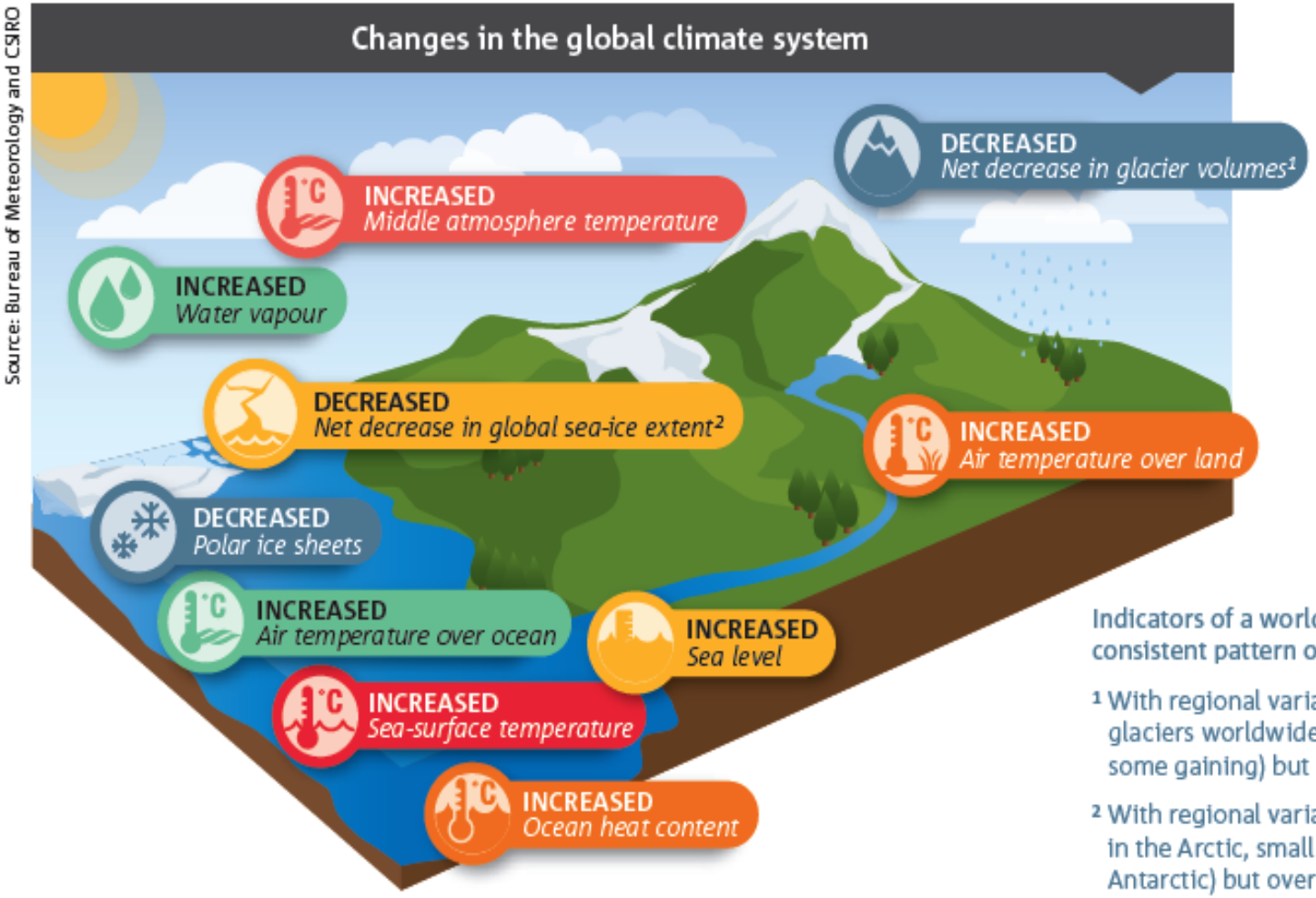
IPCC AR5 WG1 SPM

2,000 year global land temperature reconstruction



Source: Redrawn from PAGES 2k Consortium, 2013, which gives further information on the methodology used in the figure

Summary: Changes in the climate



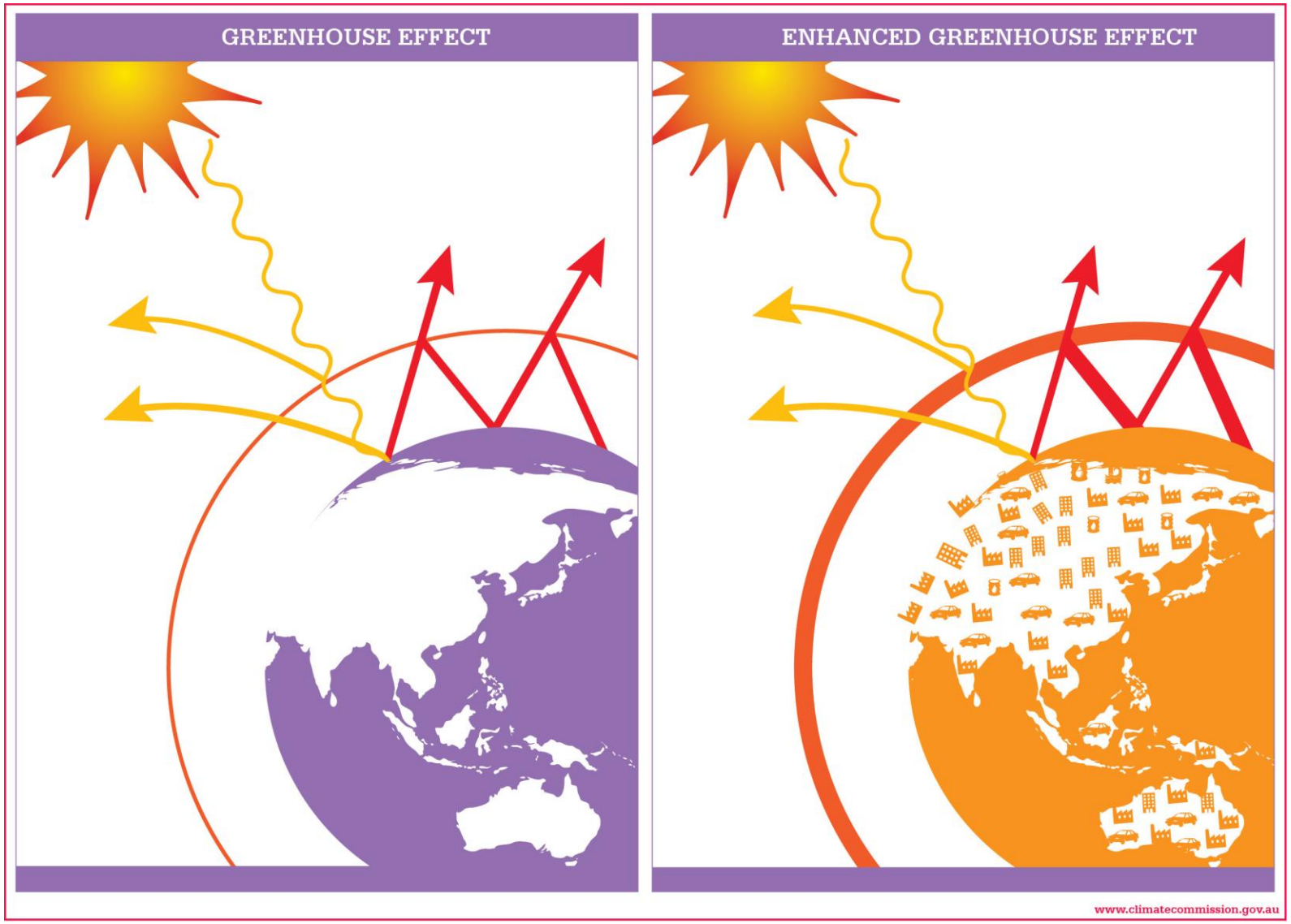
Source: Bureau of Meteorology and CSIRO

Indicators of a world experiencing a consistent pattern of warming.

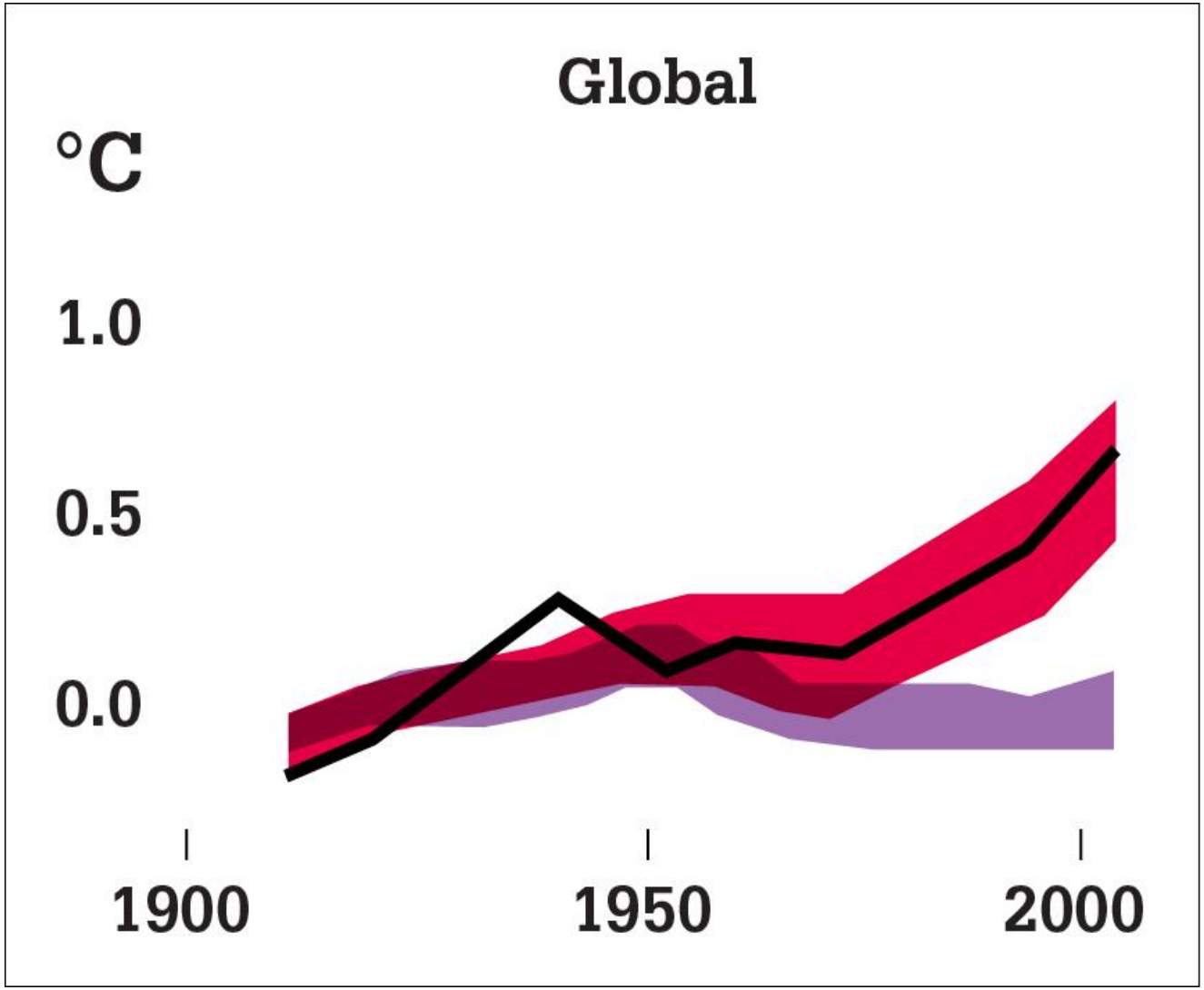
[1] With regional variation (almost all glaciers worldwide losing mass but some gaining) but overall net loss.

[2] With regional variation (large loss in the Arctic, small net gain in the Antarctic) but overall net loss.

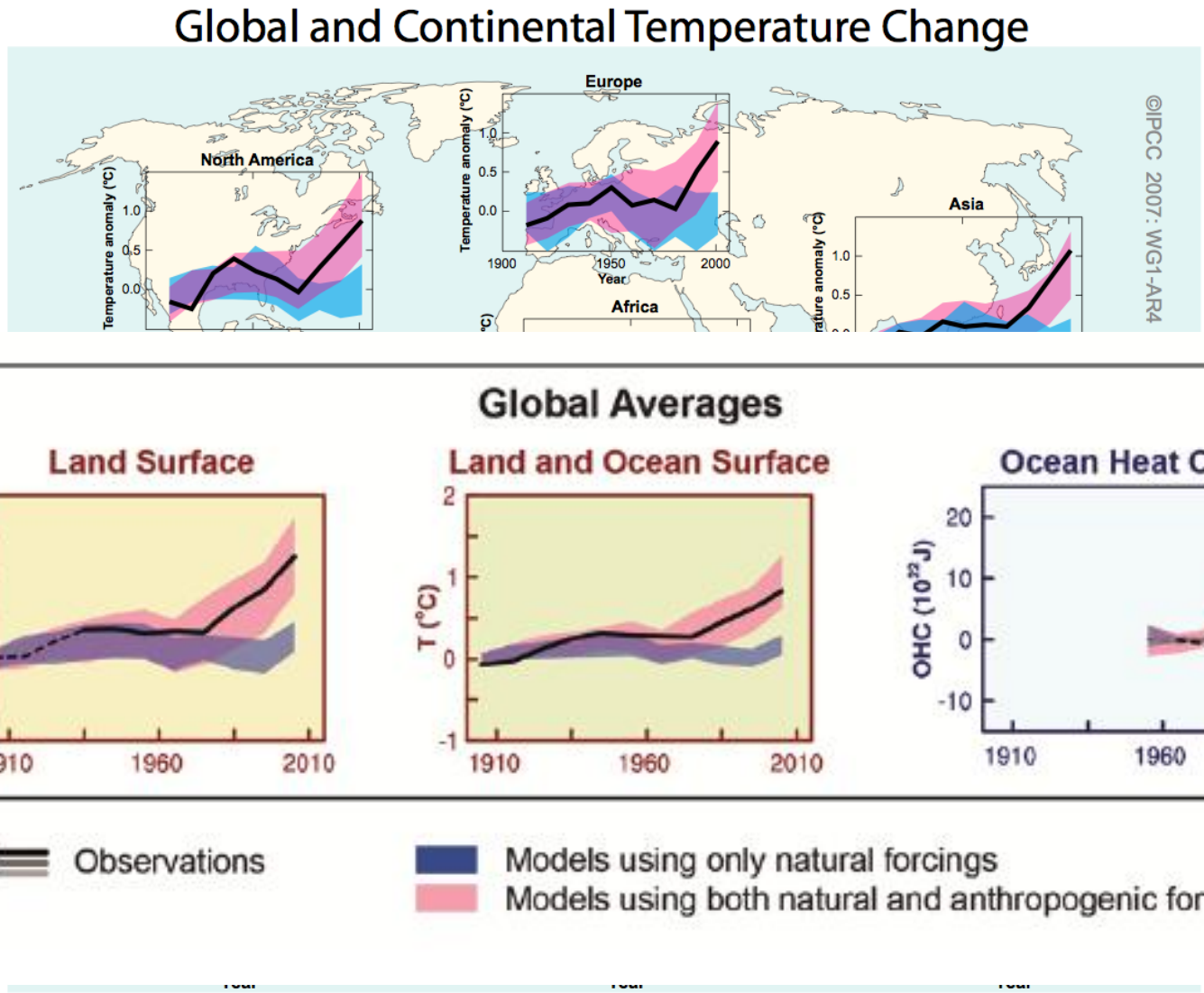
Enhanced Greenhouse Effect



Human activities making it warmer



Warming is occurring worldwide



Summary: Causes

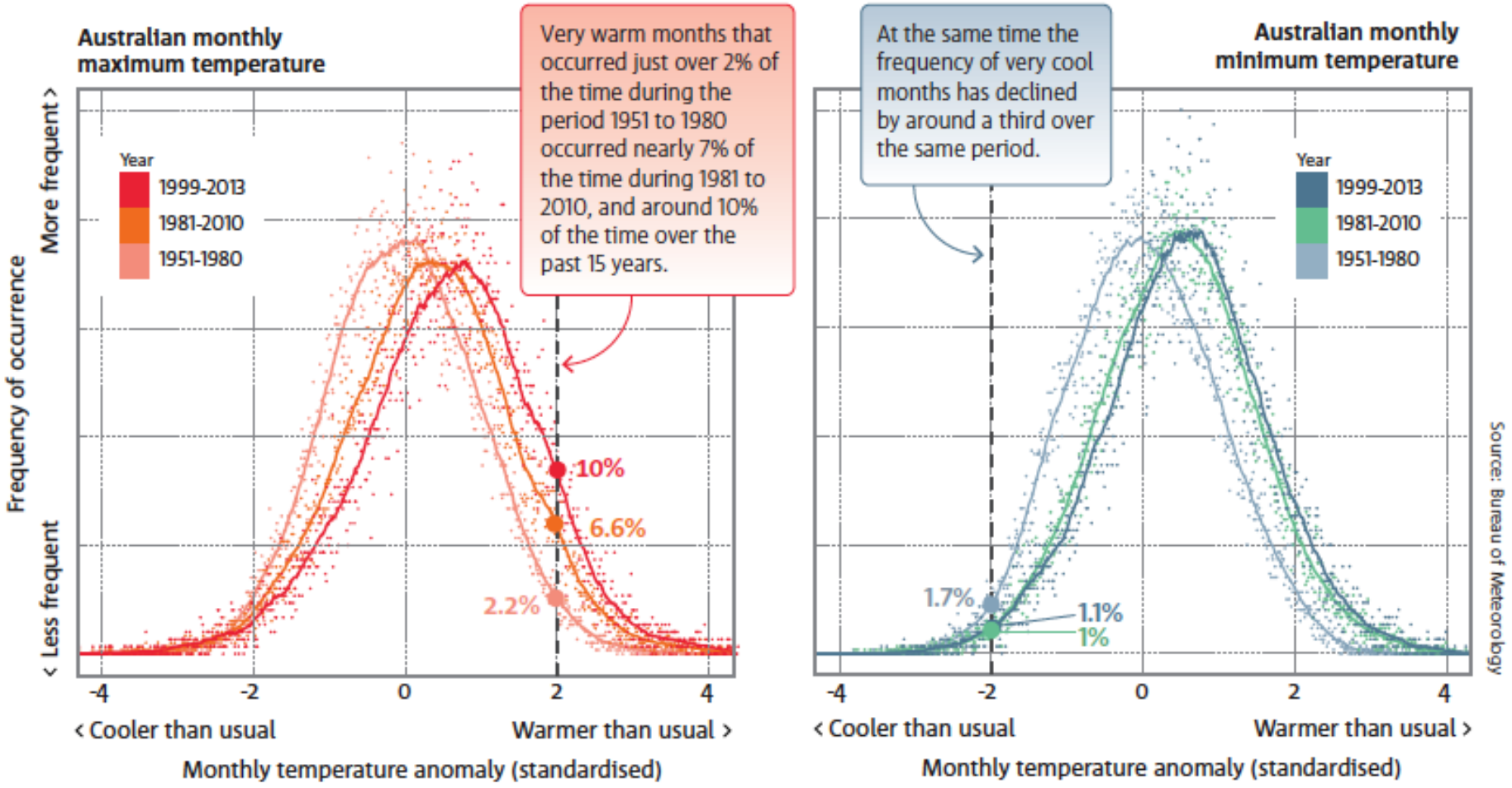
- **The total amount of energy in the climate system is increasing. The largest contribution is the increase in atmospheric concentration of CO_2 since 1750.**

- **Human influence on the climate system is clear. The primary influence is the emission of greenhouse gases most importantly, the emission of CO_2 from the burning of fossil fuels.**

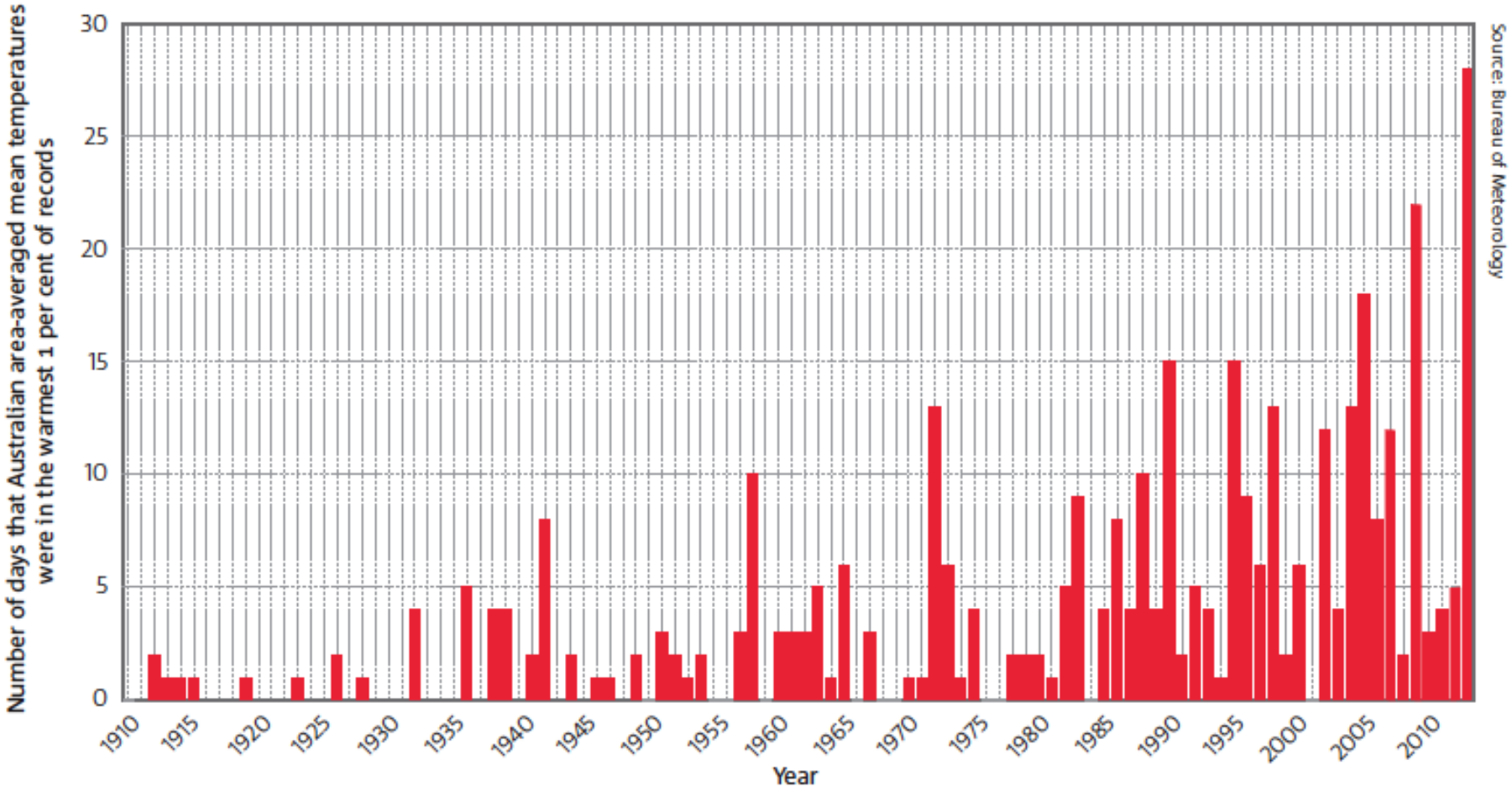
- **It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century.**

IPCC AR5 WG1 SPM

We are living in a new climate

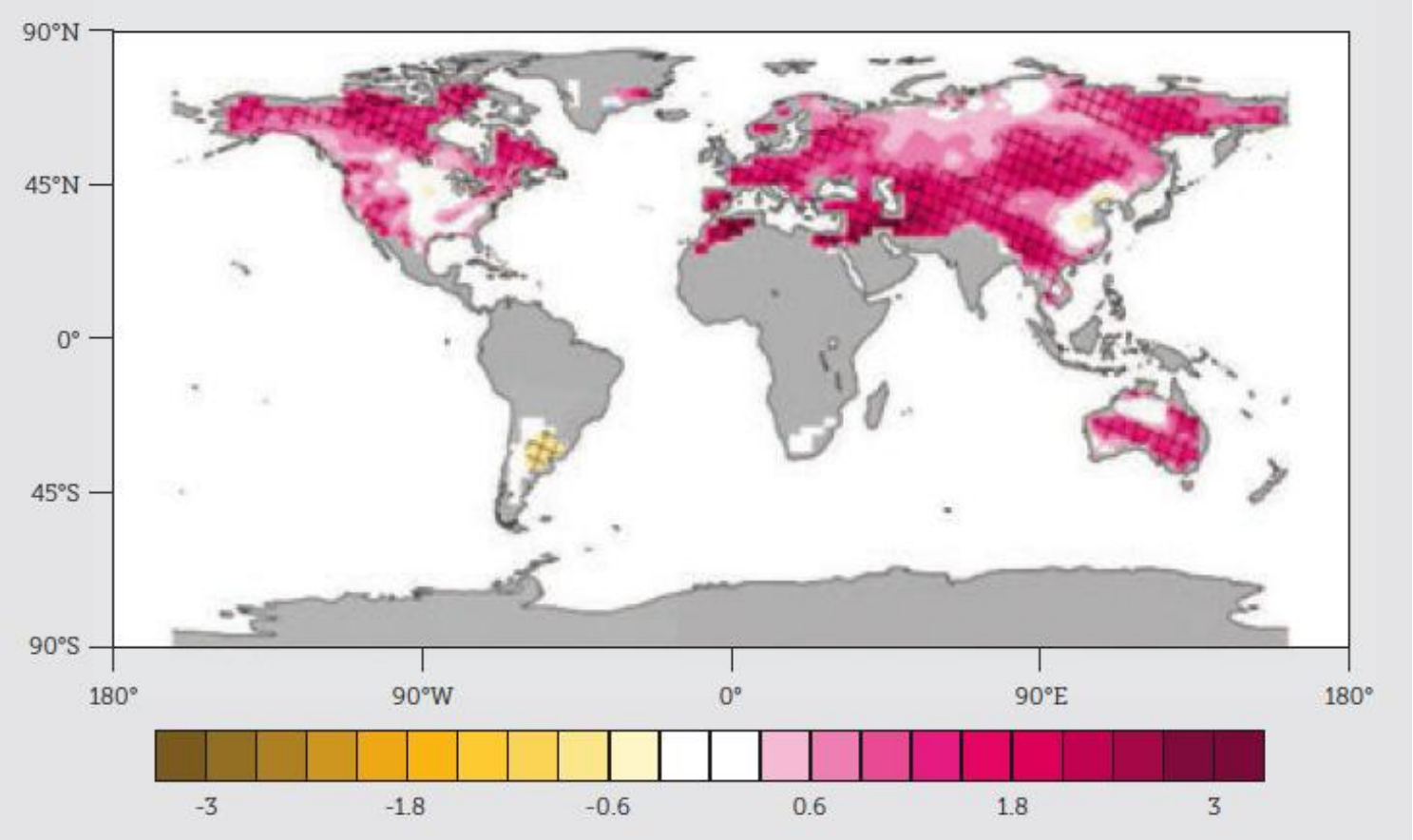


Hot weather is increasing



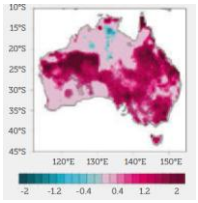
Number of days each year where the Australian area-averaged daily mean temperature is above the 99th percentile for the period 1910–2013. The data are calculated from the number of days above the climatological 99th percentile for each month and then aggregated over the year. This metric reflects the spatial extent of extreme heat across the continent and its frequency. Half of these events have occurred in the past twenty years.

Changing Australian heatwaves

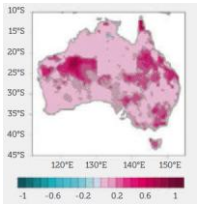


TREND IN THE NUMBER OF HEATWAVE DAYS PER DECADE

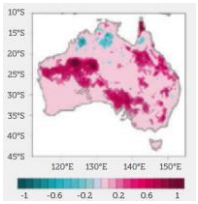
Changing Australian heatwaves



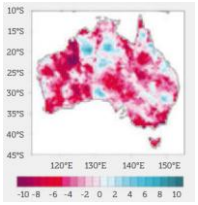
The number of heatwave days is increasing



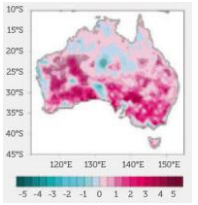
Heatwaves are occurring more frequently



The duration of the longest yearly heatwave is Increasing

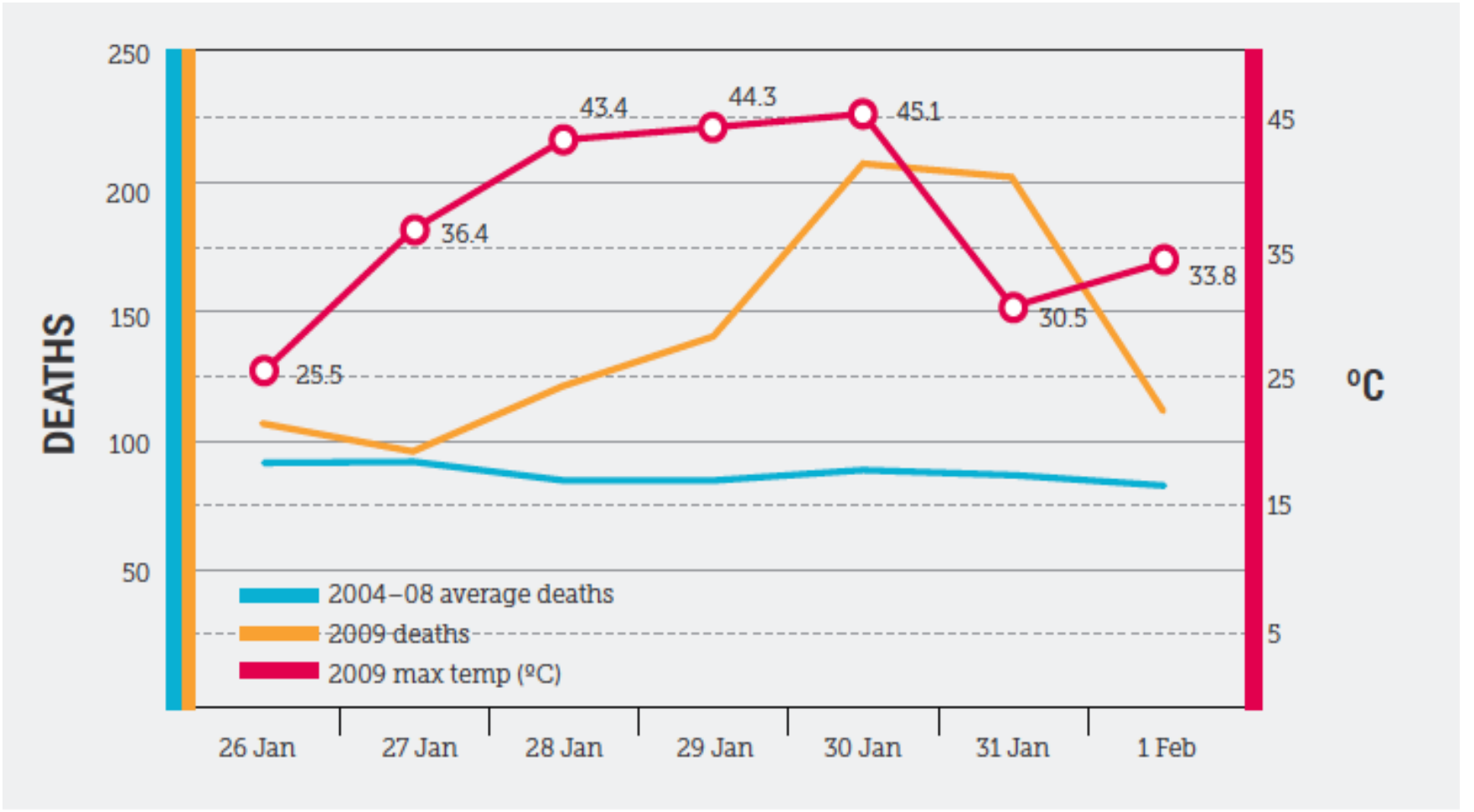


The first heatwave of the season is occurring Earlier



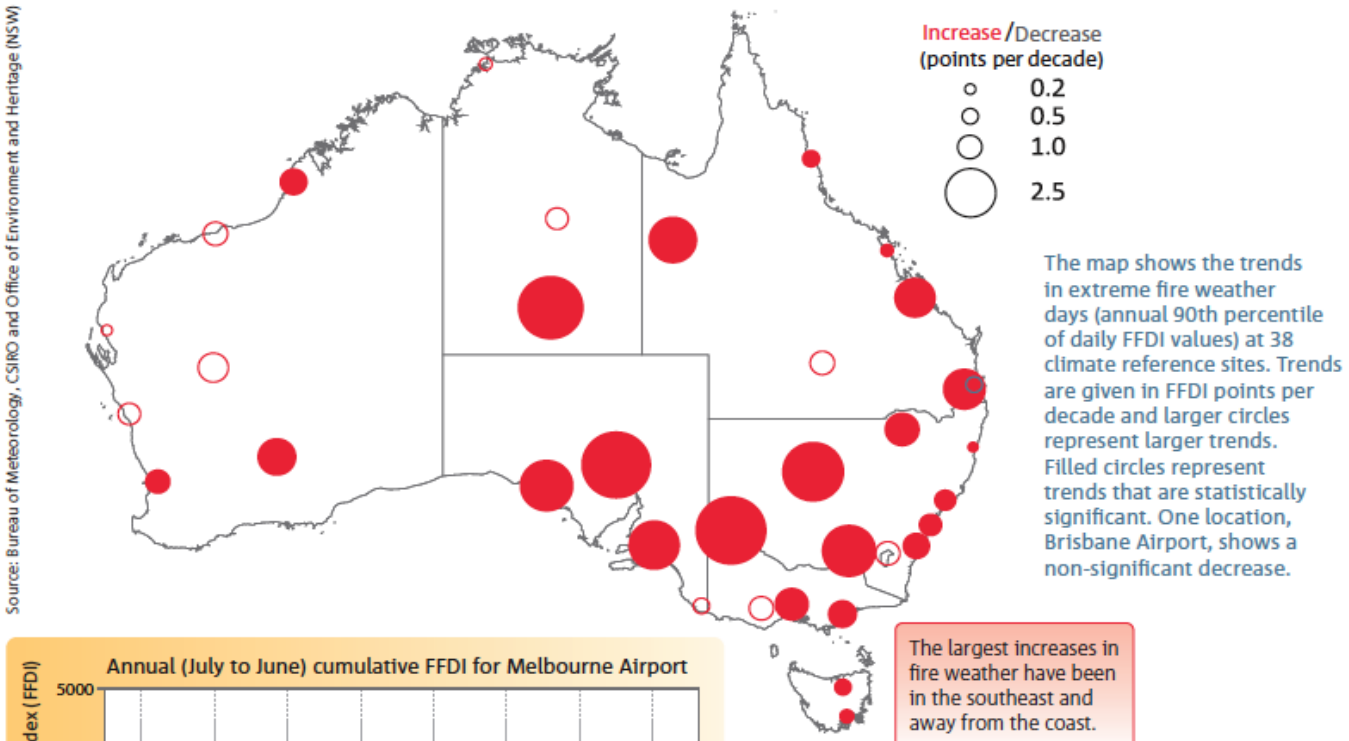
The hottest day of a heatwave is becoming hotter

Melbourne 2009 heatwave



Bushfires

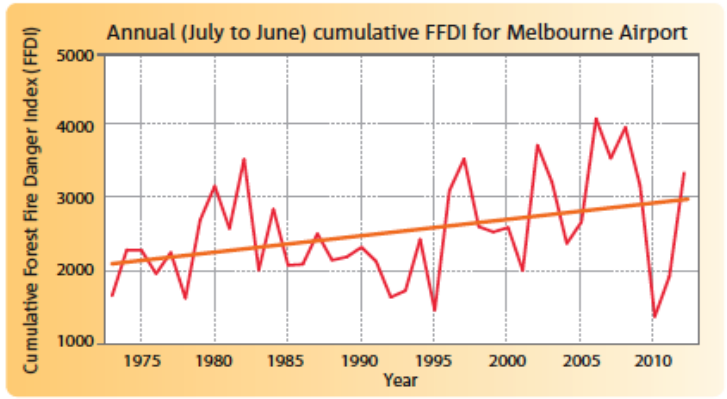
High Fire Danger Weather



Source: Bureau of Meteorology, CSIRO and Office of Environment and Heritage (NSW)

The map shows the trends in extreme fire weather days (annual 90th percentile of daily FFDI values) at 38 climate reference sites. Trends are given in FFDI points per decade and larger circles represent larger trends. Filled circles represent trends that are statistically significant. One location, Brisbane Airport, shows a non-significant decrease.

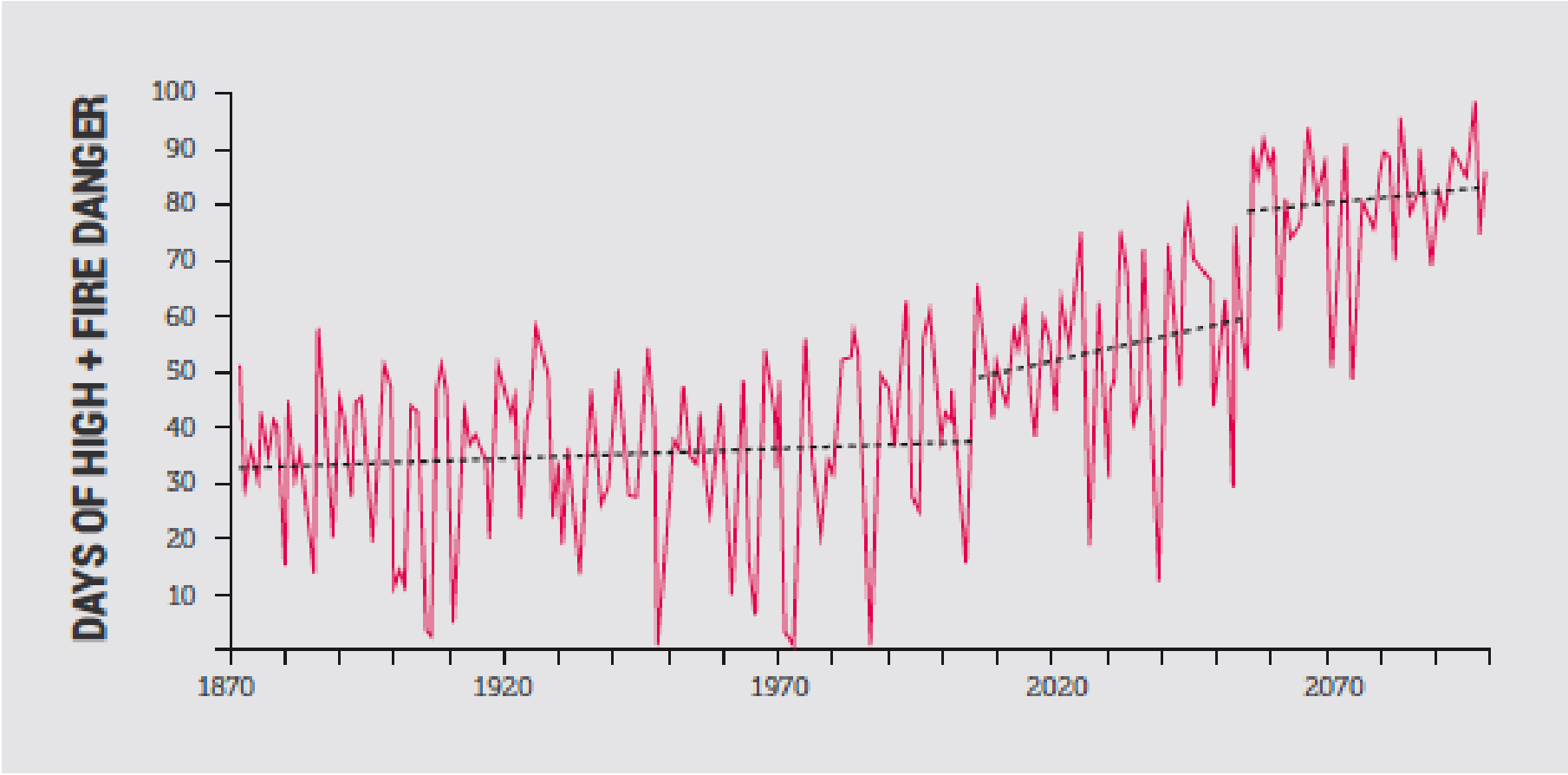
The largest increases in fire weather have been in the southeast and away from the coast.



Time series showing the increasing trend in the annual cumulative Forest Fire Danger Index (FFDI) at Melbourne Airport. A long-term trend is discernible despite significant annual variability.

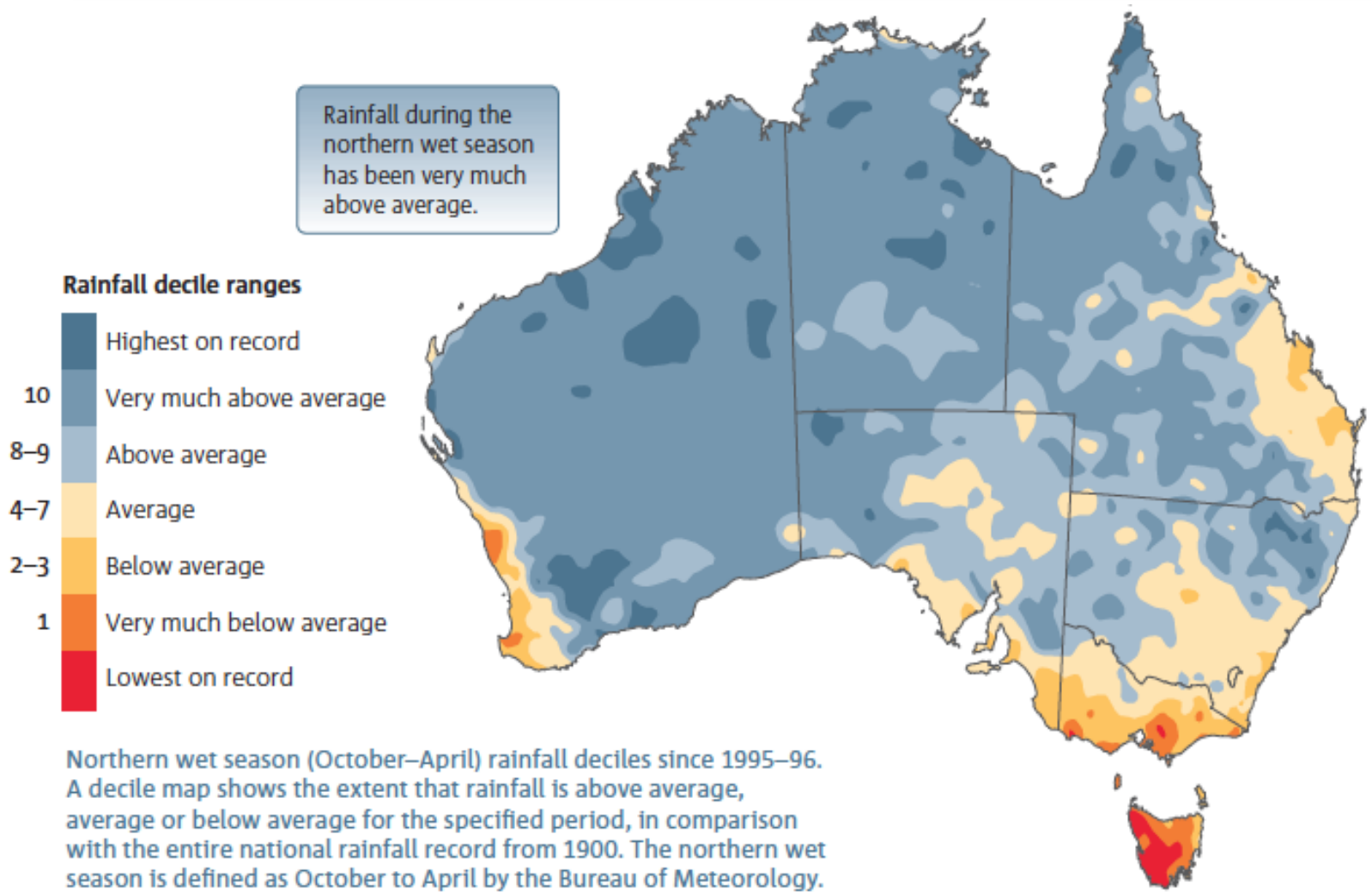
Sources: BoM and CSIRO 2014; Clark et al. 2013; Jones et al. 2013

High Fire Danger Weather



Model-based projections for high fire danger weather for Melbourne

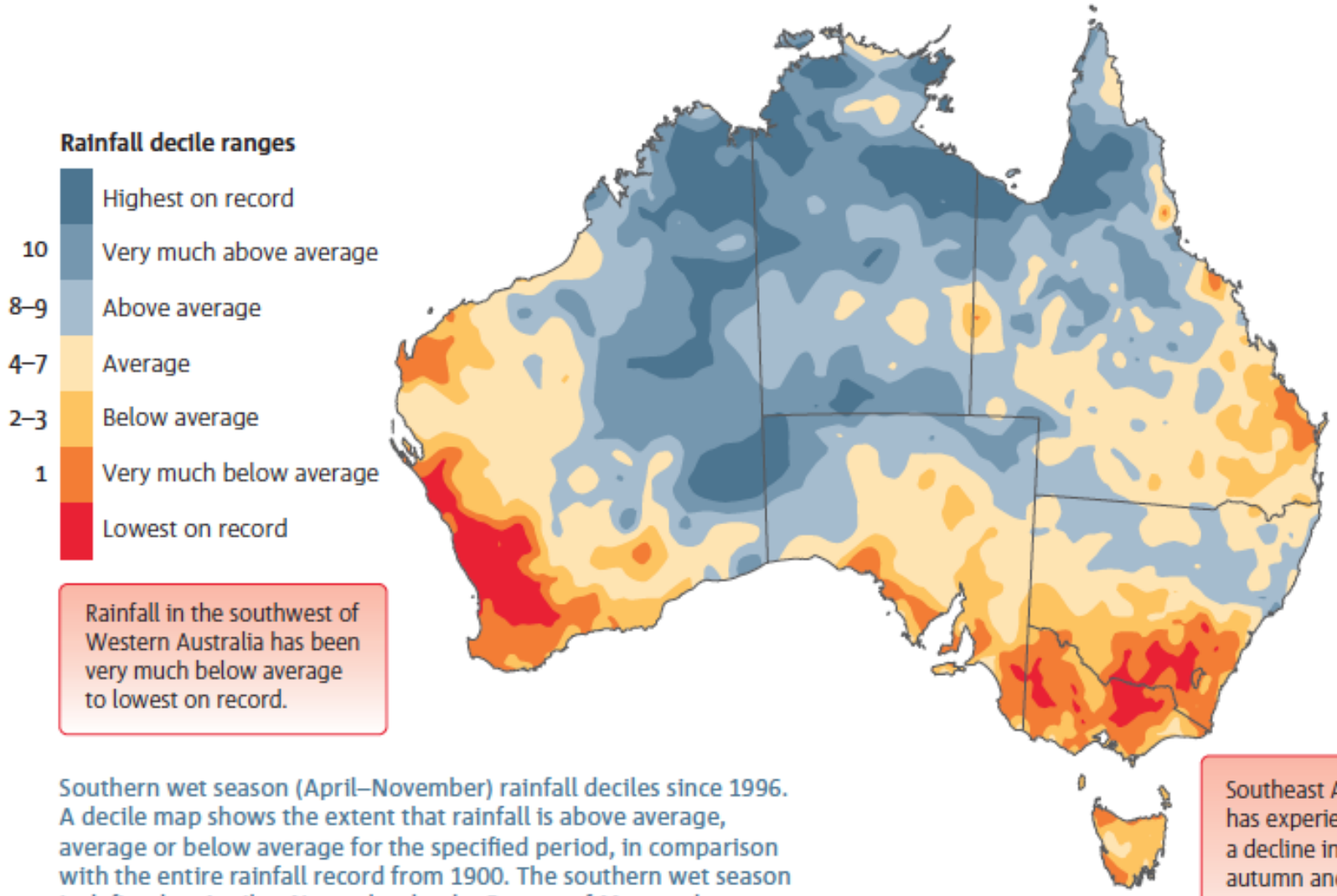
Rainfall: water resources



Northern wet season (October–April) rainfall deciles since 1995–96. A decile map shows the extent that rainfall is above average, average or below average for the specified period, in comparison with the entire national rainfall record from 1900. The northern wet season is defined as October to April by the Bureau of Meteorology.

Source: Bureau of Meteorology

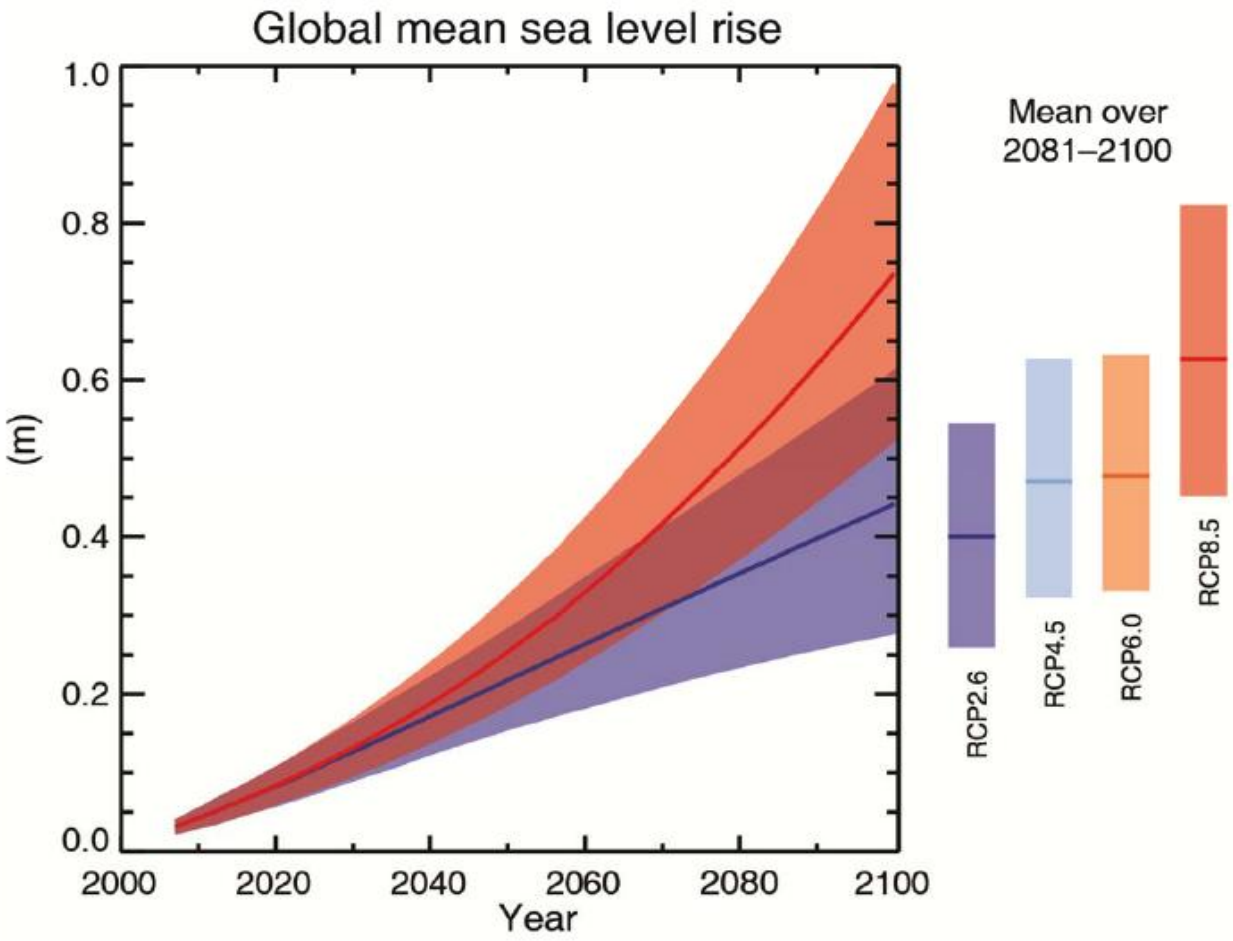
Rainfall: water resources



Southern wet season (April–November) rainfall deciles since 1996. A decile map shows the extent that rainfall is above average, average or below average for the specified period, in comparison with the entire rainfall record from 1900. The southern wet season is defined as April to November by the Bureau of Meteorology.

Source: Bureau of Meteorology

Sea-level rise projections



There is high confidence that sustained warming greater than some threshold (likely between 1 and 4°C) would lead to the near-complete loss of the Greenland ice sheet over a millennium or more, causing a global mean sea-level rise of up to 7 m.

Polar ice sheets and sea-level rise

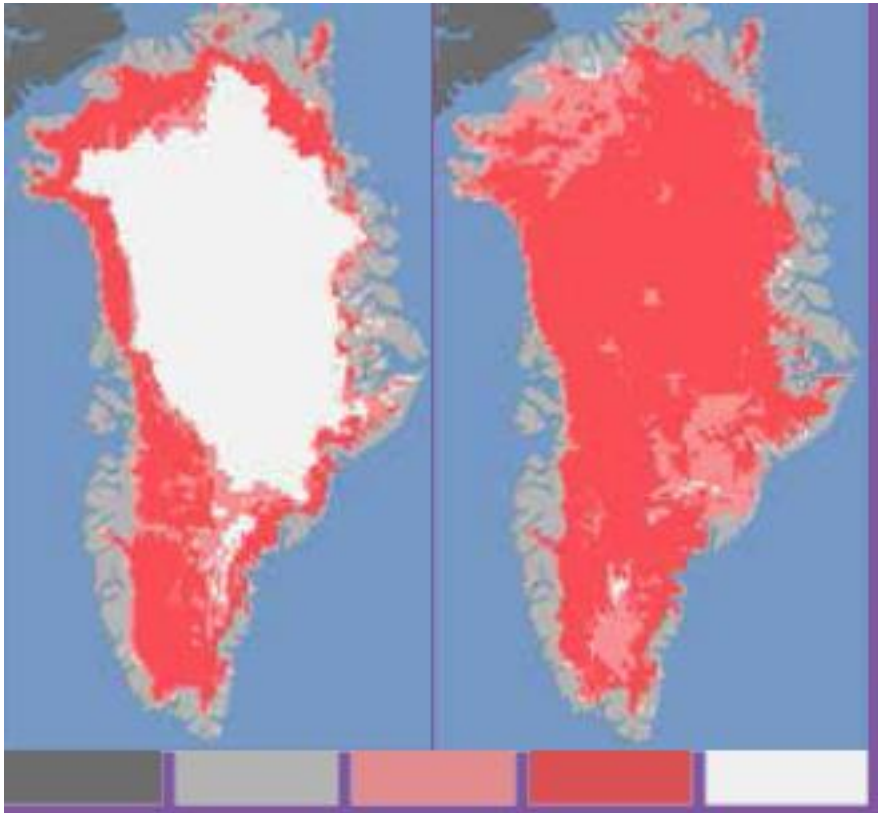


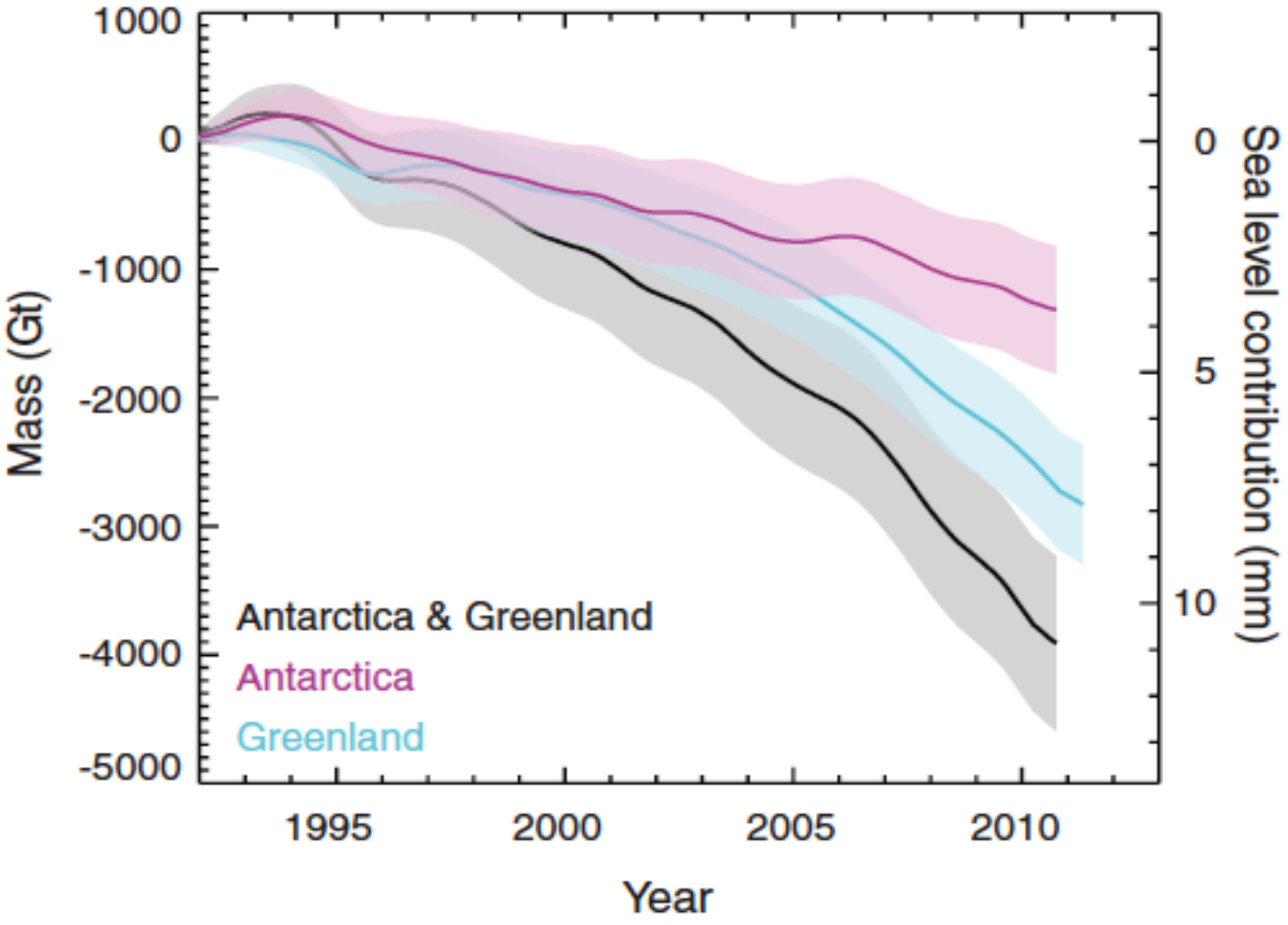
Figure 33: NASA satellite image of the extent of surface melt over Greenland's ice sheet on 8 July (left) 2012 and 12 July 2012 (right)

Source: NASA, 2012

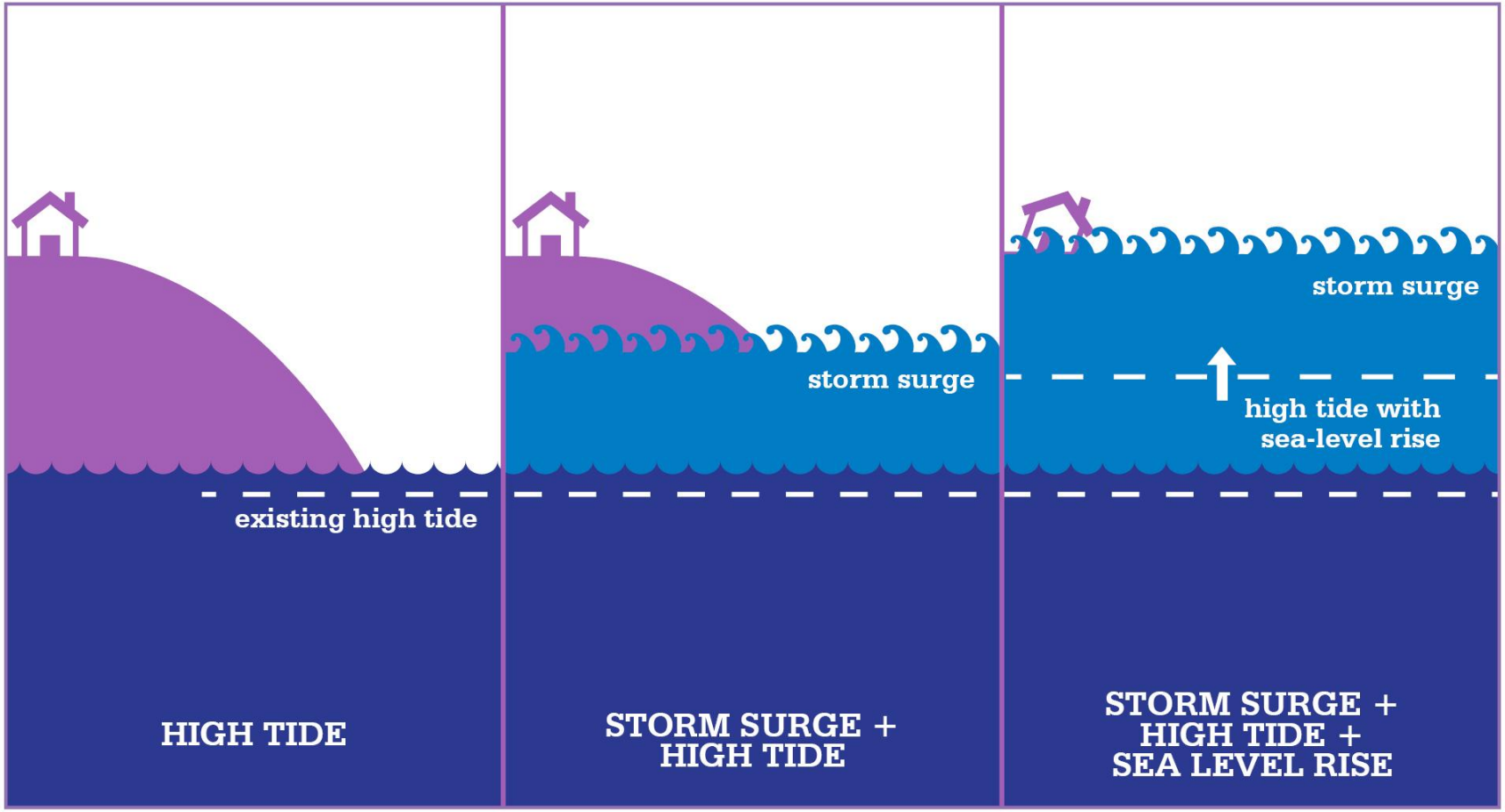
Figure 34: Ice sheets often lose their mass by calving. Ice calving is a sudden breaking away of a mass of ice from the edge of the ice sheet and its loss to the sea. Ice calving in Ausfonna, Norway pictured.

Source: Flickr/Yukon White Light

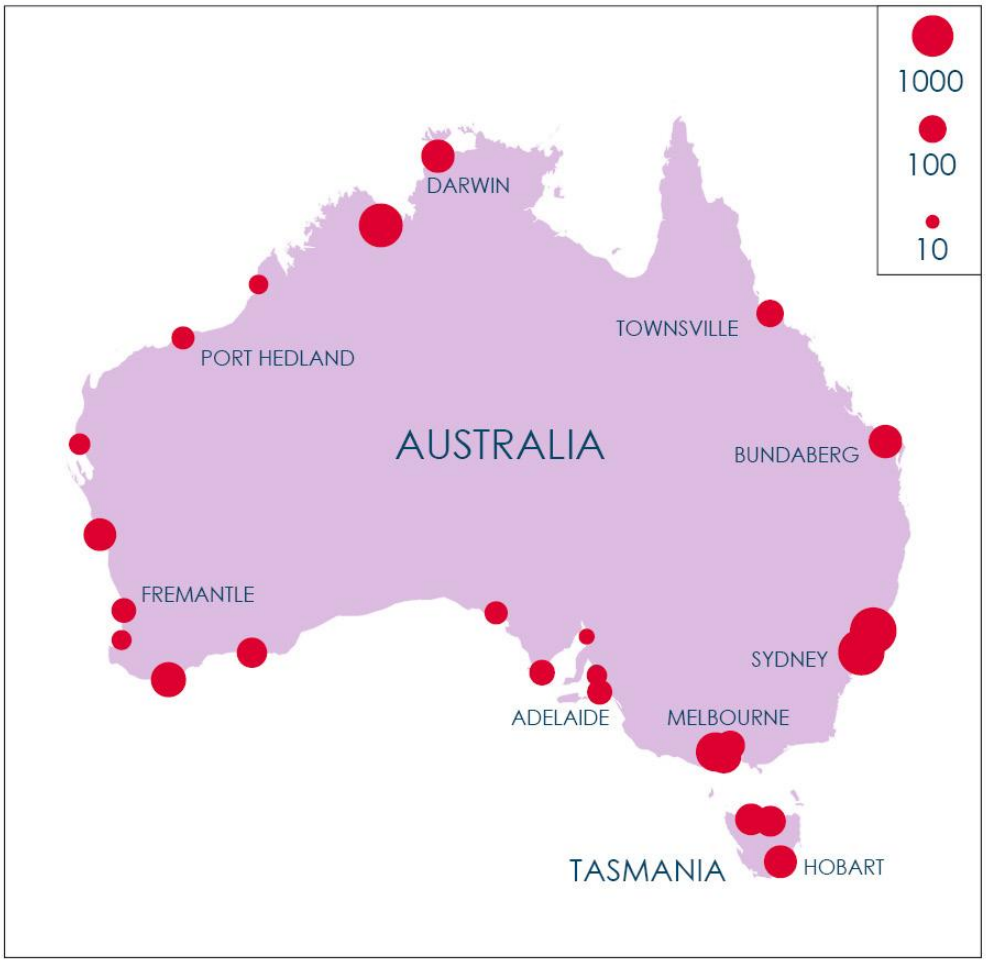
Polar ice sheets and sea-level rise



Influence of sea-level on coastal flooding



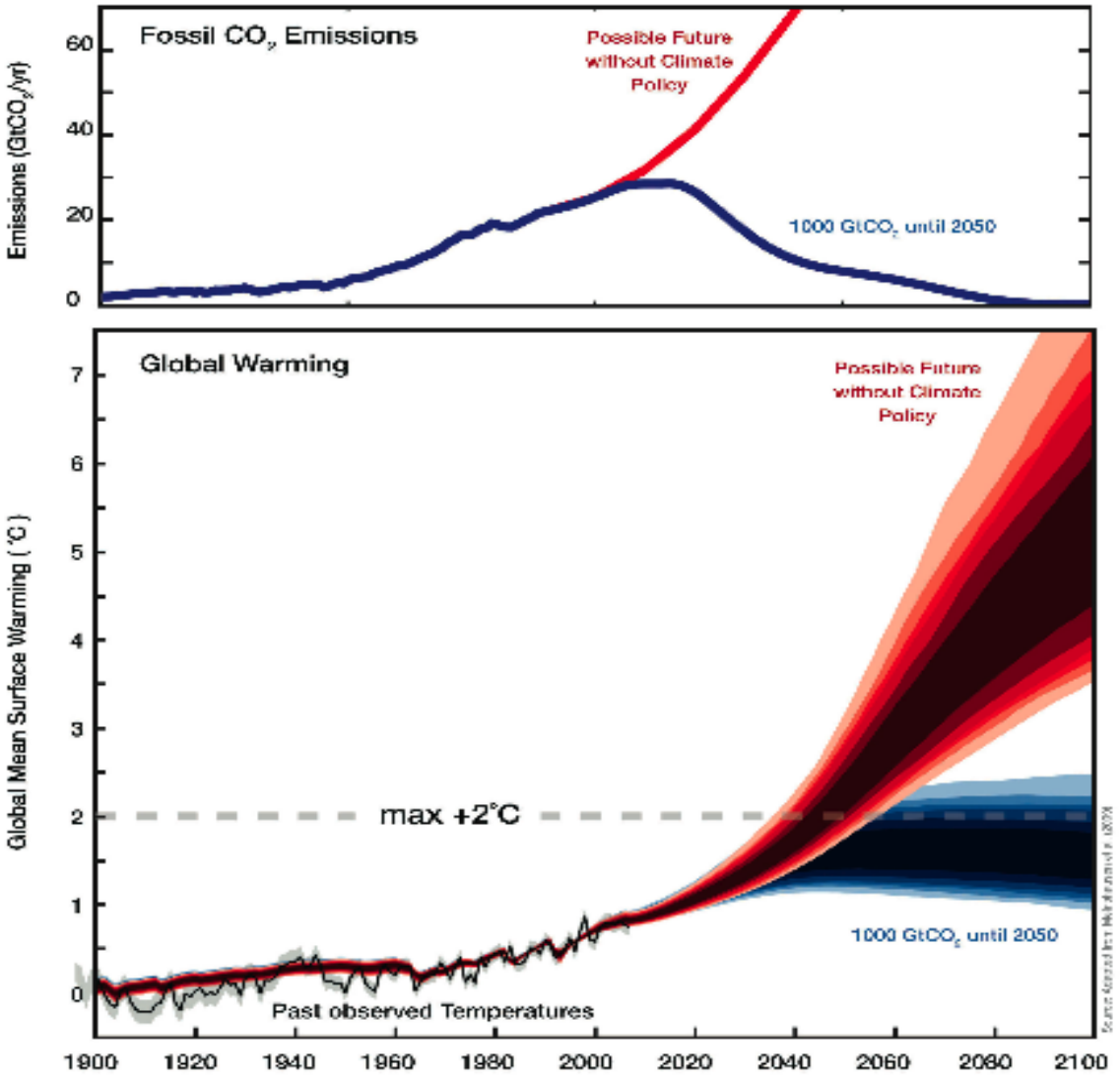
Increased risk of coastal flooding with sea-level rise of 0.5m



Source: Hunter, 2012

www.climatecommission.gov.au

What does a destabilising climate mean?



Meinshausen et al. 2009

Overspend in the carbon budget

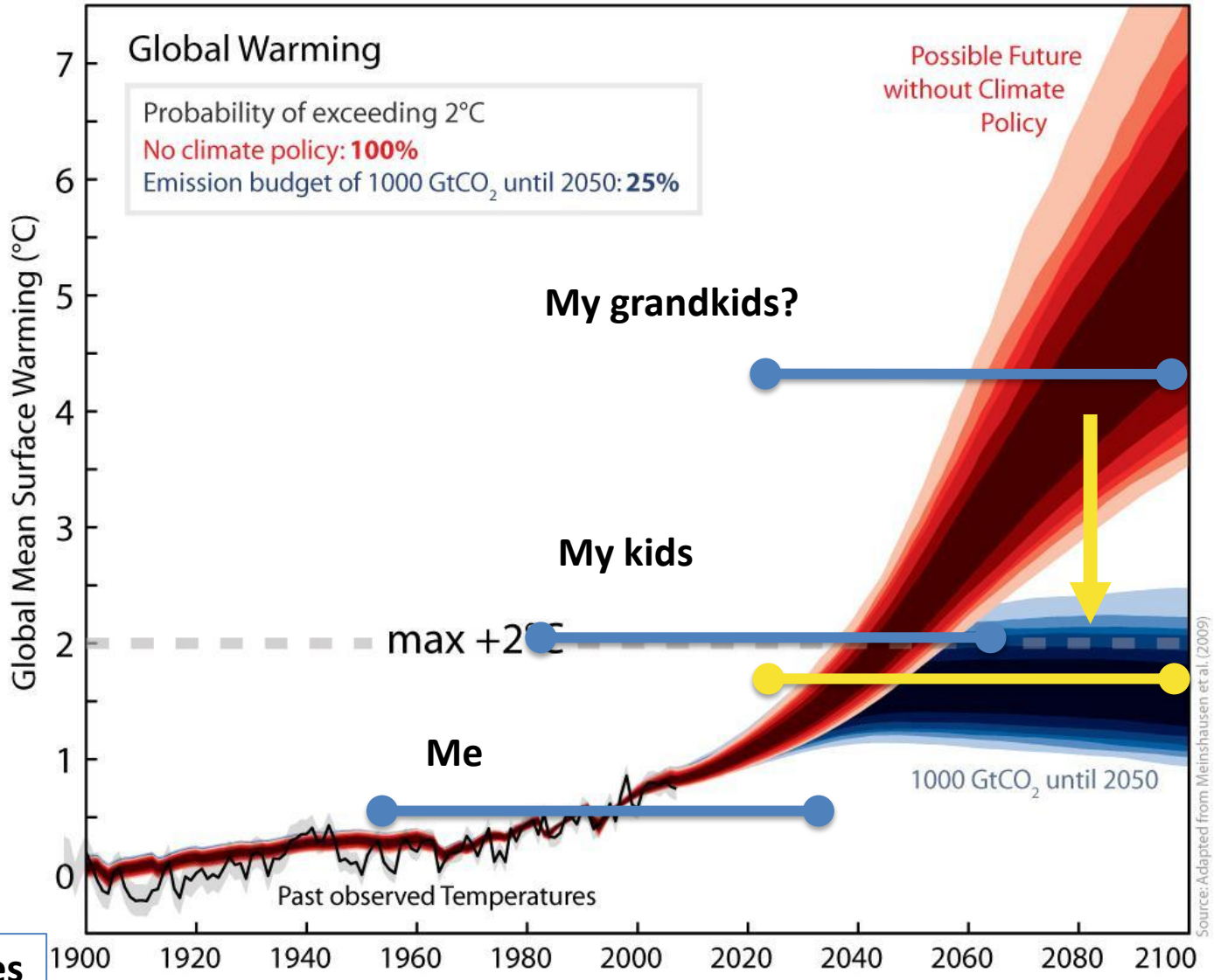
The fossil fuel equation

- The remaining global budget for CO_2 emissions from fossil fuel combustion is about 600 billion tonnes if we are to stay within the 2^{o}C limit.

- The world's indicated fossil fuel reserves (coal, oil and gas), if all were burnt, would emit nearly 3,000 billion tonnes of CO_2 (IEA, 2012).

- This means that we can burn only about 20% of the world's known fossil fuel reserves. Most will have to stay in the ground.

This is the critical decade for action



Prof Lesley Hughes

Key Messages

- **Warming of the climate system is unequivocal, especially since the 1950s. The atmosphere and ocean have warmed, snow and ice have diminished, and sea level has risen.**

- **We are more certain than ever that the warming since 1950 has been caused primarily by human activities.**

- **A destabilising climate poses great risks for Australia. These include extreme heat, sea-level rise, heavy rainfall events and increasing bushfire risk.**

- **To stabilise the climate, the world must move rapidly away from fossil fuels.**

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