

A group of people, including children and adults, are standing in shallow water, planting small green mangrove saplings. The water is clear and reflects the sky. The background shows a line of trees under a cloudy sky.

Sustainable Development on a Warming Planet? What the IPCC Report says

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IPCC Vice-chair

Prof. climate sciences, Université catholique de Louvain
Twitter: @JPvanYpersele
UN Palais des Nations, Geneva, 24 April 2014

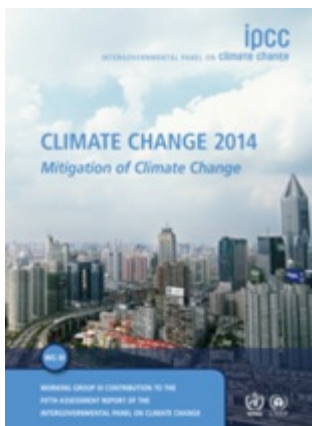
Thanks to the Belgian Federal Science Policy Office (BELSPO) for its support



What is happening in the climate system?



What are the risks?



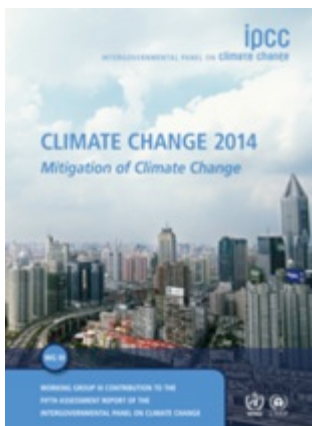
What can be done?



WG I (Physical science basis): 209 lead authors, 2014 pages, 54.677 review comments



WG II (Impacts, Adaptation and Vulnerability): 243 lead authors, 2500 pages, 50.492 review comments



WG III (Mitigation of Climate Change): 235 coordinating and lead authors, 2000 pages, 38.315 review comments

Why the IPCC ?

Established by WMO and UNEP in 1988

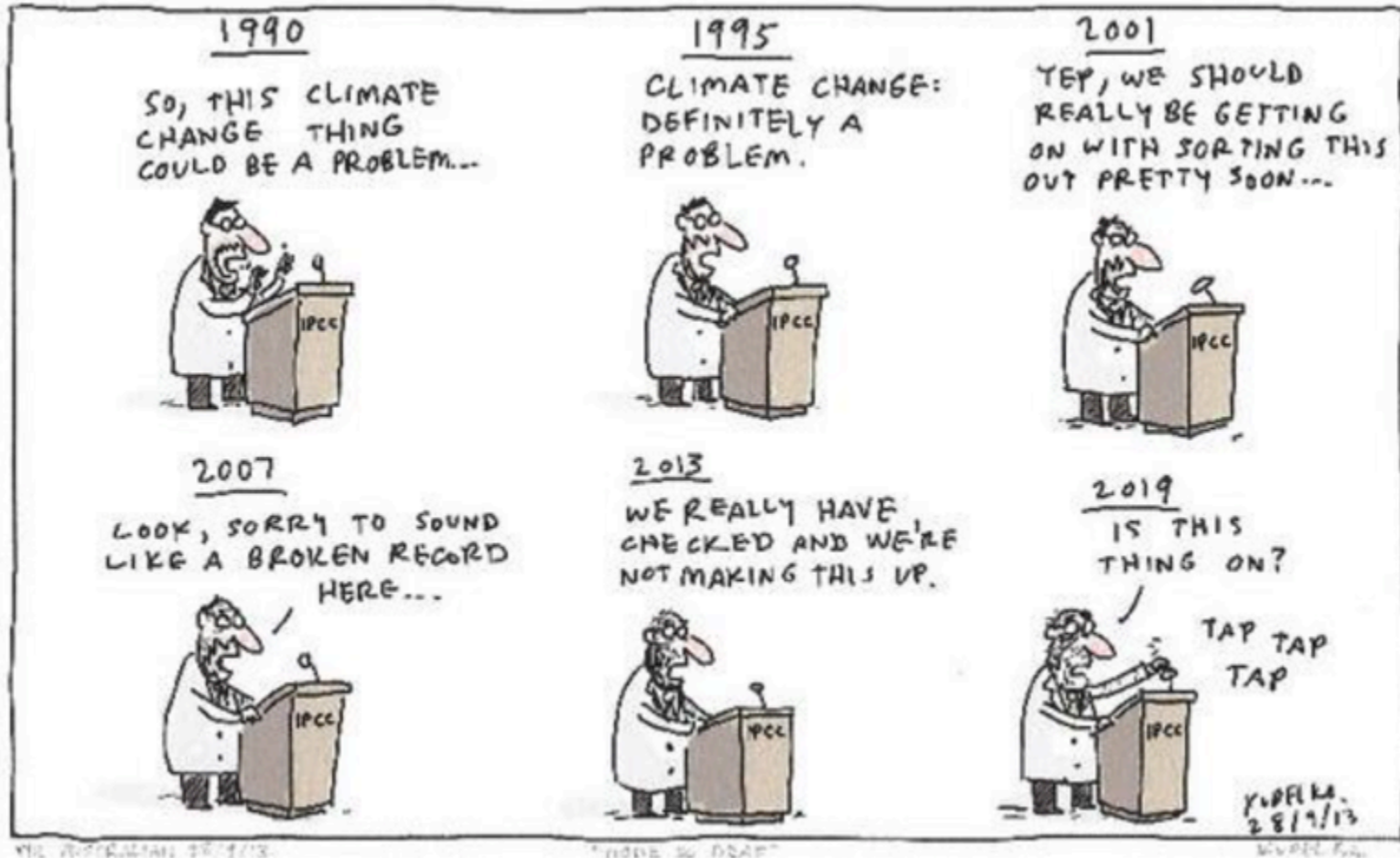
to provide **policy-makers** with an **objective source of information** about

- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

WMO=World Meteorological Organization
UNEP= United Nations Environment Programme



None So Deaf



THE ASSOCIATION OF 1990

"NONE SO DEAF"

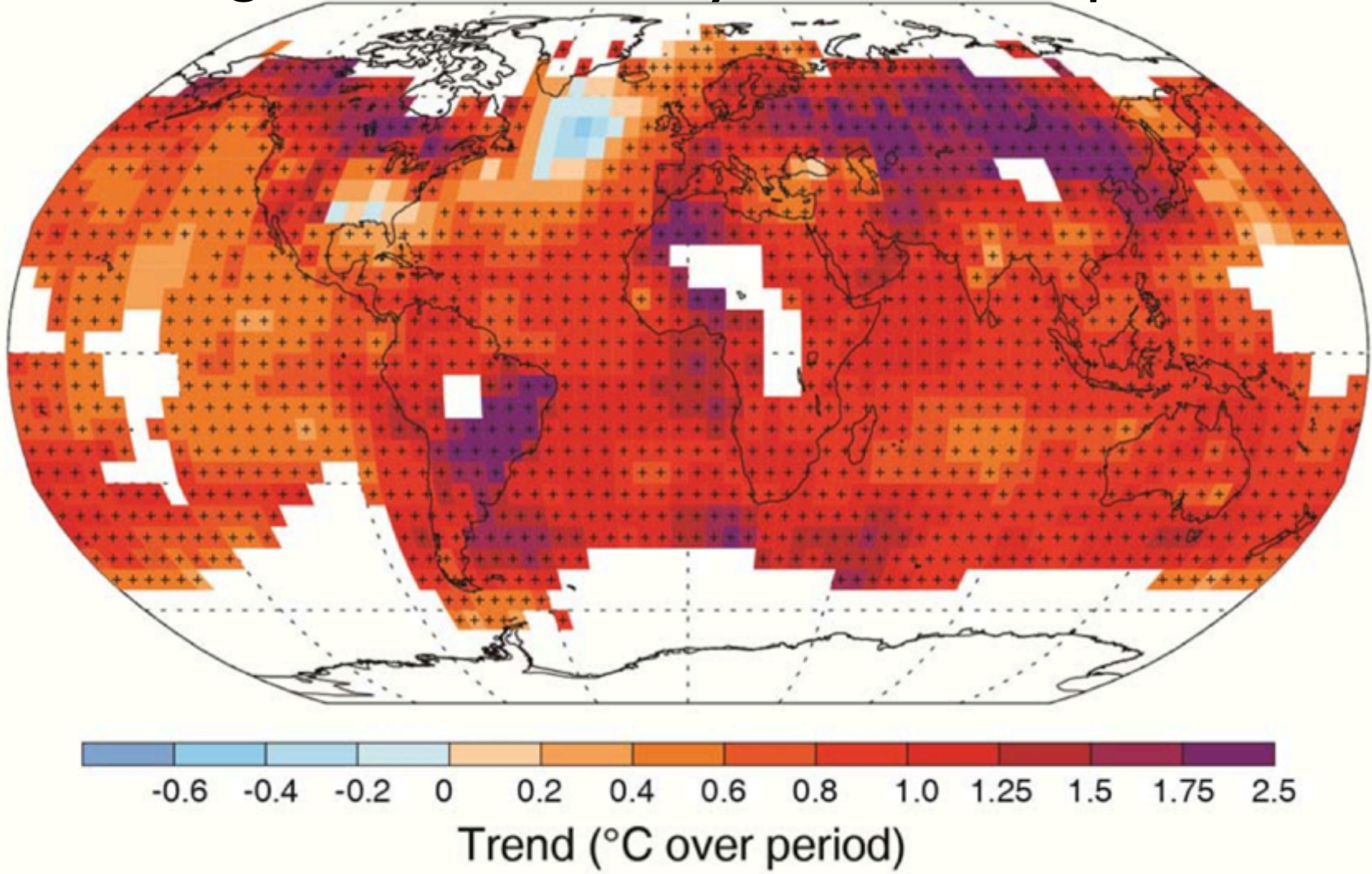
IPCC.COM



What is happening in the climate system?

Change in average surface temperature 1901-2012

Warming in the climate system is unequivocal



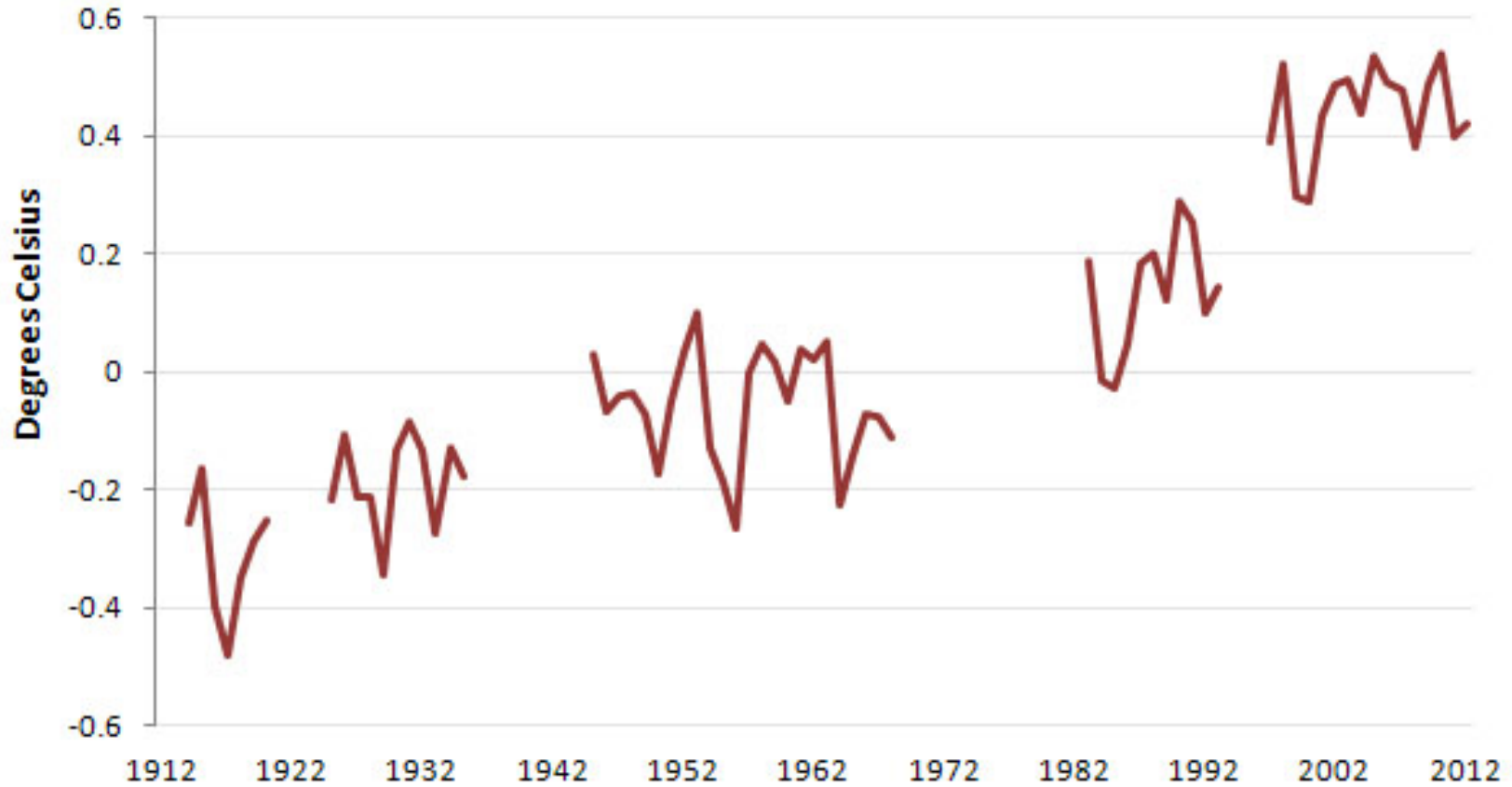
Lying With Statistics, Global Warming Edition

Temperature Change From 1961-1990 Average



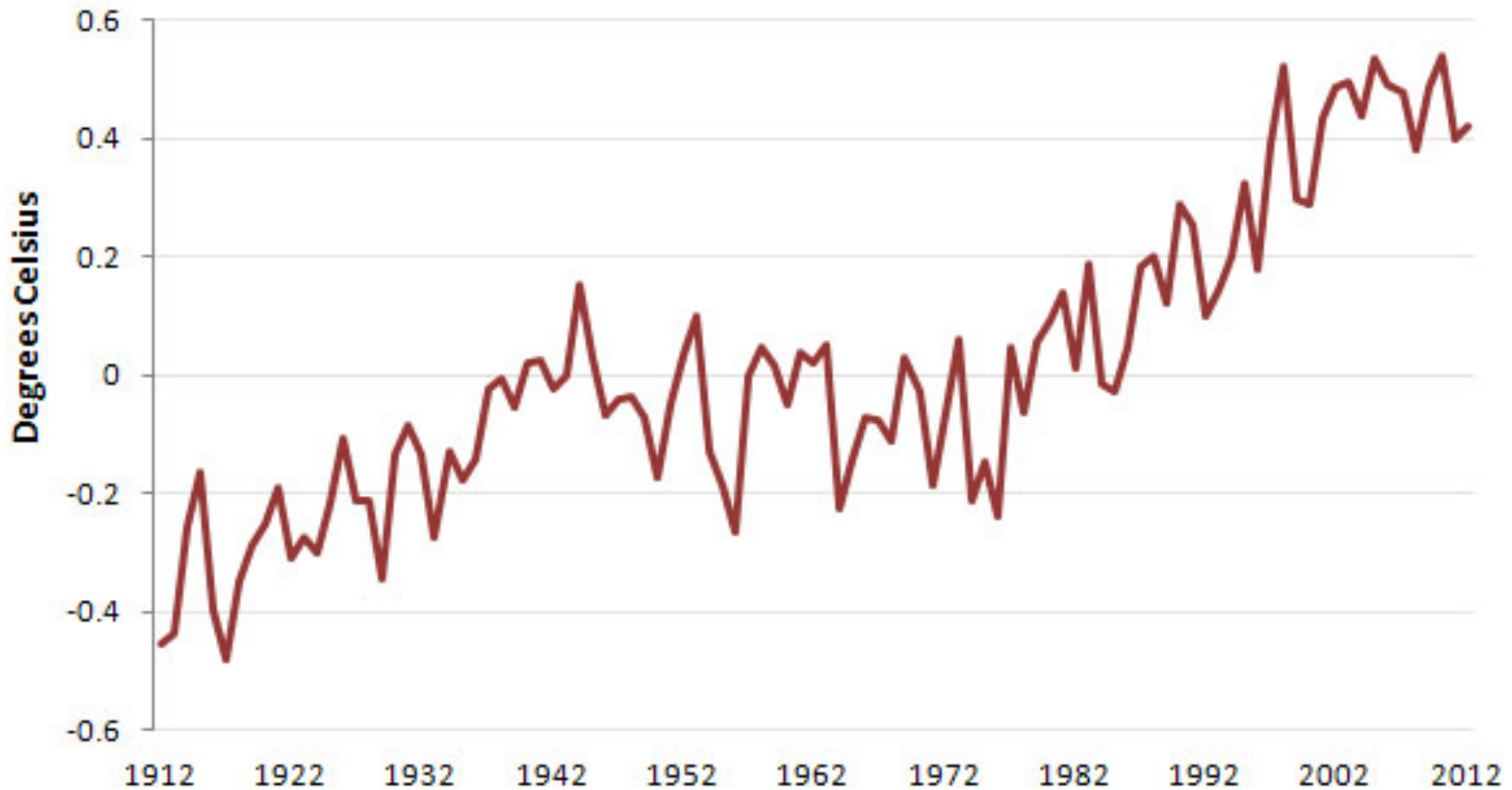
Lying With Statistics, Global Warming Edition

Temperature Plateaus — 1912-2012



Lying With Statistics, Global Warming Edition

Temperature Change From 1961-1990 Average



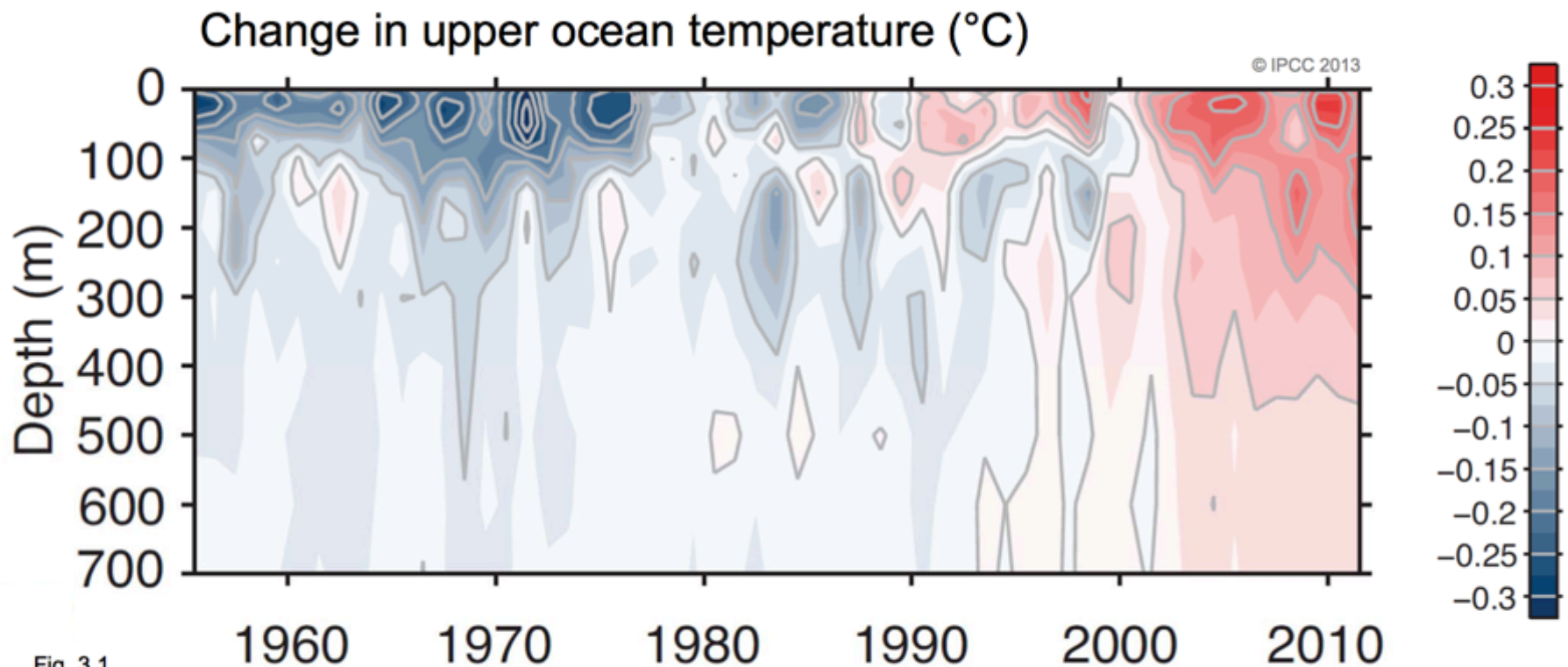


Fig. 3.1

It is *virtually certain* that the upper ocean (0-700 m) warmed from 1971 to 2010, [...]. It is *likely* that the ocean warmed between 700 and 2000 m from 1957 to 2009.

Plateau Glacier (1961) (Alaska)



http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Plateau Glacier (2003) (Alaska)



http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Atmospheric CO₂ concentration

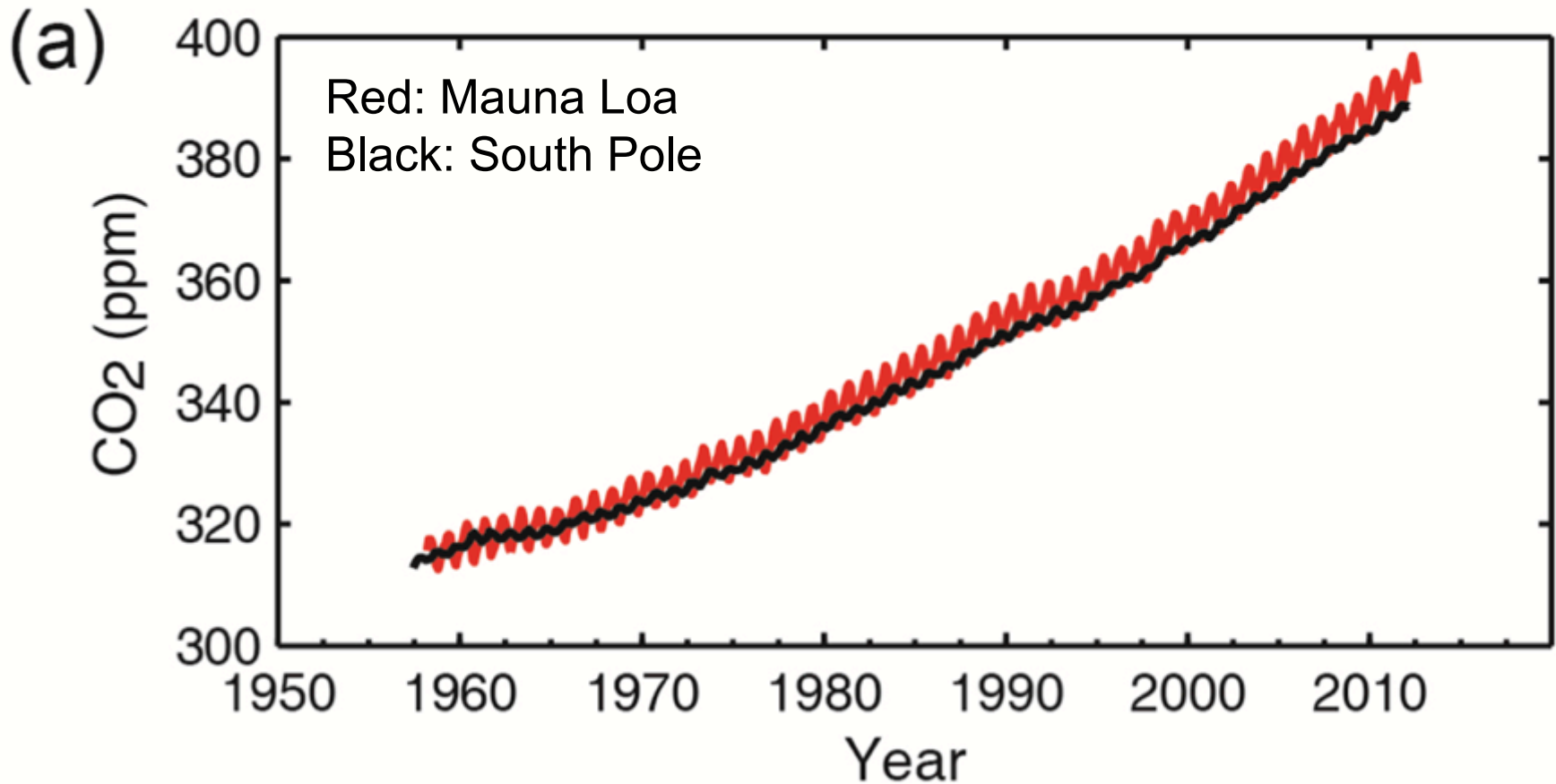
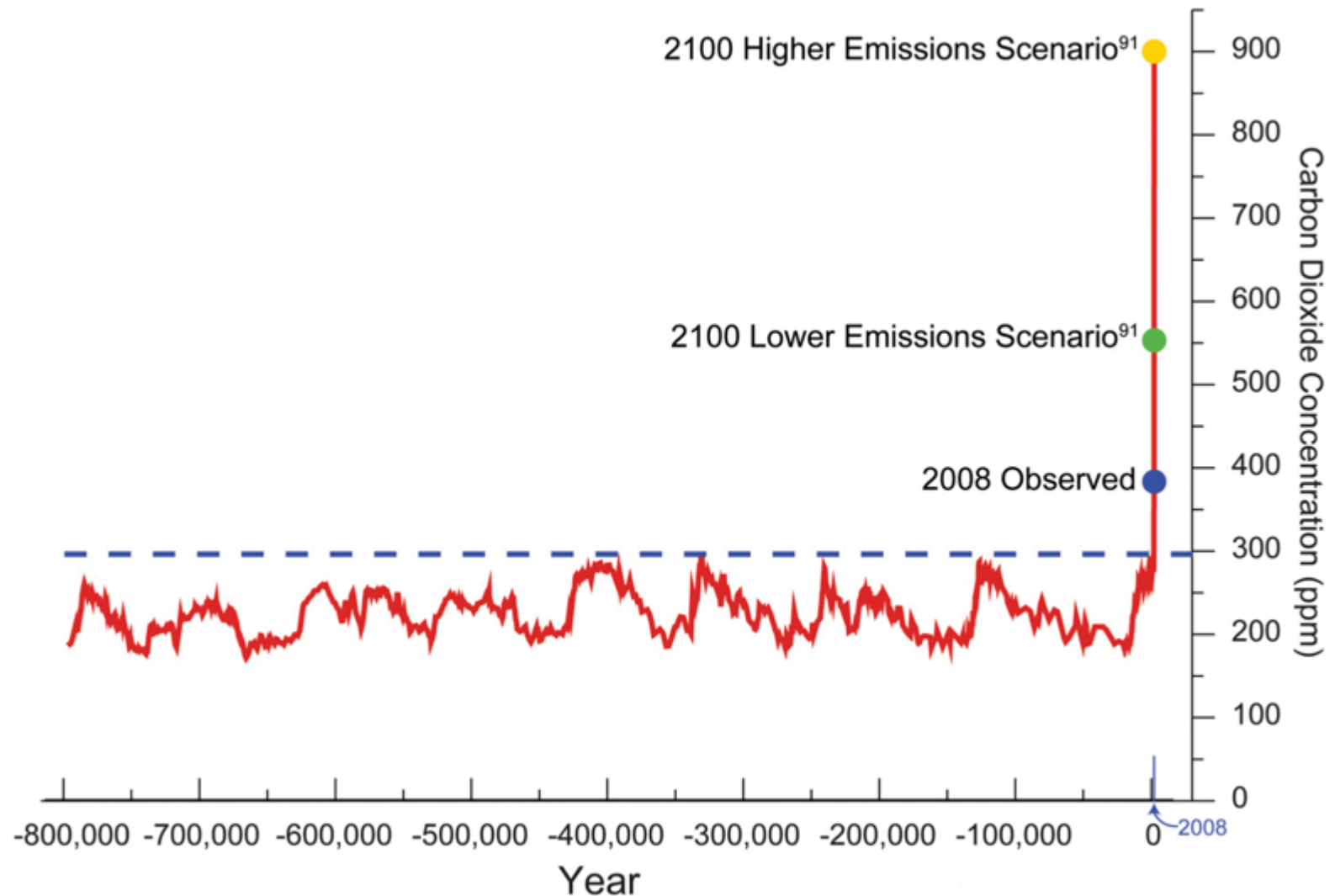


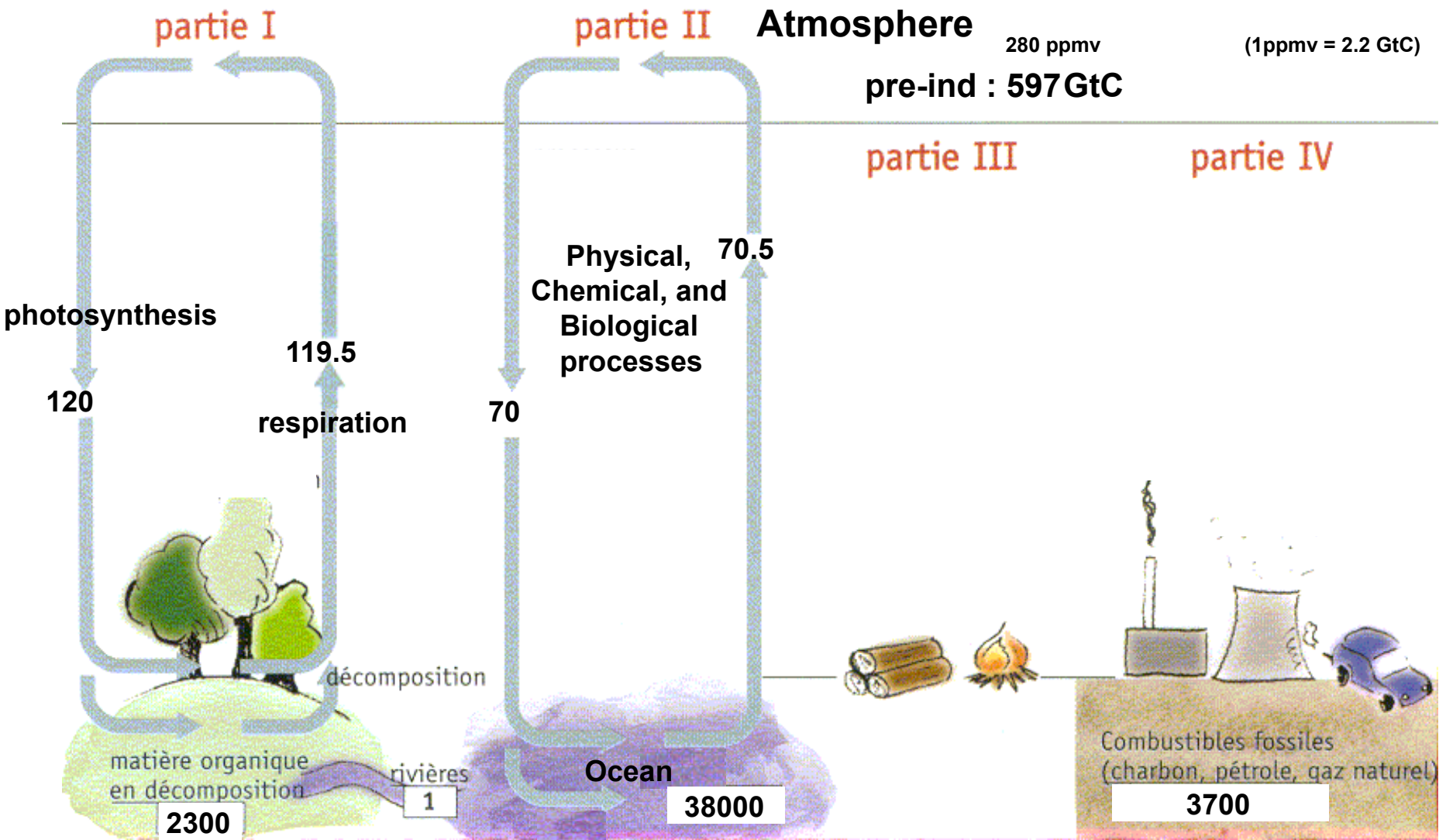
Fig SPM 4a

Atmospheric CO₂ over the last 800,000 years



Lüthi *et al.*; Tans; IIASA²

Carbon cycle: unperturbed fluxes



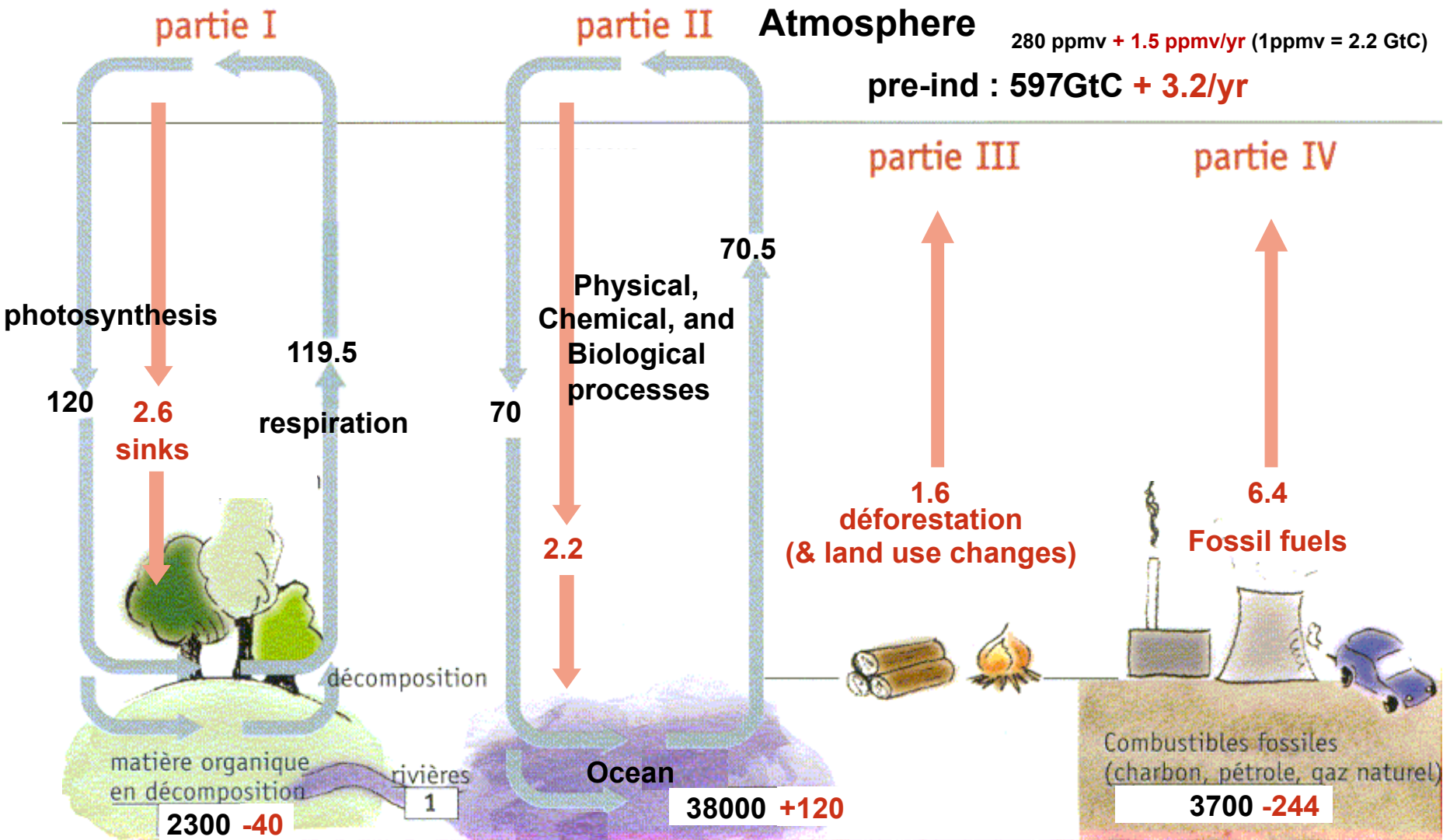
Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get GtCO₂)

Source: vanyp@climate.be

Based on IPCC AR4 - Fig 7.3

Carbon cycle: perturbed by human activities

(numbers for the decade 1990-1999s, based on IPCC AR4)

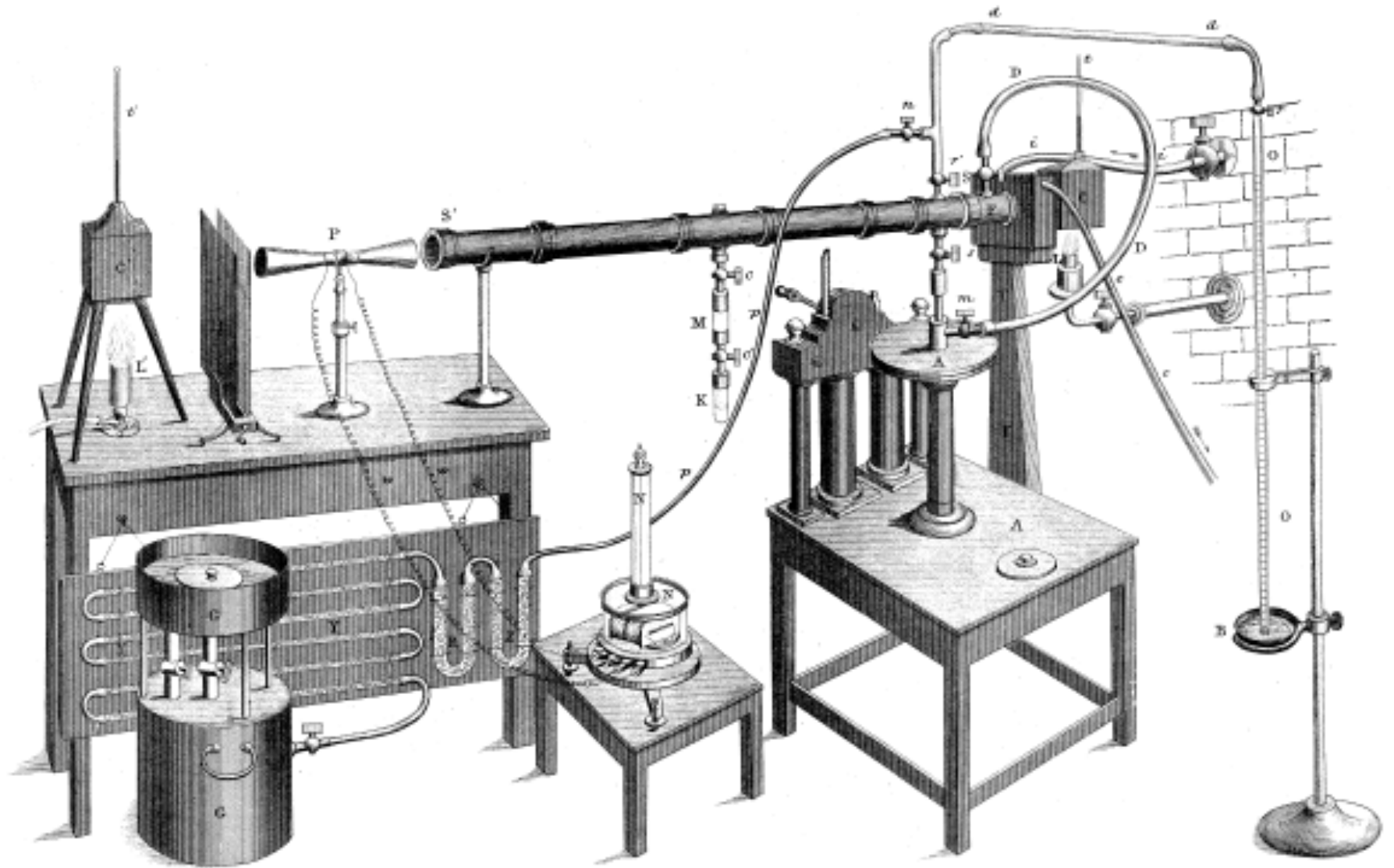


Units: GtC (billions tons of carbon) or GtC/year

Stocks!

The carbon cycle is policy-relevant

- CO₂ accumulates in the atmosphere as long as human emissions are larger than the natural absorption capacity**
- Historical emissions from developed countries therefore matter for a long time**
- As warming is function of cumulated emissions, the carbon « space » is narrowing fast (to stay under 1.5 or 2°C warming)**



Tyndall (1861) measures differential absorption of light and infrared rad.

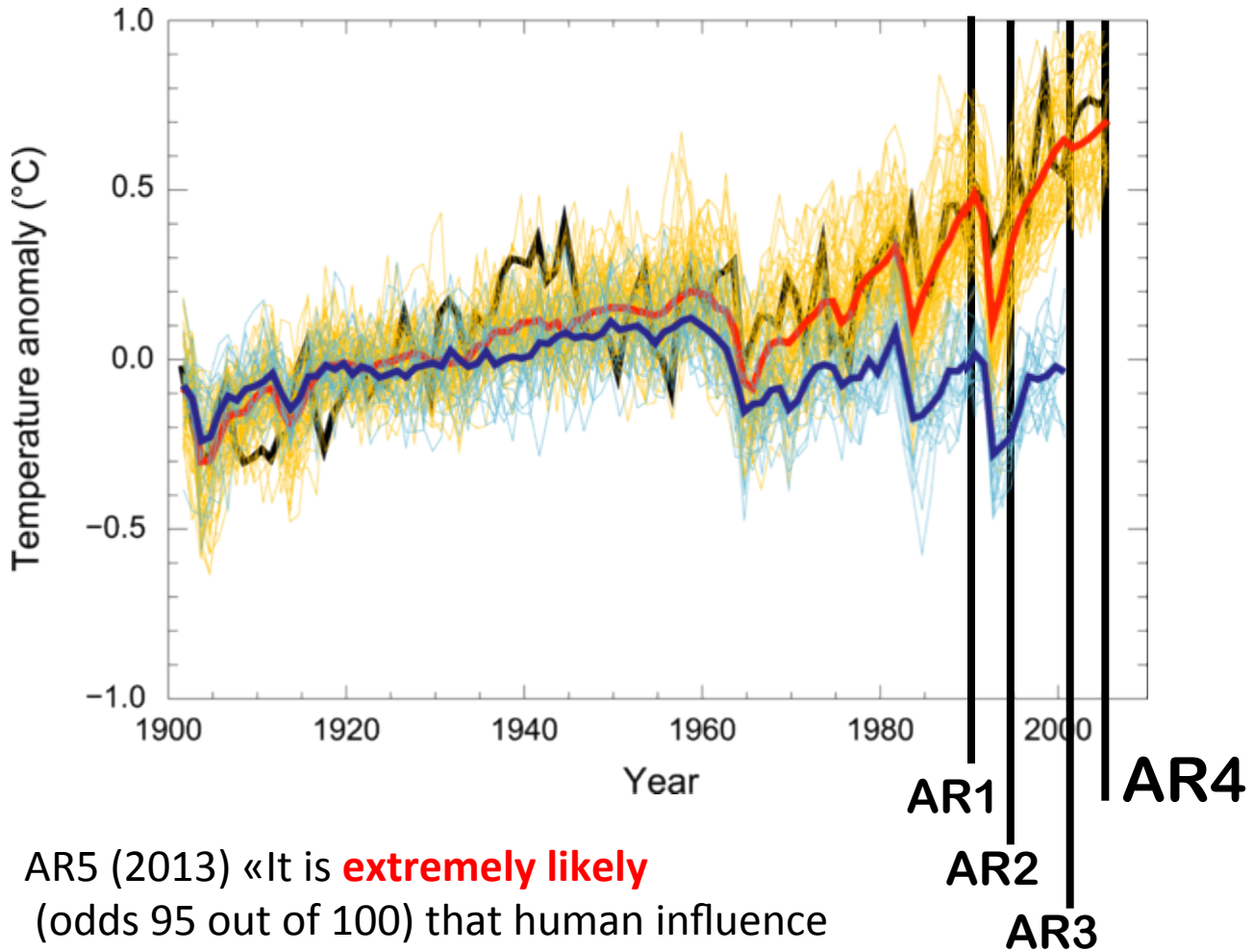
A Progression of Understanding: Greater and Greater Certainty in Attribution

AR1 (1990):
“unequivocal detection
not likely for a decade”

AR2 (1995): “balance
of evidence suggests
discernible human
influence”

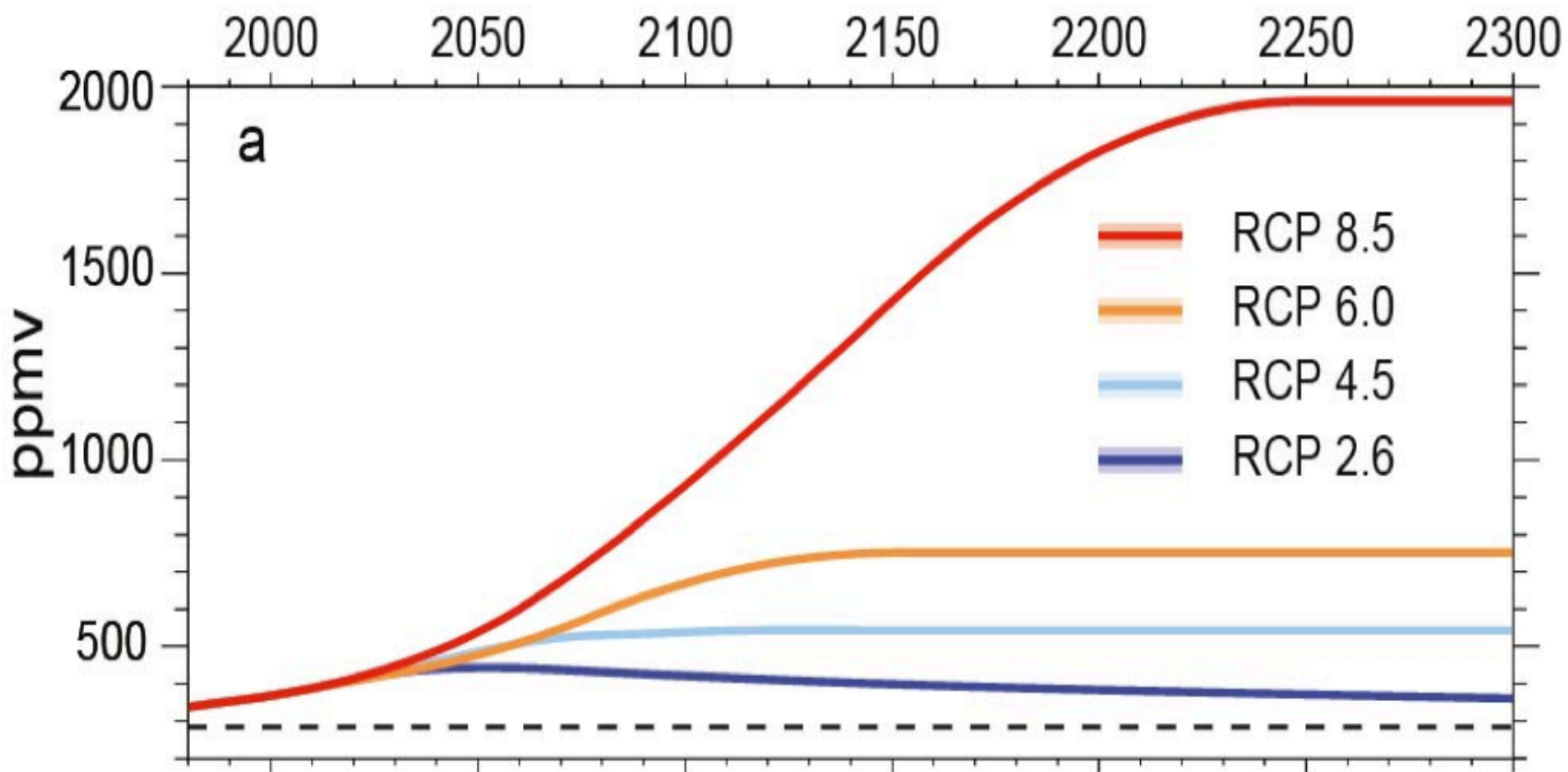
AR3 (2001): “most of
the warming of the
past 50 years is **likely**
(odds 2 out of 3) due
to human activities”

AR4 (2007): “most of
the warming is **very
likely** (odds 9 out of 10)
due to greenhouse
gases”



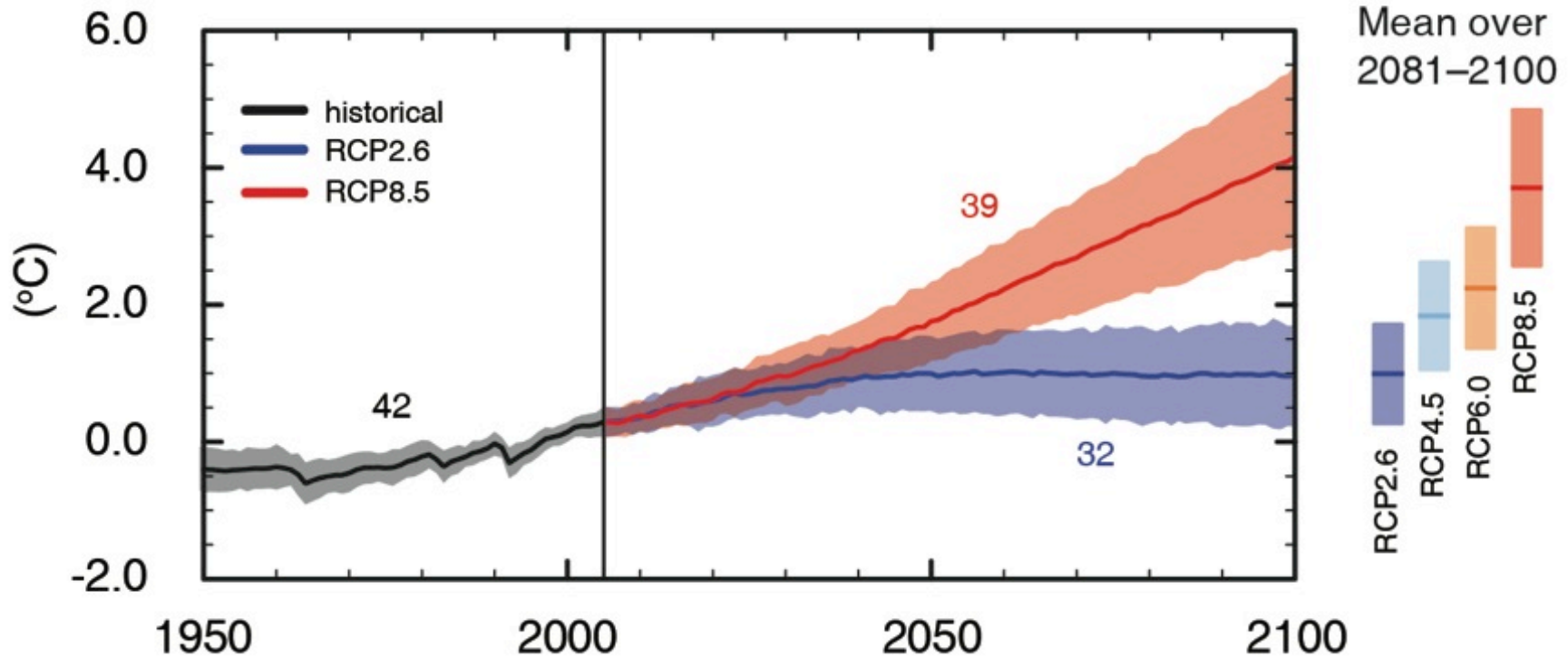
AR5 (2013) «It is **extremely likely**
(odds 95 out of 100) that human influence
has been the dominant cause... »

RCP Scenarios: Atmospheric CO₂ concentration



Three stabilisation scenarios: RCP 2.6 to 6
One Business-as-usual scenario: RCP 8.5

Global average surface temperature change



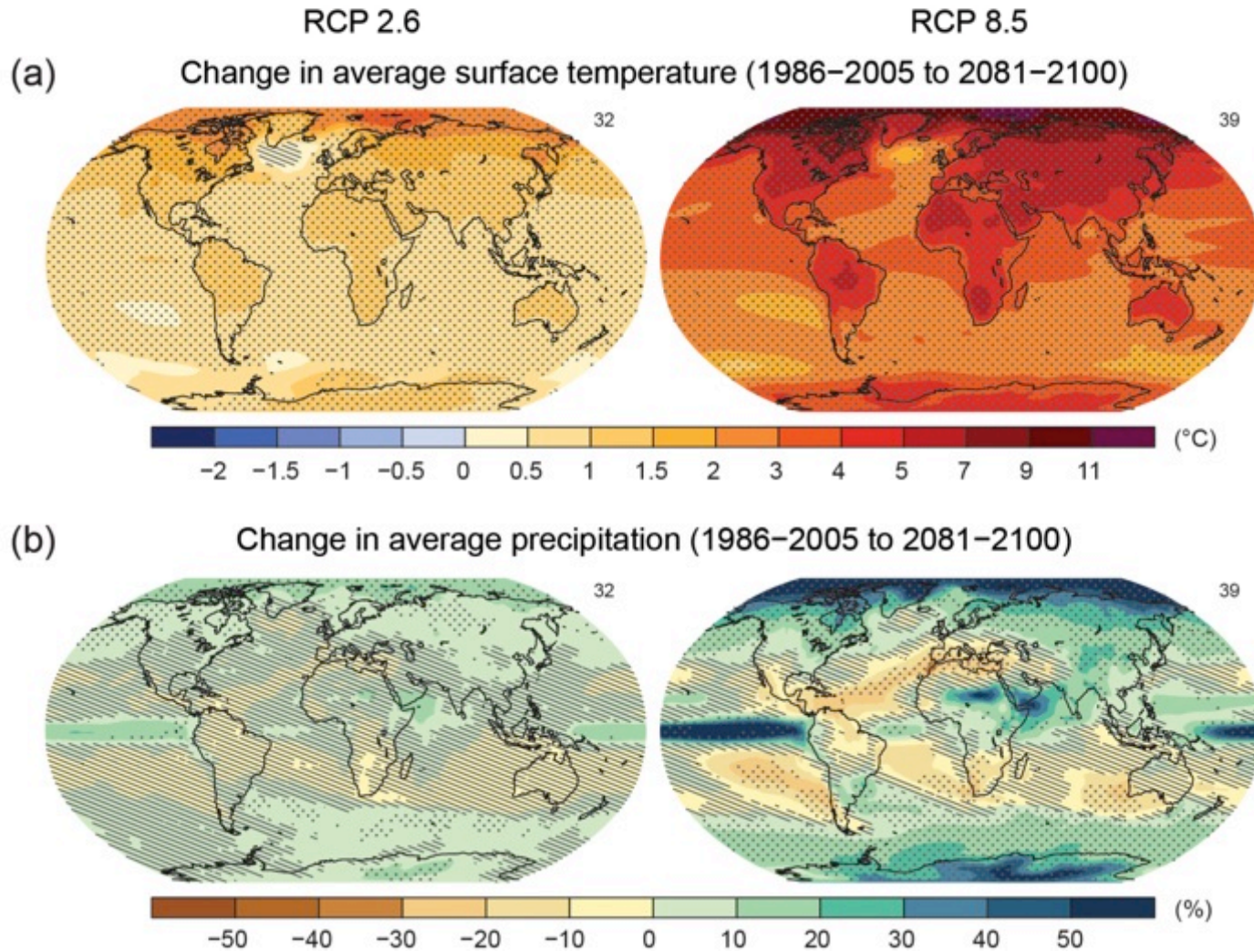
(IPCC 2013, Fig. SPM.7a)

Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850 for all scenarios

Figure SPM.8a,b

Maps of CMIP5 multi-model mean results

All Figures © IPCC 2013



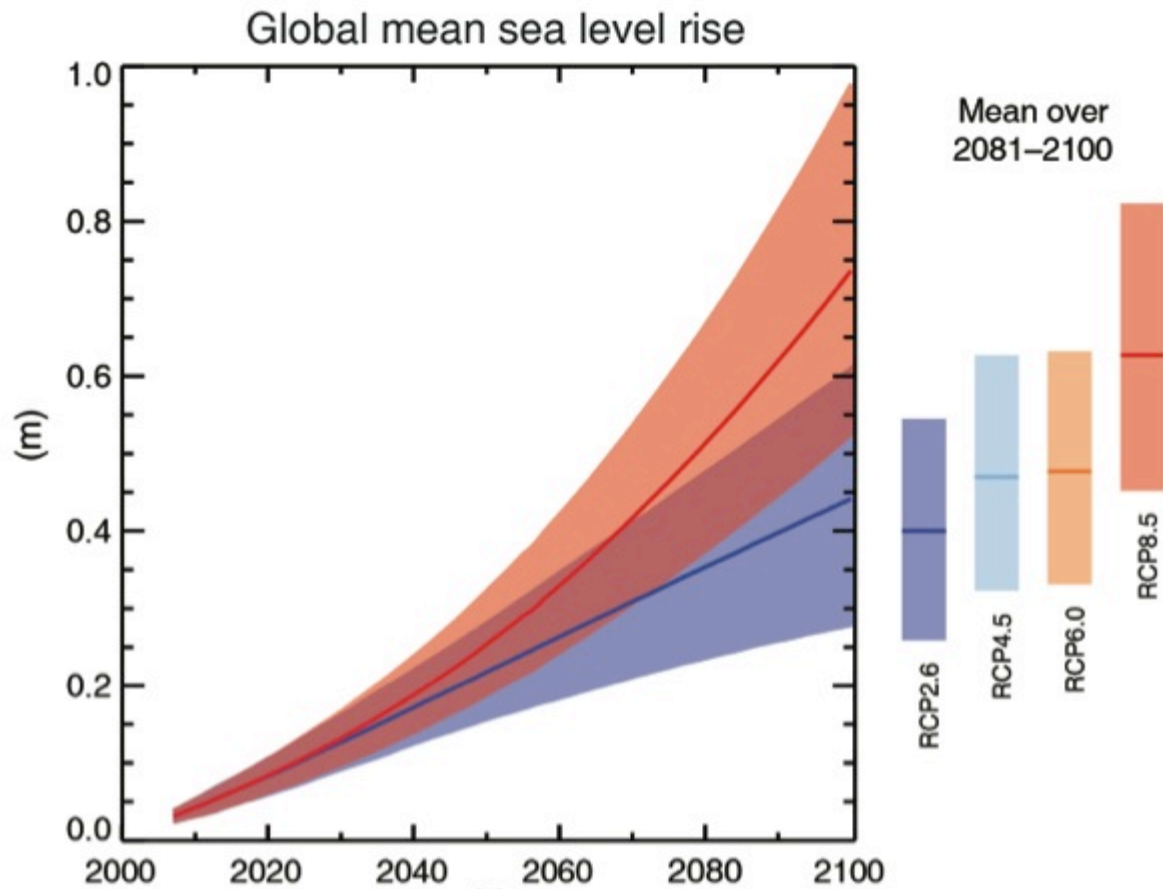


Fig. SPM.9

RCP2.6 (2081-2100), *likely* range: 26 to 55 cm

RCP8.5 (in 2100), *likely* range: 52 to 98 cm

(Reference level: 1986-2005)

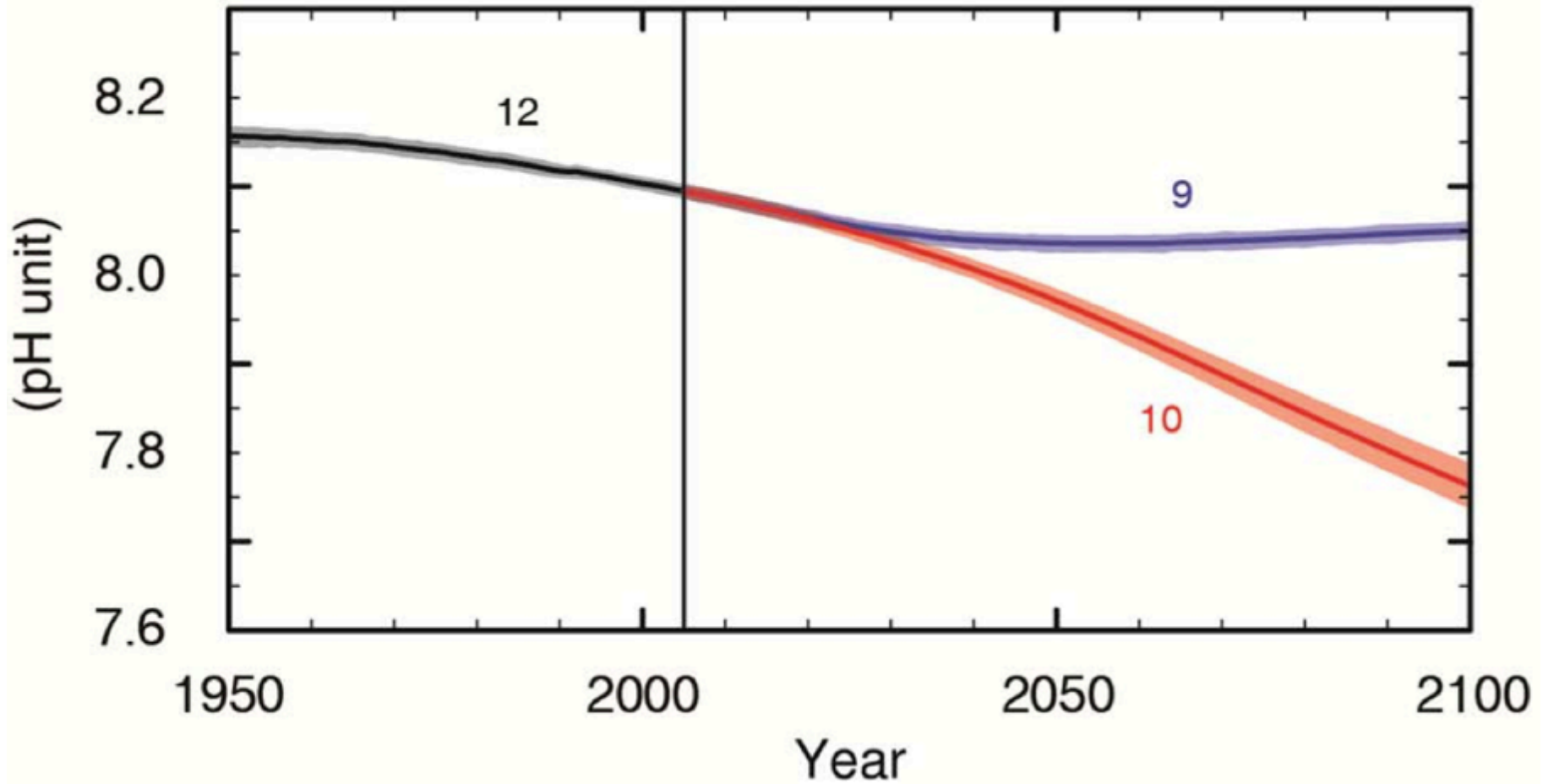
Since 1950, **extreme hot days** and **heavy precipitation** have become more common



There is evidence that anthropogenic influences, including increasing atmospheric **greenhouse gas concentrations**, have changed these extremes

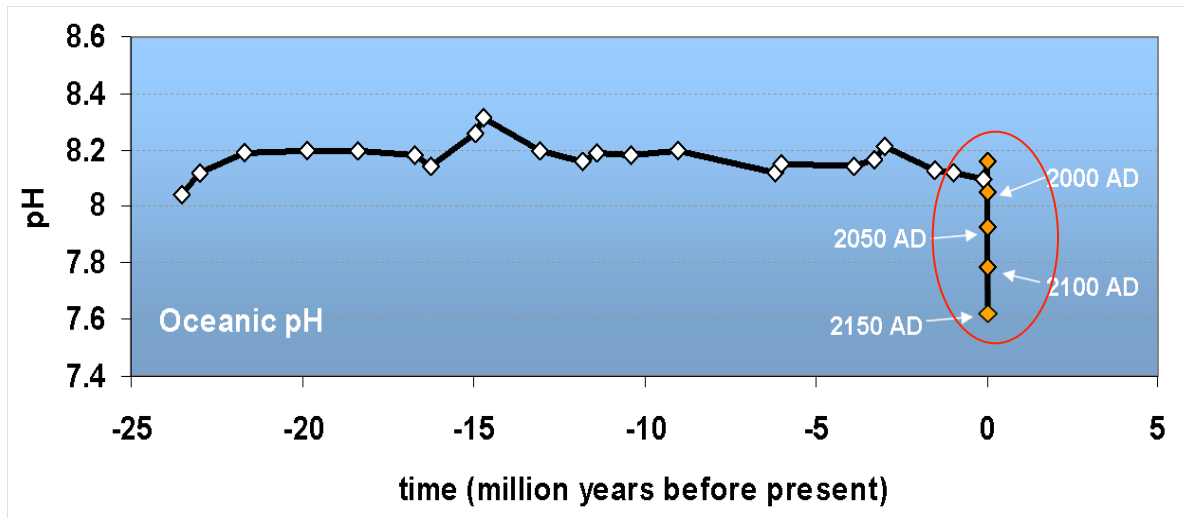
Global ocean surface pH (projections)

Ocean Acidification, for RCP 8.5 (orange) & RCP2.6 (blue)



Oceans are Acidifying Fast...

Changes in pH over the last 25 million years



“Today is a rare event in the history of the World”

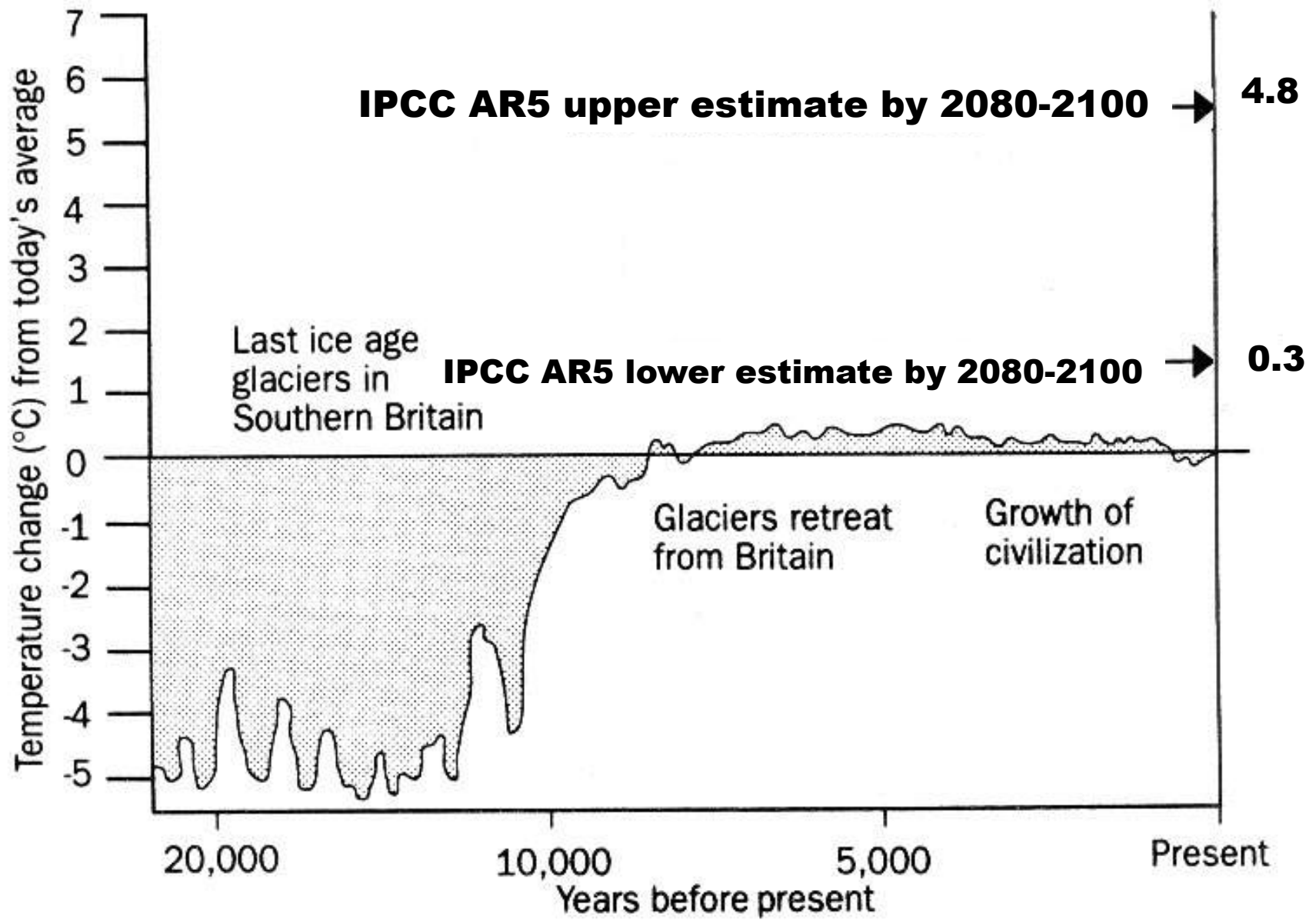
- It is happening now, at a **speed and to a level** not experienced by marine organisms for about 60 million years
- Mass extinctions linked to previous ocean acidification events
- Takes 10,000' s of years to recover

Turley et al. 2006

Slide courtesy of Carol Turley, PML



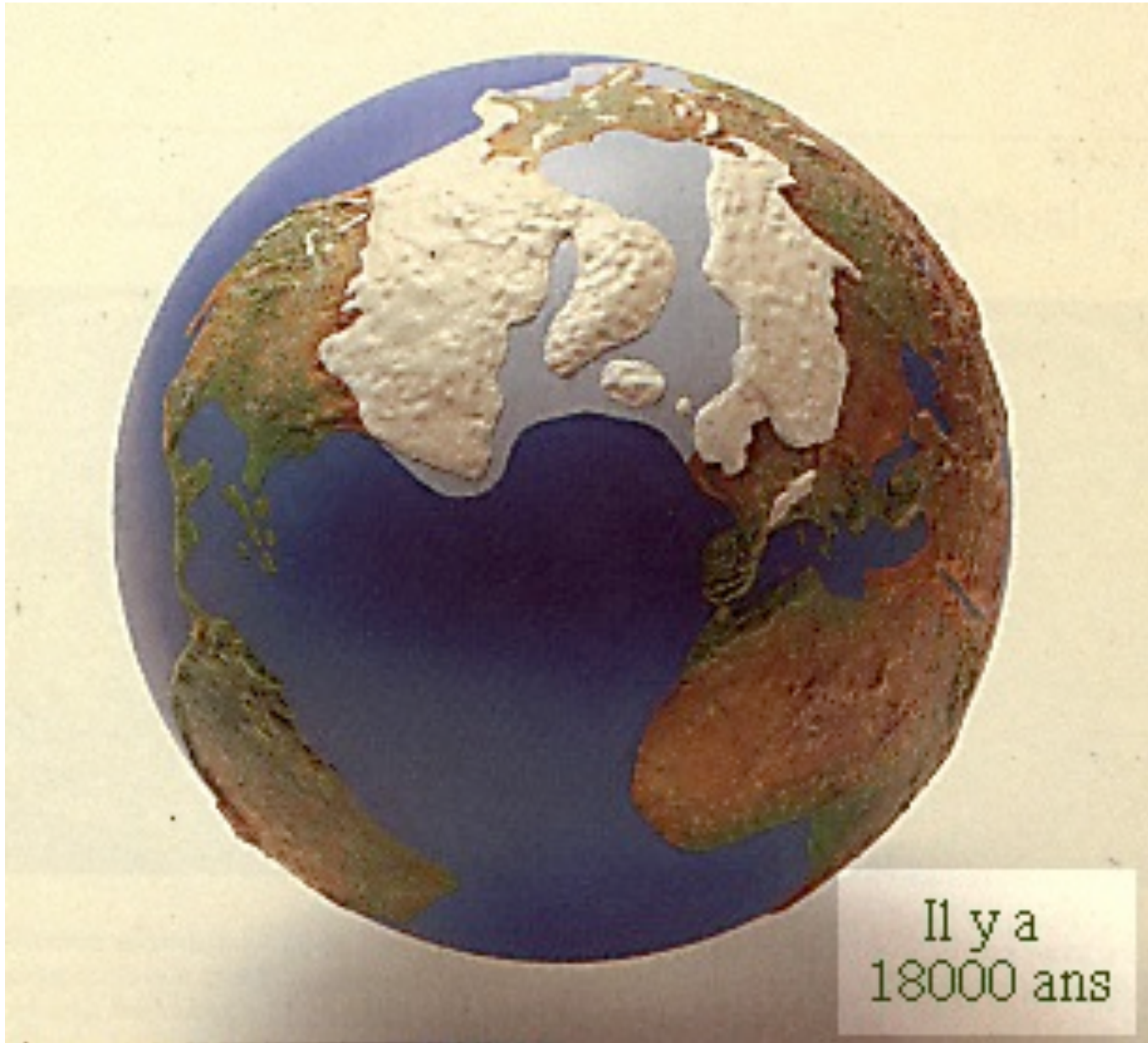
What are the risks?



Adapted from: International Geosphere Biosphere Programme Report no.6, Global Changes of the Past, July 1988

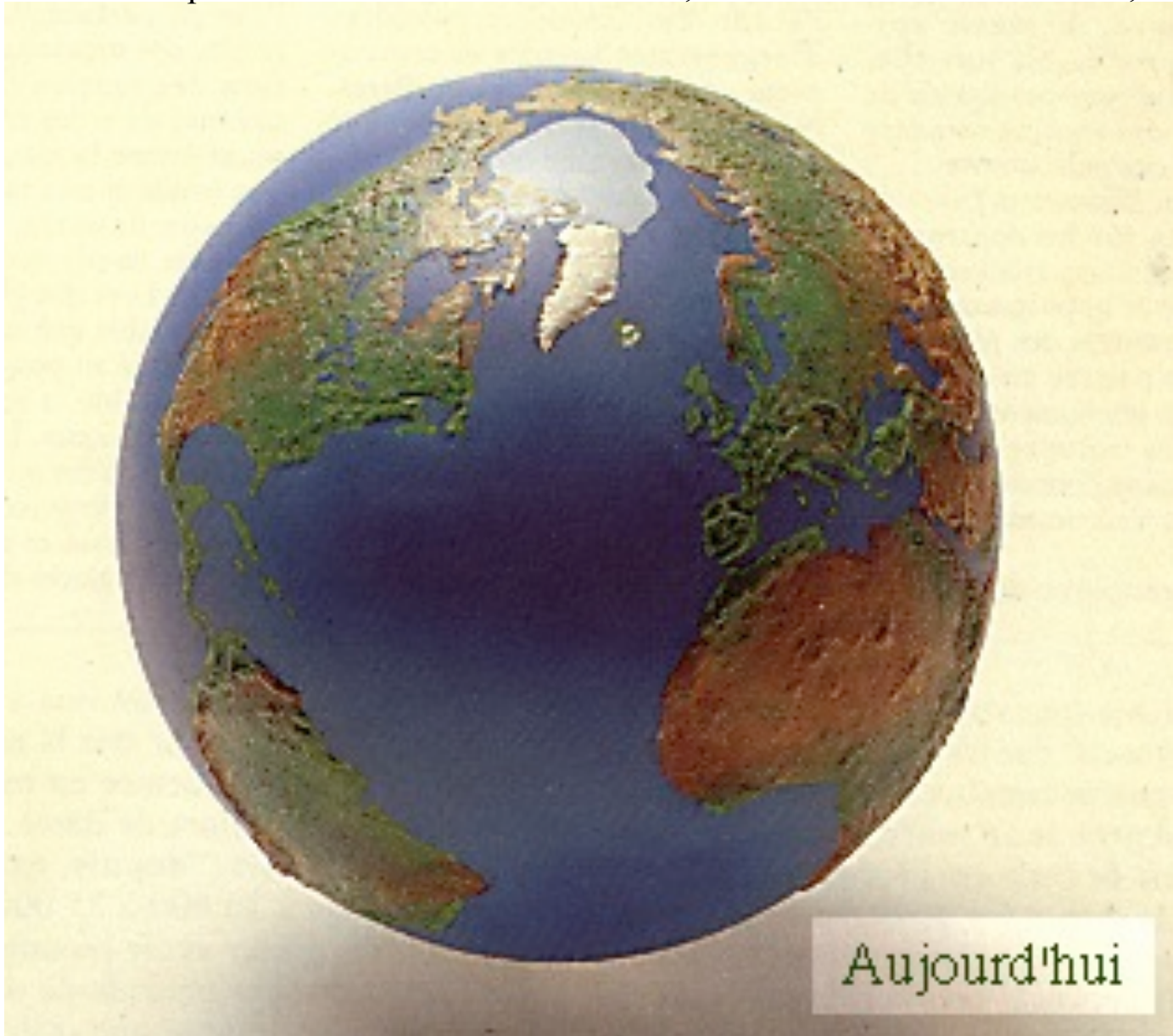
18-20000 years ago (Last Glacial Maximum)

With permission from Dr. S. Jousaume, in « Climat d'hier à demain », CNRS éditions.



Today, with +4-5°C globally

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.



An underwater photograph of a coral reef. The water is a deep, dark green. In the foreground, there is a large, dense field of coral. The coral is mostly brown and yellow, indicating significant bleaching. A single, prominent, light-colored, fan-shaped coral structure stands out in the center. The background shows more coral structures and some small fish swimming in the distance.

WIDESPREAD OBSERVED IMPACTS

A CHANGING WORLD

(A)



Confidence in attribution to climate change

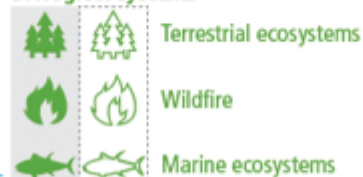


Observed impacts attributed to climate change for

Physical systems



Biological systems



Human and managed systems



Regional-scale impacts

Outlined symbols = Minor contribution of climate change
Filled symbols = Major contribution of climate change

Effects on Nile delta: 10 M people above 1m



(Time 2001)

Risk = Hazard x Vulnerability x Exposure (Katrina flood victim)



More heavy precipitation and more droughts....

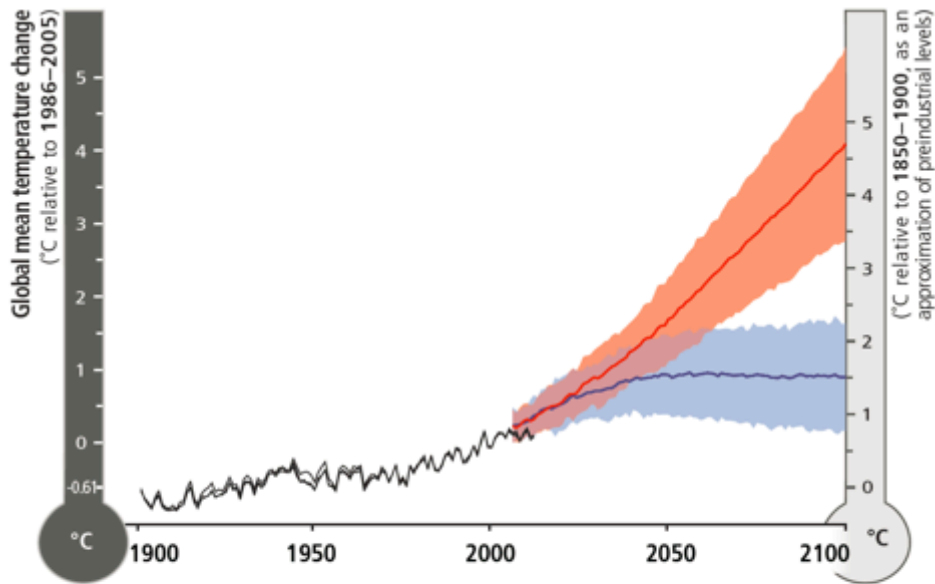




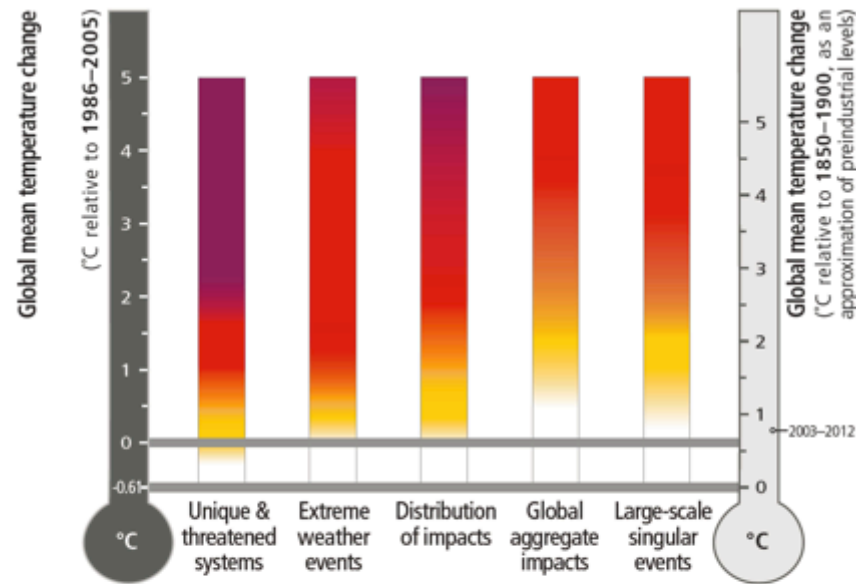
ADAPTATION IS ALREADY OCCURRING

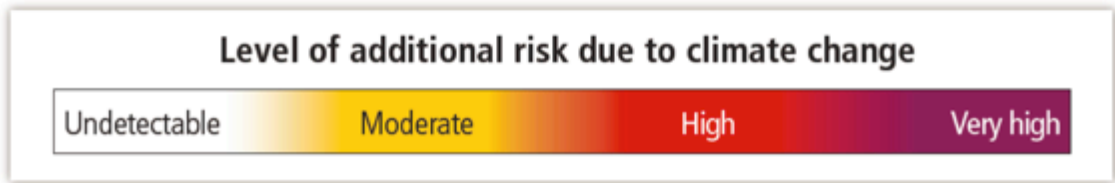
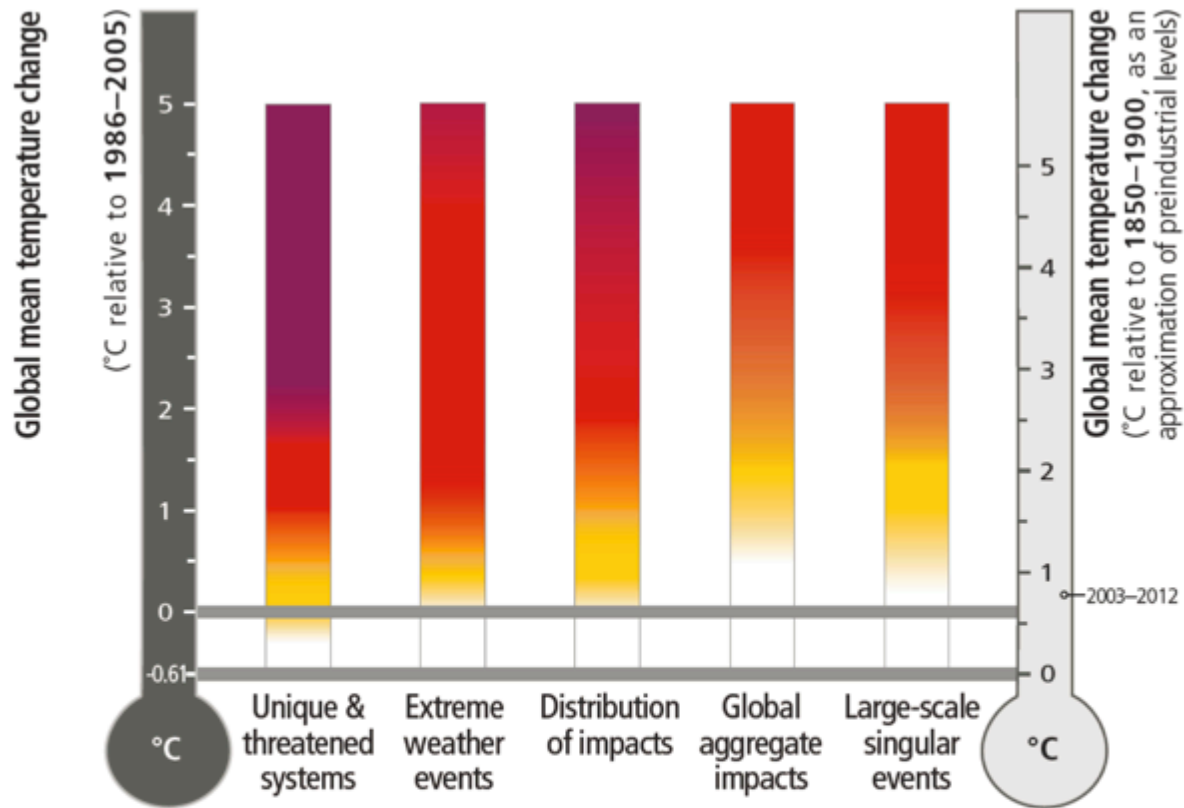


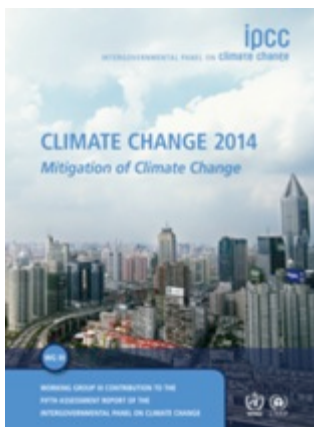
RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS



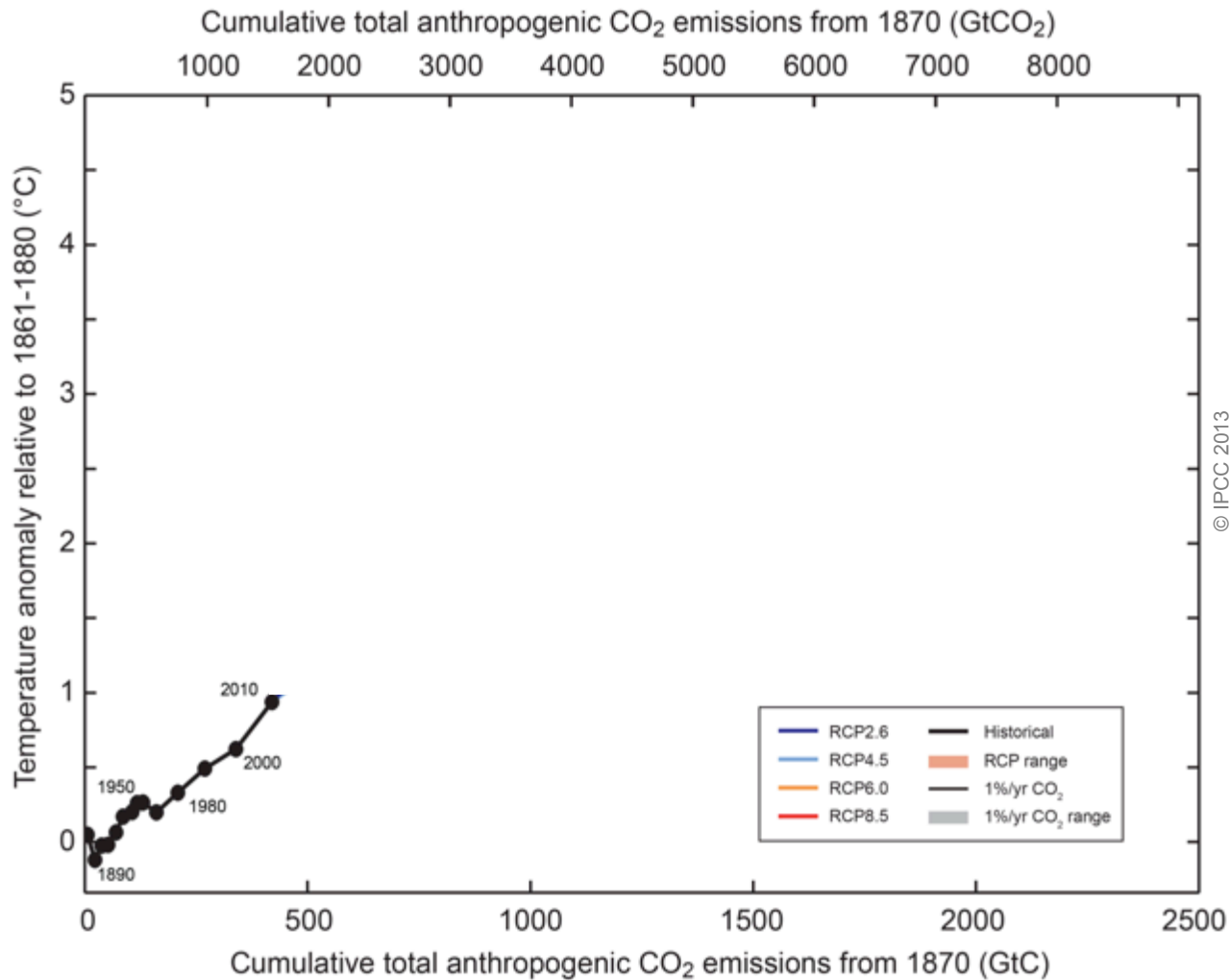
- Observed
- RCP8.5 (a high-emission scenario)
- Overlap
- RCP2.6 (a low-emission mitigation scenario)







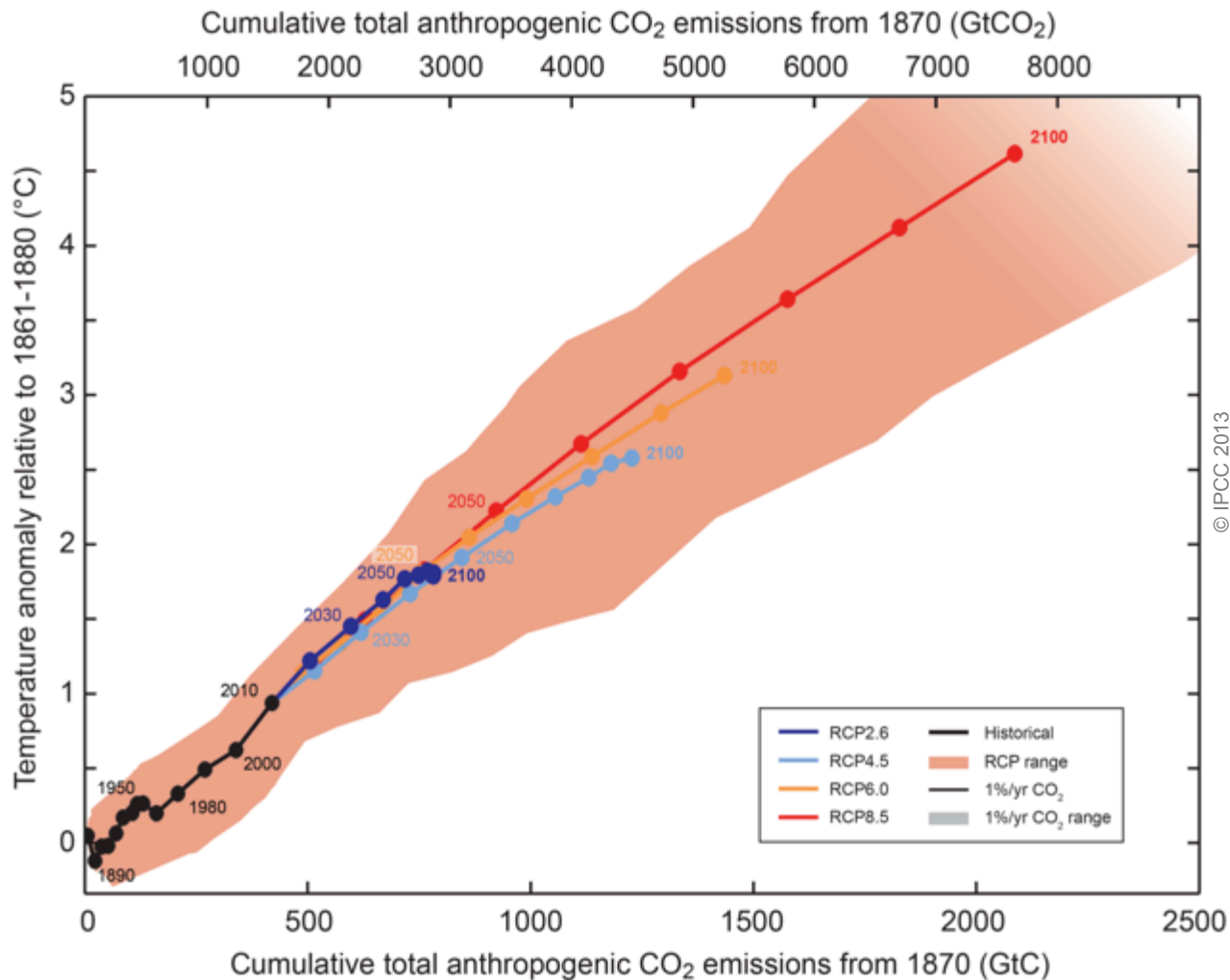
What can be done?



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Fig. SPM.10

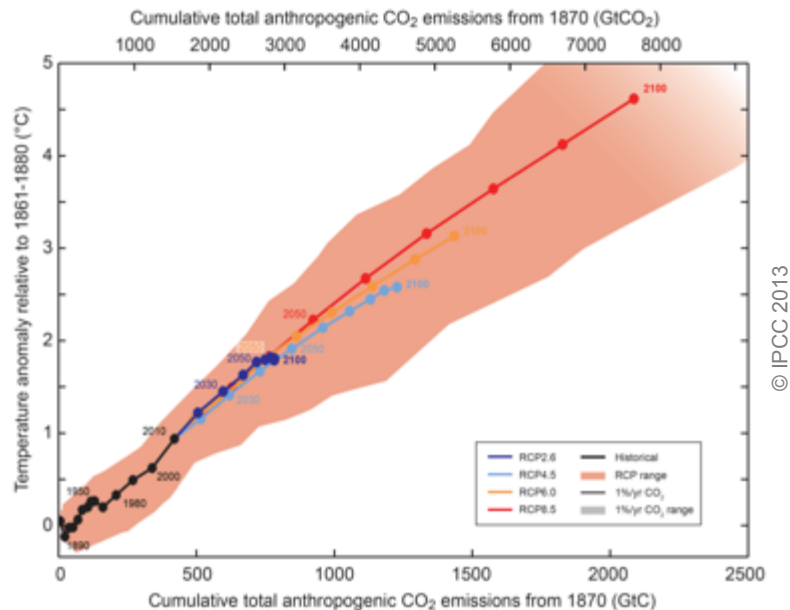
Cumulative emissions of CO₂ largely determine global mean surface warming by the late 21st century and beyond.



© IPCC 2013

Fig. SPM.10

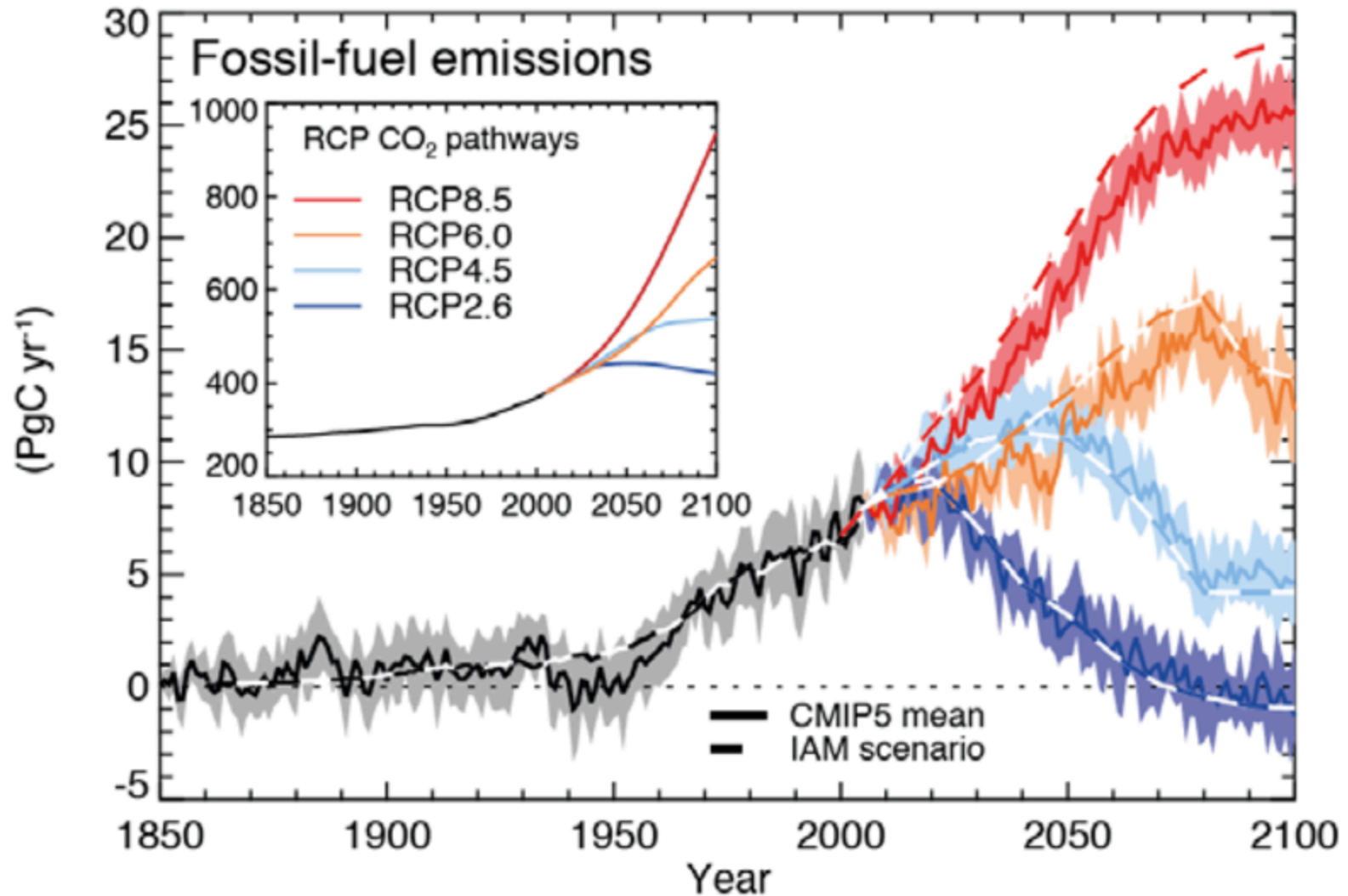
Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.



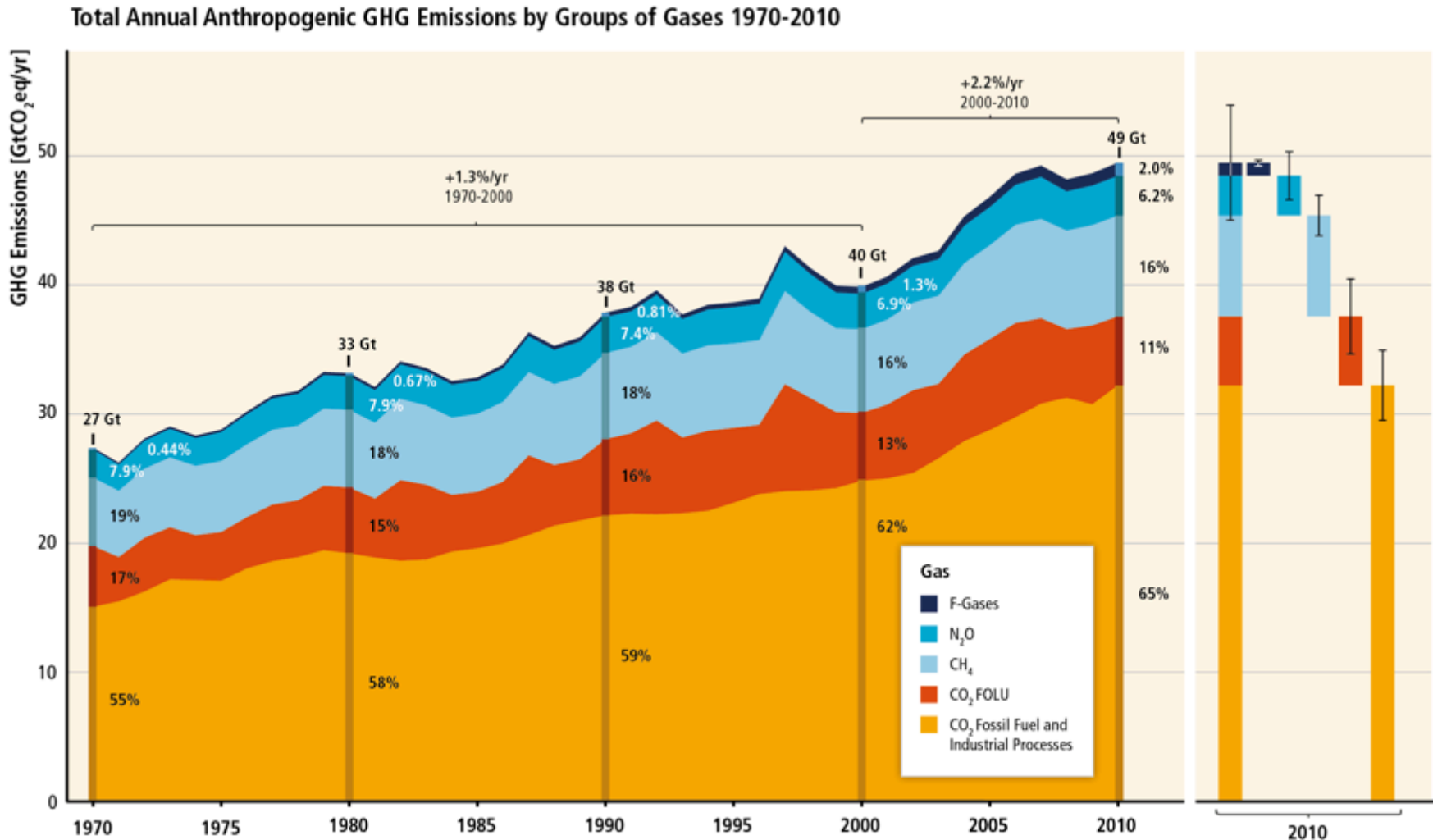
Limiting warming to *likely* less than 2°C since 1861-1880 requires cumulative CO₂ emissions to stay below 1000 GtC. Until 2011, over 50% of this amount has been emitted.

Accounting for other forcings, the upper amount of cumulative CO₂ emissions is 800 GtC; over 60% have been emitted by 2011.

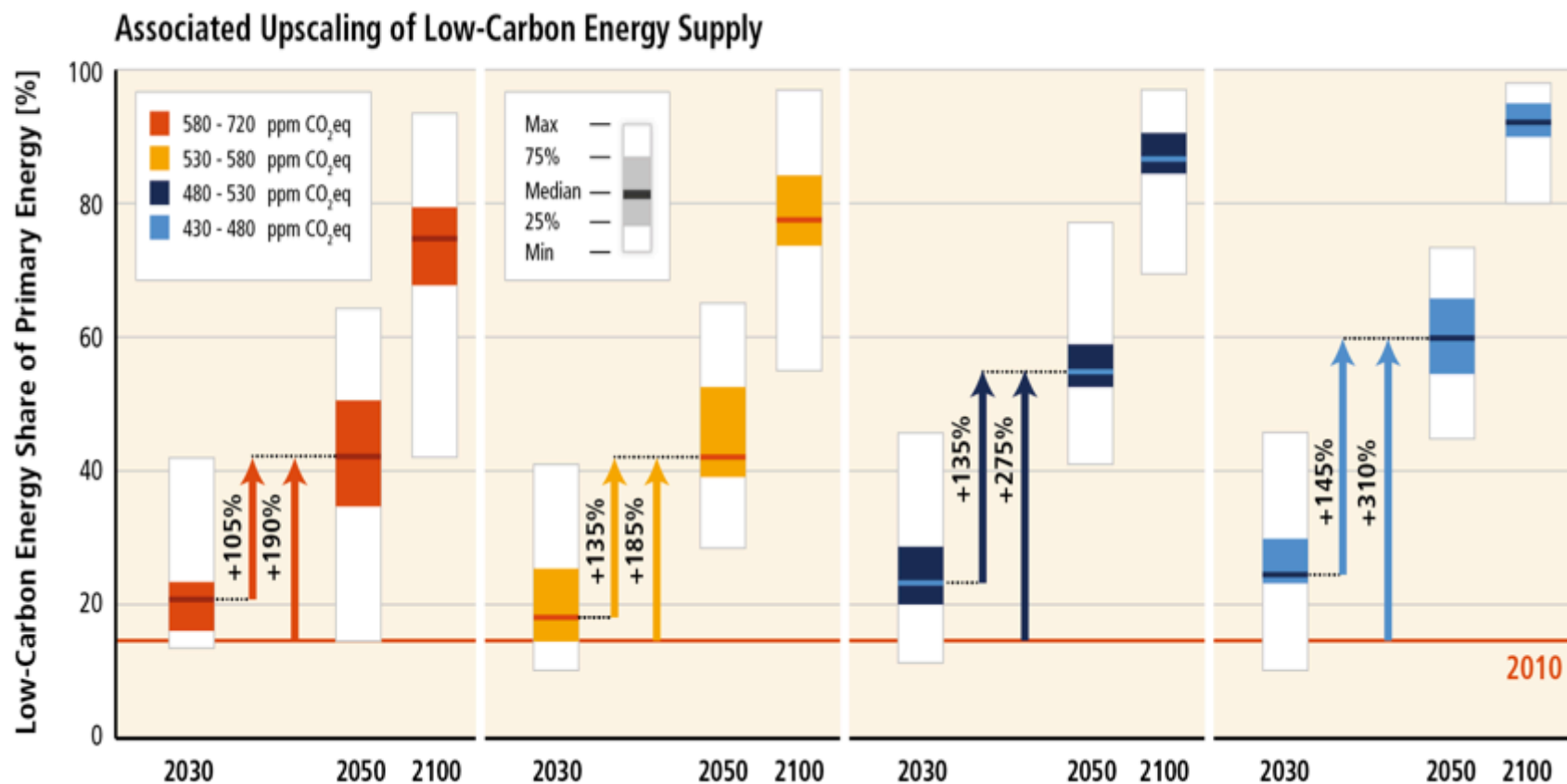
Compatible fossil fuel emissions simulated by the CMIP5 models for the four RCP scenarios



GHG emissions accelerate despite reduction efforts. Most emission growth is CO₂ from fossil fuel combustion and industrial processes.

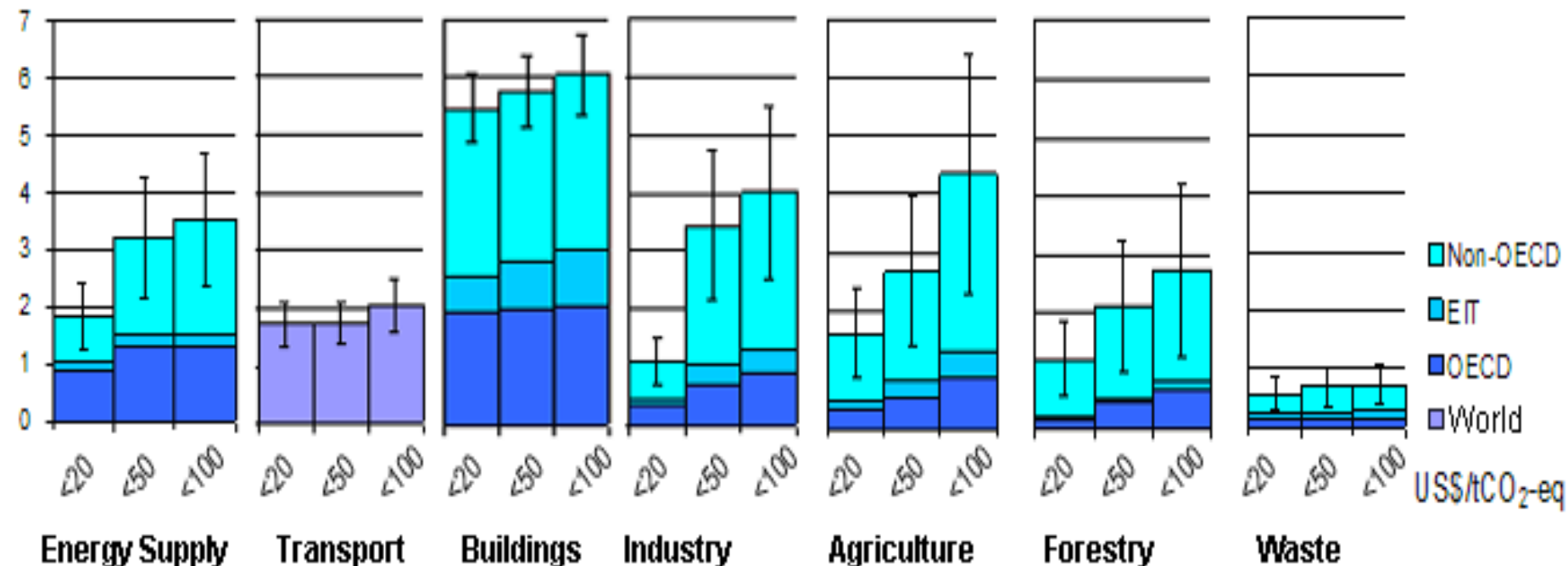


Mitigation requires major technological and institutional changes including the upscaling of low- and zero carbon energy



All sectors and regions have the potential to contribute by 2030

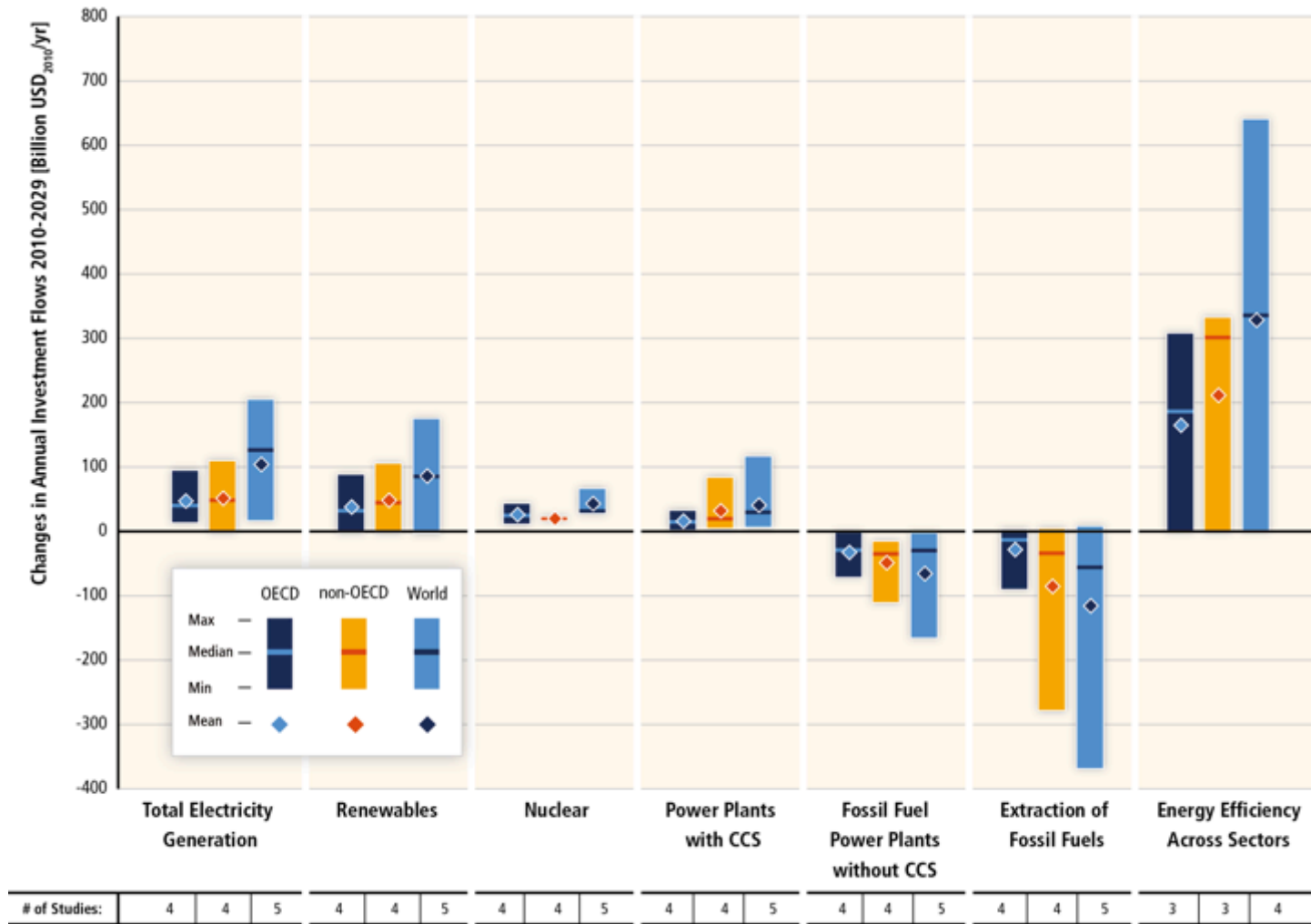
GtCO₂-eq / year (avoided emissions: the higher, the better)



IPCC AR4 (2007)

Note: estimates do not include non-technical options, such as lifestyle changes.

Substantial reductions in emissions would require large changes in investment patterns.



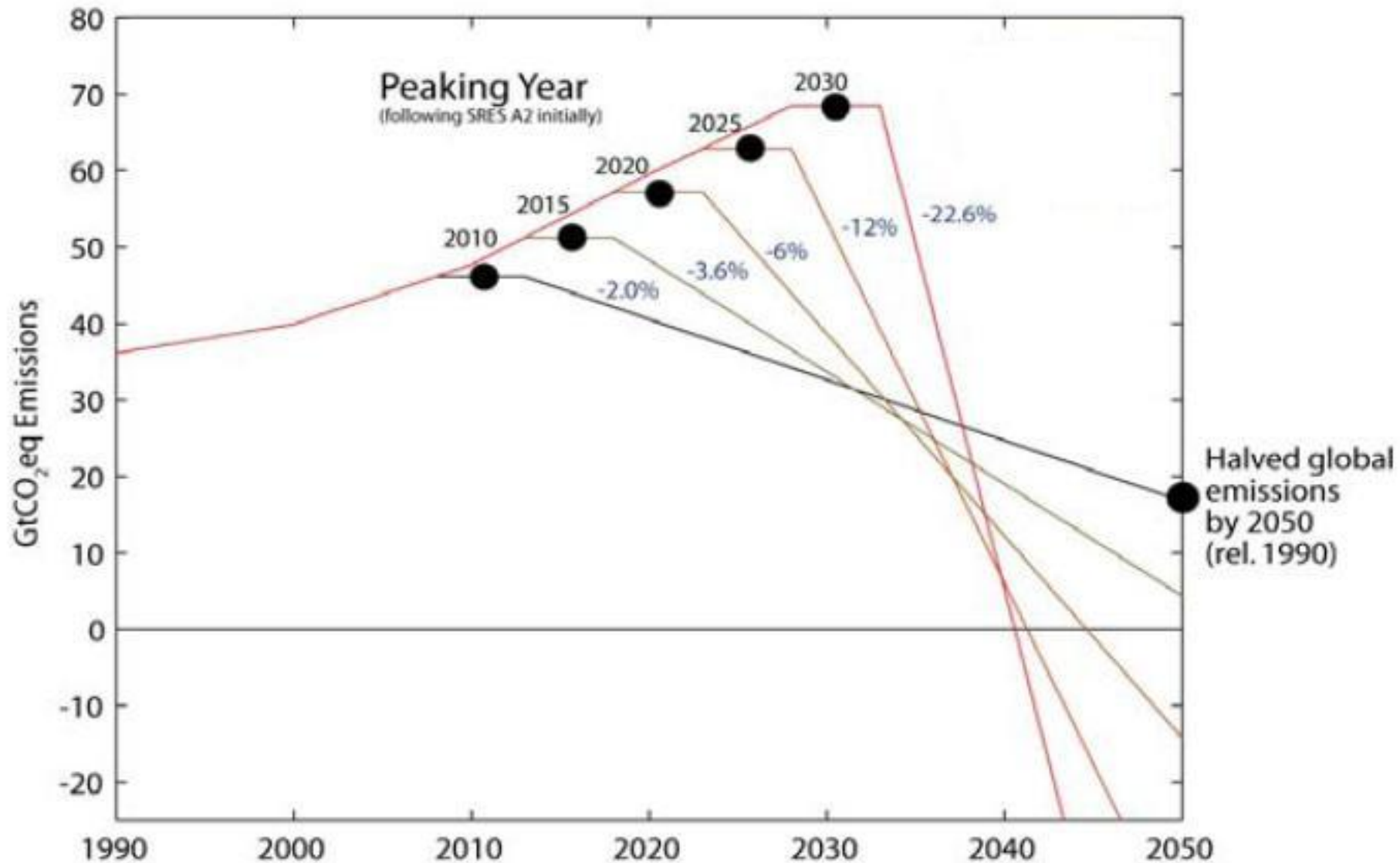
Since AR4, there has been an increased focus on policies designed to integrate multiple objectives, increase co-benefits and reduce adverse side-effects.

- Sector-specific policies have been more widely used than economy-wide policies.
- Regulatory approaches and information measures are widely used, and are often environmentally effective.
- Since AR4, cap and trade systems for GHGs have been established in a number of countries and regions.
- In some countries, tax-based policies specifically aimed at reducing GHG emissions—alongside technology and other policies—have helped to weaken the link between GHG emissions and GDP
- The reduction of subsidies for GHG-related activities in various sectors can achieve emission reductions, depending on the social and economic context.

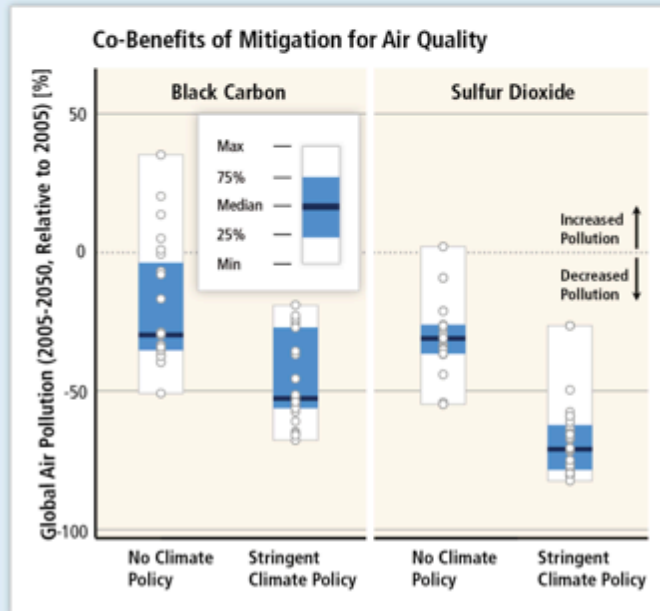
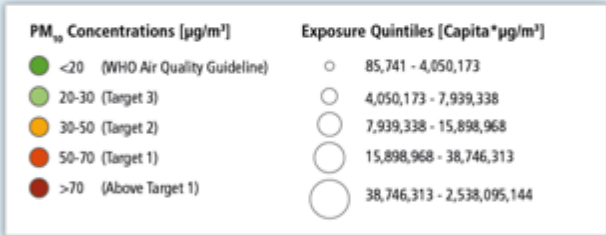
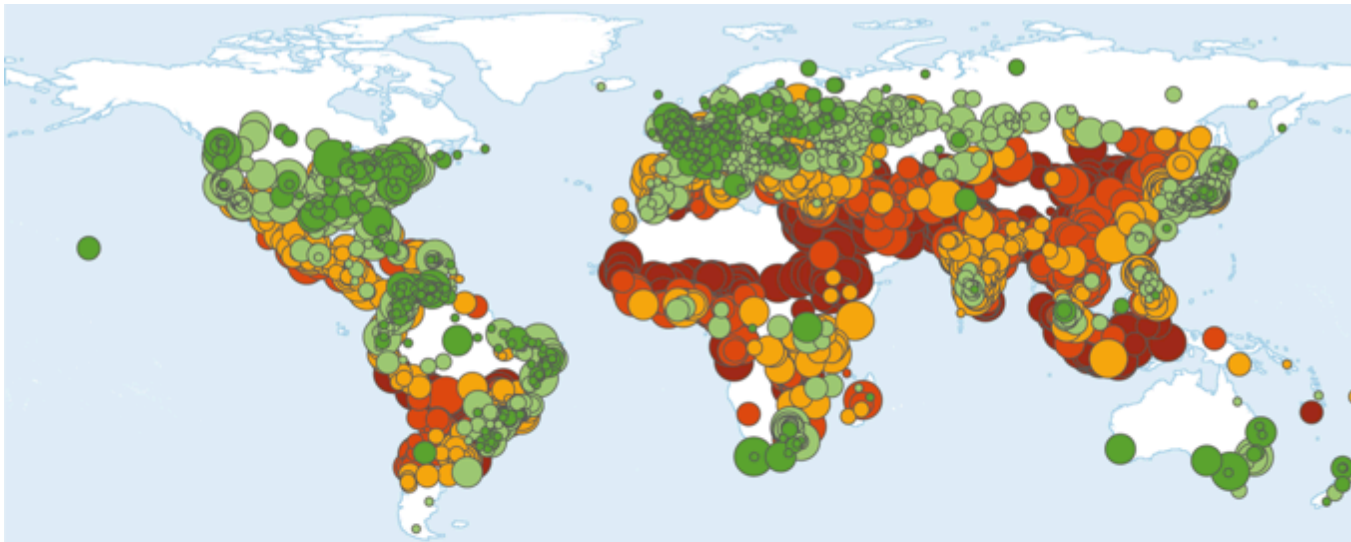
Effective mitigation will not be achieved if individual agents advance their own interests independently.

- Existing and proposed international climate change cooperation arrangements vary in their focus and degree of centralization and coordination.
- Issues of equity, justice, and fairness arise with respect to mitigation and adaptation.
- Climate policy may be informed by a consideration of a diverse array of risks and uncertainties, some of which are difficult to measure, notably events that are of low probability but which would have a significant impact if they occur.

The more we wait, the more difficult it will be



Source: Meinshausen et al. - Nature, 30th April 2009



Mitigation can result in large co-benefits for human health and other societal goals.

P. Rabhi: « La part du colibri L'espèce humaine face à son devenir »

Un jour, dit la légende amérindienne, il y eut un immense incendie de forêt. Tous les animaux terrifiés et atterrés observaient, impuissants, le désastre.

Seul le petit colibri s'active, allant chercher quelques gouttes d'eau dans son bec pour les jeter sur le feu.

Au bout d'un moment, le tatou, agacé par ses agissements dérisoires, lui dit : « Tu n'es pas fou ? Tu crois que c'est avec ces gouttes d'eau que tu vas éteindre le feu ? »

« Je le sais, répond le colibri, mais je fais ma part. »

Telle est notre responsabilité à l'égard du monde car nous ne sommes pas totalement impuissants si nous le décidons

Useful links:



- www.ipcc.ch : IPCC
- www.climate.be/vanyp : my slides and other documents
- www.skepticalscience.com: excellent responses to climate confusers arguments
- **On Twitter: @JPvanYpersele**