Basic climate science and the threat from fossil energy

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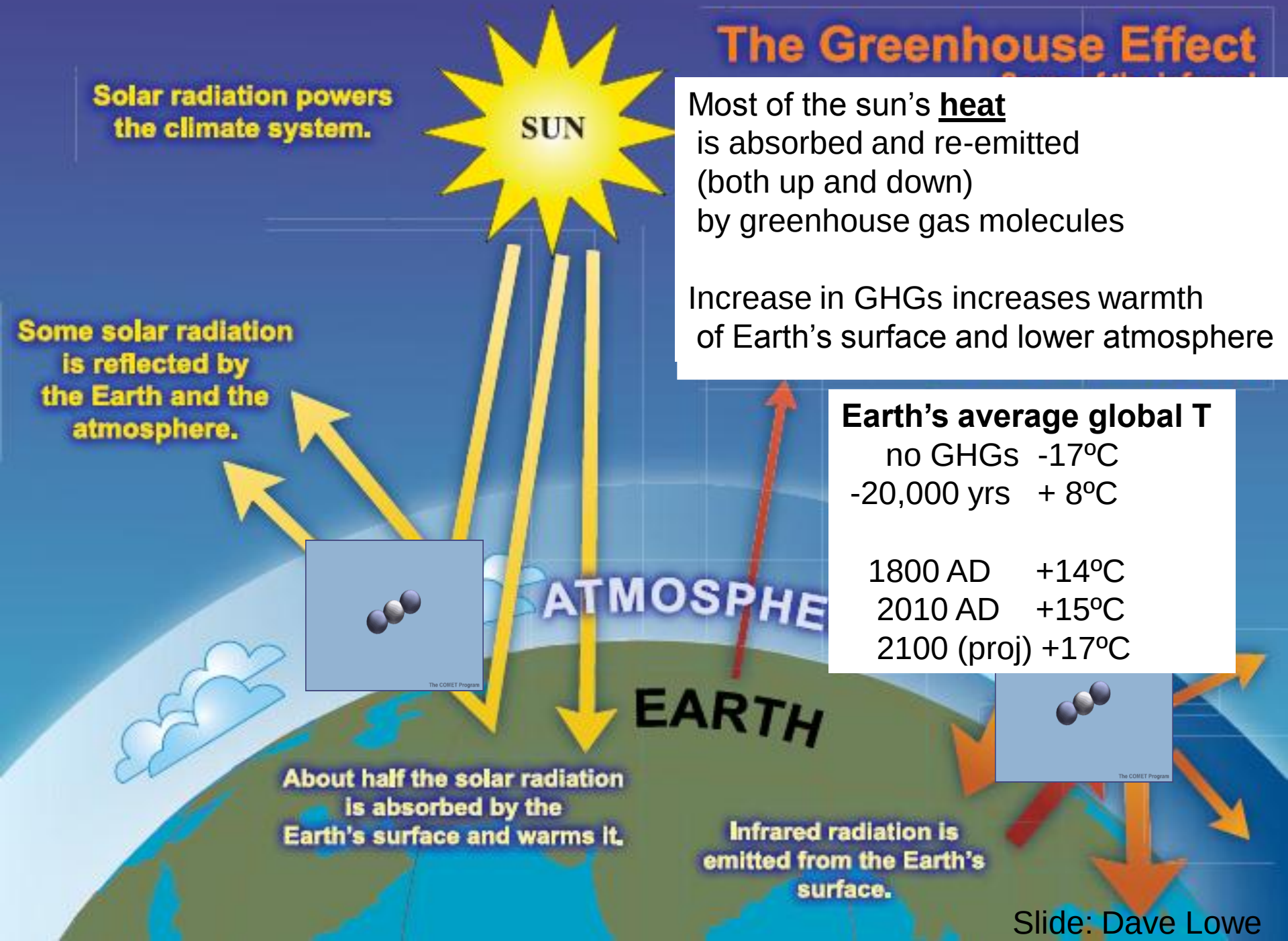
Barrett farm, Koromatua, ~1960

The Greenhouse Effect



Most of the sun's **heat** is absorbed and re-emitted (both up and down) by greenhouse gas molecules

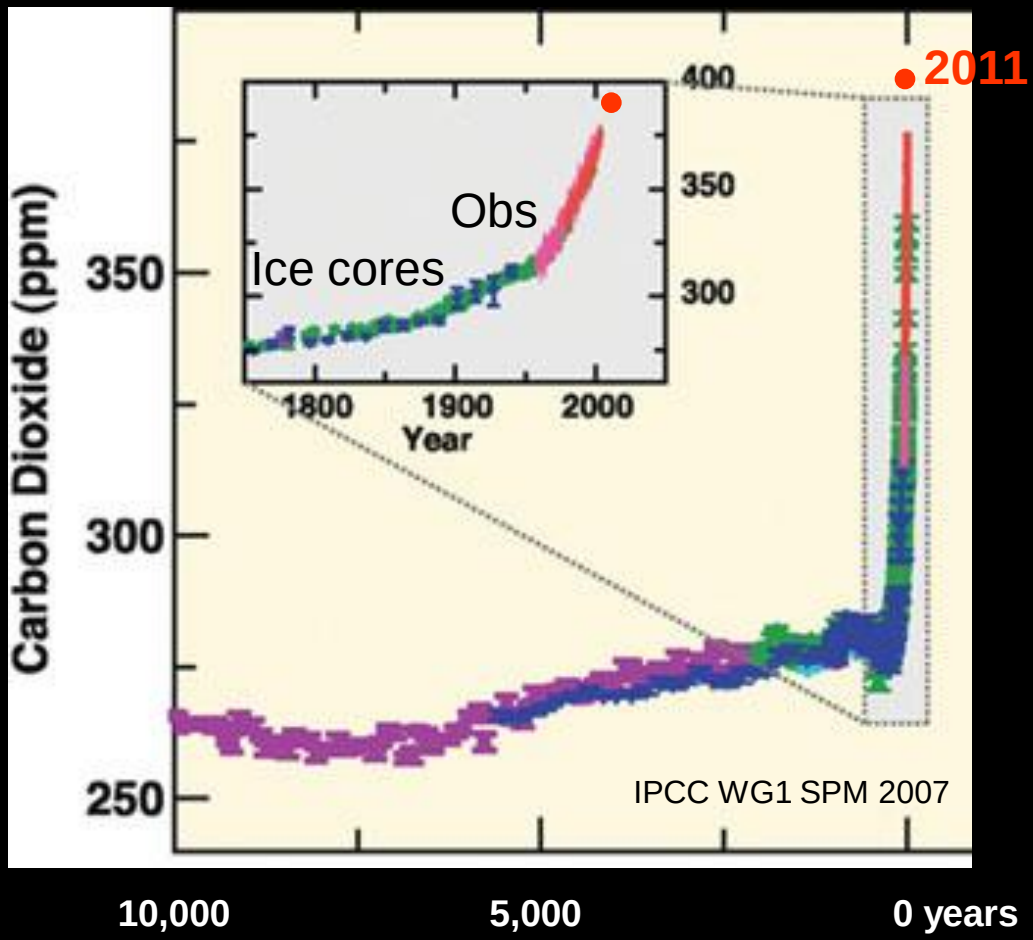
Increase in GHGs increases warmth of Earth's surface and lower atmosphere

Earth's average global T

no GHGs	-17ºC
-20,000 yrs	+ 8ºC
1800 AD	+14ºC
2010 AD	+15ºC
2100 (proj)	+17ºC

Slide: Dave Lowe

CO_2 for last 10,000 years



levels varied between 260 and 280 ppm until ~1900 – now 39

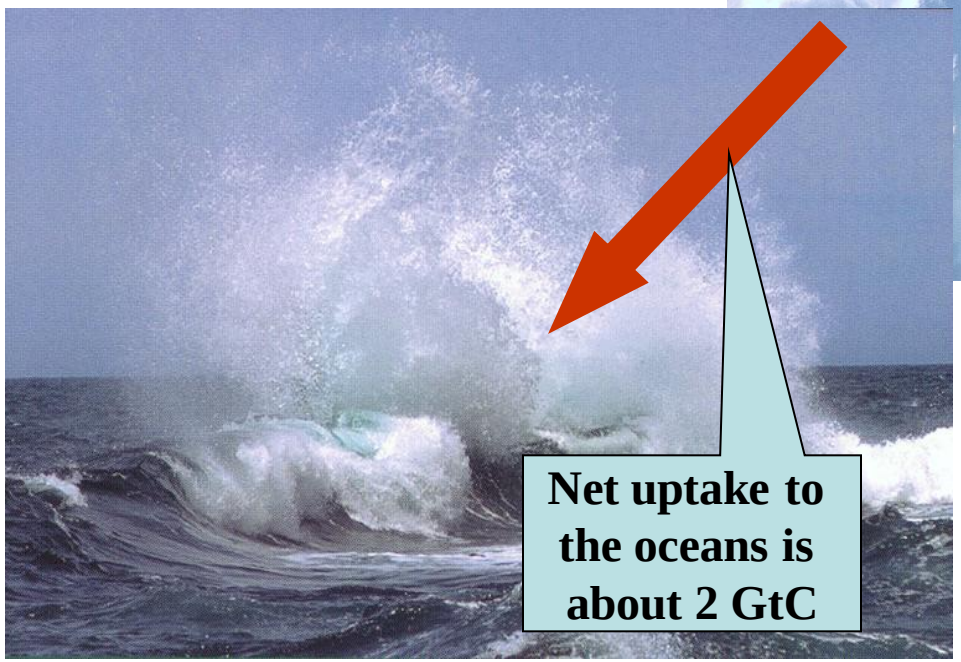
Changing the carbon balance: the enhanced greenhouse effect

Power
Transport
Heating

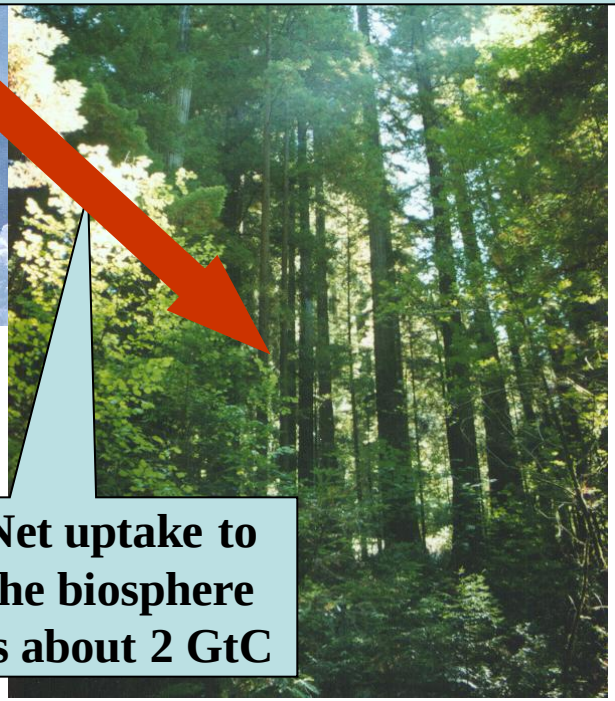
Fossil fuel emissions added 8.8GtC in 2008 to the atmosphere as CO_2. Deforestation added another 1.5GtC

The atmosphere gains about 6 GtC each year ..ie about 60% of the added CO_2 stays in the atmosphere

- ½ left after 5000 years
- ¼ stays indefinitely



Net uptake to the oceans is about 2 GtC



Net uptake to the biosphere is about 2 GtC

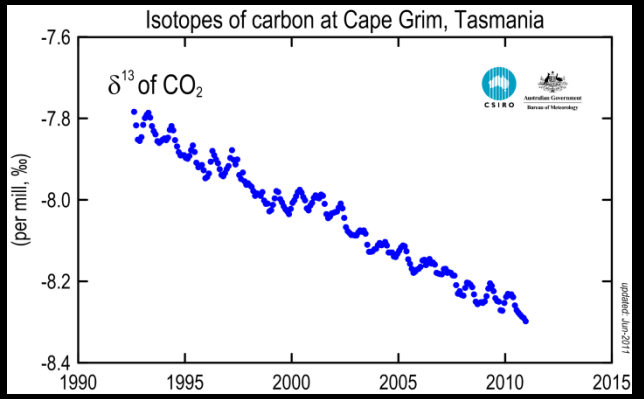
Note 1 GtC = 1 billion tonnes of carbon = 10^{12}kg C

Slide: Dave Lowe

What shows extra CO_2 comes from fossil fuel?

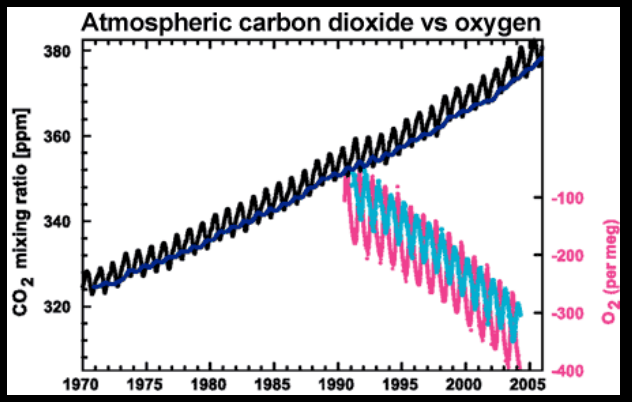
1. Budget (previous slide) shows
   Fossil fuels burned annually
   ~= increase in atmosphere less uptake by oceans

2. Isotope ratio for atmospheric carbon shows increasing dilution over last century from "light" carbon characteristic of fossil hydrocarbons (typically -20 to 25 permil)



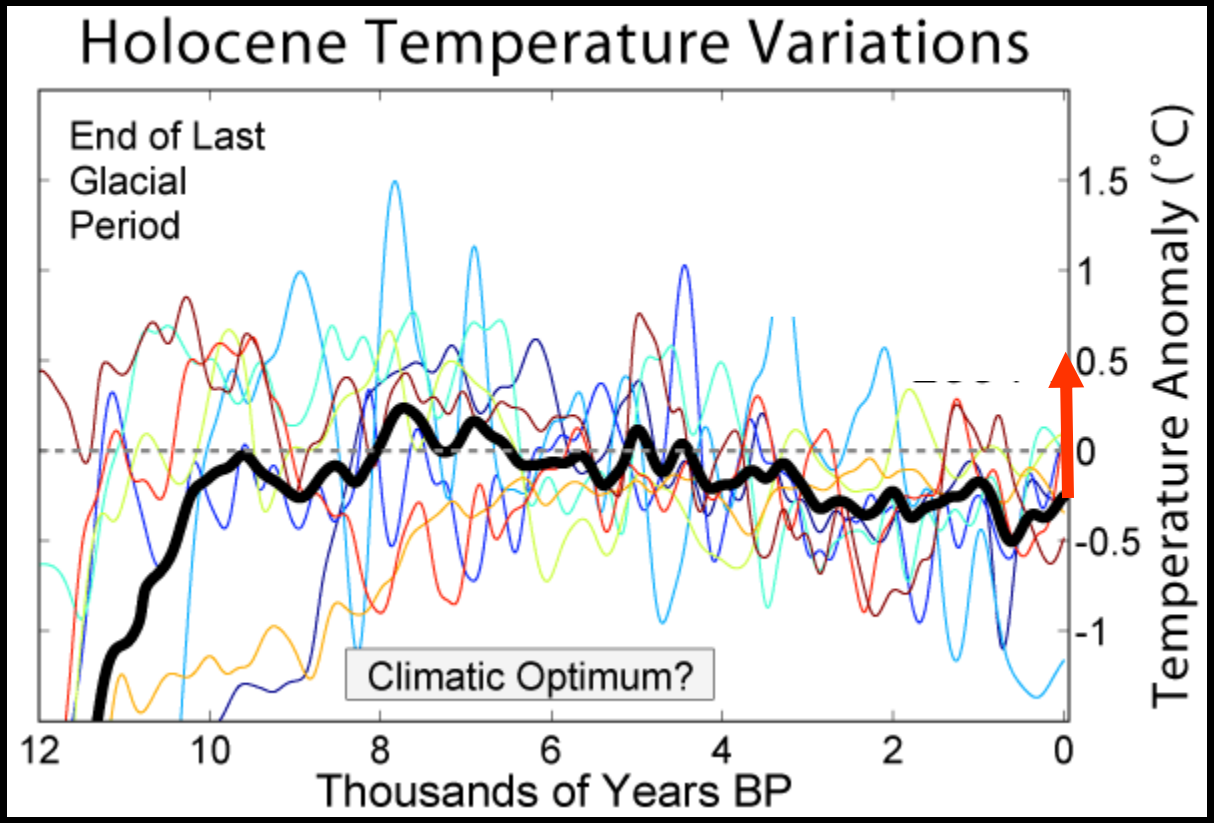
www.skepticalscience.com/pics/cg_d13C.png

3. Atmospheric oxygen levels (blue/pink) are declining as CO2 (black) rises, as expected from burning fossil fuels.



IPCC 2007 AR4 WG1 Fig 2.3

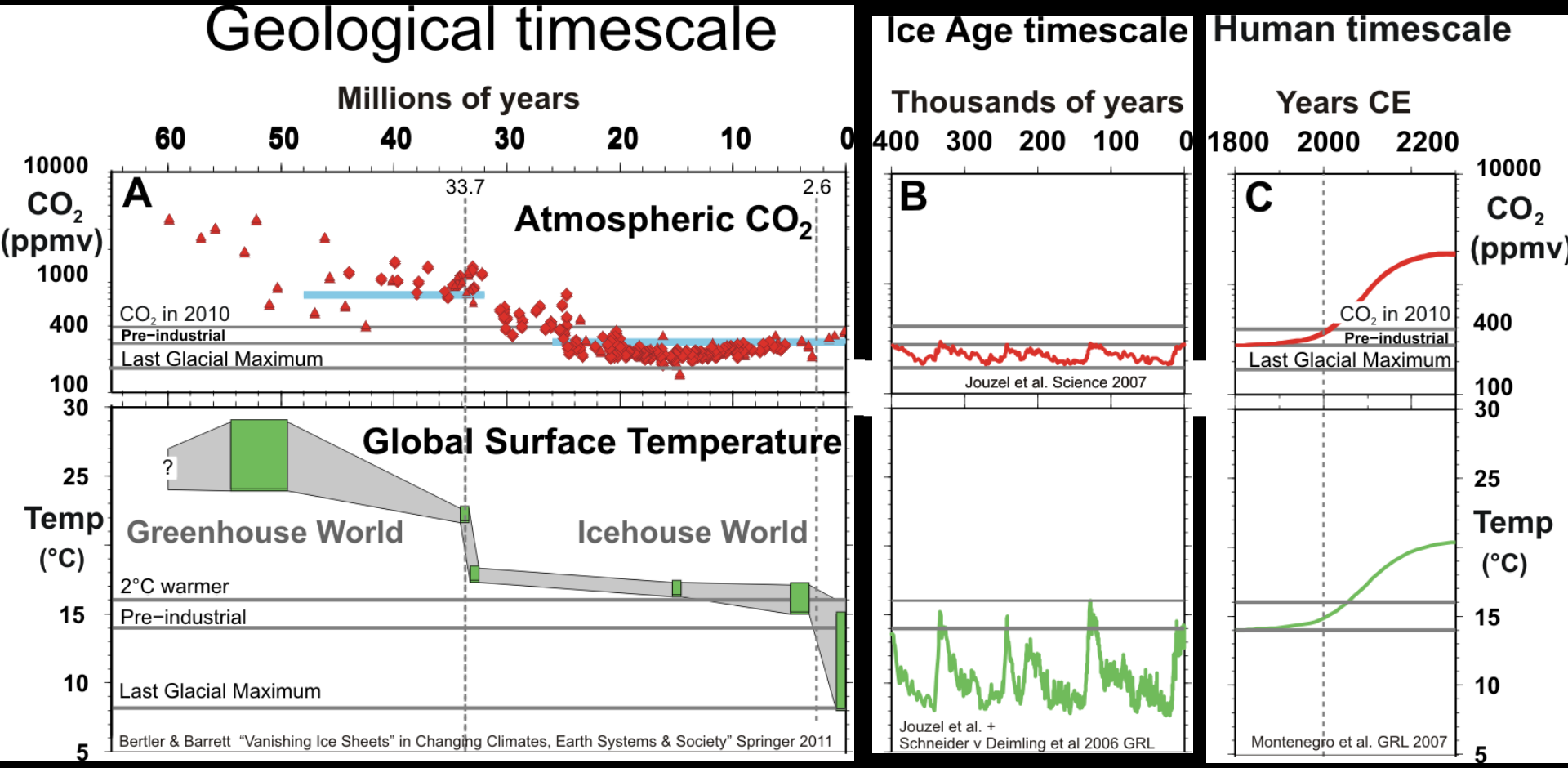
Global avr T for last 10,000 years



Up 0.8°C since 1900 [with further 0.8°C to come]

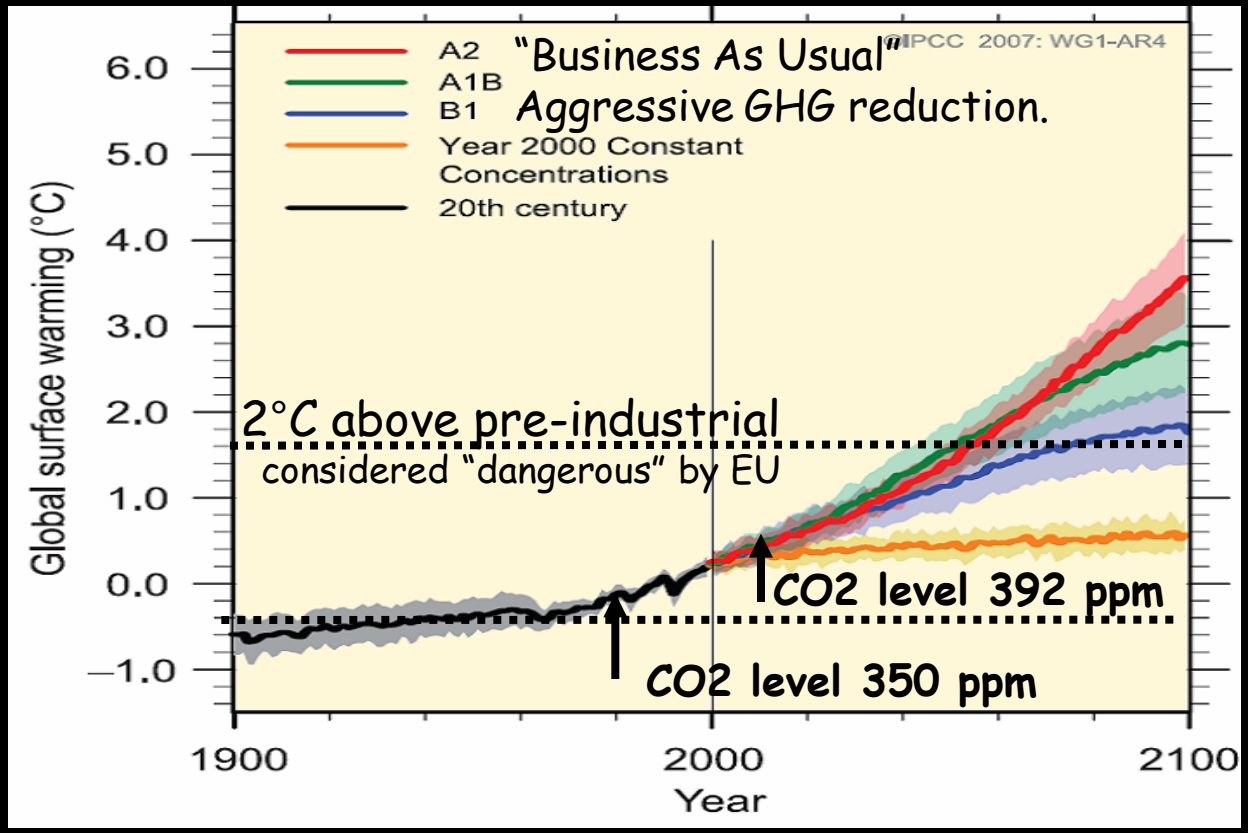
http://www.globalwarmingart.com/wiki/File:Holocene_Temperature_Variations_Rev_png

Global T and CO_2 over the last 65 million years



CO_2 already higher than during the Ice Ages. Projected to reach "Greenhouse World" with BAU by 2200 with T following.

The next 100 years

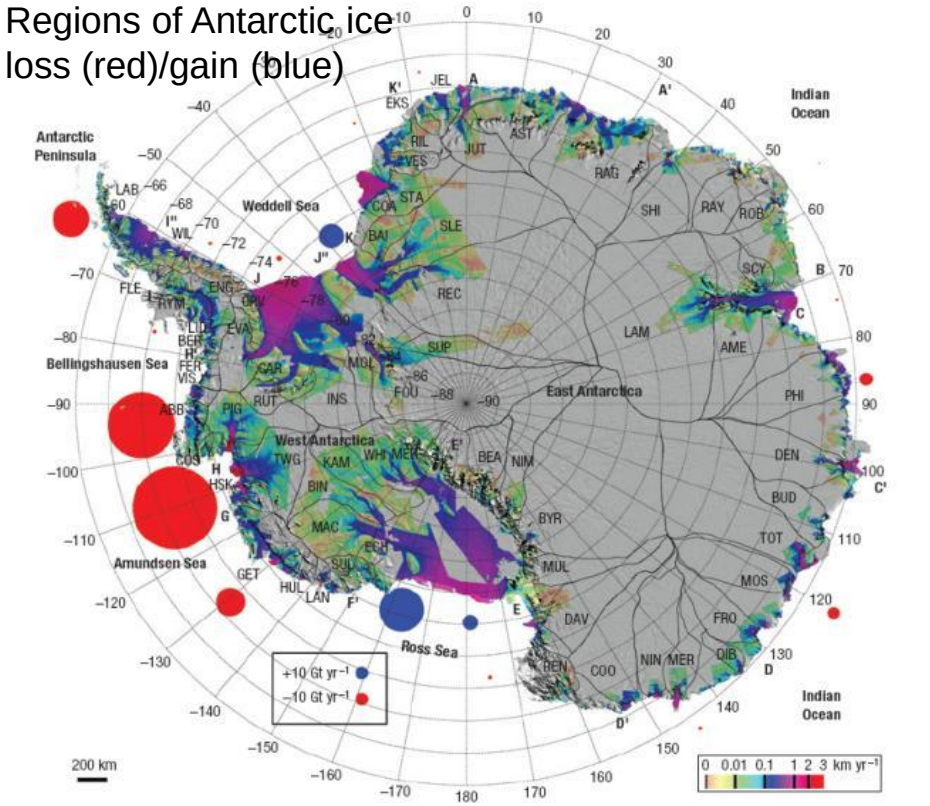


Decisions in the next few years determine long term trends

Loss from ice sheets over last two decades

Based on satellite measurements

Regions of Antarctic ice loss (red)/gain (blue)



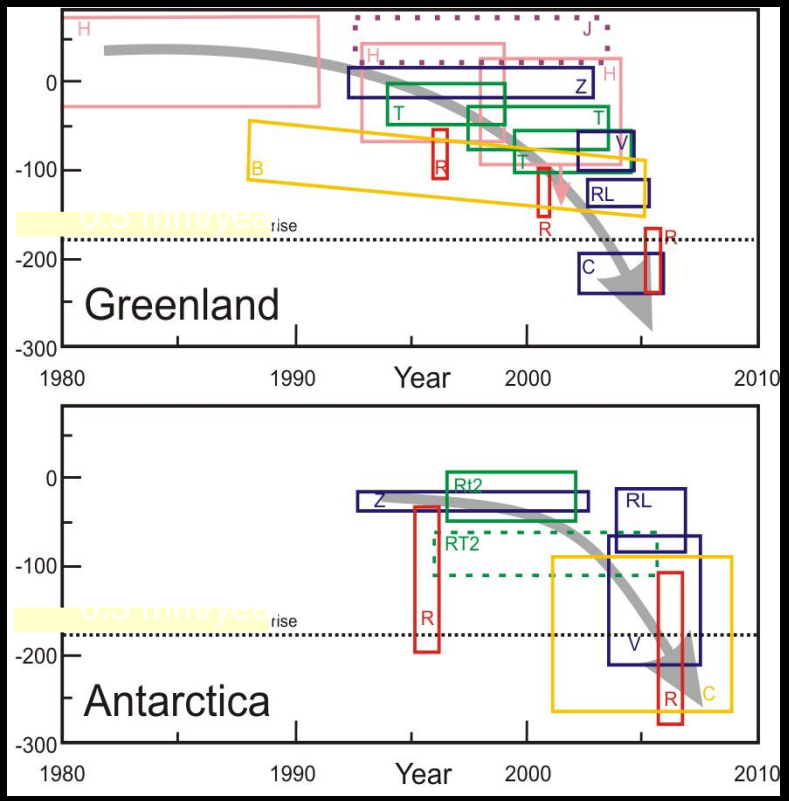
Net loss for 2006 0.5 ± 0.3 mm SLE*

Rignot et al. Nature 2008

*Sea Level Equivalent

Ice loss/gain (billions of tonnes/year)

(various satellite studies – see Bertler & Barrett 2010 "Vanishing ice sheets")



Loss from both ice sheets

1.3±0.4 mm/year SLE* and rising

Rignot et al. GRL 2011

Credible sea level rise (all sources) by 2100

0.8 to 2 m

Pfeffer et al. Science 2008

Consequences

- rising sea level from warming oceans and melting ice

- more and greater extreme weather events from more energetic atmosphere with more water vapour

- consequences of these + higher temperatures and increased ocean acidity for life on earth (humans included)

Consequences

BUSINESS NEWS

$A1.7b The cost of damage from a 1999 hailstorm in Sydney.

Extreme weather outguns quakes

Canterbury's quakes may worry reinsurers, but they have bigger fears. Rob Stock reports.

NEW ZEALANDERS can be forgiven for being fixated on the impact of geophysical catastrophes such as the Christchurch earthquakes, but in our region and around the world it is weather and water posing the fastest-growing threats.

The number of earthquakes, tsunamis and volcanic eruptions has risen slightly over the past 30 years, however, it is the frequency of major storms, floods and extreme weather events, including droughts, that is causing the biggest concern.

Together, these have tripled over the same period, according to data from major reinsurance provider Munich Re, which says the annual frequency of weather and "hydrological" catastrophes has risen globally from under 400 in 1980 to over 900. Last year saw 960 catastrophes.

Munich Re's Martin Kreft told *Sunday Star-Times* that 2011 looks to be heading for a similar figure.

Insurance premiums have been rising as reinsurers raised their higher average water levels and storms result in more claims.

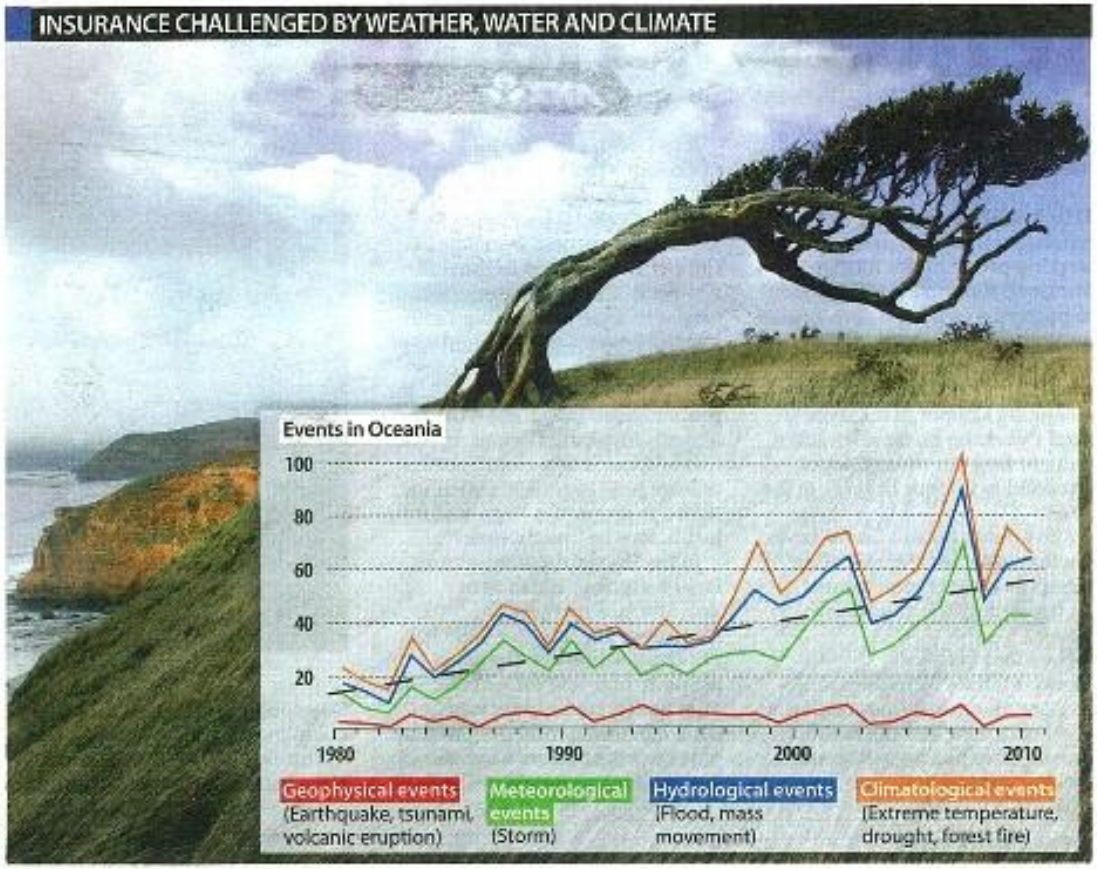
Ryan said property buyers would have to be as aware of insurance costs as they now are of the rates bill. The changes would also in time lead to insurers offering reductions in their premiums if owners excluded damage from specific causes, such as storm damage for coastal properties.

In time that could also drive patterns of property ownership away from areas where insurance costs are prohibitive, or where such "exclusions" apply. Those changes are still probably years away, but one major event could trigger changes much sooner.

Over time the track for reinsurance premiums, and hence home insurance here, would rise, but it was unlikely to do so in a straight line, said Kreft.

Big insurance events could drive sudden spikes in premiums for a region, and quiet periods could see them ease.

A good example of that has



Fossil CO_2 release a legacy issue

- Socioeconomic dependence on fossil energy with built in commitment of decades
- Only half of T rise from CO_2 is immediate – rest takes several decades
- Once released CO_2 absorbed slowly – about half left after 5000 year

Note: we are burning up fossil CO_2 about a million times faster than it was sequestered

Alternatives to fossil solar energy

- reduce energy use
  (better efficiency/housing/public transport)

- shift to real time solar energy
  (Wind/hydro/tidal/wave/solar direct)
  (+ non-solar geothermal)

SUMMARY

What we can be sure of

- Recent T rise is due to CO_2 rise (directly & indirectly)
- T rise will continue until net GHG emissions are reduced to zero

What to do

- move to a sustainable lifestyle and encourage family, colleagues and community to do the same

  [think energy efficiency/fossil fuel reduction]
- stay cool with those that don't get it yet
- stay informed