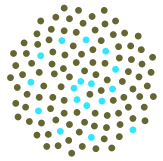


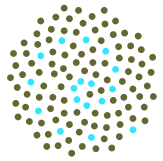
Emission reduction targets: Where do they come from?

Ian G. Enting

MASCOS

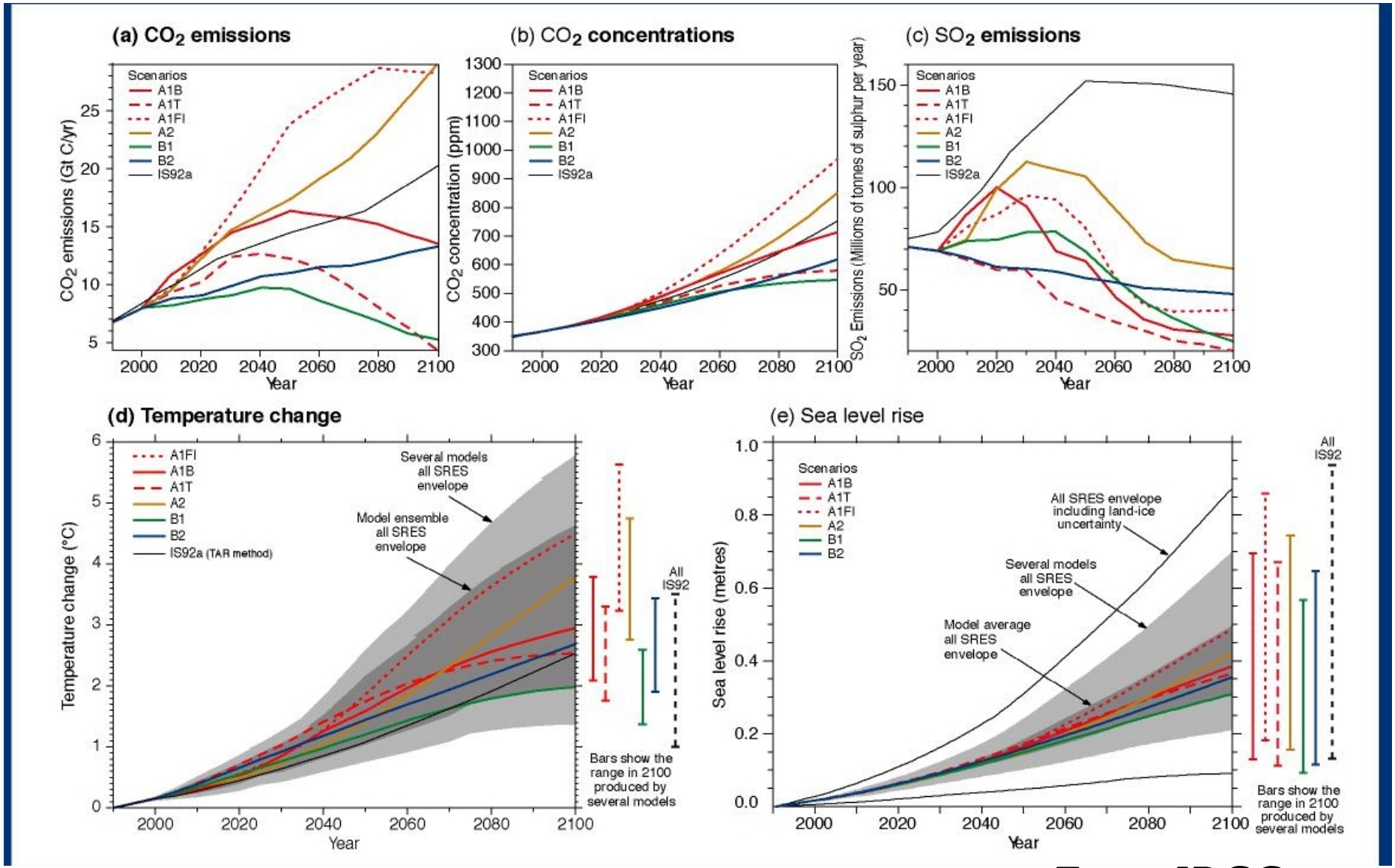
The University of Melbourne

Summary



- The anthropogenic greenhouse effect
- The carbon cycle
- Stabilising carbon dioxide
- National targets
- The real climate debate – the role of feedbacks

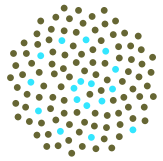
Greenhouse warming



From IPCC.

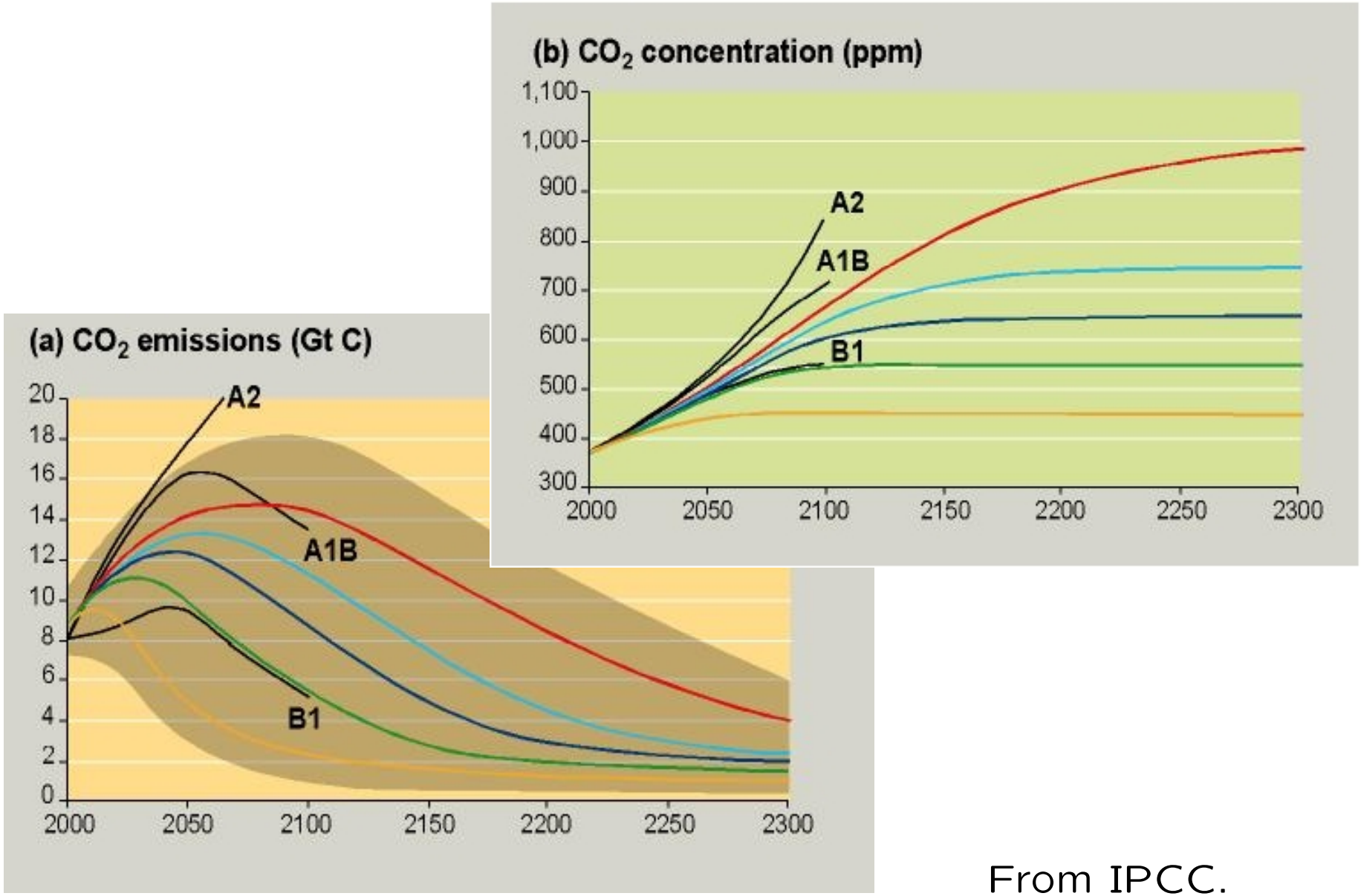
Dispelling the myths about climate change science: Emission reductions

21st century warming



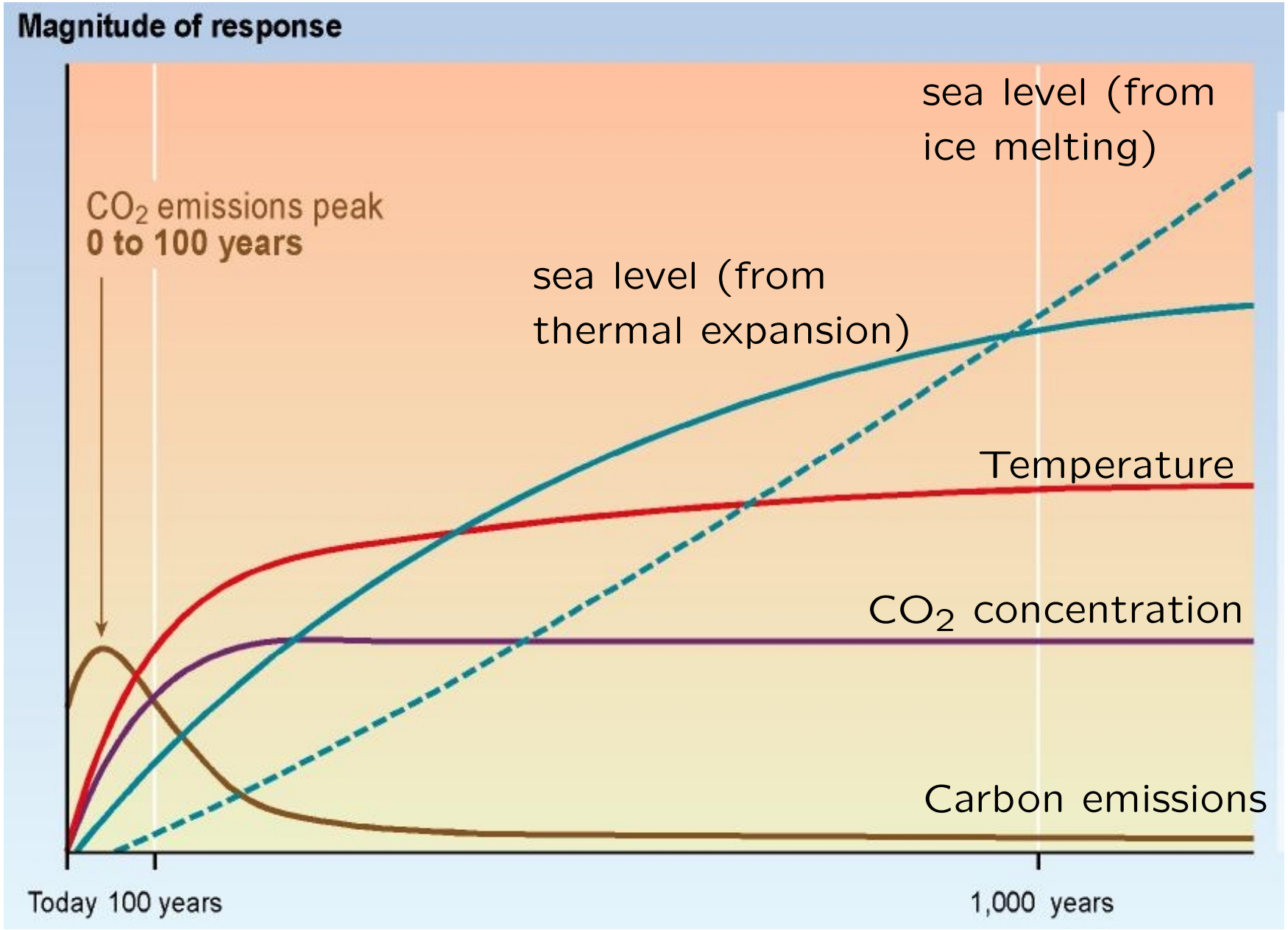
	*** 7 ***	Billions will die
Alarmism	*** 6 ***	Shut-down of Gulf Stream
	— — —	
	*** 5 ***	Combined ‘worst-case’
Serious risks	*** 4 ***	Ice-sheet instability
.	*** 3 ***	Carbon-climate feedbacks
IPCC low-end	*** 2 ***	Proportional warming
	— — —	
Downplay	*** 1 ***	Warming is good
Denial	*** 0 ***	Earth is cooling

Stabilising CO_2



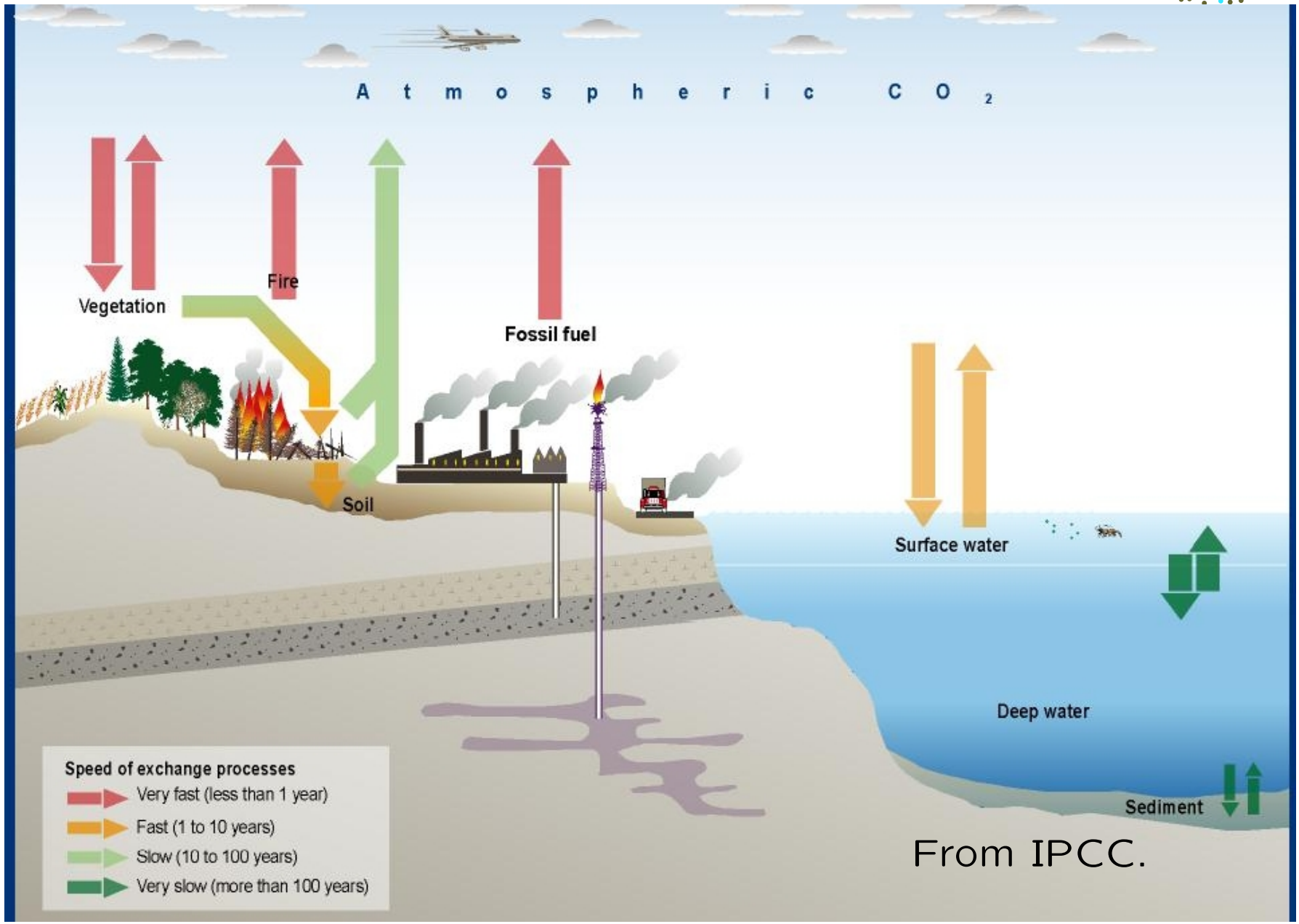
From IPCC.

Timescales

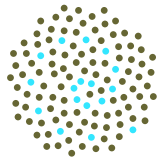


From IPCC.

The carbon cycle



Carbon budget: 1980-99

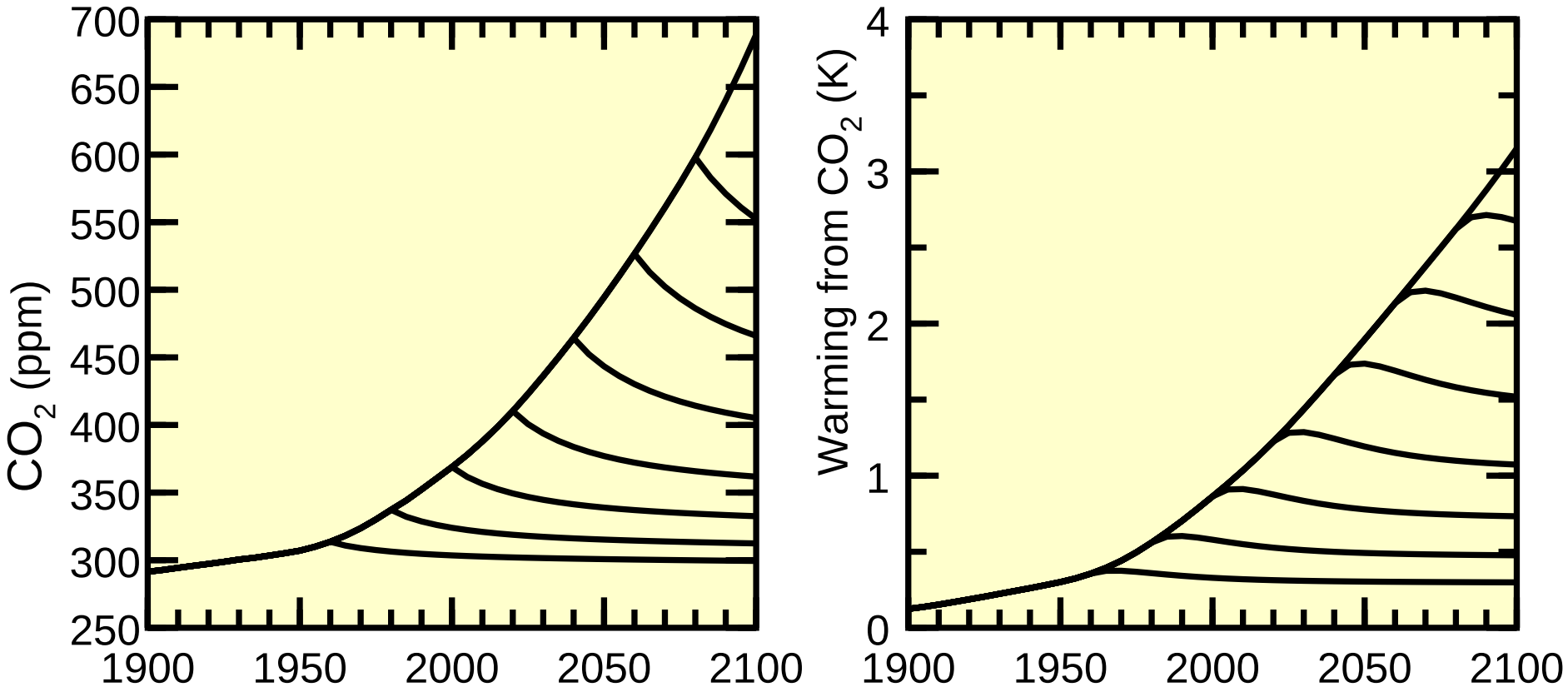


Reservoir exchange	Natural 2-way exchange	Net human addition
Fossil to atmosphere	–	5.9 GtC/yr
Atmosphere to oceans	70+20 GtC/y	1.9 GtC /yr
Atmosphere to land	56 GtC/yr	1.8 GtC/yr
Deforestation etc	–	1.2 GtC/yr
Net atmospheric increase		3.6 GtC/yr

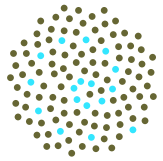
The carbon as CO_2 from human activities is redistributed between atmosphere, oceans and land vegetation, unlike other greenhouse gases such as CH_4 which, are completely destroyed by various loss processes.

A slowly responding system

CO_2 and temperature, from emissions in 20-yr blocks.
Concentration from past emissions drops off slowly;
Warming from past emissions drops off even slower
(after initial increase — committed warming)



Deducing emission targets



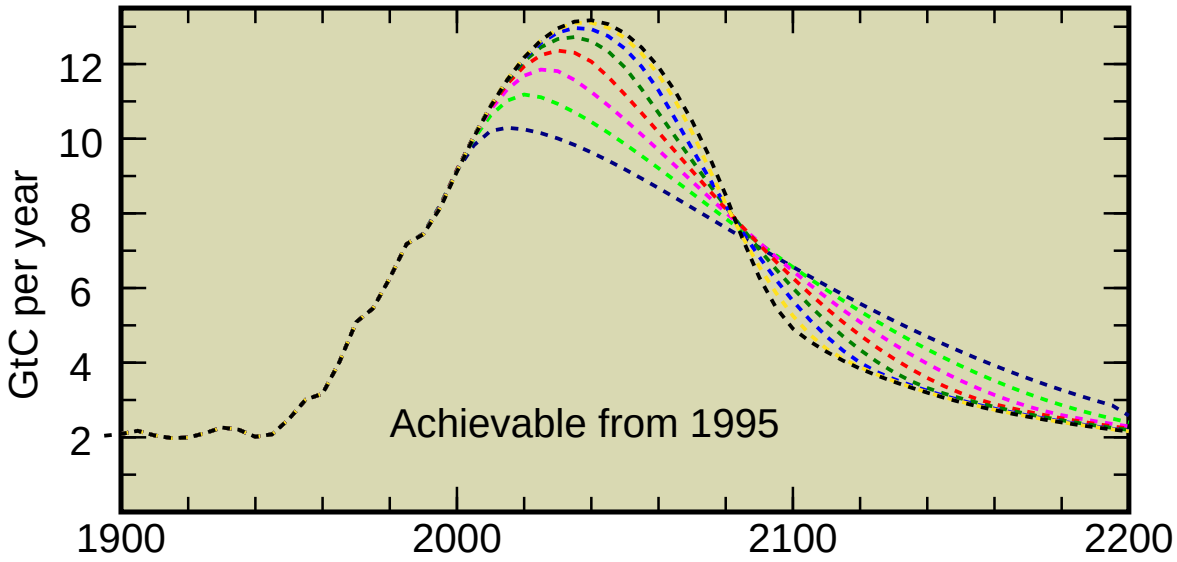
Usual modeling determines concentrations from sources:

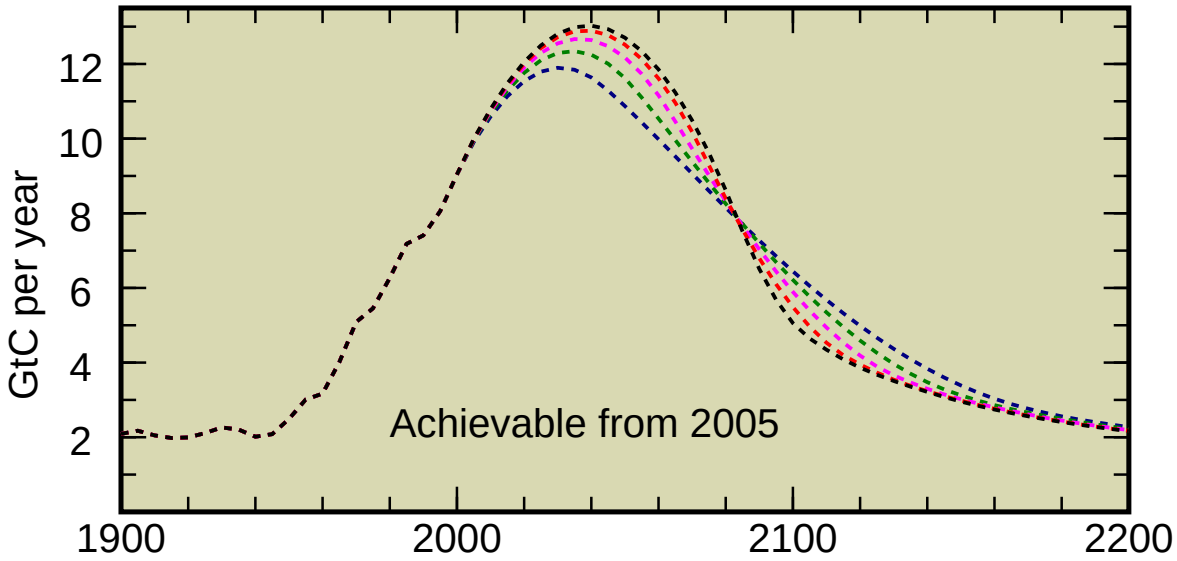
Change in concentration
= source − loss from atmosphere

Turn around the model of loss to give:

Required source
= Change in target concentration
+ loss from atmosphere

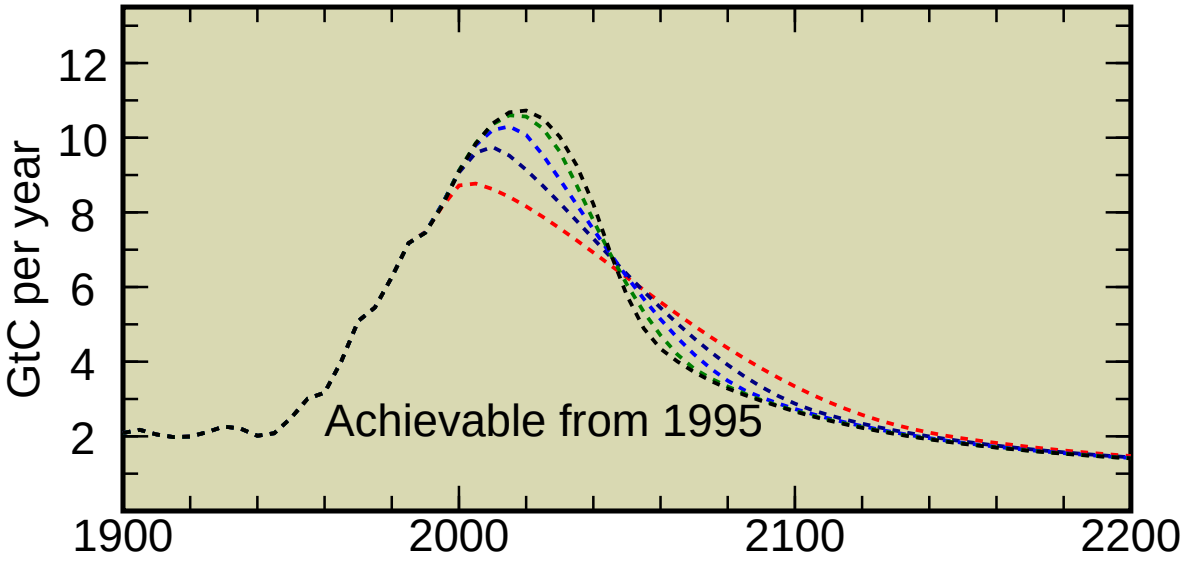
Stabilising CO_2 at 550 ppm

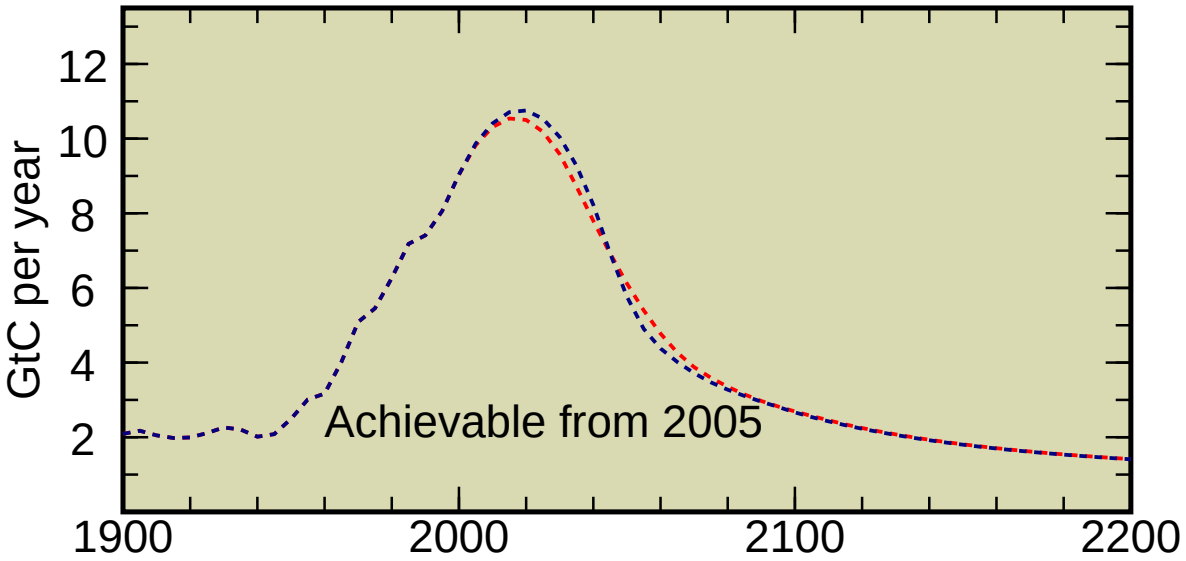




Family of cases, with smoothly changing emissions, showing the trade-off between higher peak and rapid subsequent reductions.

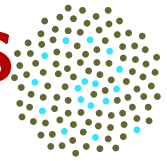
Stabilising CO_2 at 450 ppm





For lower target concentrations, delay in beginning emission reductions greatly reduces the scope for a smooth transition to stabilisation.

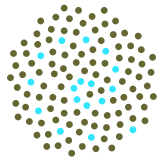
Frameworks for national targets



Contraction and convergence Nations converge towards equal *per capita* emissions.

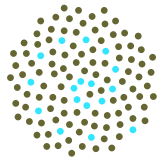
Brazilian proposal Each nation's emission cuts are in proportion to its historical responsibility for global warming

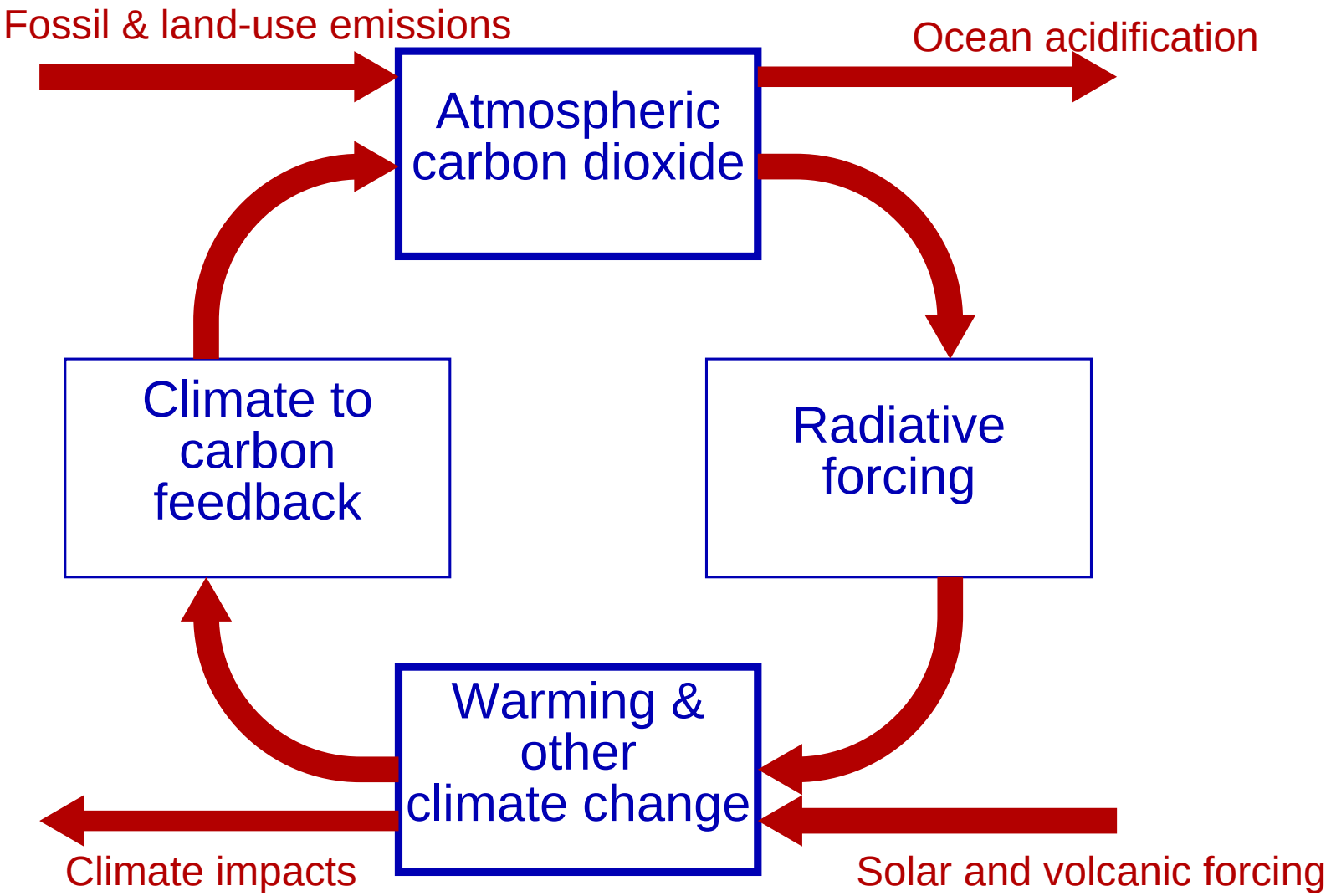
IPCC caveats



- The magnitude of the positive feedback between climate change and the carbon cycle is uncertain. (AR4: TS.5.5).
- Dynamical processes not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. (AR4: TS.5.5).

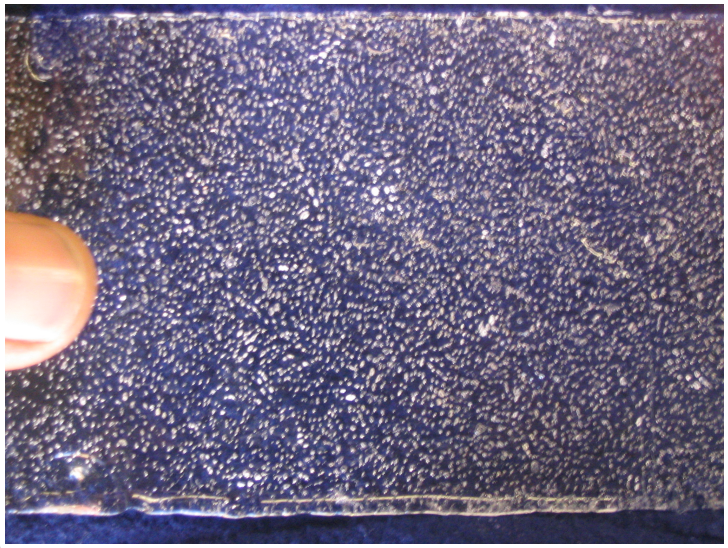
Feedbacks

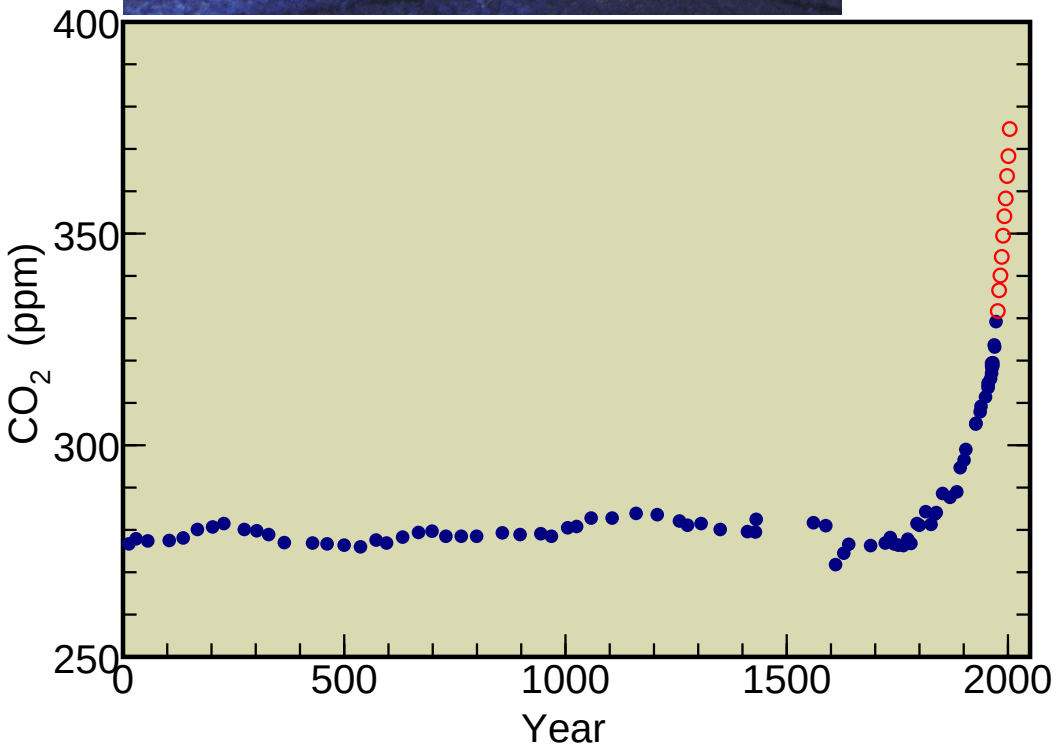




From *Twisted:*

Observing feedbacks



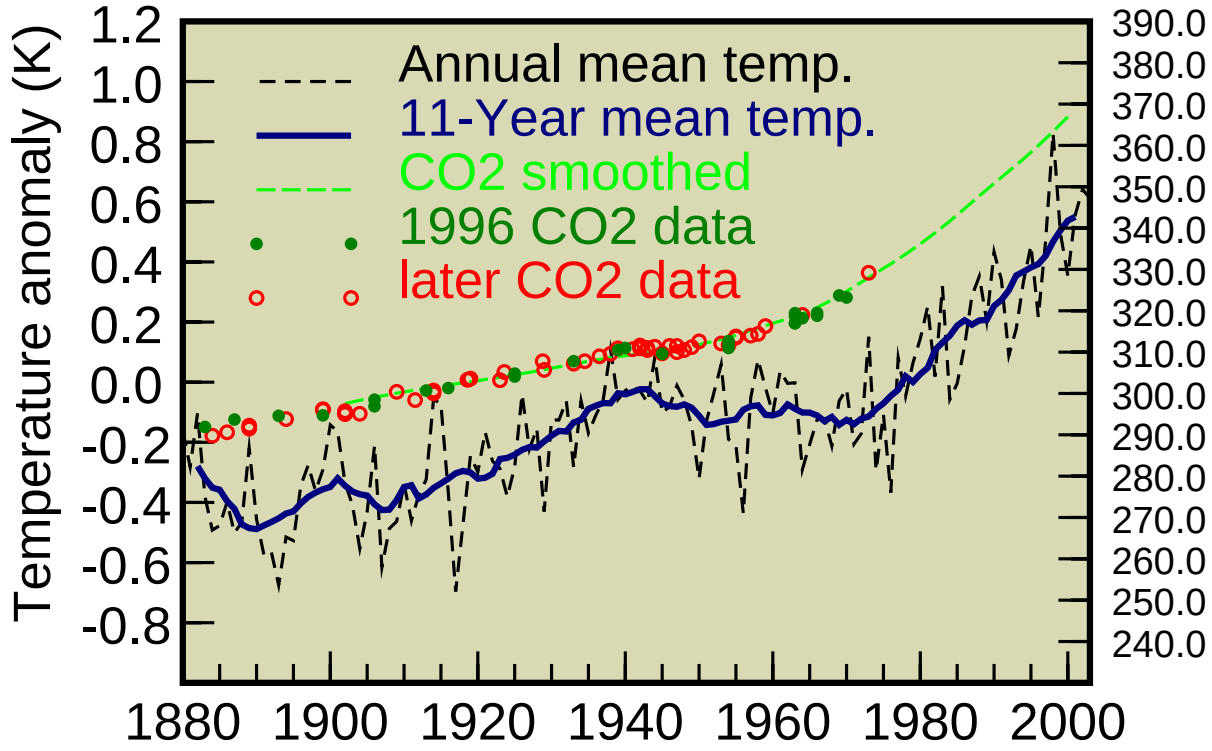


CO_2 concentrations from air in bubbles in polar ice and direct atmospheric measurements.

Dip from 1600 to 1800 is climate to carbon feedback from little ice age.

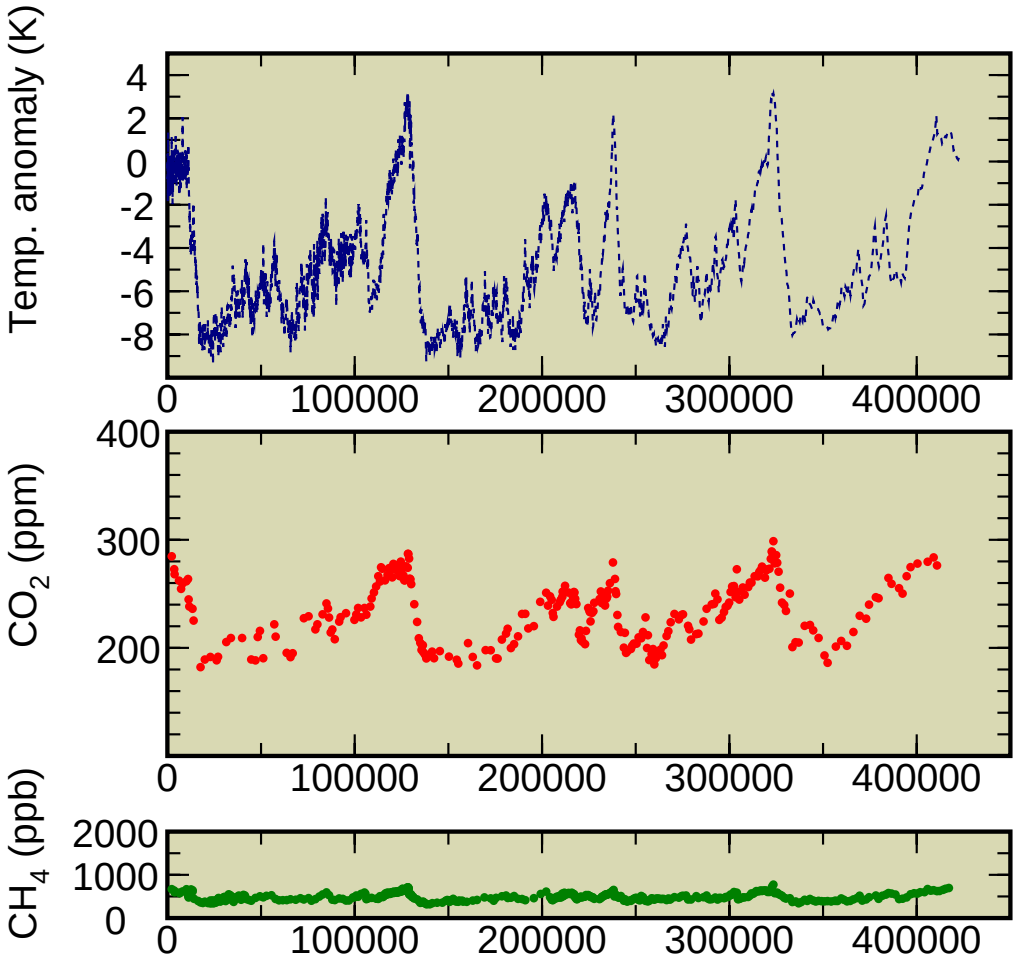
Carbon-13 data show most change was on land, not in oceans.

Feedbacks in 20th century



At time of slow emissions growth (depression and WW2) a northern hemisphere cooling led to a net CO_2 growth close to zero.

Glacial-interglacial

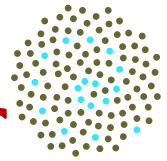


Data from Vostok ice-core, with (i) regional temperature estimated from isotope measurements (ii) CO_2 and (iii) CH_4 each plotted proportional to expected global warming effect.

As with the delay between changes in temperature and gases, this indicates that CO_2 amplifies ice age changes, but is not the cause.


THANK YOU

TWISTED: The Distorted Mathematics of Greenhouse Denial



I. G. Enting.

For publication by Australian Mathematical Sciences Institute, October, 2007.

- Contradictions by 'greenhouse sceptics'
- Distortions by greenhouse sceptics
- New calculations of emission targets