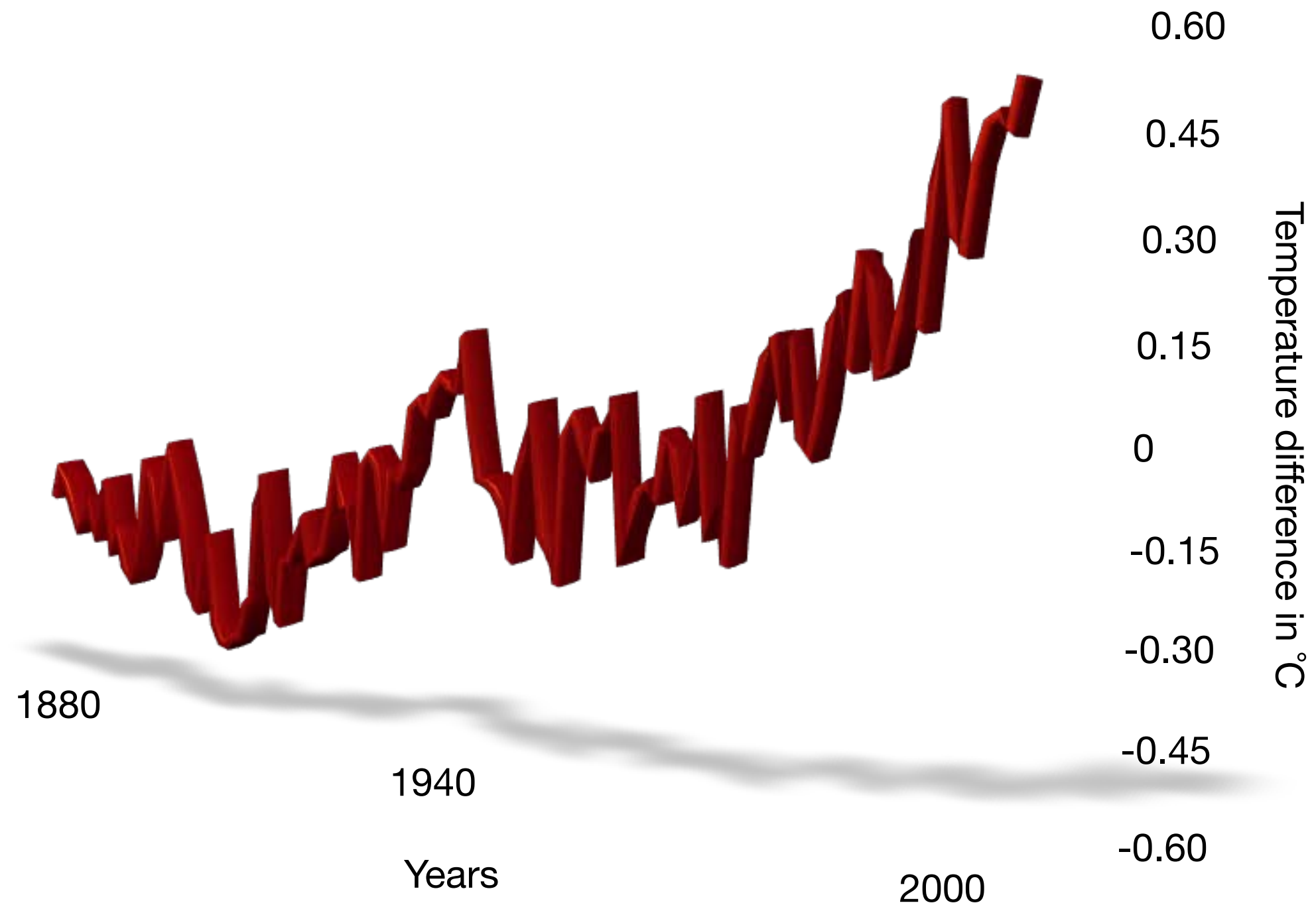




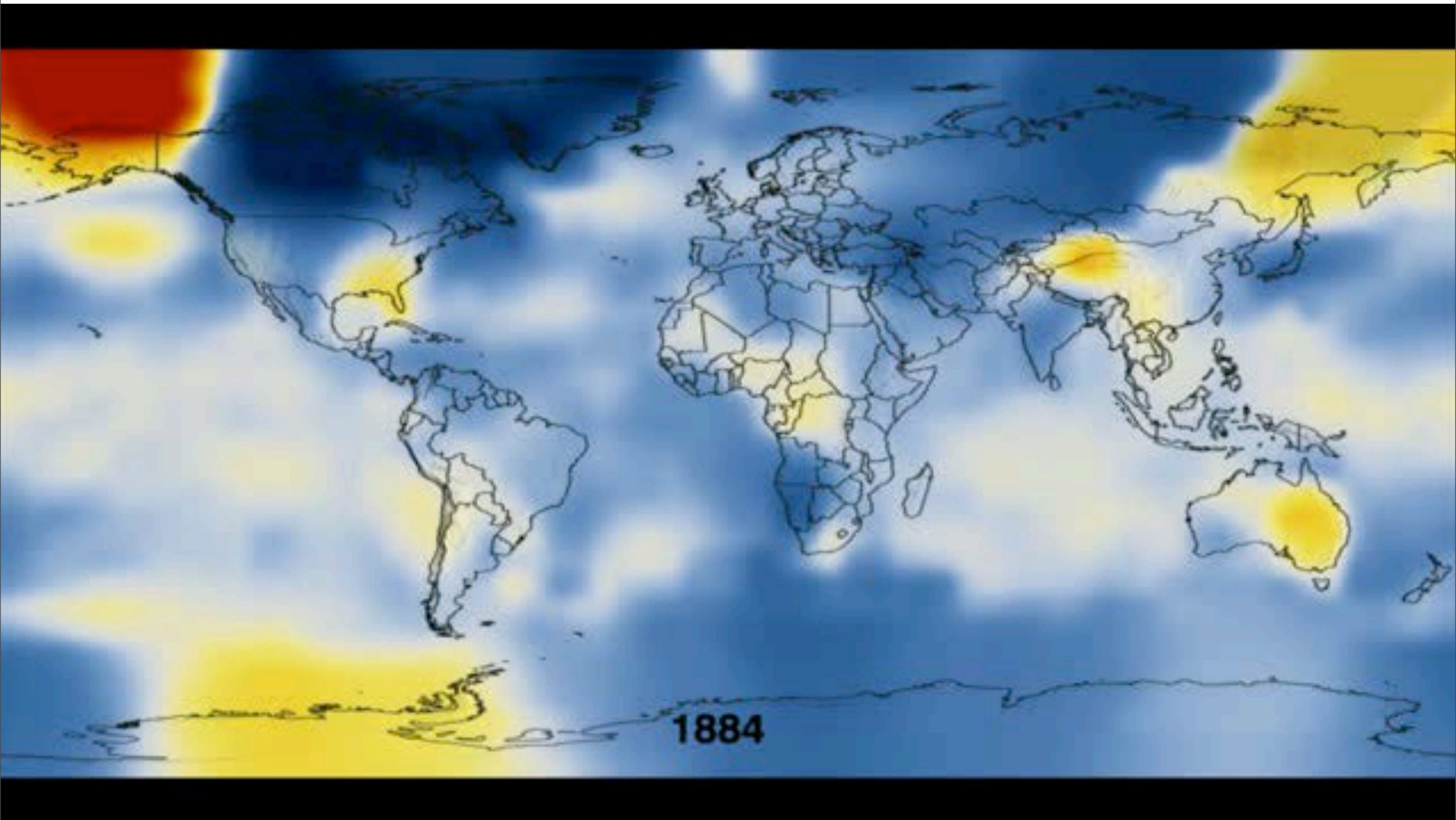
Climate Change: Lessons from the Past

Professor Chris Turney
University of New South Wales

Historical change



Changing Trends over Time



WED 13 JUL 2005 www.time.com AOL Keyword: Time

SPECIAL REPORT GLOBAL WARMING

TIME

BE WORRIED. BE **VERY** WORRIED.

Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well

EARTH AT THE TIPPING POINT
HOW IT THREATENS YOUR **HEALTH**

HOW CHINA & INDIA CAN HELP
SAVE THE WORLD—OR DESTROY IT

THE CLIMATE CRUSADERS



metro
ROVE: WHY I'M GOING BACK TO STAND-UP

sport
DNA COACHES SAY NO

HOW TO SURVIVE DIVORCE money

THE AGE

WEDNESDAY JULY 13, 2005 http://www.theage.com.au

Out of the rough: Kennett and Kroger end feud with clubs

Melbourne water crisis 'to get worse'

Big Brother or big brothel? MPs to probe the house

WEIRD WE WATCHED ON MONDAY NIGHT

WEATHER

STATE PURSUES HOME GRANT CHEATS TO RECOUP MILLIONS

THE PLACE TO BE

Card trust details

History Can Only Take You So Far

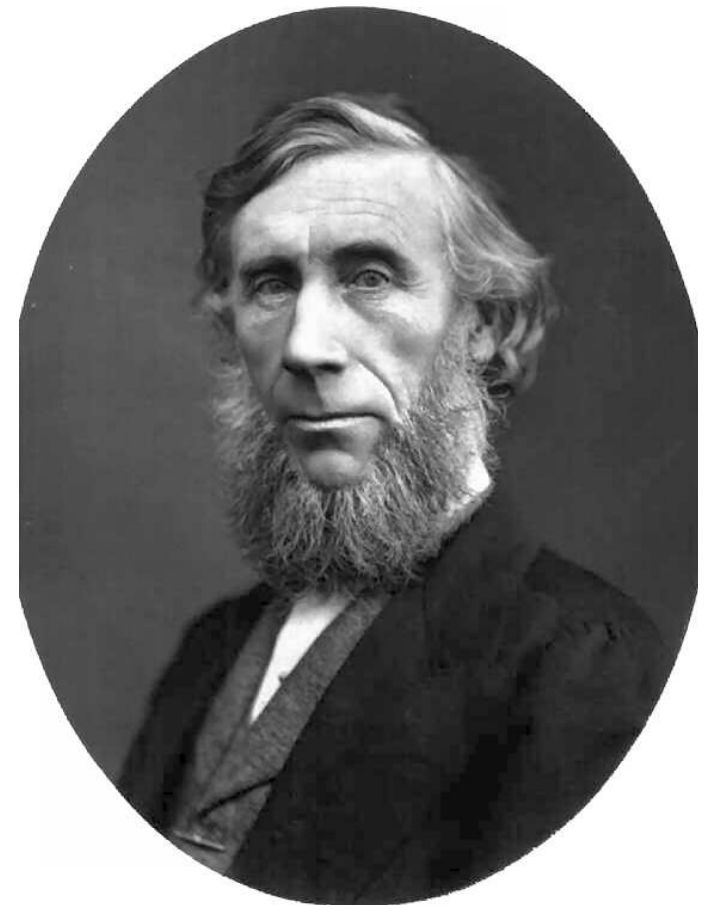


Discovery of the Greenhouse Effect

1827 Joseph Fourier likened the atmosphere to a 'glass bowl'



1861 John Tyndall measured heat absorbing properties of different gases, including carbon dioxide



Greenhouse Gases

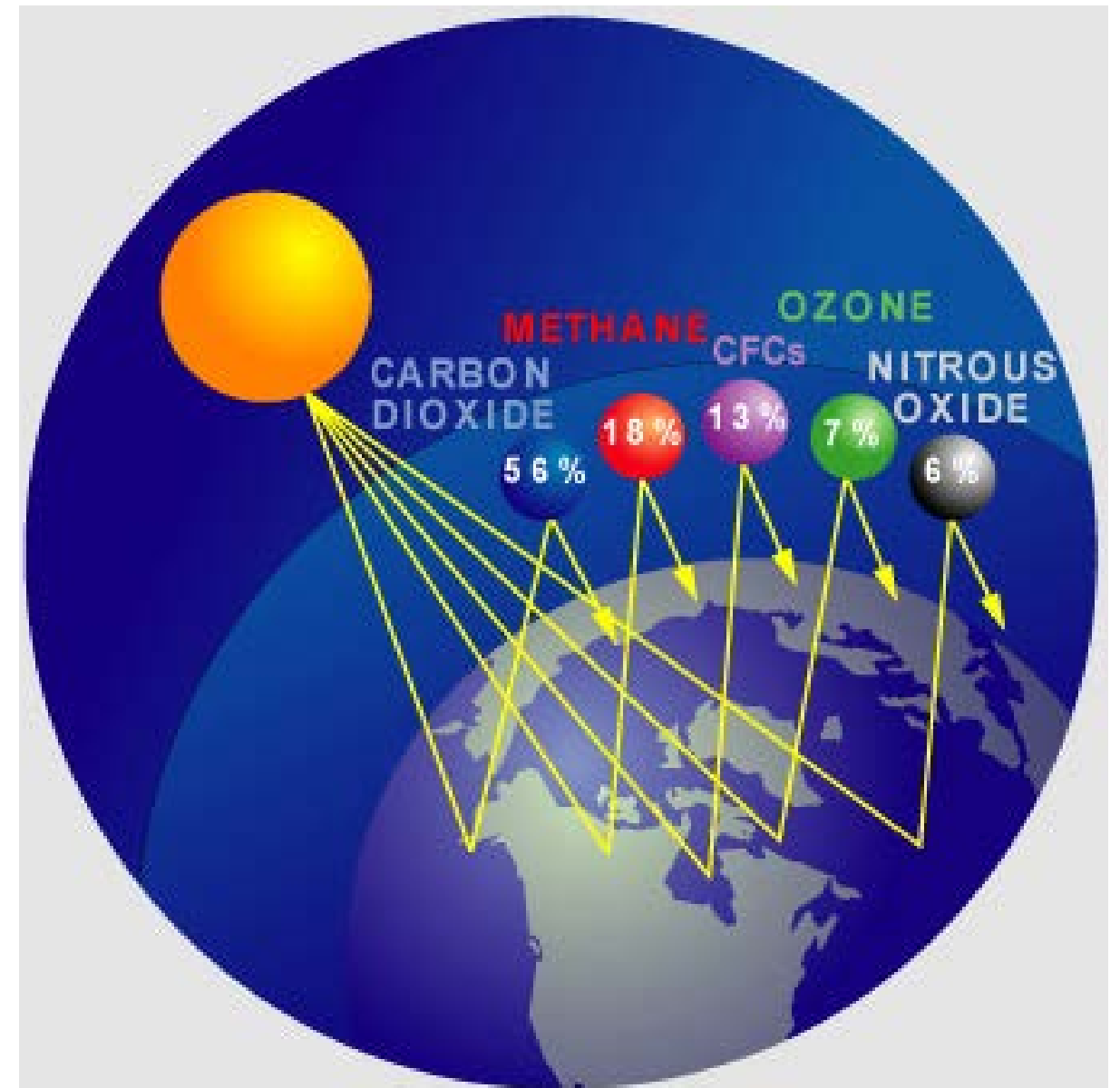
Water (H_2O)

Carbon dioxide (CO_2)

Methane (CH_4) x20-25 CO_2

Nitrous oxide (N_2O) x300
 CO_2

and many others



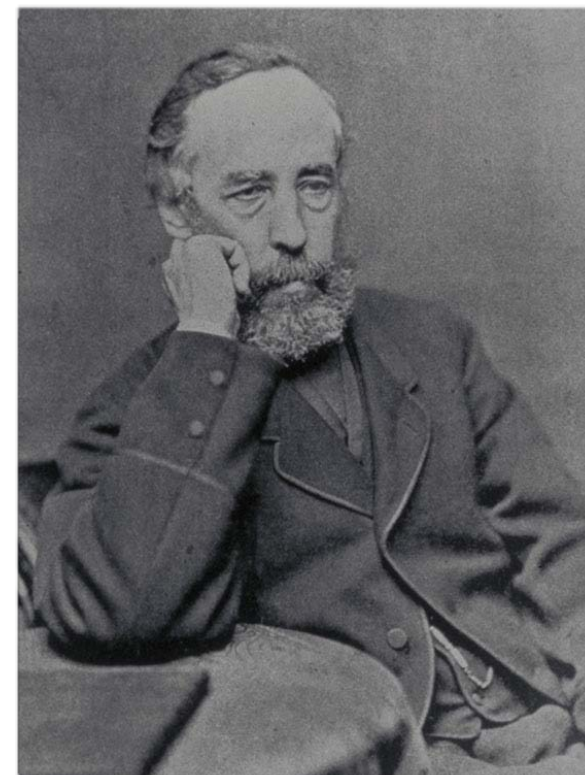
Often measured in parts per million (or billion) e.g.
380 ppm means 380 molecules of carbon dioxide
for every million molecules of dry air

The Great Ice Age

- 1837: Agassiz's lecture on the Great Ice Age
- By 1860s, had declared the world was fully covered in ice
- 1875: Croll proposed three different orbital controls on ice ages
- 1920: Milankovitch calculated changes in heat from Sun at different latitudes. Cool summers were key.



'The development of these huge ice sheets must have led to the destruction of all organic life at the Earth's surface'

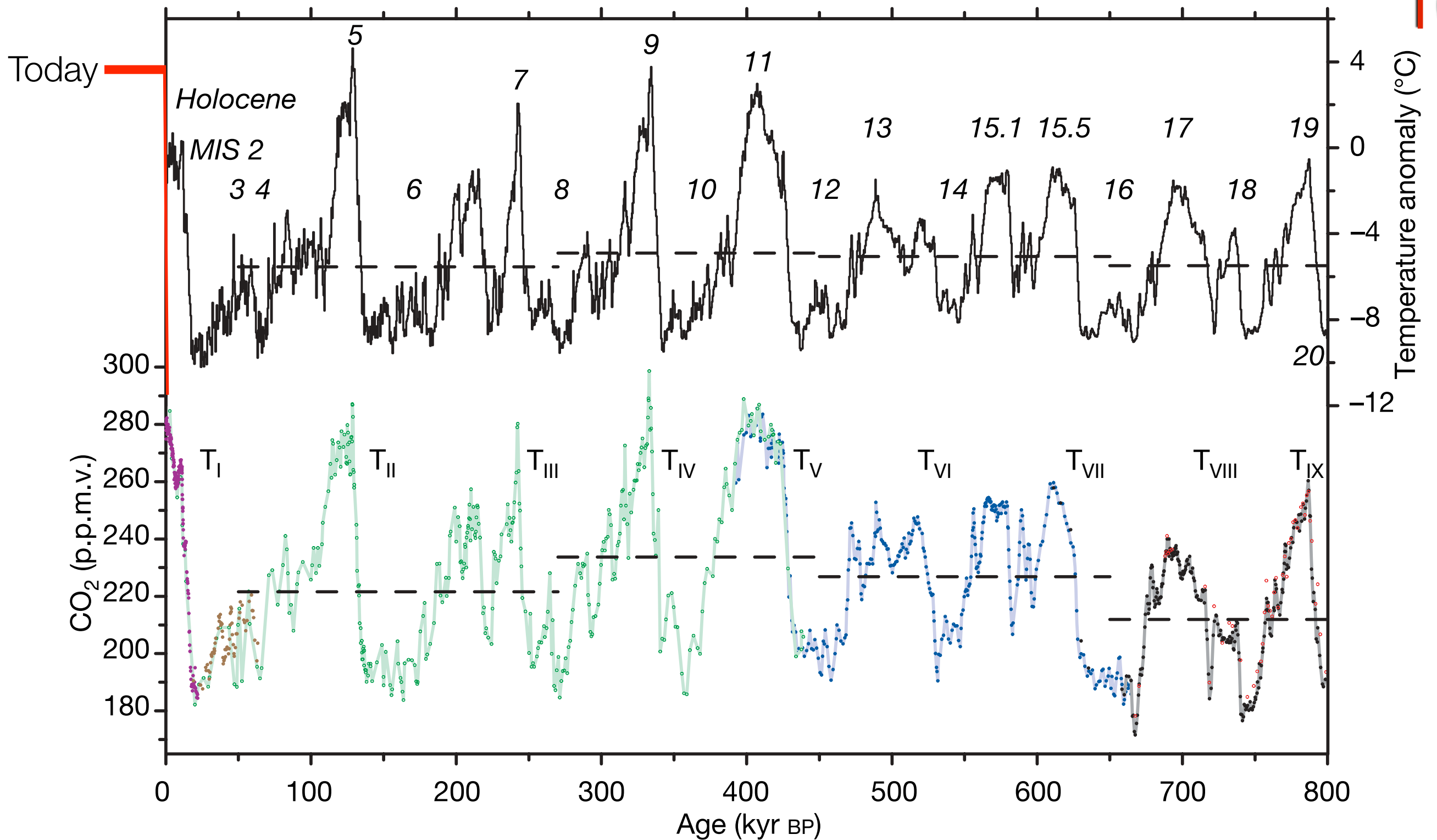


Svante Arrhenius

- 1895, calculated an increase in carbon dioxide by 50% might lead to a warming of 3°C; doubling by nearly 6°C
- Feedback from water vapour



‘We would then have some right to indulge in the pleasant belief that our descendants, albeit after many generations, might live under a milder sky and in less barren natural surroundings than our lot at present.’

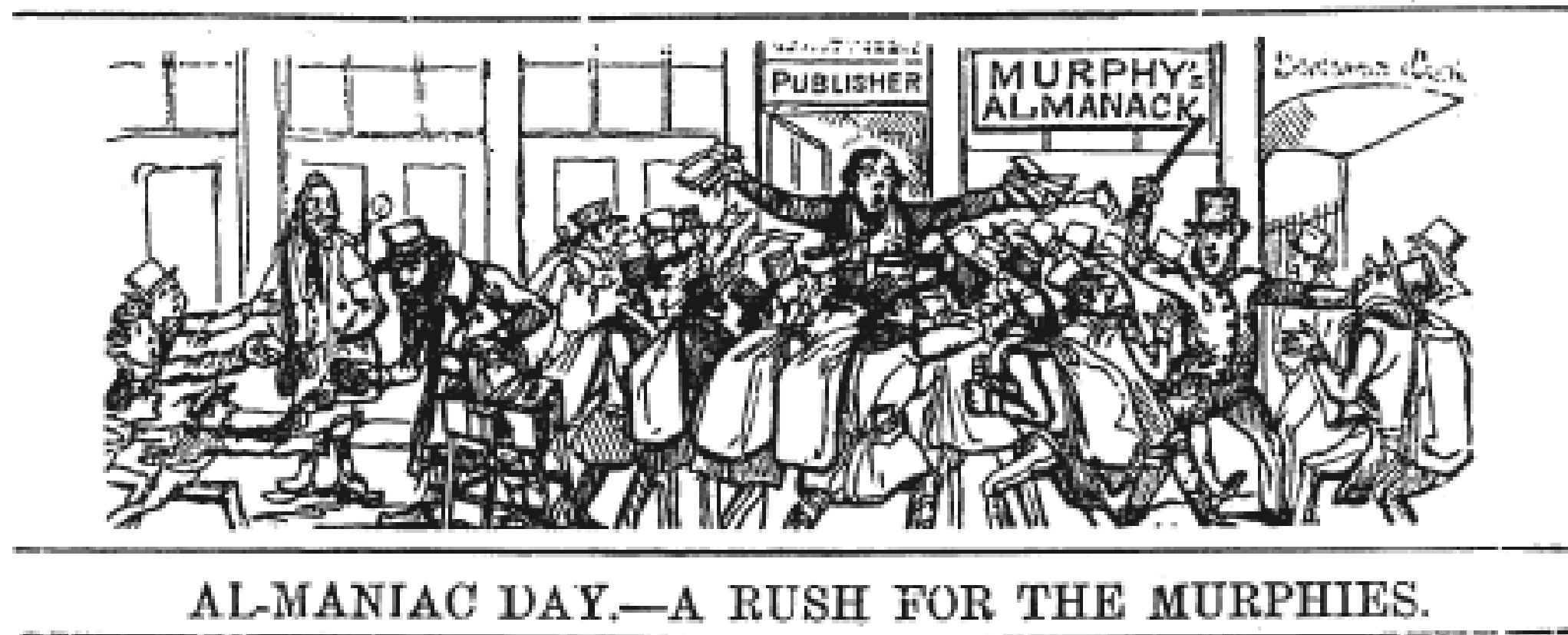


Exceptional greenhouse gas
 levels today compared to
 natural 'recent' past

Luthi *et al.*, 2008, *Nature*

Early Attempts at Prediction

1838: Patrick Murphy (MNS)



Early Forecasting

Robert Fitzroy

Took Darwin round world between 1831 and 1836

1854, British Meteorological Office set up to collect weather data; Fitzroy head

1860, network of observation stations could give warning of impending storms

1861, first national forecasts (coined the term); published in *The Times*

Not everyone satisfied!

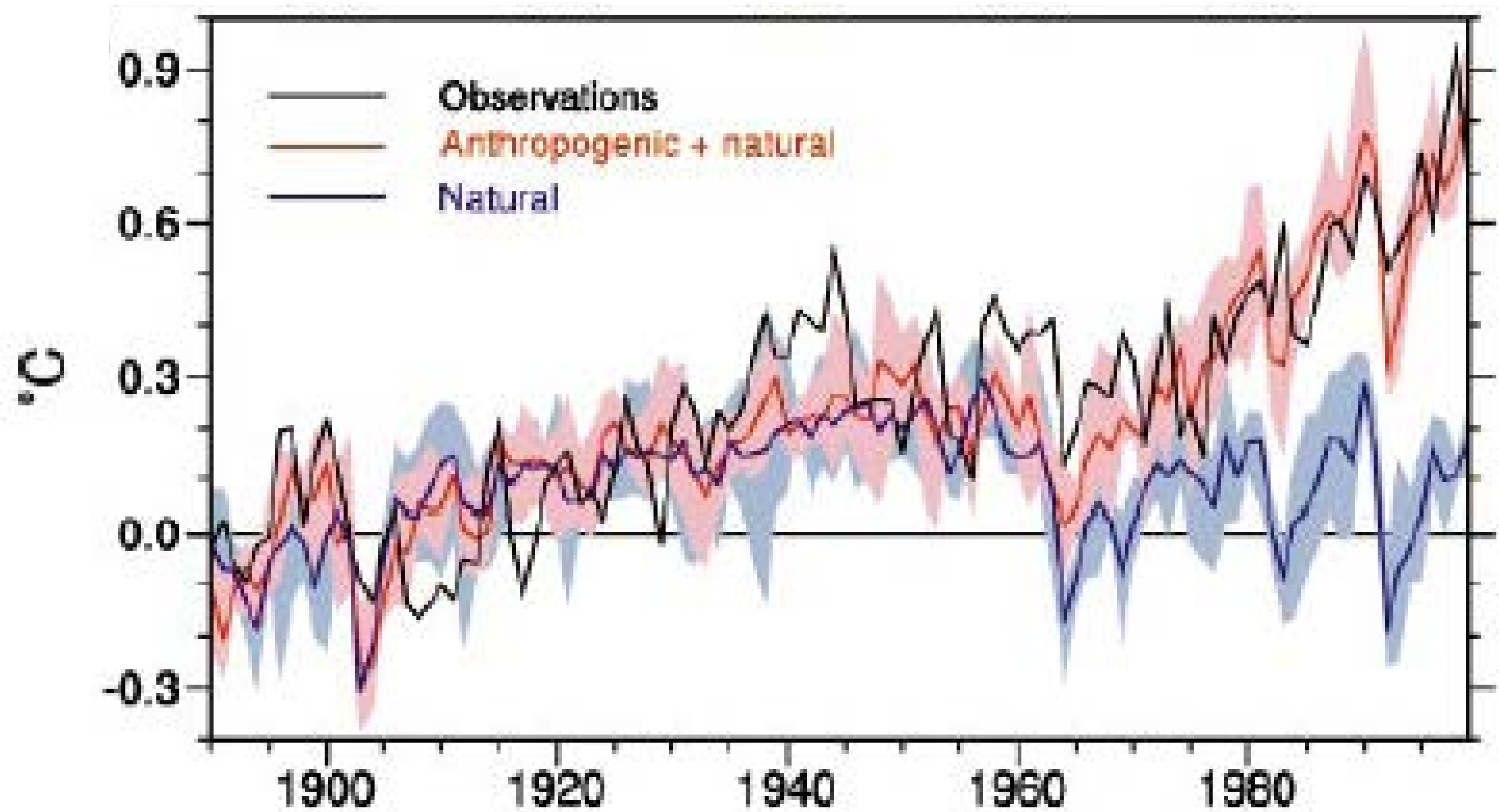
ADMIRAL FITZROY AND THE WEATHER.

TO THE EDITOR OF THE TIMES.

Sir,—Admiral Fitzroy a few days since called attention to a case in which his prediction of a “heavy rotary gale” coincided with a remarkable and prolonged equilibrium of atmosphere. It may help the public judgment on the value of these “forecasts” to point out, while the events are fresh in memory, a converse kind of discrepancy scarcely less curious, a succession of gales occurring without any warning of such events appearing in the published forecasts.



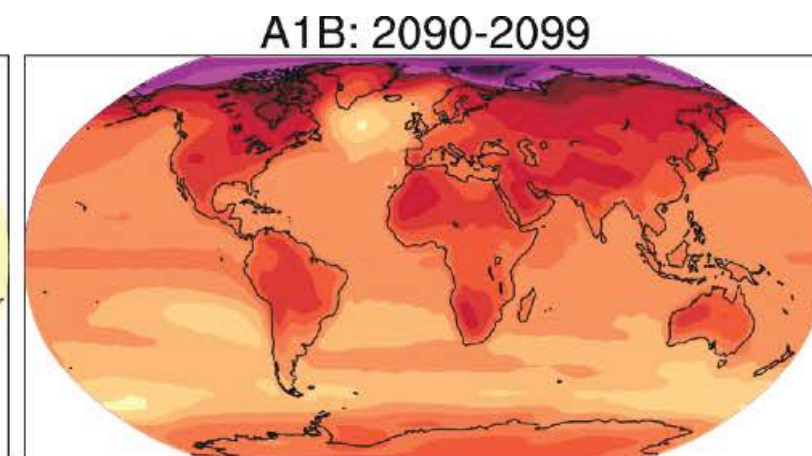
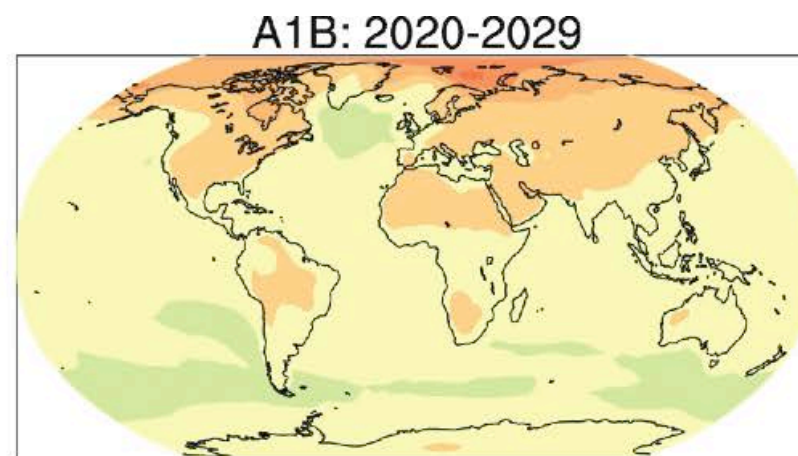
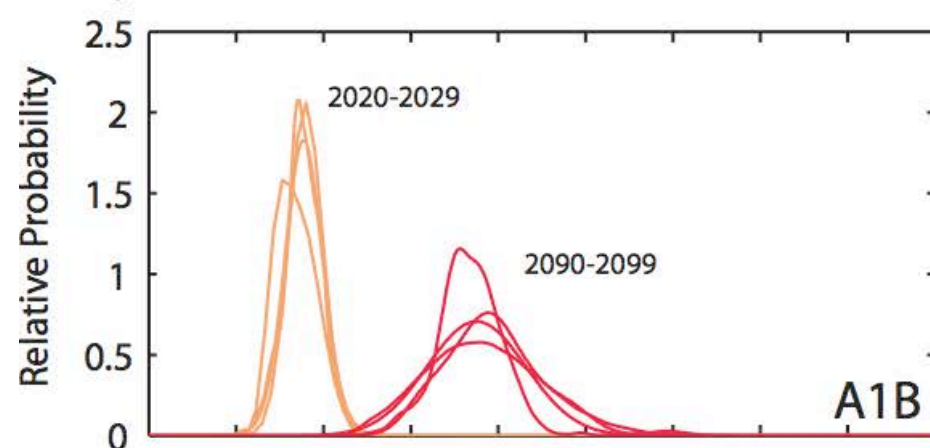
Nature vs. Human



Projections for End of 21st Century

UN Intergovernmental Panel on Climate Change (2007)

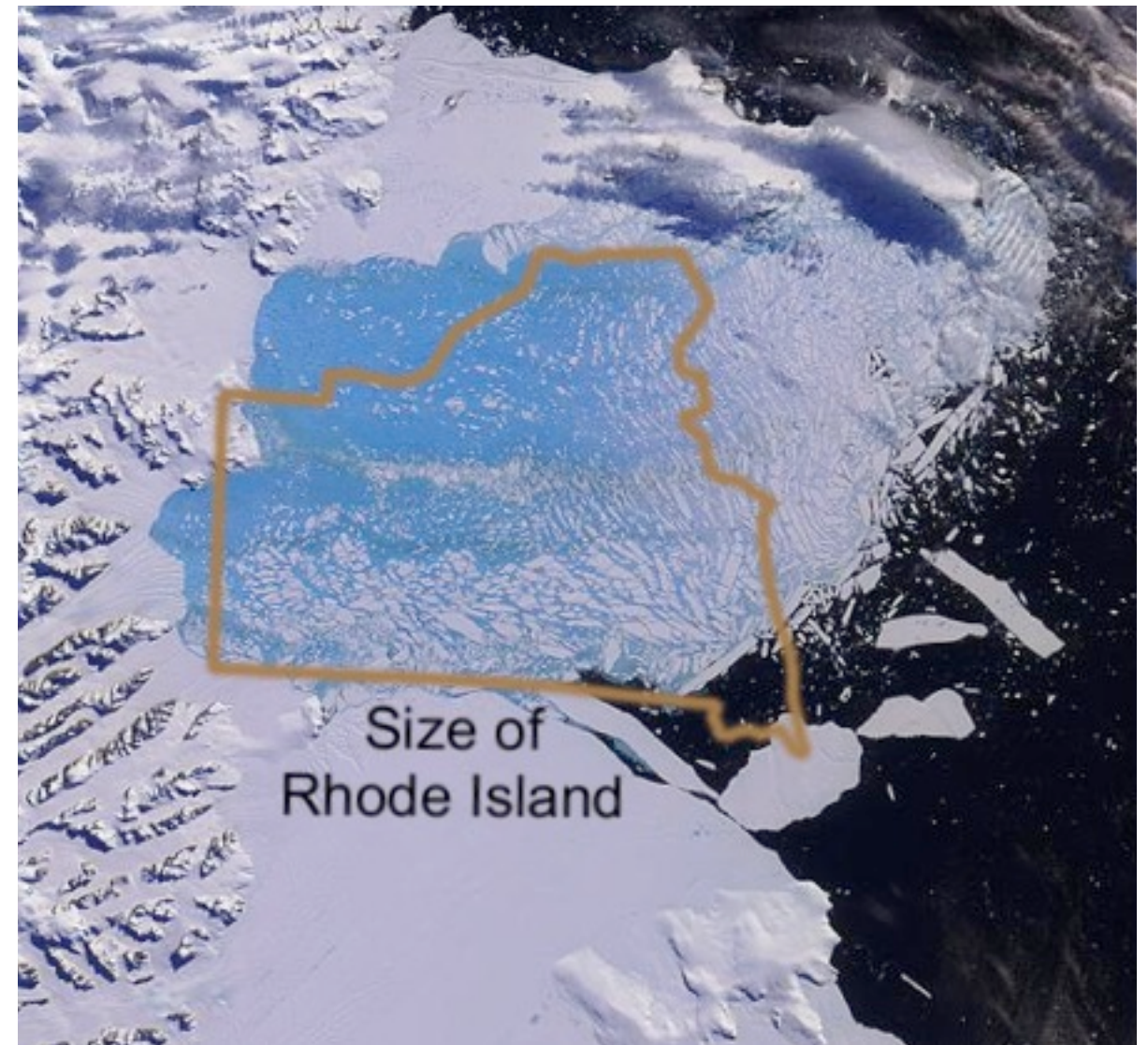
	Temp. °C	Sea Level, m
Global	1.1-6.4	0.18-0.59





Unprecedented
change for 12,000
years

Larsen B (2002)



Domack et al. (2005)

‘Canaries in a coalmine’

- Glacier National Park in the US has lost 80% of 150 glaciers
- Kilimanjaro has had ice for 12,000 years but will be gone between 2015 and 2020



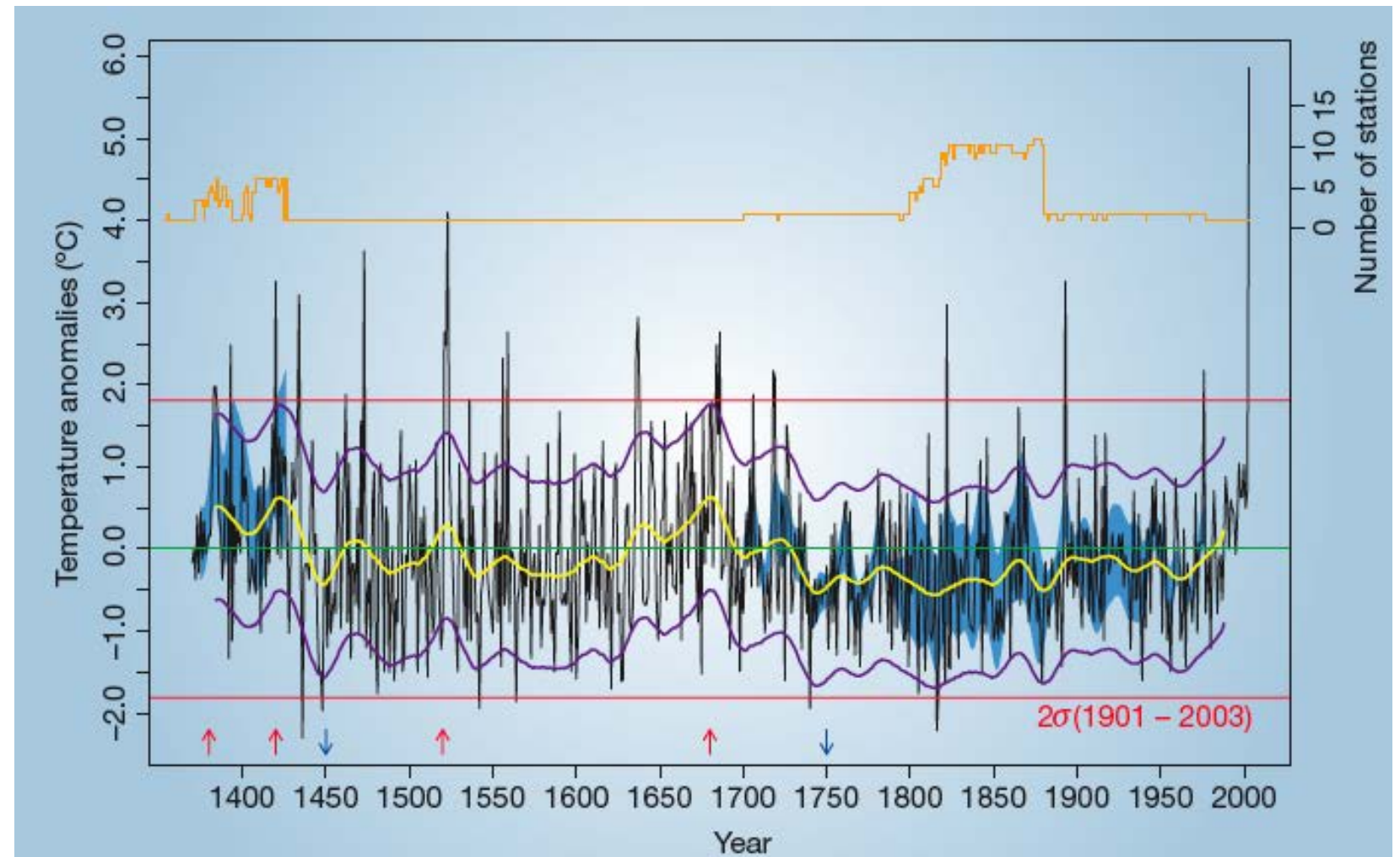
AD 900-1350
(‘Medieval Climate
Anomaly’)



AD 1350-1850
(‘Little Ice Age’)

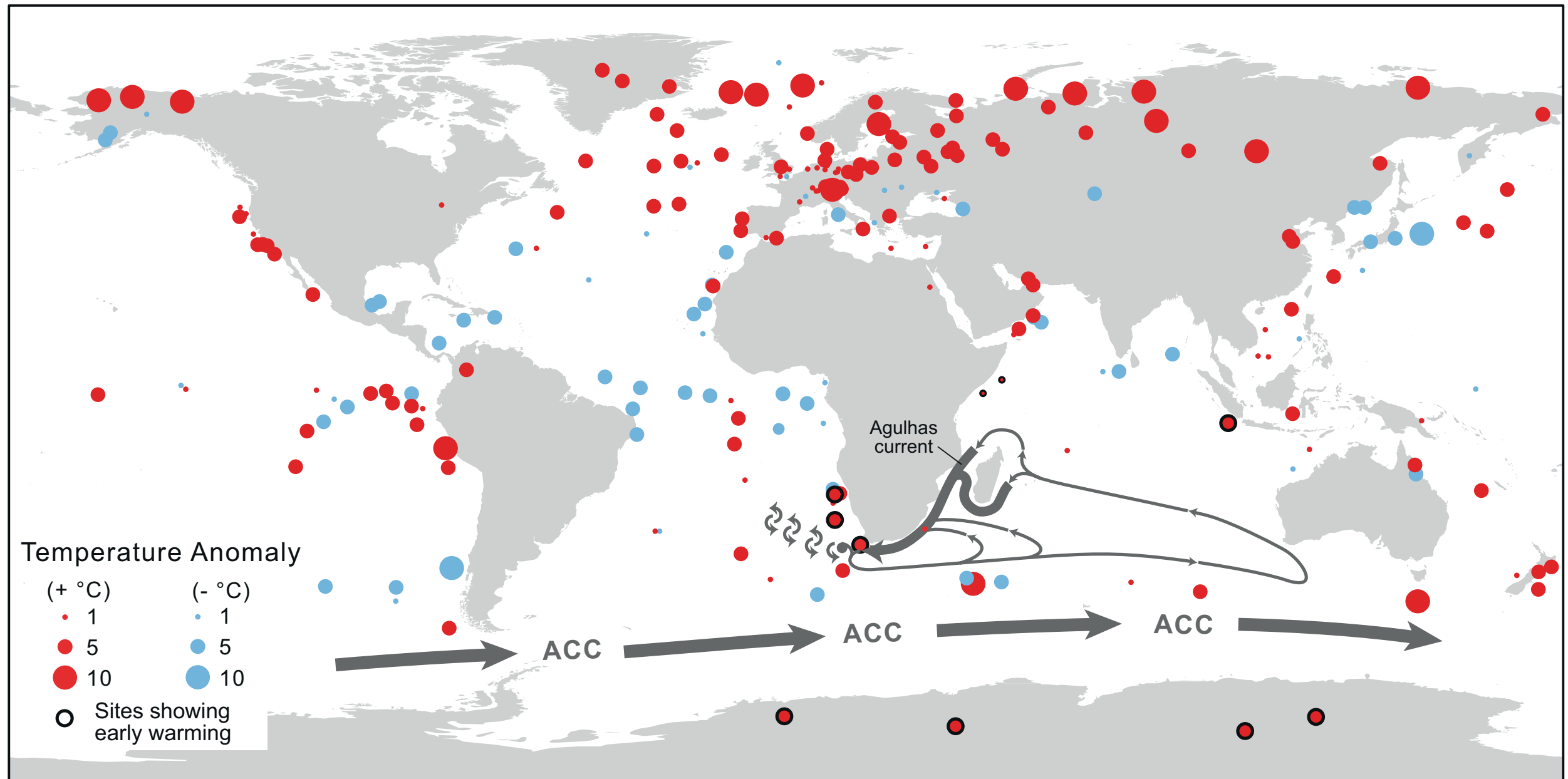


Using Burgundy Pinot noir grapes (Chuine et al., 2004)



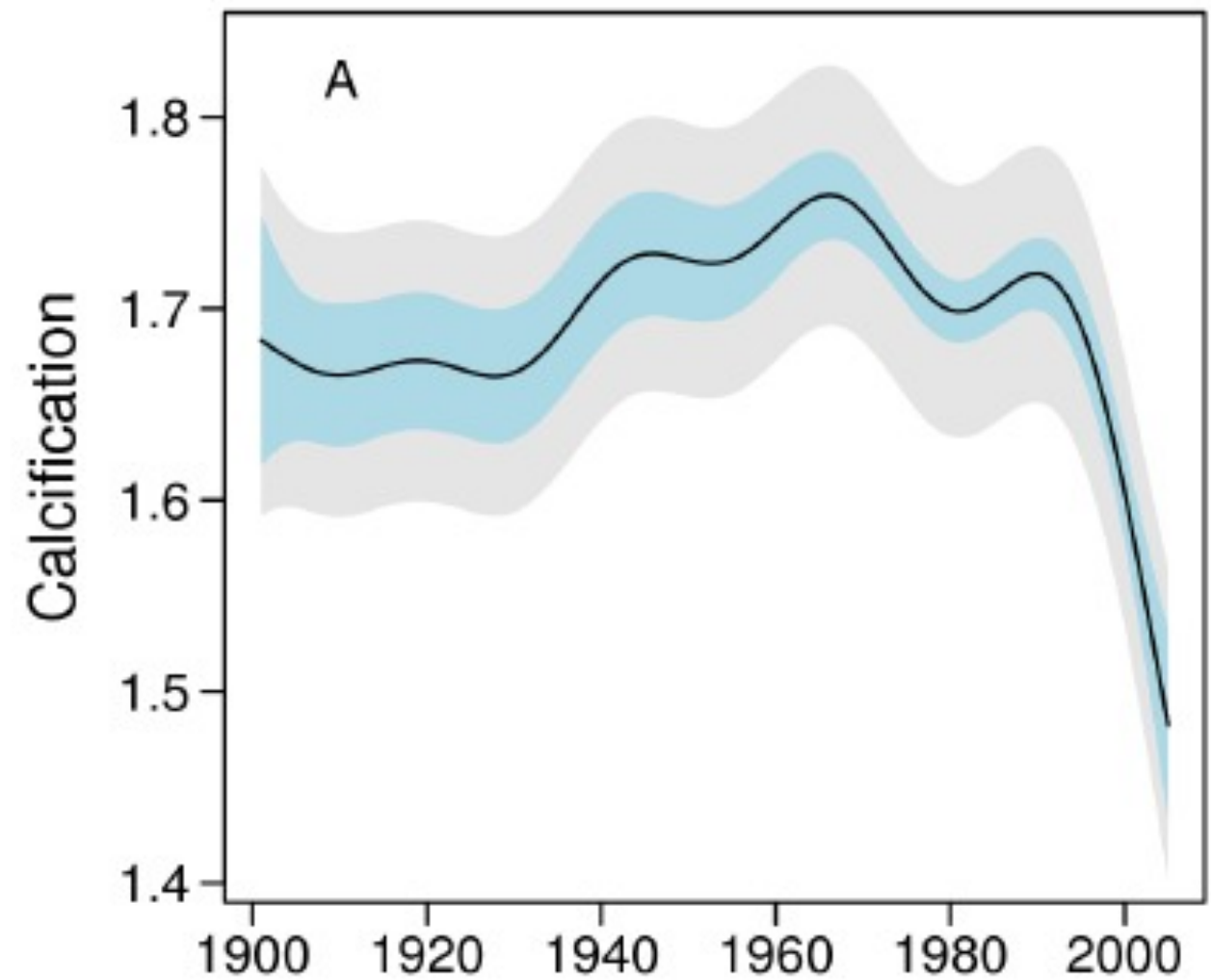
2003 6°C warmer than normal over past 633 years

The Last Interglacial (130,000-116,000 years ago) 19



~2°C warmer than pre-industrial temperatures
Sea level 6.6-9.4 metres higher than today

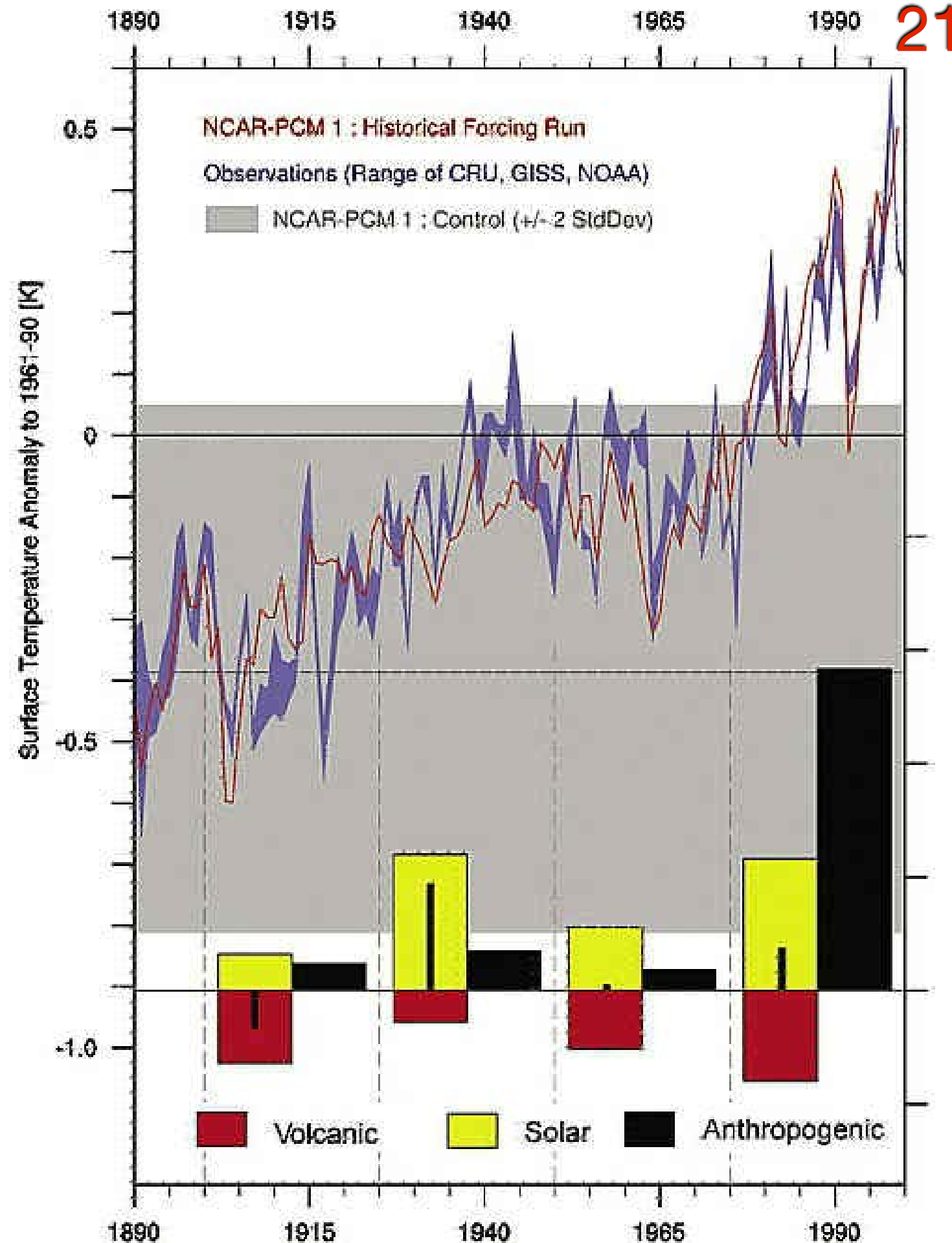
It's Not Just About Climate



De'ath *et al.*, 2009, *Science*

Volcanic Forcing: A Future Option?

- Volcanic ash and sulphate aerosols can help reflect incoming sunlight
- Paul Crutzen (2006) suggested injecting sulphate into stratosphere to offset warming
- Note highest temperature in 1998



Positive proof of global warming.



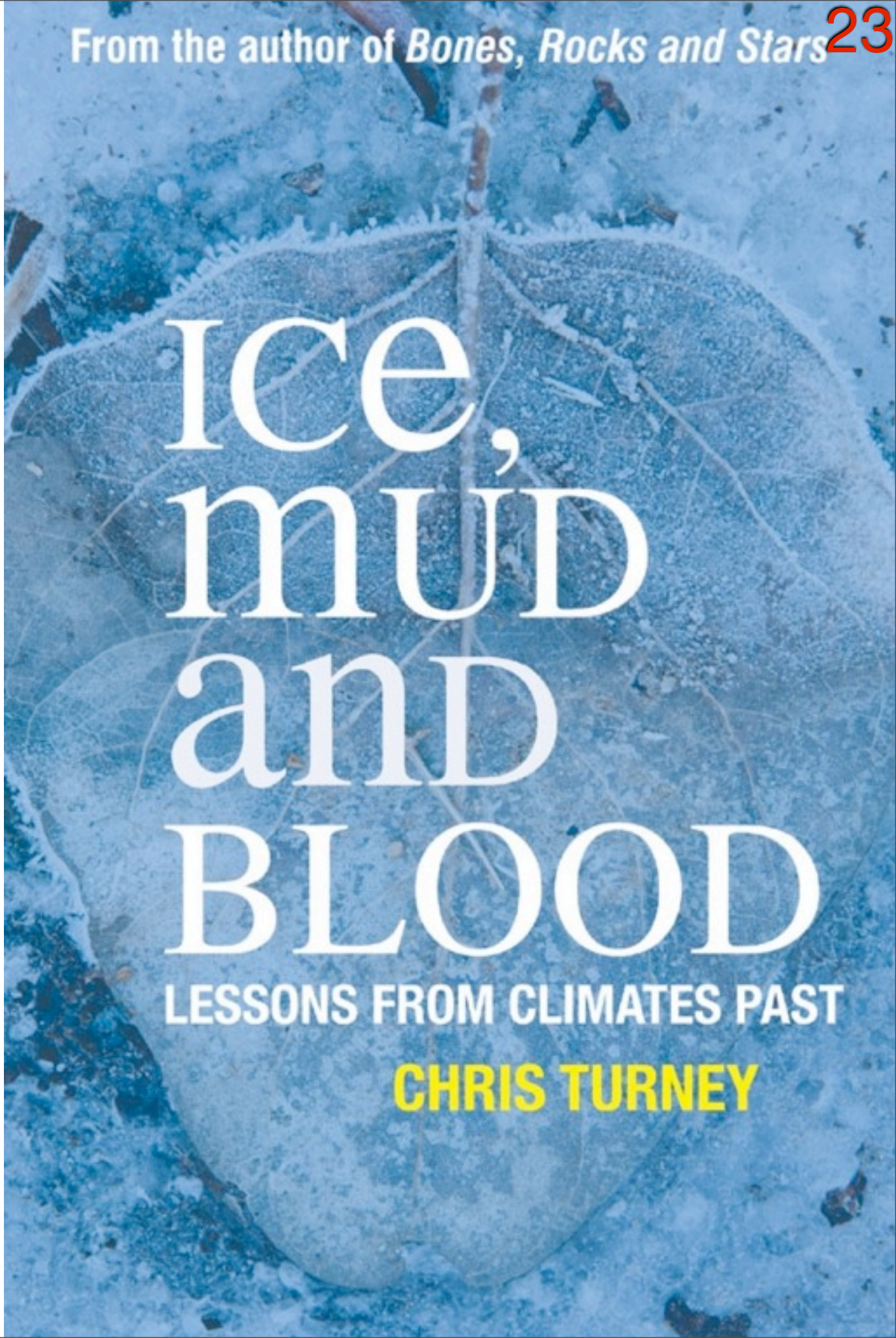
Final proof!

Chris Turney

Climate Change Research Centre
and School of Biological Earth
and Environmental Sciences,
UNSW

Popular science website:
www.christurney.com

From the author of *Bones, Rocks and Stars* ²³



Ice, mud and BLOOD

LESSONS FROM CLIMATES PAST

CHRIS TURNEY