

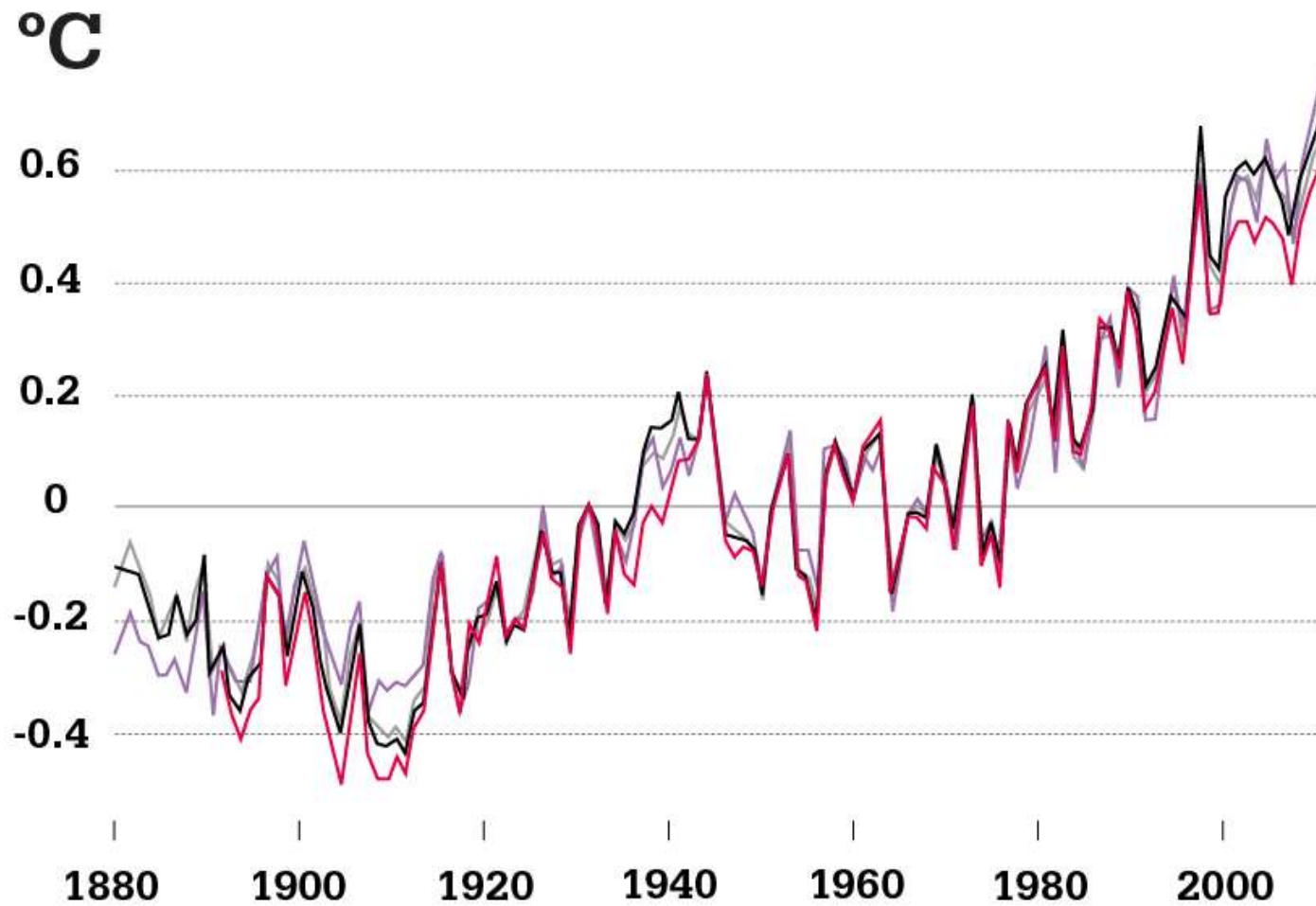


# **The Critical Decade 2013**

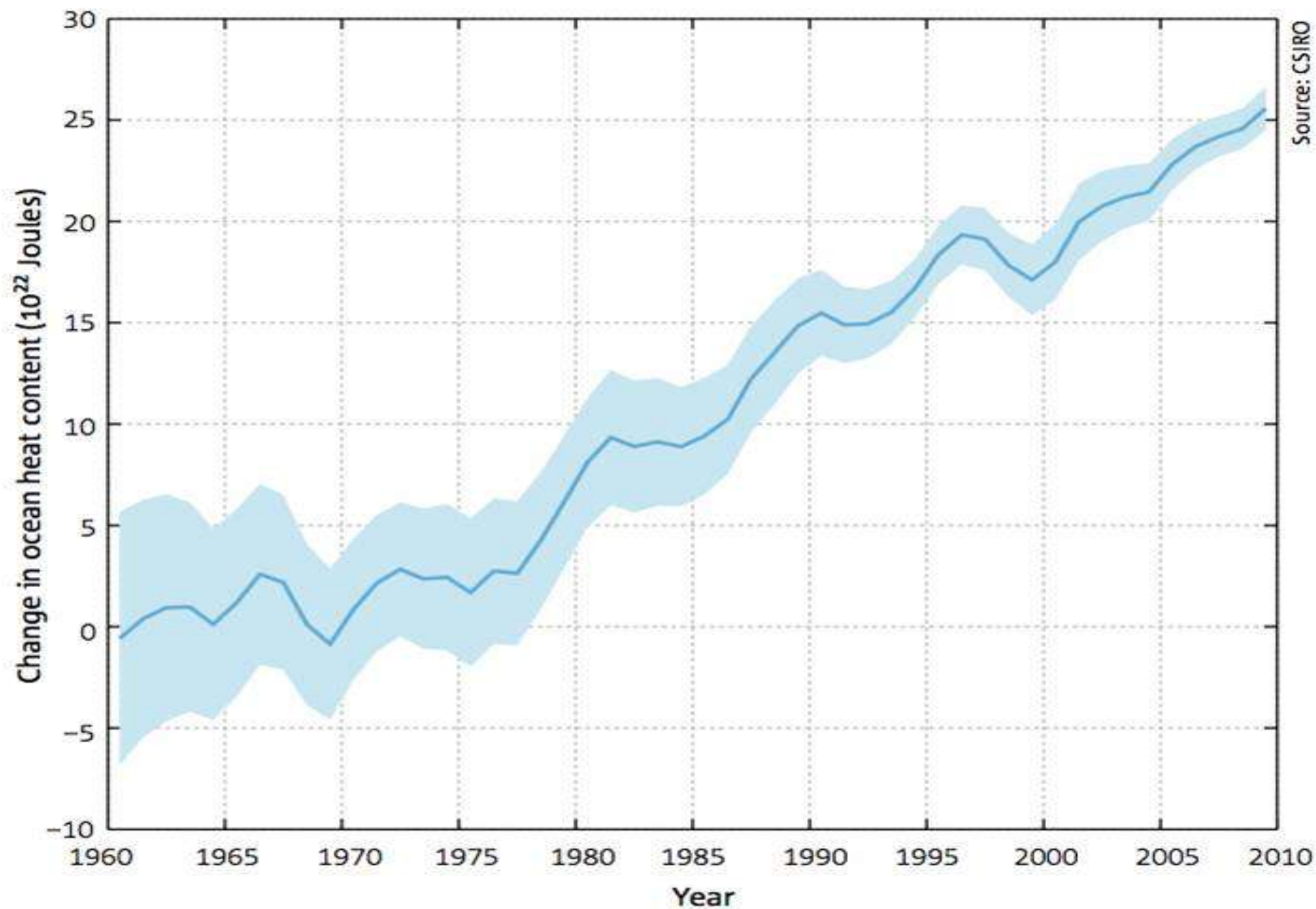
## **Climate change risks and responses**

**Professor Will Steffen**

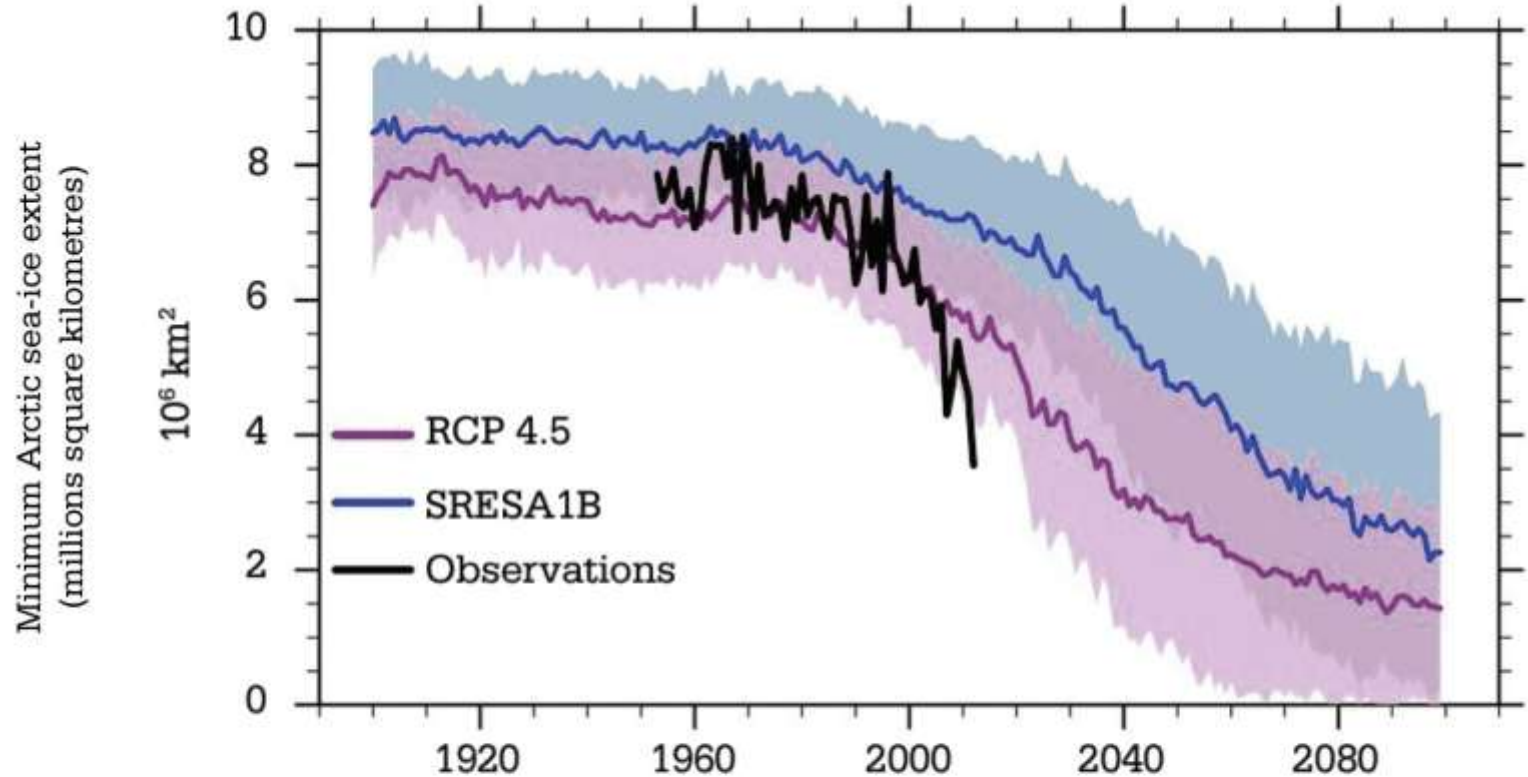
# The atmosphere is warming



# The ocean is warming

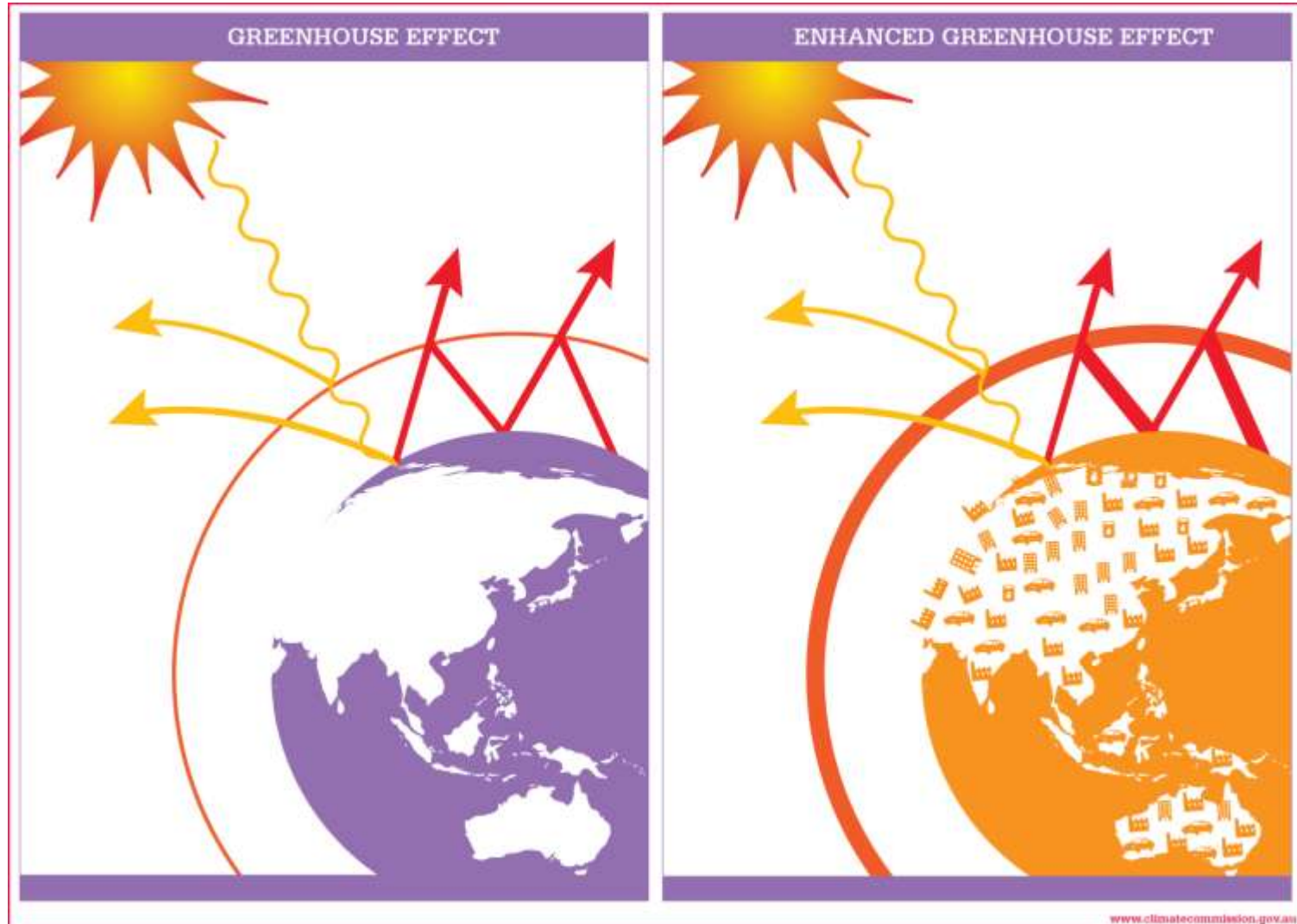


# Changes faster than predicted

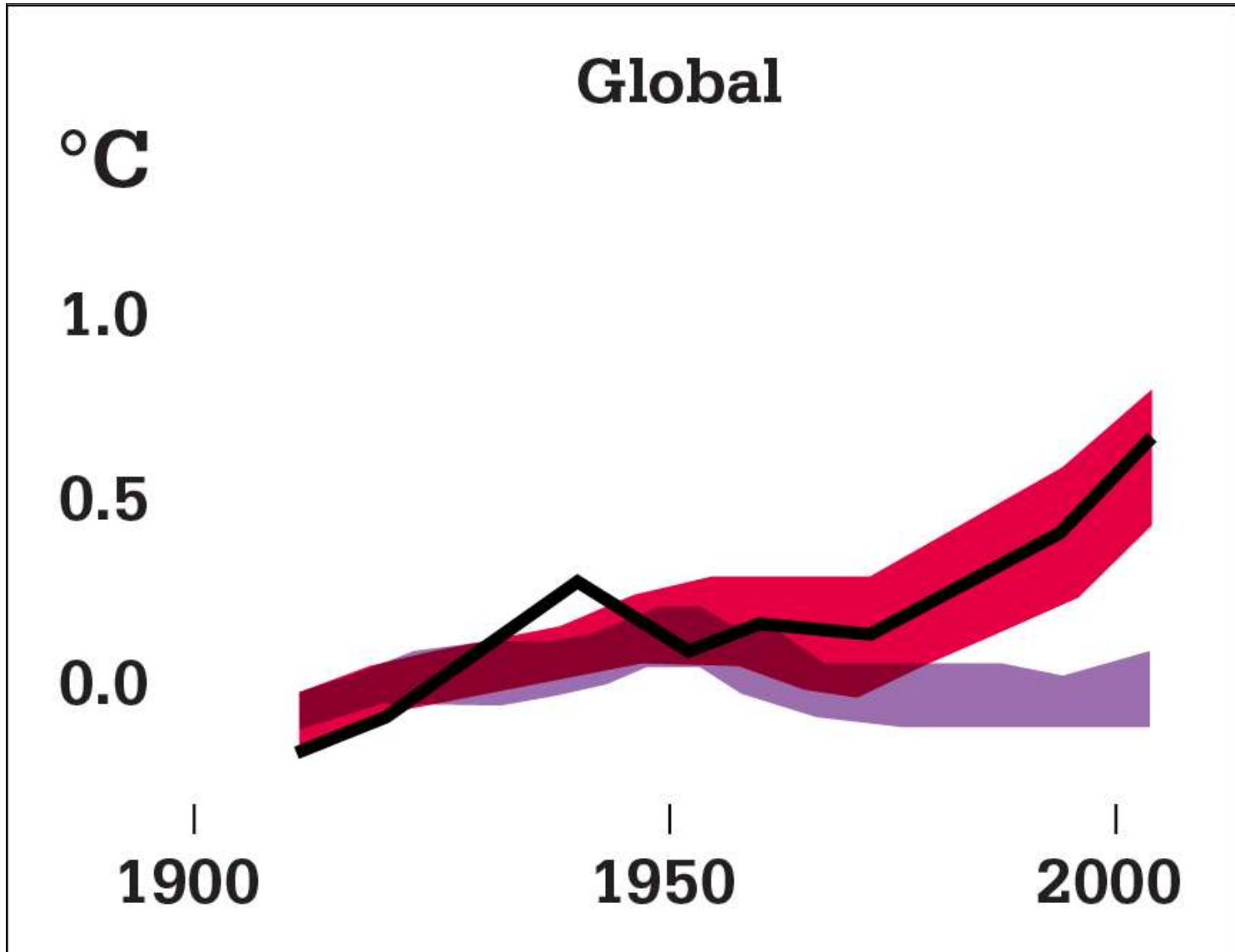


**Source:** Stroeve et al. (2012) updated to include observations to 2012

# Enhanced Greenhouse Effect



# Human activities making it warmer



# Extreme weather and climate change



Extreme weather has always occurred. But due to additional **greenhouse gases** in the atmosphere, the **climate system** now contains significantly **more heat** compared to 50 years ago.

This means that **all extreme weather events** are **influenced** by **climate change**.

The **severity** and **frequency** of many **extreme weather events** are increasing due to **climate change**.



**Heatwaves** have become longer and hotter. The number of record hot days in Australia has doubled since the 1990s. Australians will face **extreme heatwaves** and **hot days** far more often.

A hotter, wetter global climate provides more energy for **tropical cyclones**. Cyclones are likely to become **more intense** but less frequent.



**Heavy rainfall** events are increasing. Record sea surface temperatures fuelled recent very heavy rainfall events on the east coast, with damaging flooding. Across much of Australia, when rain occurs there is a **higher risk** of heavy rainfall.



Global **sea level** has risen 0.2 m over the last century. Coastal flooding happens more often when storm surges occur at higher sea levels. Further rises in sea level will drive **major impacts** to coastal cities.



Southwest and southeast Australia have become drier. In these regions **droughts** are likely to happen even **more often**.

Drier and hotter conditions have contributed to increased **bushfire** weather risk in southeast Australia.

Continued increases in hot and dry weather will likely **increase** the frequency of **extreme fire danger** here.



Extreme events have major impacts



**environmental**  
**social**  
**economic**

How quickly and deeply we reduce greenhouse gas emissions will greatly influence the severity of extreme events our children and grandchildren experience.

Find out more: [www.climatecommission.gov.au](http://www.climatecommission.gov.au)



**CLIMATE COMMISSION**

**Sources:** Hot days and Heatwaves: CSIRO and BoM, 2012; Perkins and Alexander, 2013; Alexander and Arblaster, 2009. Cyclones: Emanuel, 2000; Wing et al., 2007. Rainfall: Donat et al., 2013a; IPCC, 2012. Bushfire: Lucas et al., 2007; Clarke et al., 2011. Drought: BoM, 2013a; IPCC, 2012. Sea Level: Church and White, 2011; Church et al., 2006; Hunter, 2012.

Full references available in **The Critical Decade: Extreme Weather** [www.climatecommission.gov.au/report/extreme-weather](http://www.climatecommission.gov.au/report/extreme-weather)

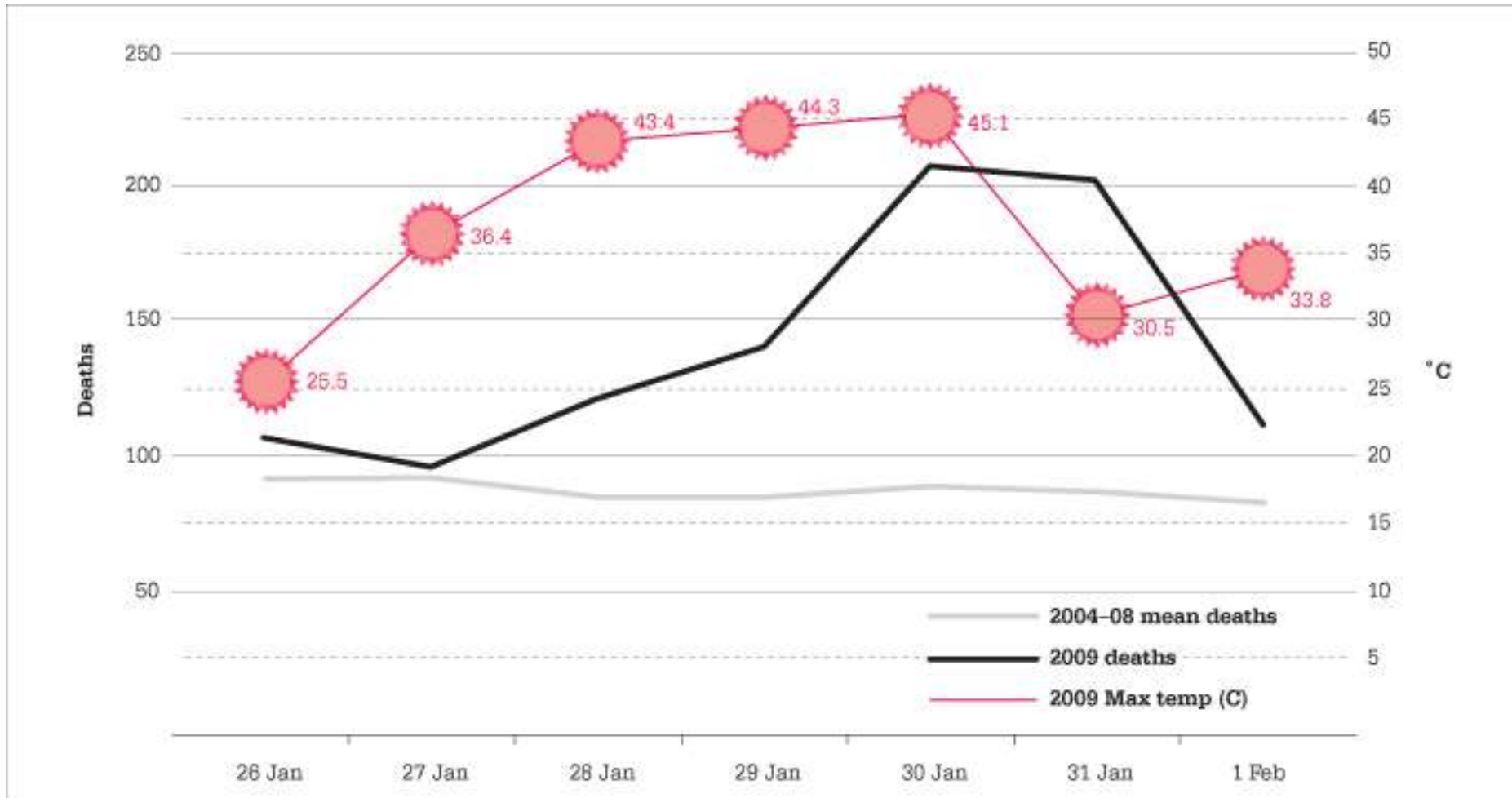
# The Angry Summer – heatwaves



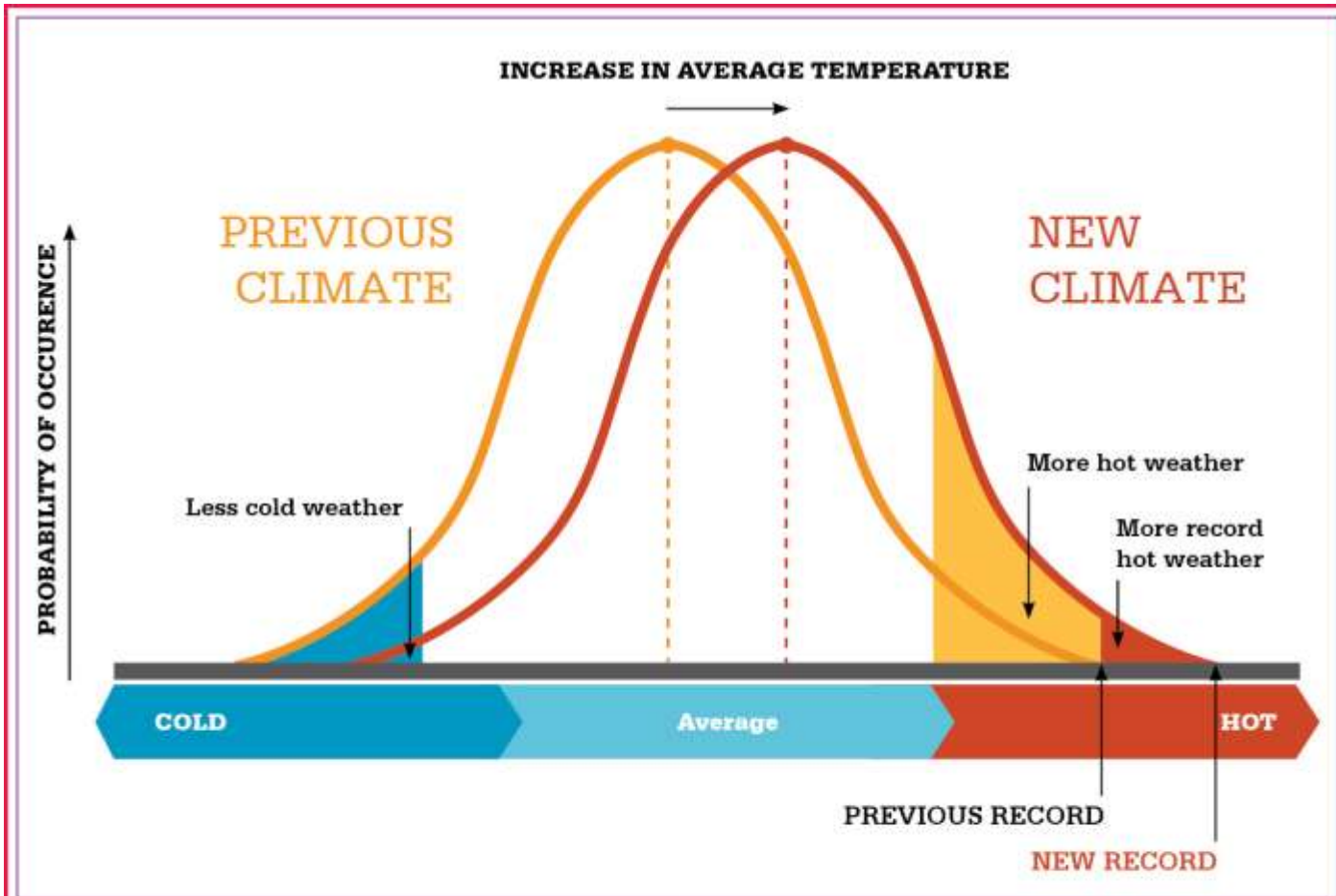
- Severe heatwave across 70% of Australia late Dec 2012 /early Jan 2013. Temperature records set in every state and territory
- Hottest ever area-averaged Australian maximum temperature, 7 January 2013: 40.30 C
- Hottest month on record for Australia – January 2013
- All-time high maximum temperatures at 44 weather stations
- Average daily maximum temperature for the whole of Australia was over 39 C for seven consecutive days (2-8 January)



# Melbourne 2009 heatwave

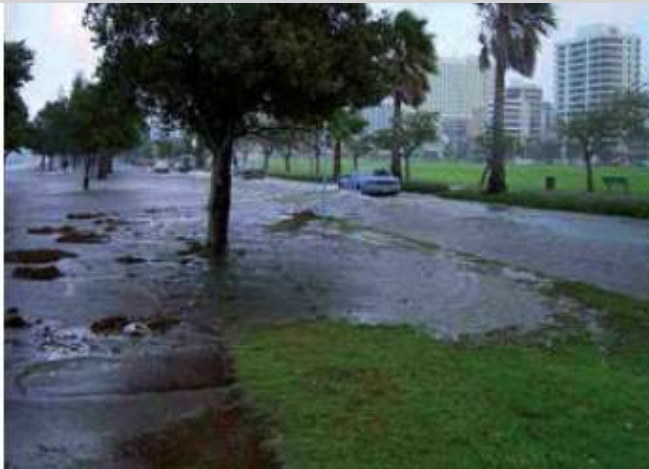


# We are living in a new climate



**Source:** Modified from IPCC, 2007

# Consequences of sea-level rise

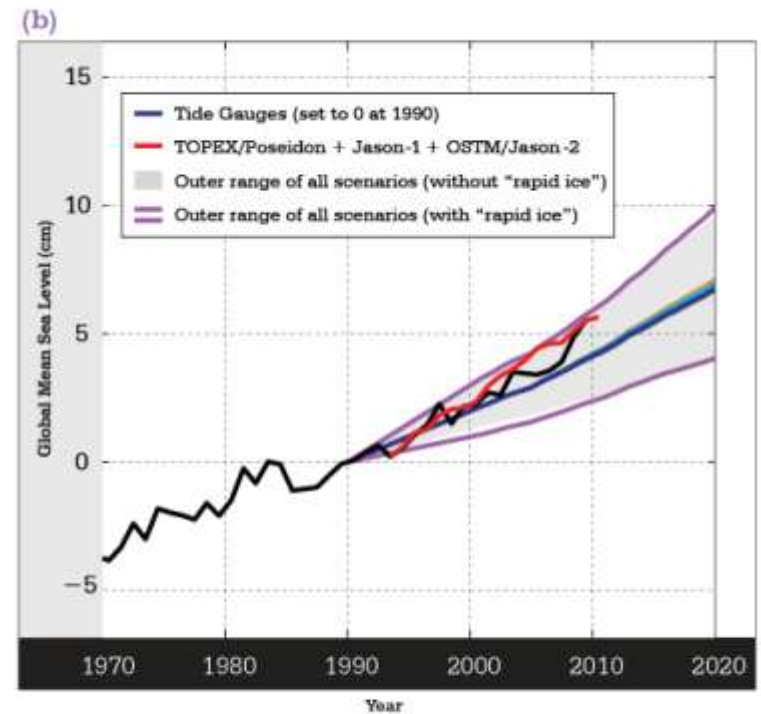
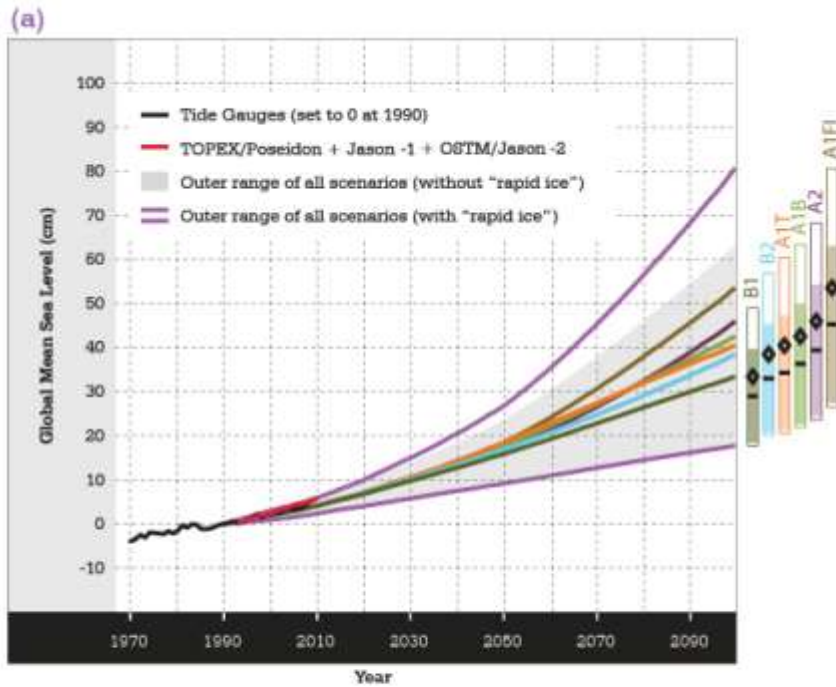


**Western Australia –  
Perth region**

**Torres Strait Islands**

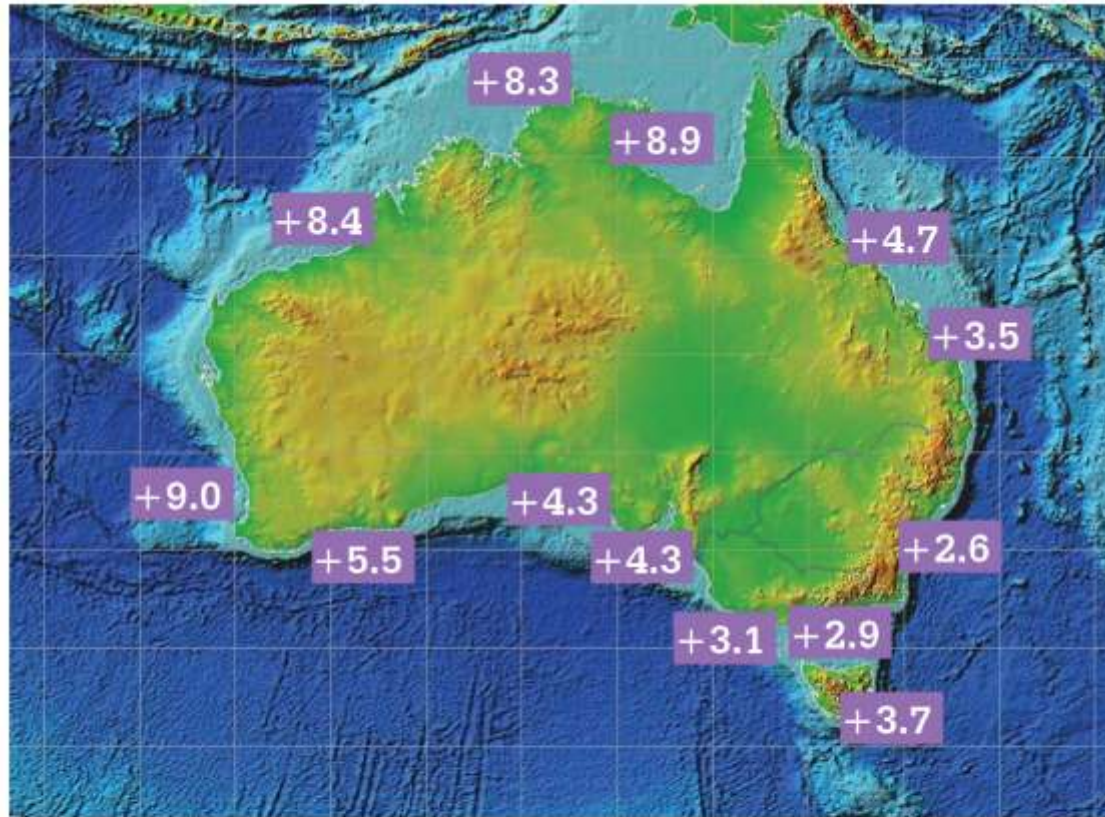


# Sea-level rise projections



Source: Church et al., 2011a

# Variation in rate of sea-level rise



Source: NTC, 2011

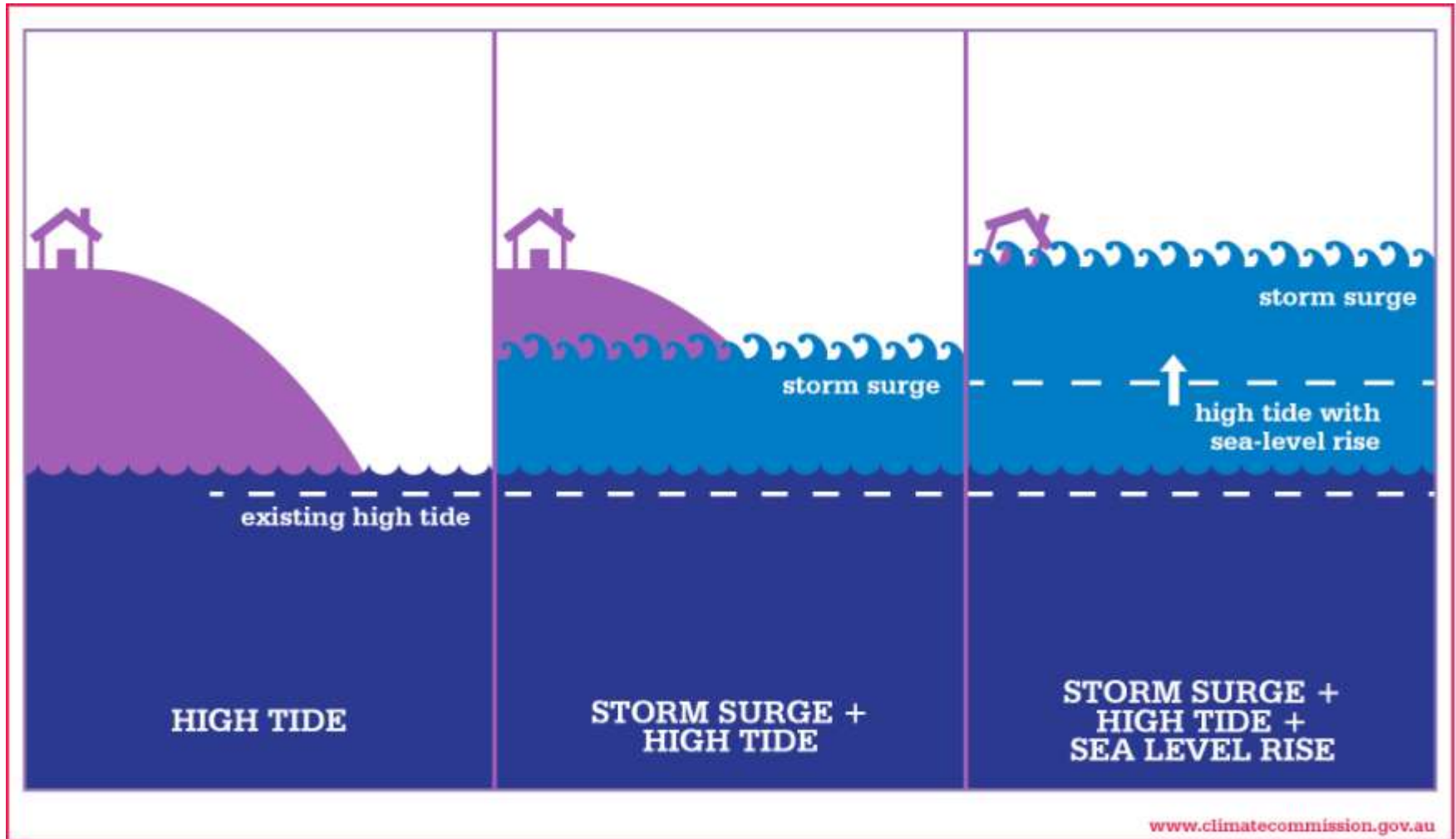
[www.climatecommission.gov.au](http://www.climatecommission.gov.au)

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



**Source:** Hunter, 2012

# Influence of sea-level on coastal flooding



# Polar ice sheets and sea-level rise

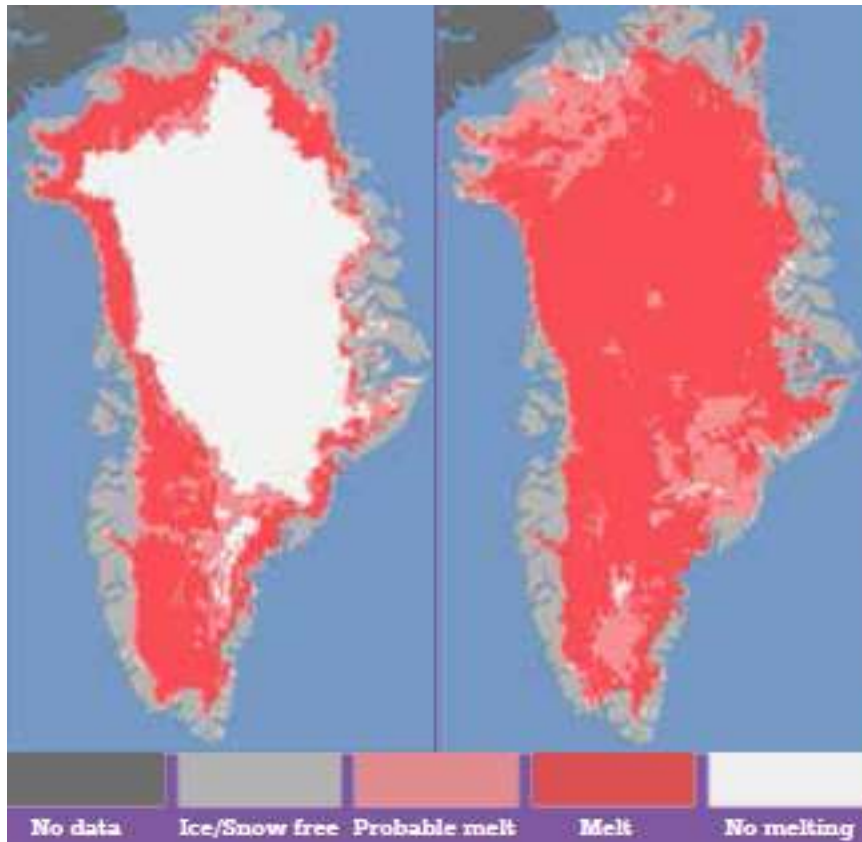
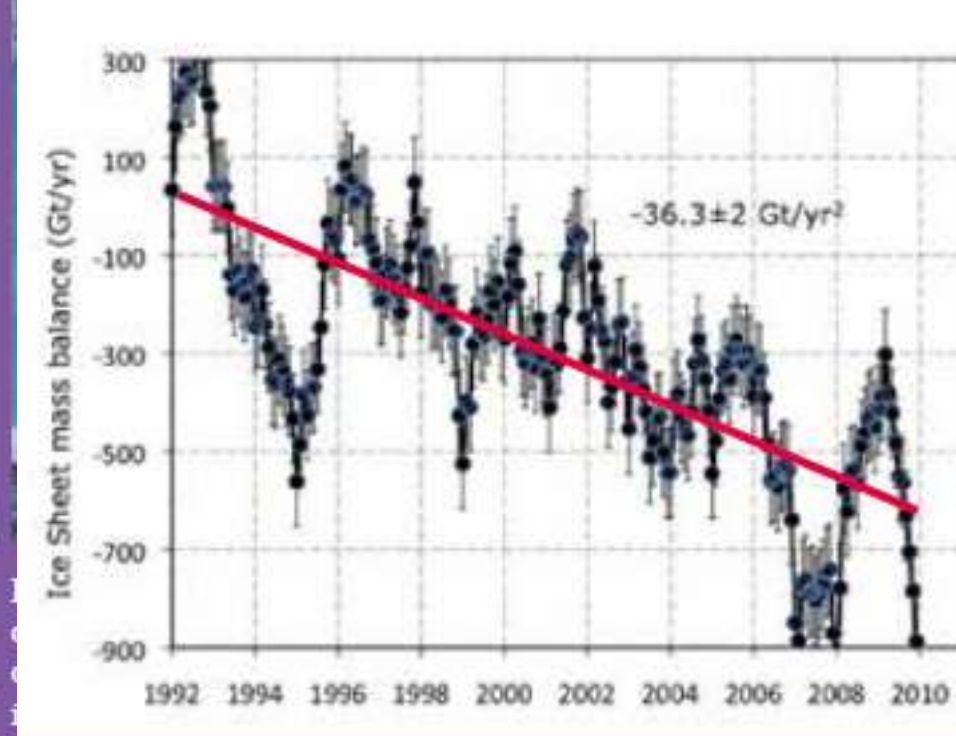


Figure 33: NASA satellite image of the extent of surface melt over Greenland's ice sheet on 8 July (left) 2012 and 12 July 2012 (right)

Source: NASA, 2012



Norway pictured.

Rignot et al. 2011

Source: Flickr/Yukon White Light



# Heavy rainfall and flooding

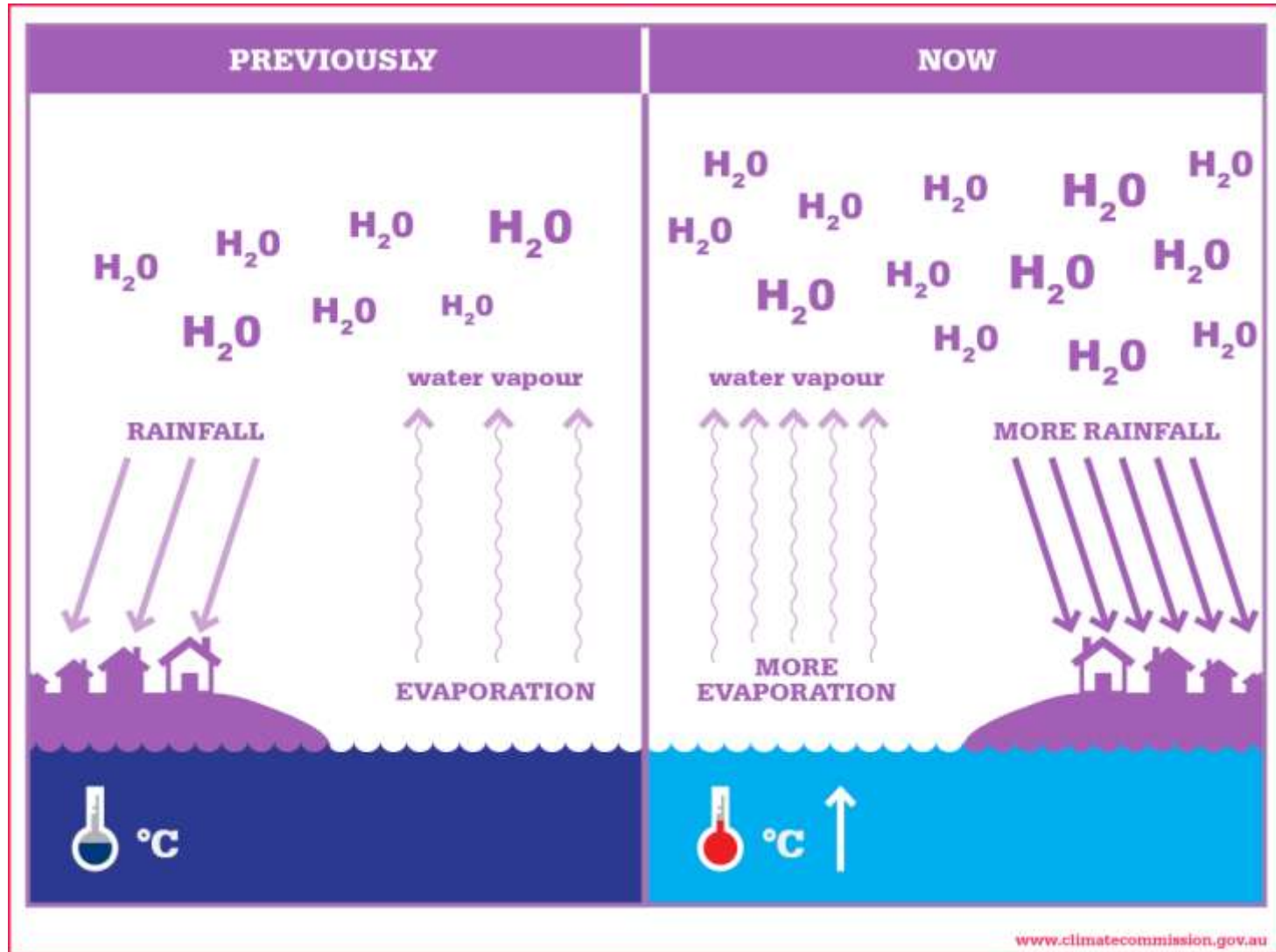


# Queensland 2010/11 floods



- December 2010 was Queensland's wettest December on record
- Floods broke river height records at over 100 observation stations
- 78% of the state was declared a disaster zone
- Economic cost estimated to be in excess of \$5 billion
- 300,000 homes and businesses lost power in Brisbane and Ipswich

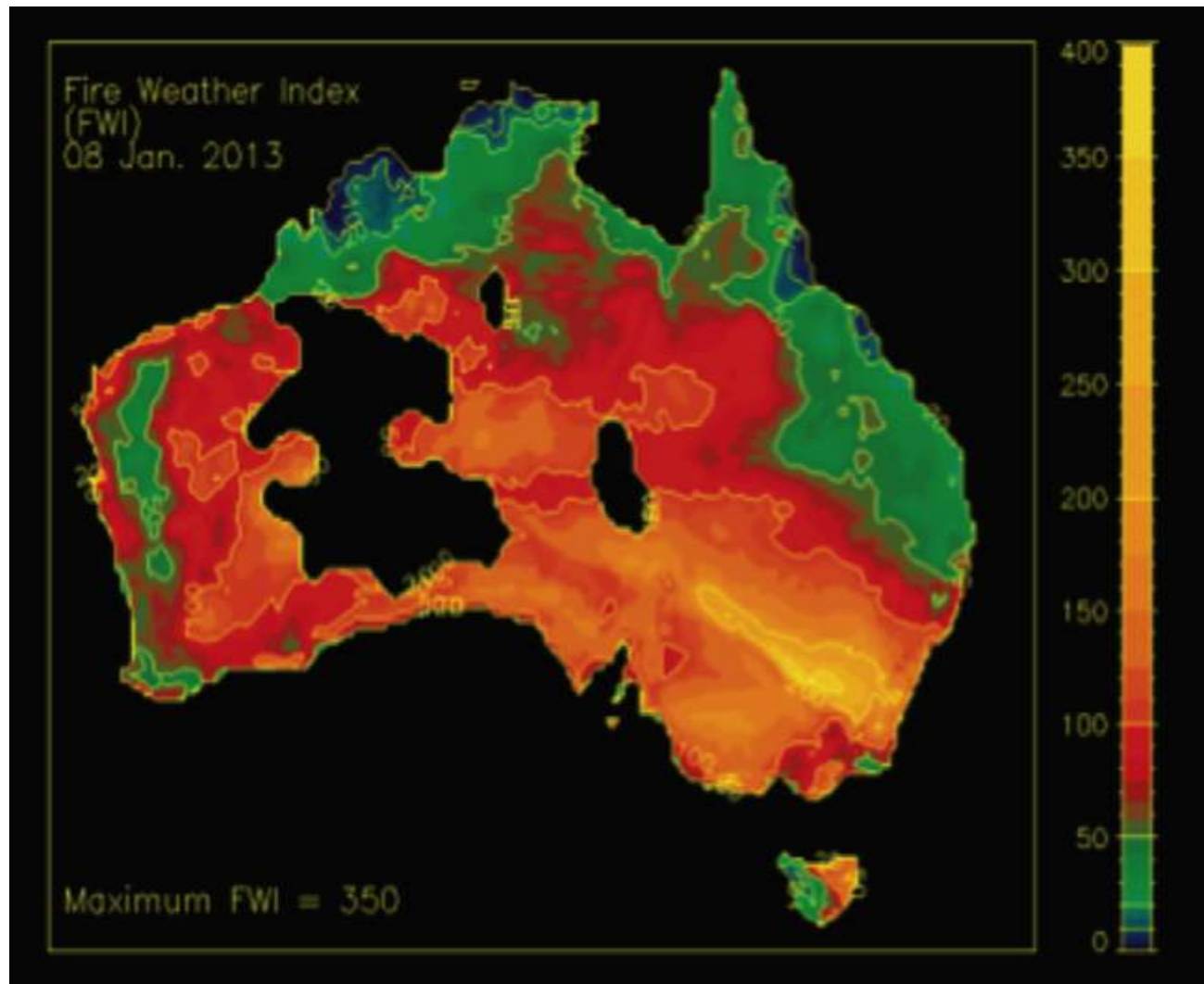
# Influence of warming on the water cycle



# Bushfires



# Fire Weather Index, 8 Jan 2013



# Bushfires and Climate Change

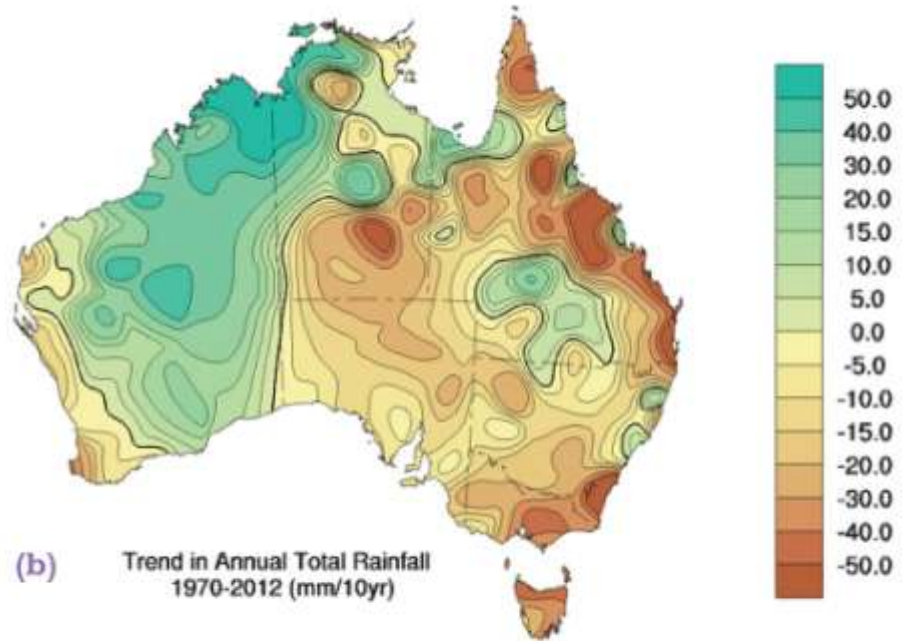
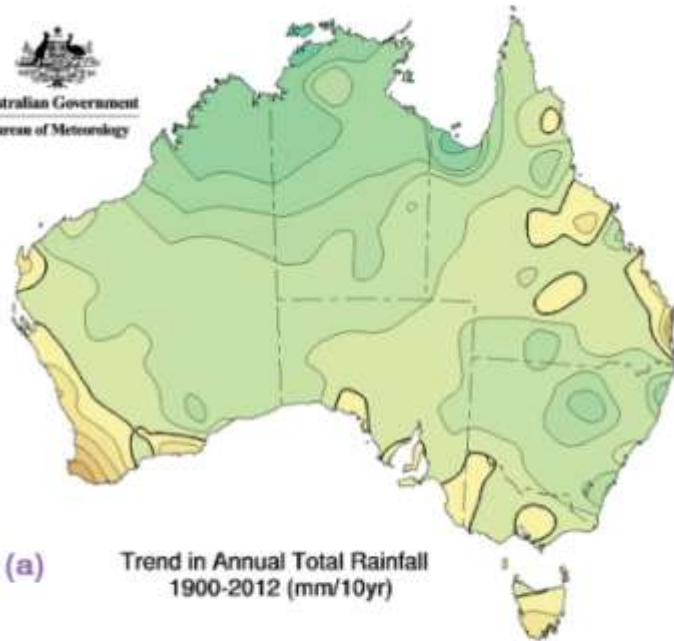


- Climate change exacerbates bushfire conditions by increasing the frequency of very hot days.
- Between 1973 and 2010 the Forest Fire Danger Index increased significantly at 16 of 38 weather stations across Australia, mostly in the southeast. None of the stations showed a significant decrease.
- Projected increases in hot days across Australia, and in dry conditions in the southwest and southeast, will very likely lead to more days with extreme fire danger in those regions.

# With changing rainfall patterns



  
Australian Government  
Bureau of Meteorology



Source: BoM, 2013c

# Coral reef states under increasing CO<sub>2</sub> and T



375 ppm +1°C



450 – 500 ppm +2°C



> 500 ppm > +3°C

**Source:** modified from Hoegh-Guldberg et al., 2007

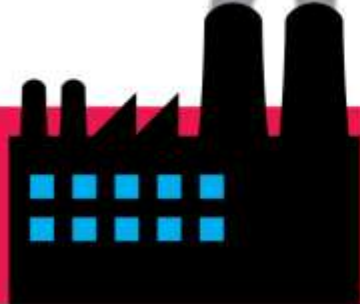
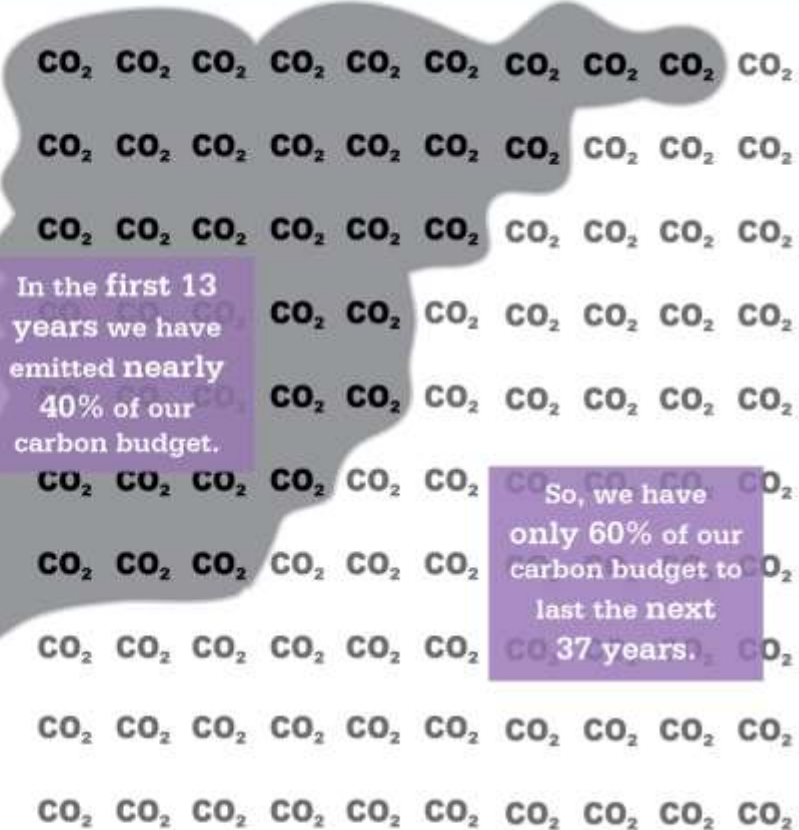
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# Overspend in the carbon budget

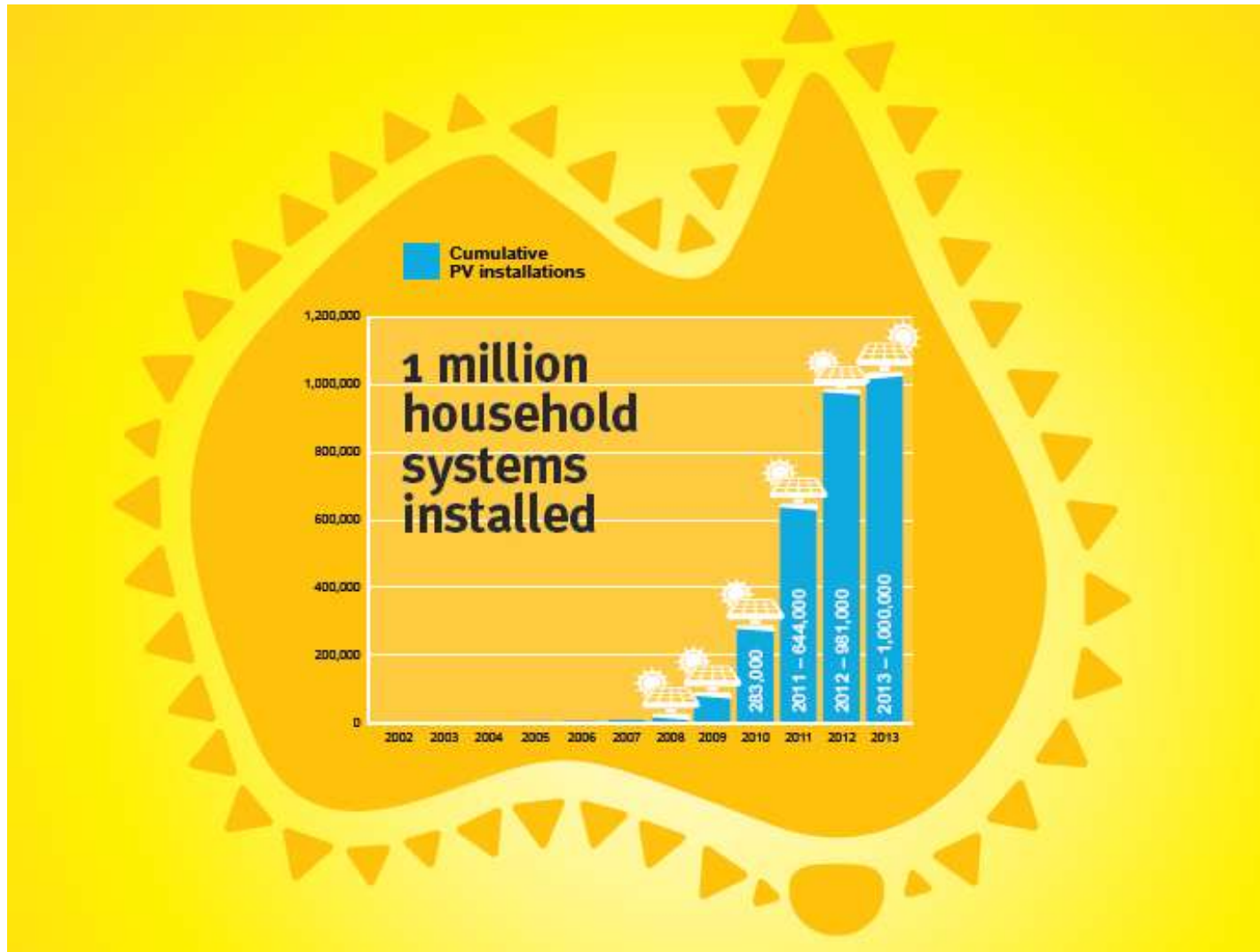


For a 75% chance of meeting the 2°C limit we can emit no more than 1,000 billion tonnes of CO<sub>2</sub> between 2000 and 2050.

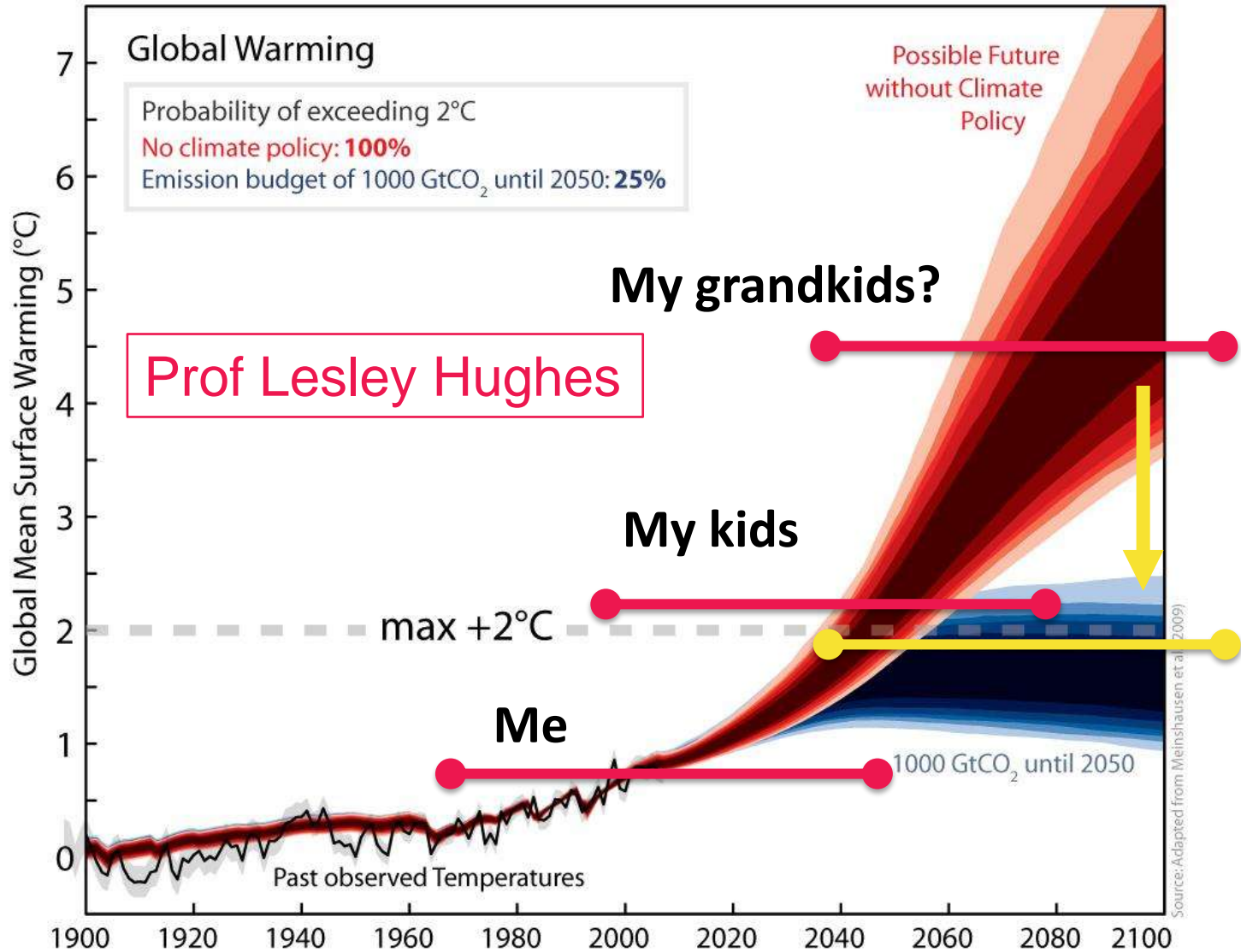


If we continue to spend our allowable emissions at our current rate, we will use up all of our allowable emissions by 2028. After the budget is completely spent, the world's economy will need to be **completely decarbonised.**

# Renewables are increasing



# This is the critical decade for action



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