

# *Investing in a two degree world: exploring the possibility of four*

**A/Prof. M. Meinshausen**

**Australian-German Climate & Energy College, The  
University of Melbourne**

with thankful acknowledgement to  
**Karl Braganza, Bureau of Meteorology,  
CSIRO, the Climate Council and many others**



AUSTRALIAN-GERMAN  
**CLIMATE & ENERGY COLLEGE**

The logo for the Australian-German Climate & Energy College, consisting of three overlapping circles of different shades of blue.

A photograph of a flooded city intersection. The water is deep, reflecting the surrounding modern buildings and the sky. Several people are wading through the water, and a few bicycles are parked on the right. Traffic lights and street signs are visible above the water level. The scene is set in a dense urban area with tall buildings and greenery.

# Investor Risk No.1: More extreme rainfall events

"Flooded intersection of Eagle and Charlotte Streets" in 2011 by Andrew Kesper - Brisbane City FloodsUploaded by Bidgee. [Licensed under CC BY 2.0 via Commons](#)



# Investor Risk No.2: More fire weather



Chepstowe Fires near Ballarat 2013. Cargnham Station burns on into the night the historic Villa was completely destroyed in the fires. Photo: Justin McManus



Tim Holmes / The Associated Press File Photo, The Holmes family takes refuge under a jetty as a wildfire rages in the Tasmanian town of Dunalley during a heat wave in January 2013



# Investor Risk No.3: Stronger Heat Waves







**Investor Risk No.4:  
More Severe Droughts**



A photograph showing severe coastal erosion. In the foreground, a wooden walkway and a yellow-topped pole with an orange safety net are partially submerged in the sea. A concrete retaining wall has collapsed, with debris scattered on the sand. The beach is narrow and eroding, with waves crashing against the shore. In the background, a large, multi-story white apartment building with balconies stands on a cliff overlooking the ocean. Other houses and trees are visible further back on the cliff.

# Investor Risk No.5: Rising Sea Level

Wetherill St Collaroy/Sth Narrabeen. Real estate potentially threatened. Taken from: <http://www.coastalwatch.com/environment/4524/impact-of-coastal-erosion-in-australia>





Central Victoria, Source: State of the Climate 2014 Report, BOM, CSIRO





Wimmera, 320km northeast, next to „Little desert national park“ in average 2C warmer, and 20% drier. Source: Climate State 2014, BOM and CSIRO.





# Investor Risk No.6: Slow Climate Shifts





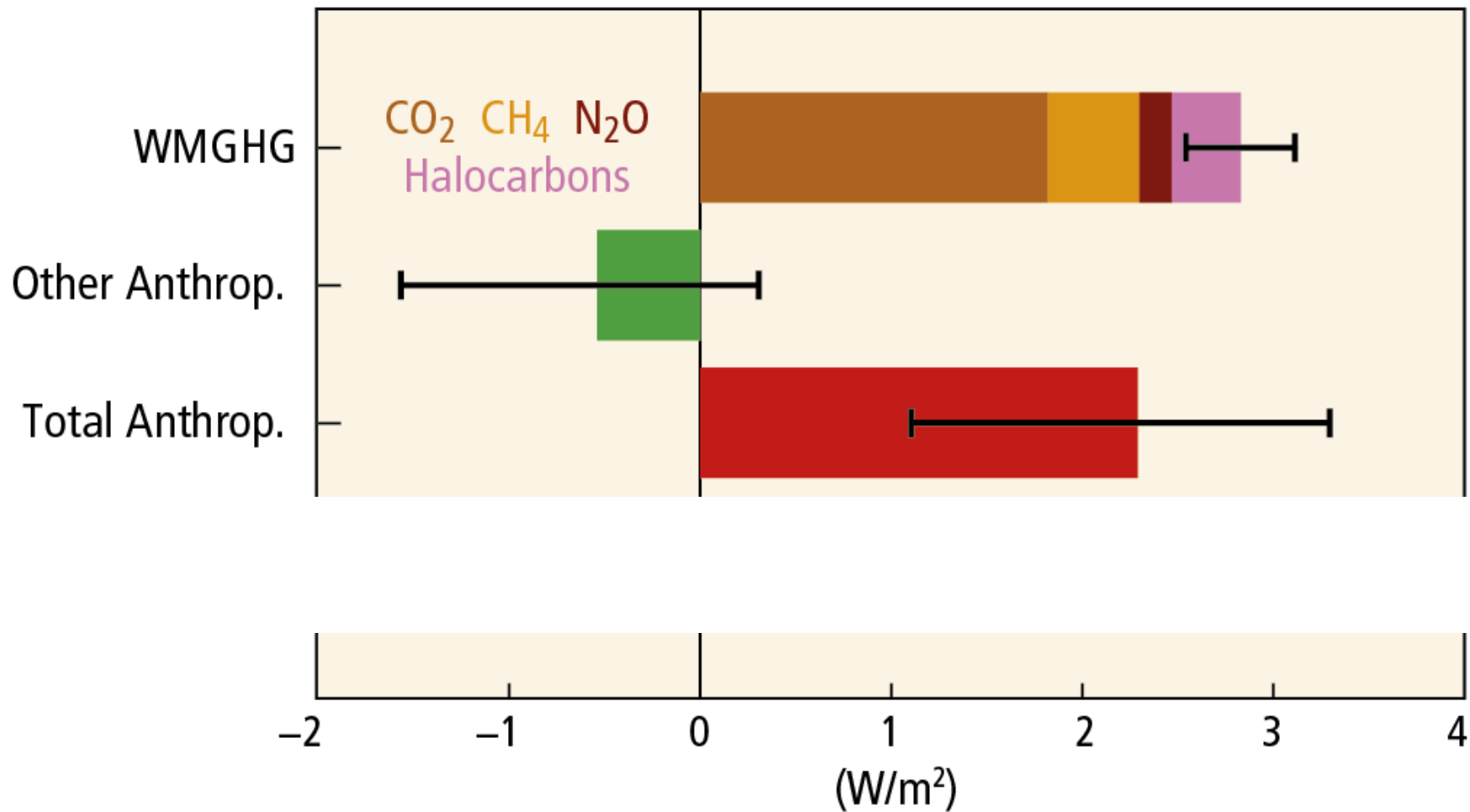
# Investor Risk No.7: Collapsing Fossil Fuel Demand

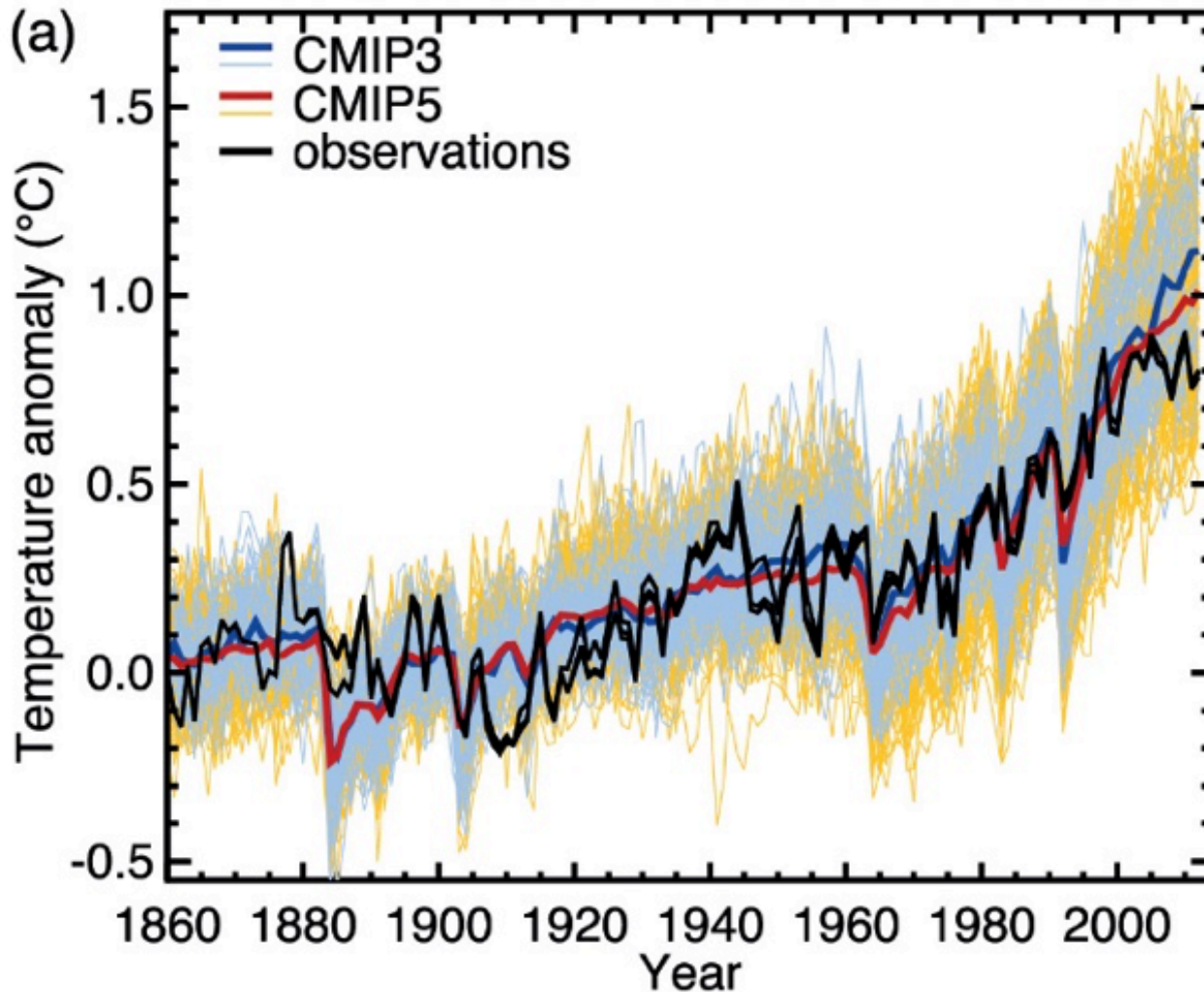
**Is the sun getting warmer?**





# Radiative forcing in 2011 relative to 1750

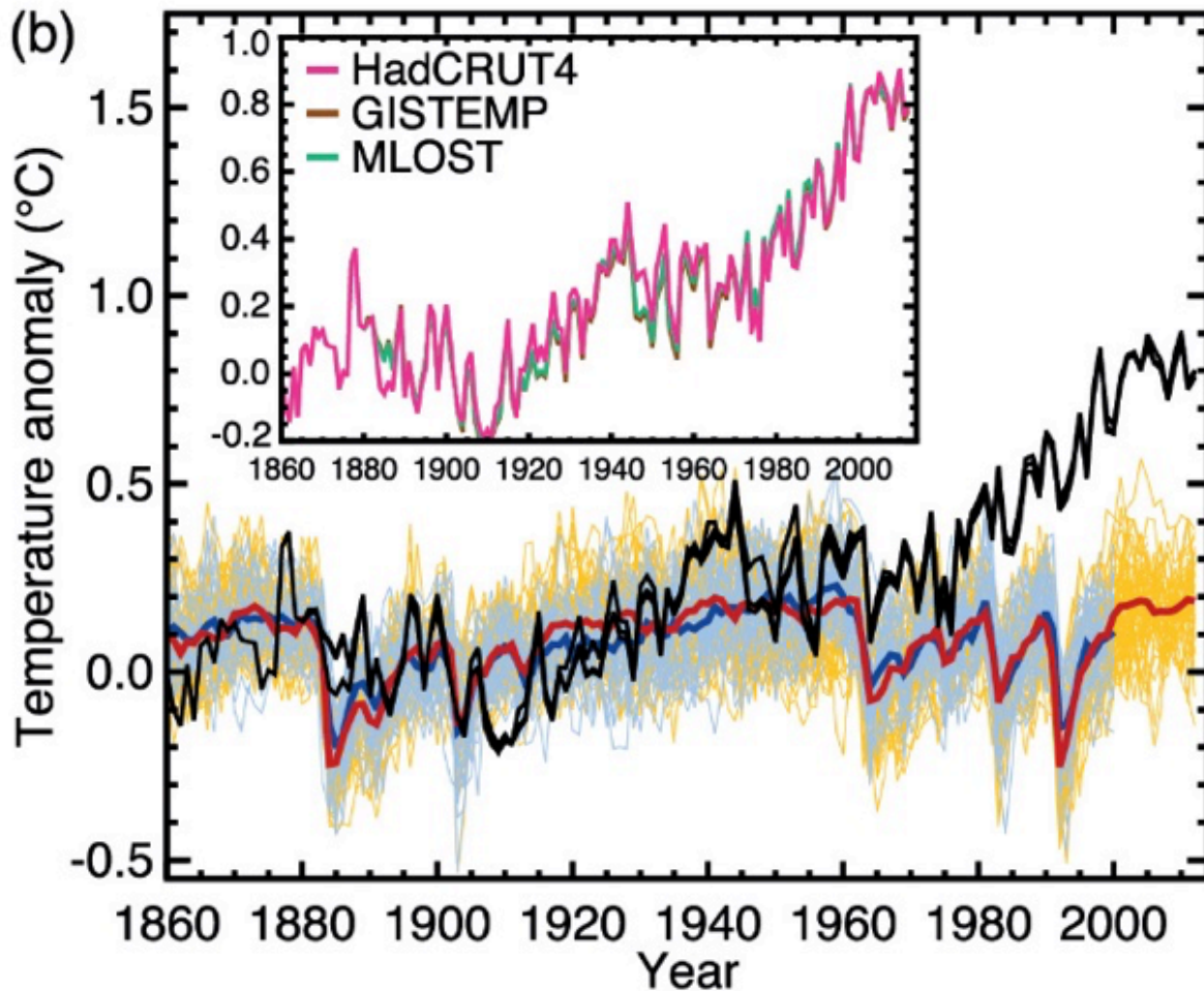




## Observations Latest Generation of Climate Models

→ Good match when models take into account all known forcings, i.e., warming anthropogenic forcings, cooling anthropogenic forcings and natural (solar, volcanic) forcings.

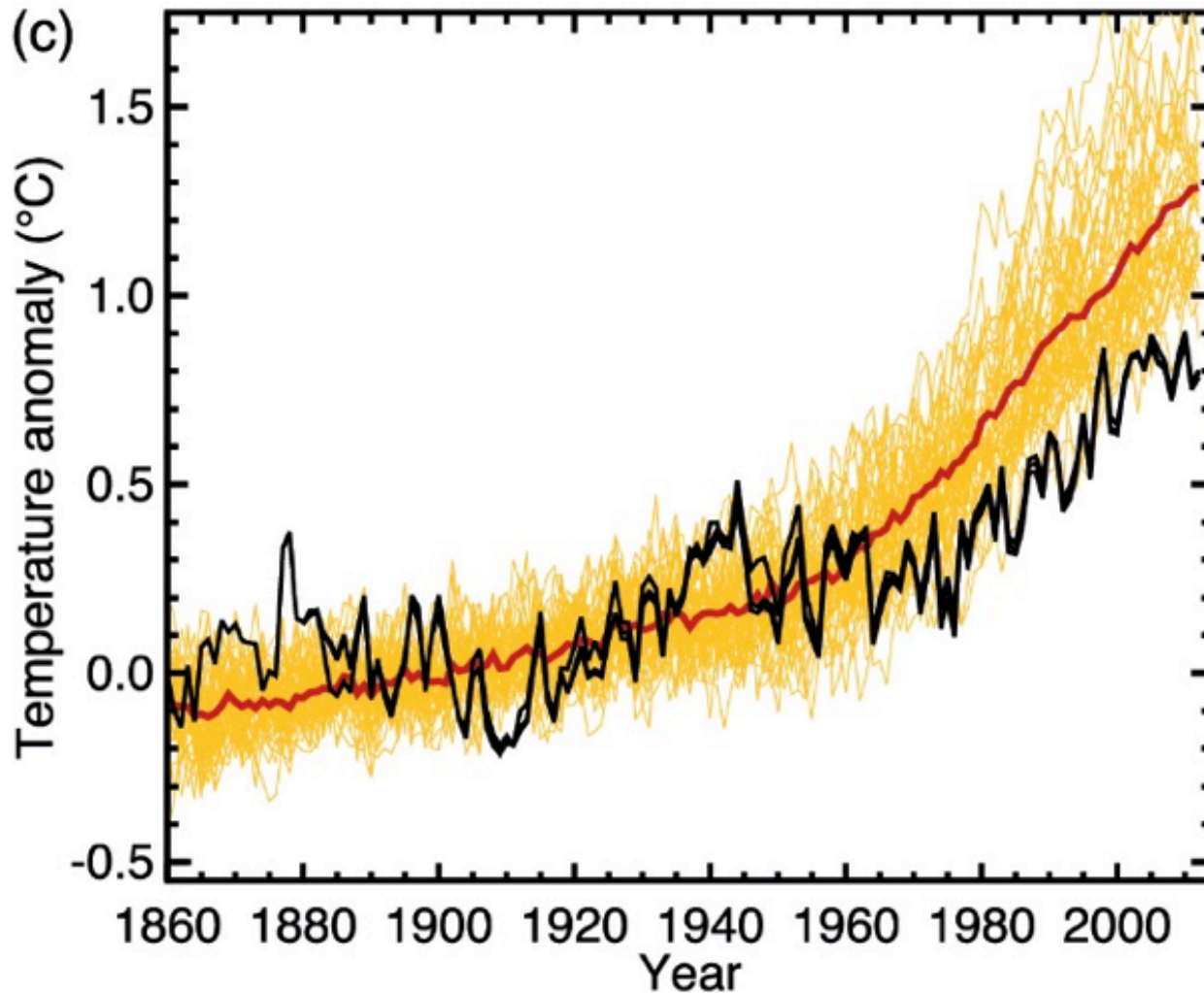




## Observations

**Only natural forcings  
in Latest Generation of  
Climate Models**

→ Not a good match.



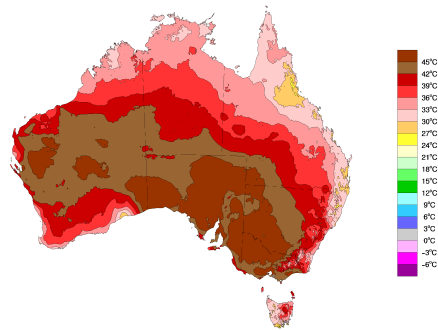
**Observations**  
**Only warming**  
**Greenhouse gases in**  
**Latest Generation of**  
**Climate Models**

→ Not a good match,  
cooling anthropogenic  
forcing important as  
well.



## Black Saturday 2009 heatwave

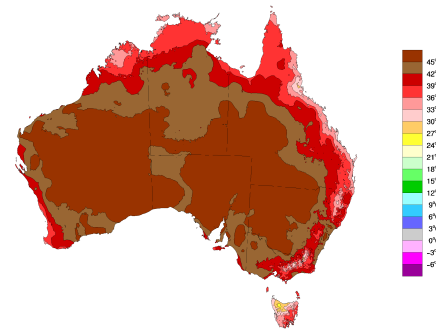
### Record-breaking heatwave across southeastern Australia



Maximum temperatures – 27 Jan – 8 Feb 2009

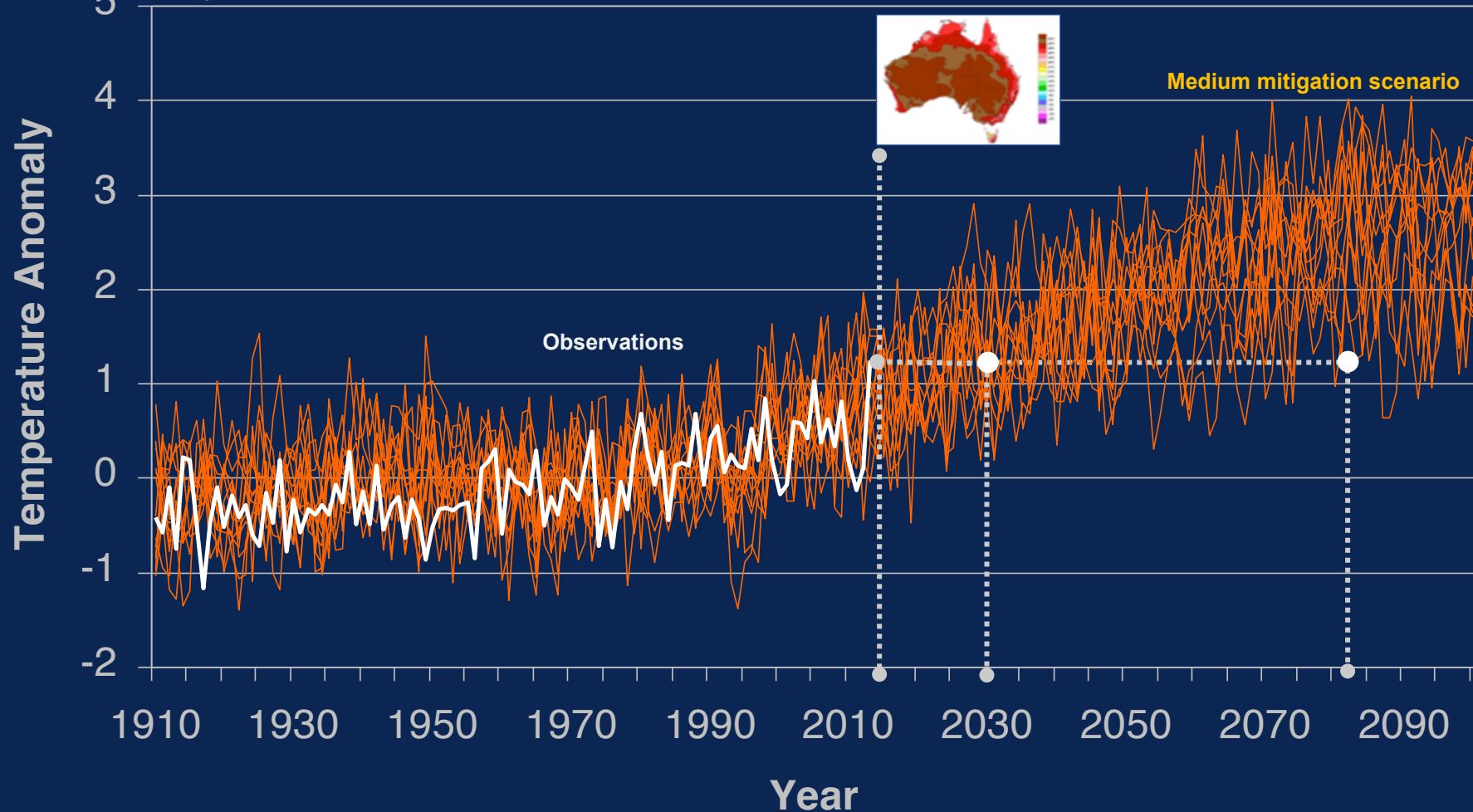
## January 2013 heatwave

### Over 70% of the continent recording temperatures in excess of 42°C



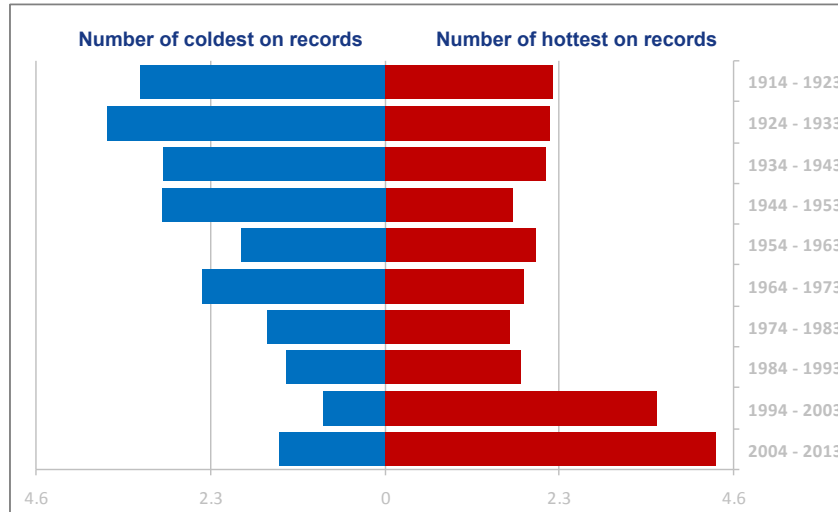
Maximum temperatures – first half of Jan 2013

# Projections of Australian annual temperature





# We are setting more temperature records



**The frequency  
of cold records  
has declined**

**The frequency  
of hot records  
has increased  
dramatically  
since 1900**

Figure: State of the Climate 2014 Report, CSIRO, Bureau of Meteorology

# Exceptional heat is becoming more frequent

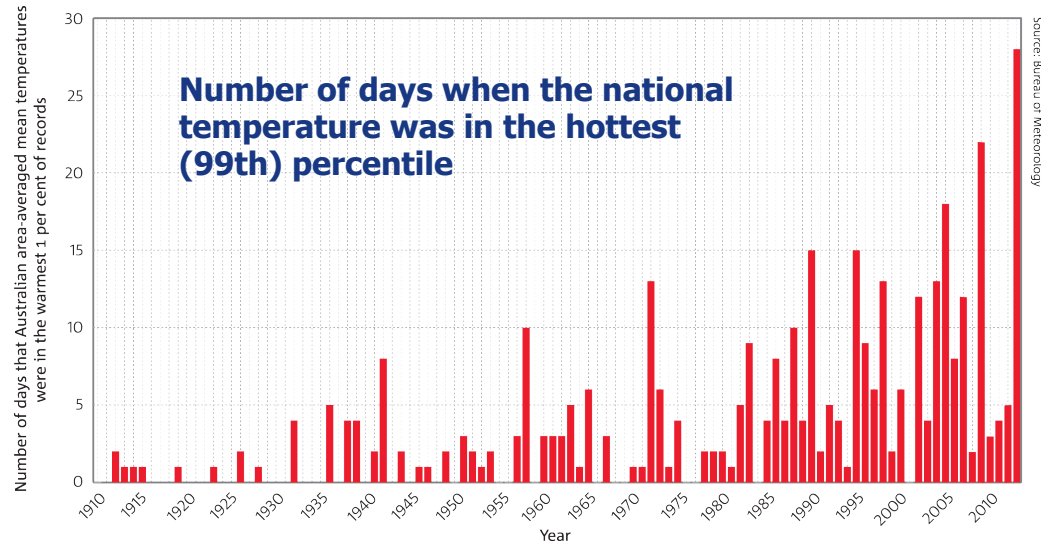
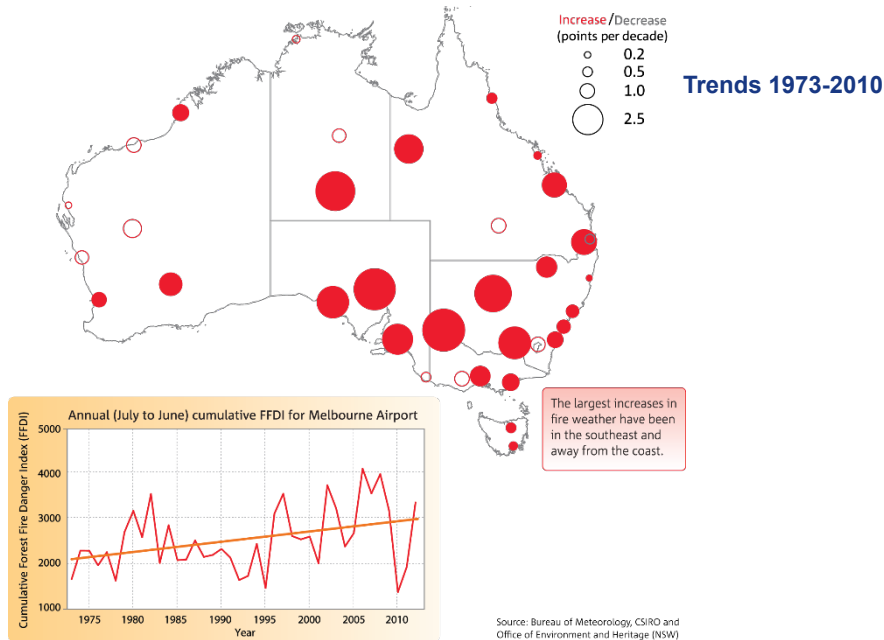


Figure: State of the Climate 2014 Report, CSIRO, Bureau of Meteorology



# More fire weather, a longer fire season

## Forest fire danger index (FFDI)

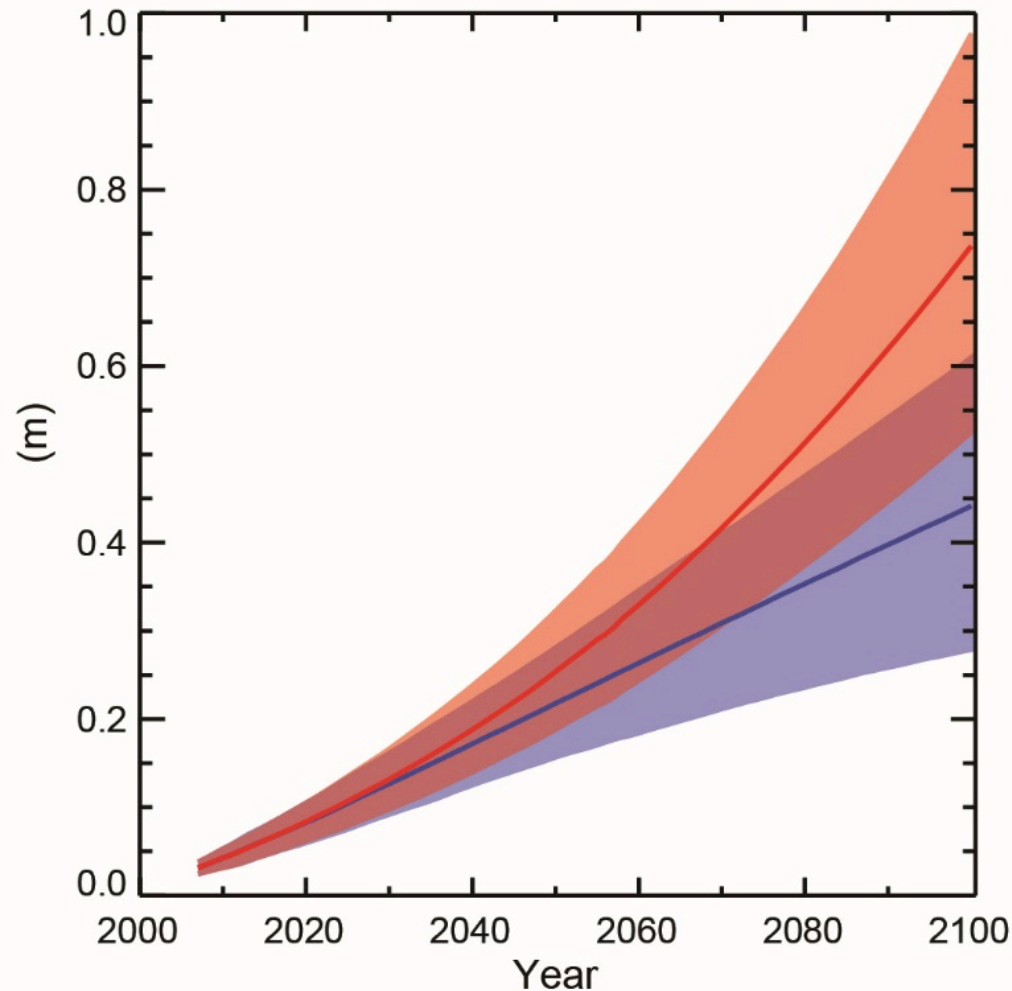


The map shows the trends in extreme fire weather days (annual 90th percentile of daily FFDI values) at 38 climate reference sites. Trends are given in FFDI points per decade and larger circles represent larger trends. Filled circles represent trends that are statistically significant. One location, Brisbane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

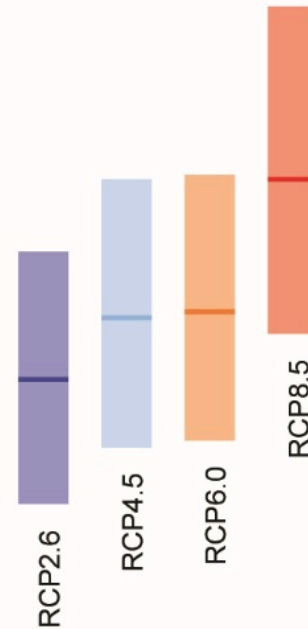
Time series showing the increasing trend in the annual cumulative Forest Fire Danger Index (FFDI) at Melbourne Airport. A long-term trend is discernible despite significant annual variability.

Figure: State of the Climate 2014 Report, CSIRO, Bureau of Meteorology

# Global mean sea level rise

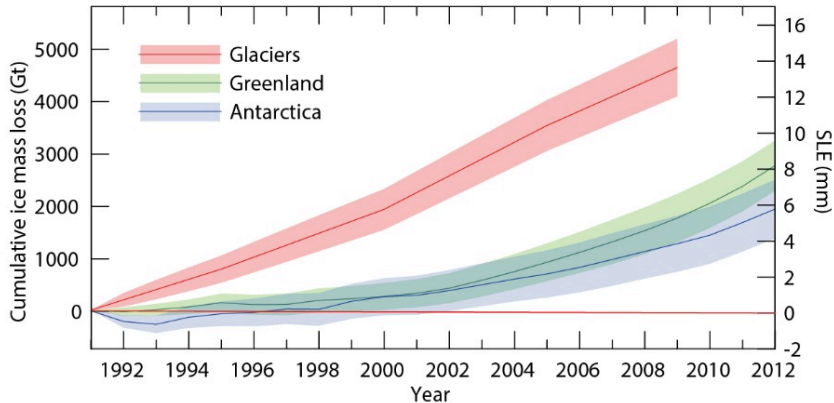
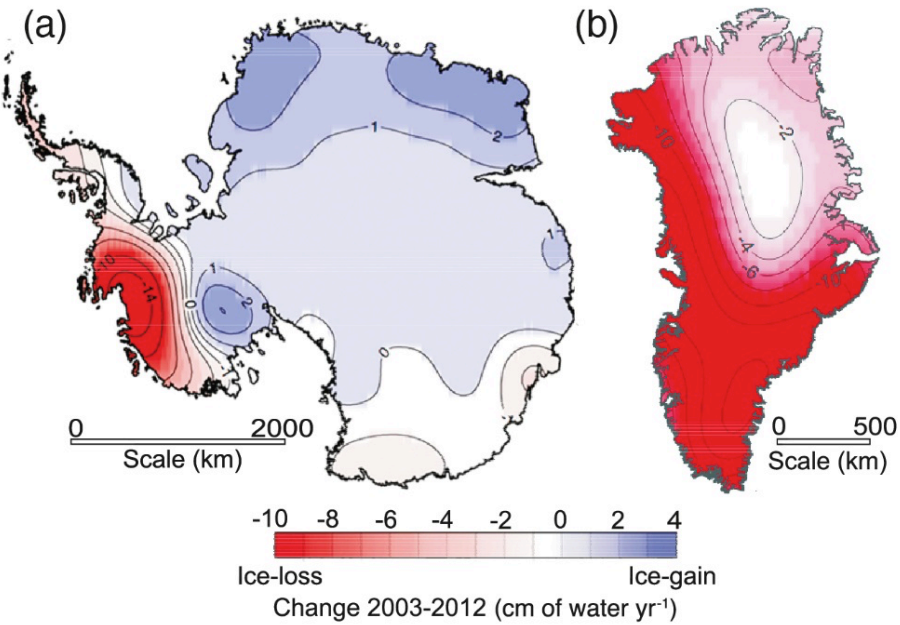


Mean over  
2081–2100



- **Sea level rise around Australia's coasts: ~10% higher than global mean, which is 45cm in best case scenario.**
- **75cm in high business-as-usual.**
- **And rising beyond 2100.**



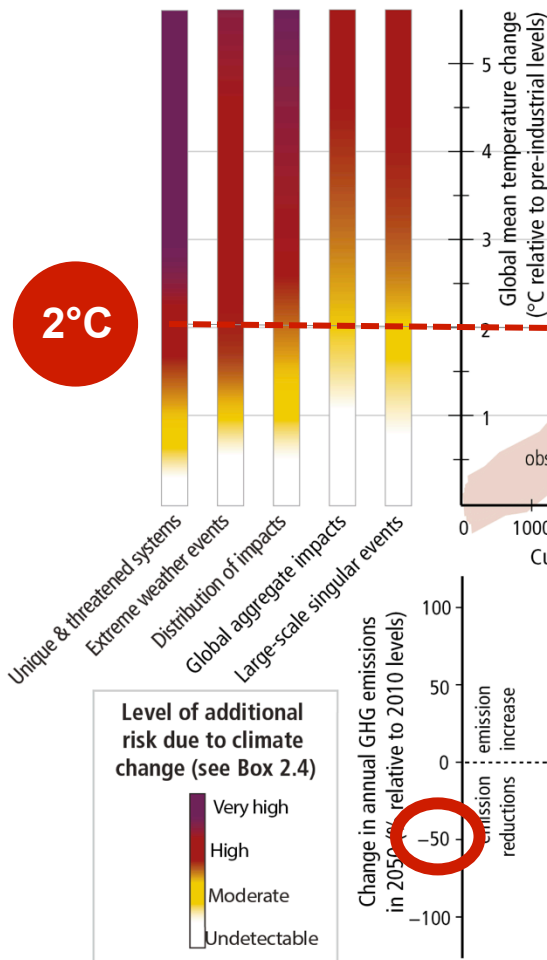


**We already woke up the sleeping giant ice sheets.**

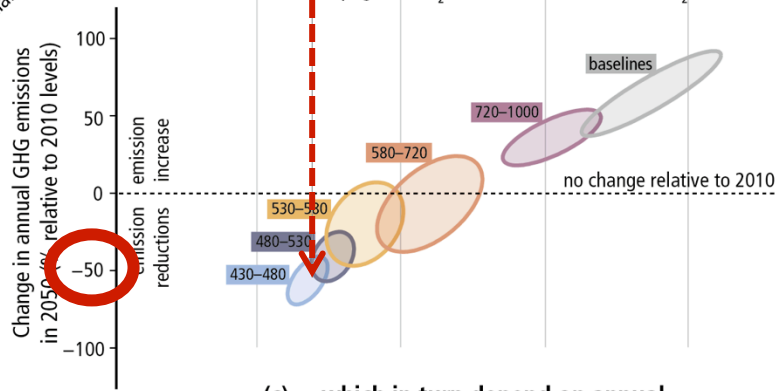
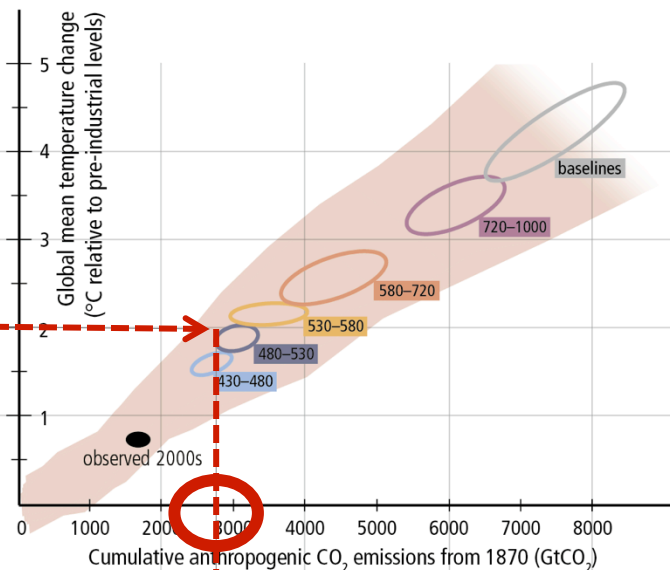
**If we burn all fossil fuels,  
Antarctica will melt.  
→ 58m sea level rise from  
Antarctica.**

Figure, IPCC WG1 AR5. & Finding: Winkelmann et al. 2015. Science advances.

(a) Risks from climate change...



(b) ...depend on cumulative CO<sub>2</sub> emissions...



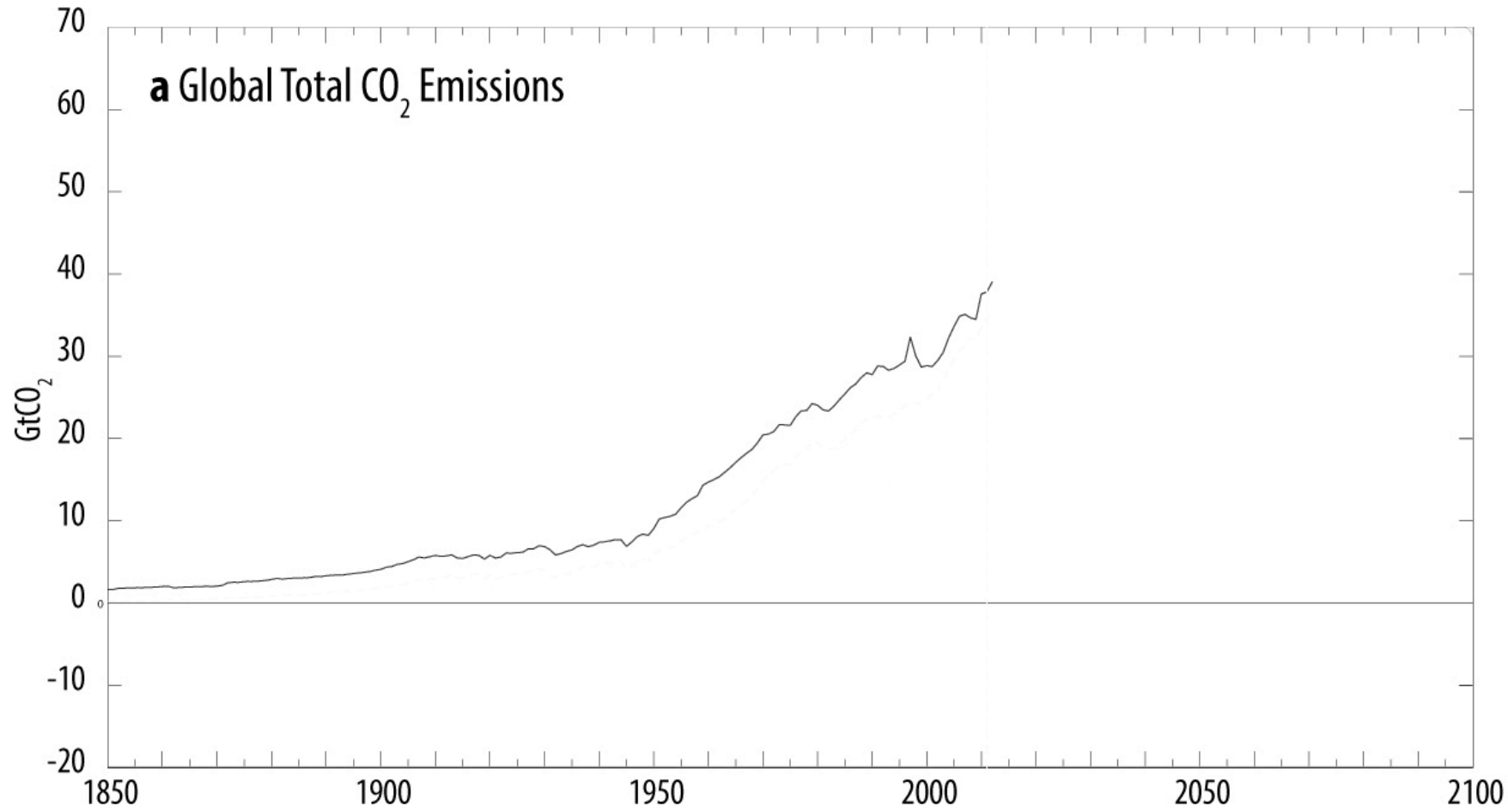
(c) ...which in turn depend on annual GHG emissions over the next decades

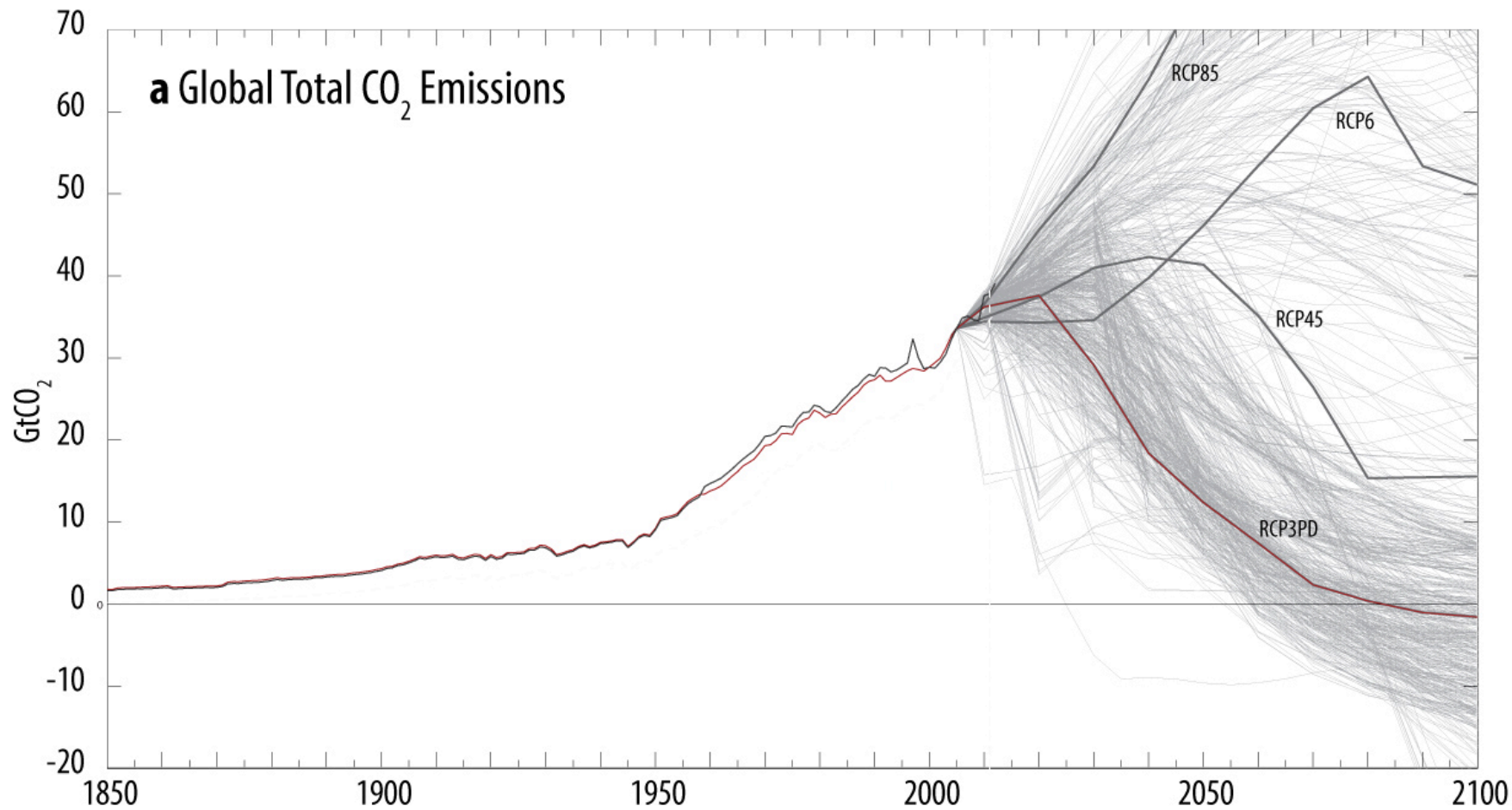
2°C

Staying below 2°C with likely chance means at least halving GHG by 2050...

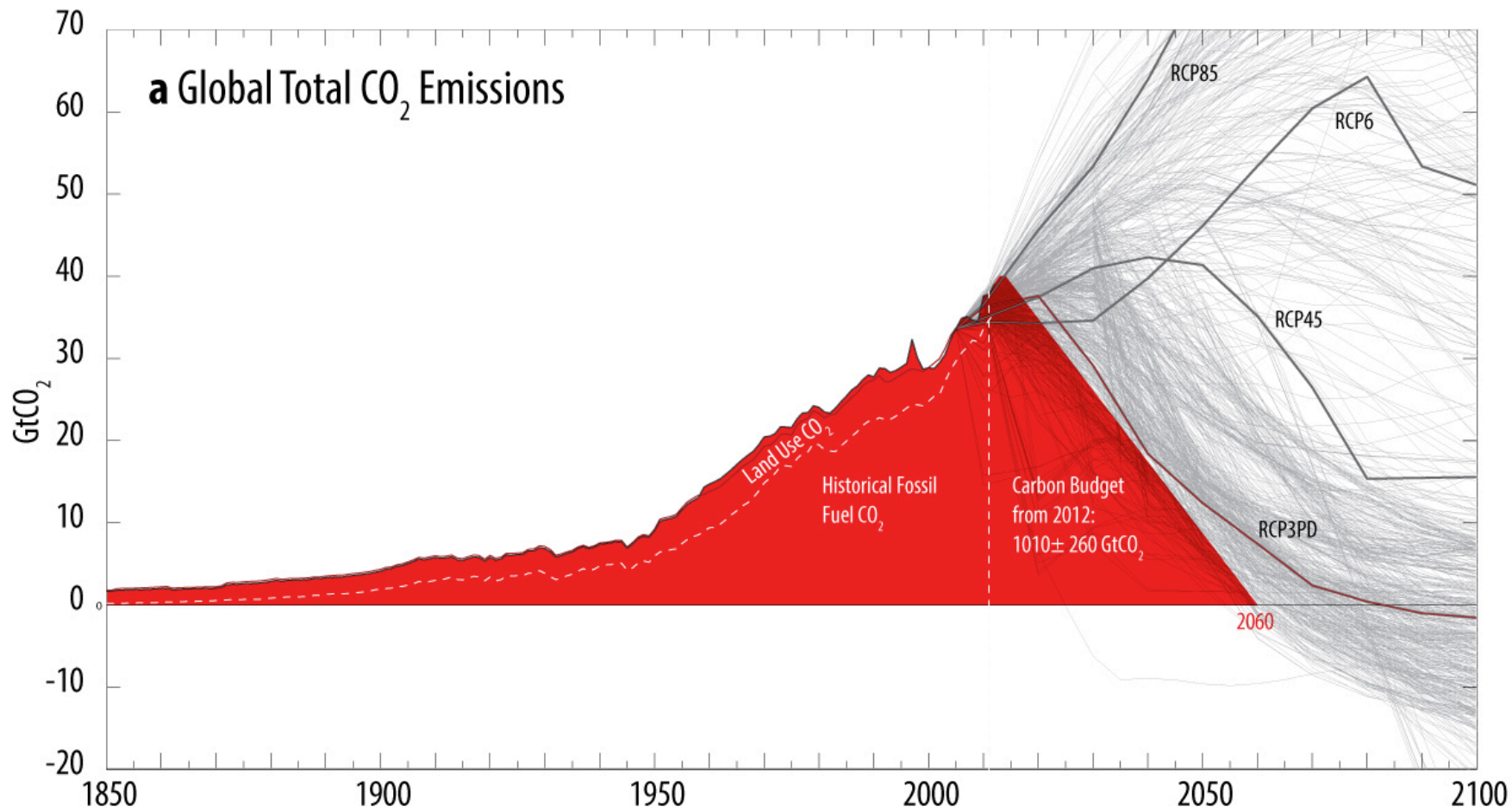
.. and limiting cumulative CO<sub>2</sub> emissions to 1900 Gt

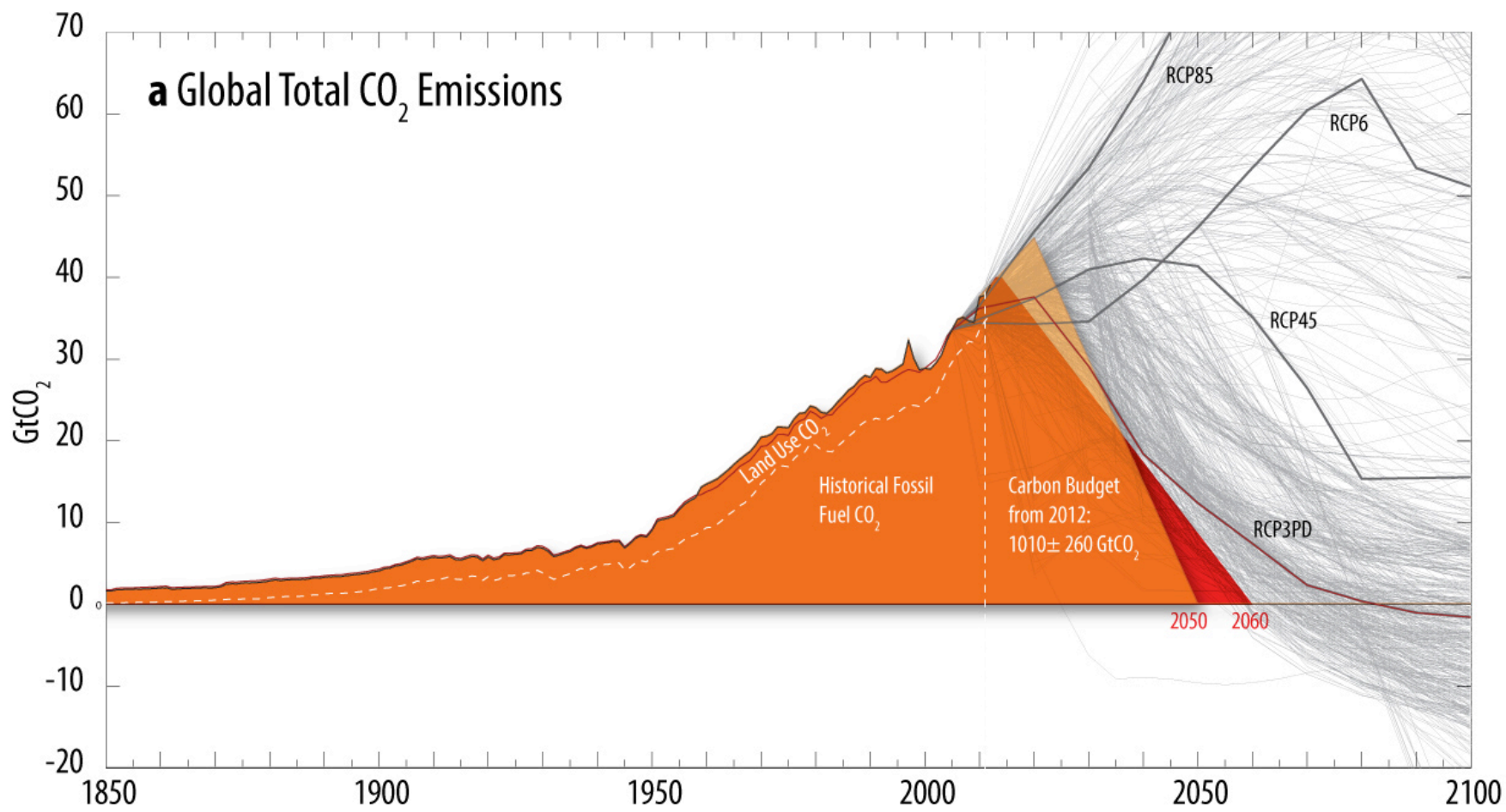












zero

*Gt Co<sub>2</sub>*



**Investor Risk No. 7: The sun is setting for fossil fuels.**

**Thank you!**  
**[climatecollege.unimelb.edu.au](http://climatecollege.unimelb.edu.au)**