

Comment les changements climatiques menacent l'habitabilité de la Terre, et pourquoi ce n'est pas une fatalité

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ULB – IGEAT, Bruxelles, 20/10/2014

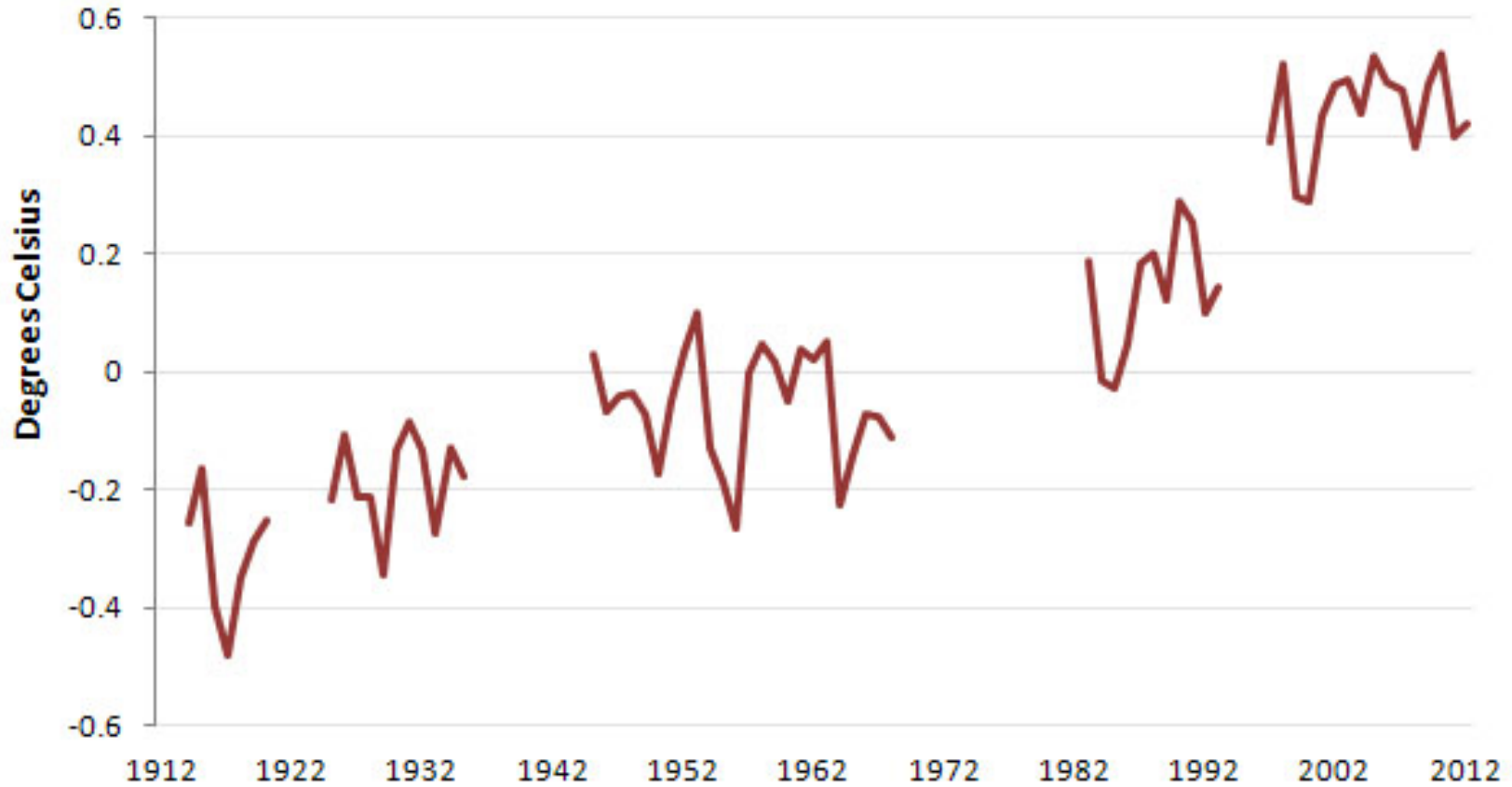
**Merci aux Services fédéraux (belges) de la Politique scientifique (BELSPO)
et à mon équipe à l'Université catholique de Louvain
pour leur soutien**

Temperature Change From 1961-1990 Average



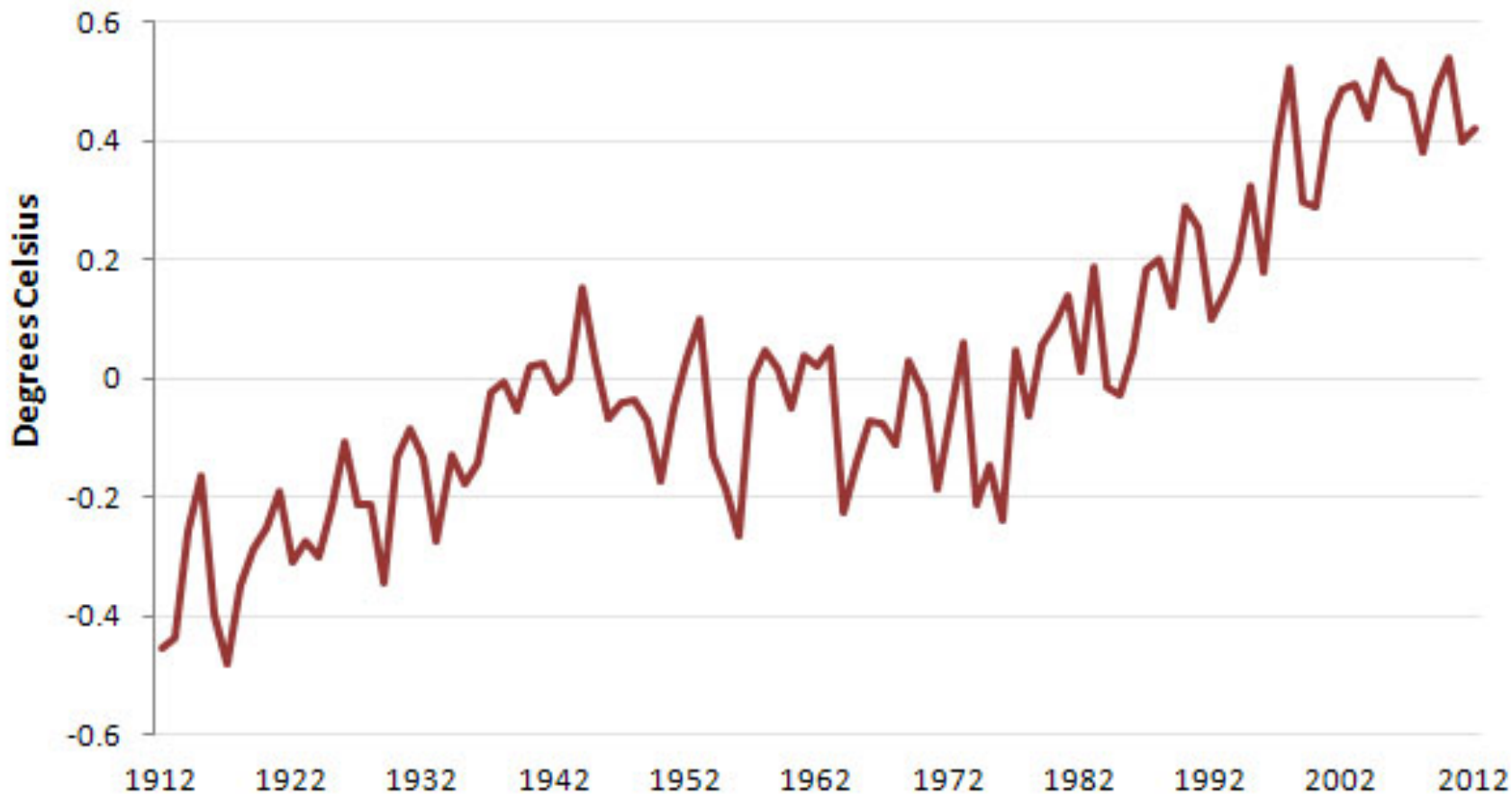
Lying With Statistics, Global Warming Edition

Temperature Plateaus — 1912-2012



Lying With Statistics, Global Warming Edition

Temperature Change From 1961-1990 Average



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



IPCC writing cycle (5 years, 2500 scientists)

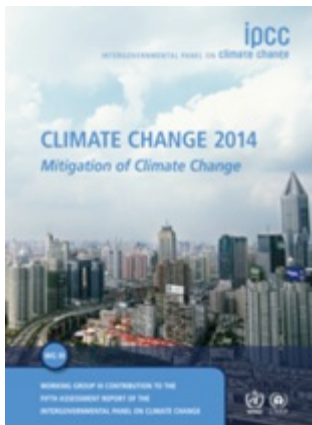
- Plenary decides table of content of reports
- Bureau appoints world-class scientists as authors, based on publication record
- Authors assess all scientific literature
- *Draft* – Expert review (+ Review editors)
- *Draft 2 (+ Draft 1 Summary for Policy Makers (SPM))* – Combined expert/government review
- *Draft 3 (+ Draft 2 SPM)* – Government review of SPM
- Approval Plenary (interaction authors – governments) – *SPM and full report*
- ***NB: the authors have the last word for words that are in the SPM***



What is happening in the climate system?



What are the risks?



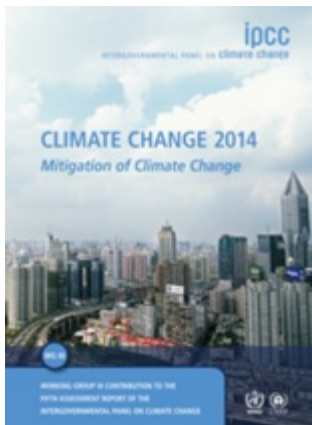
What can be done?



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

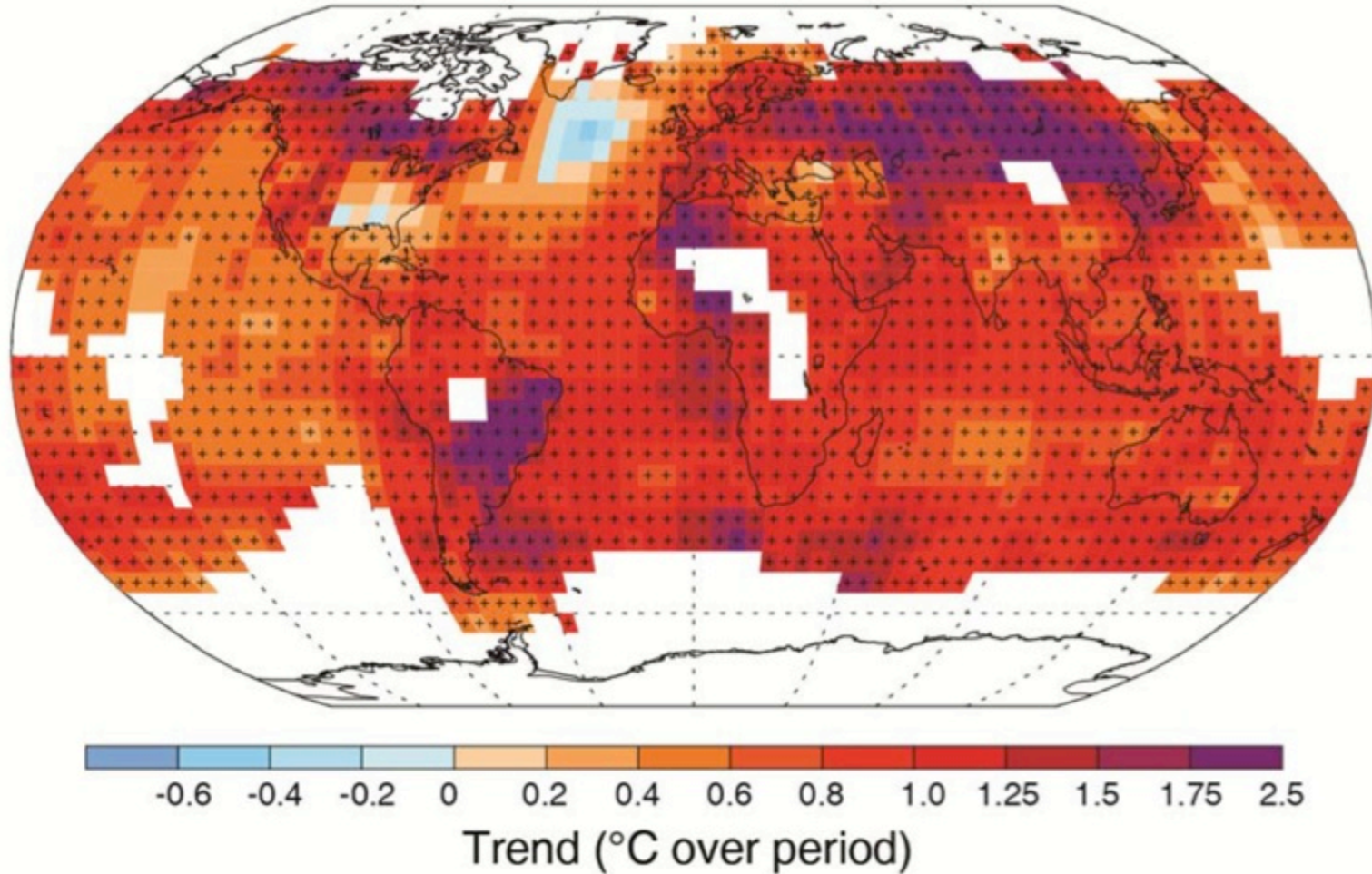


WG III (Mitigation of Climate Change): 235 coordinating and lead authors, 2000 pages, 38.315 review comments



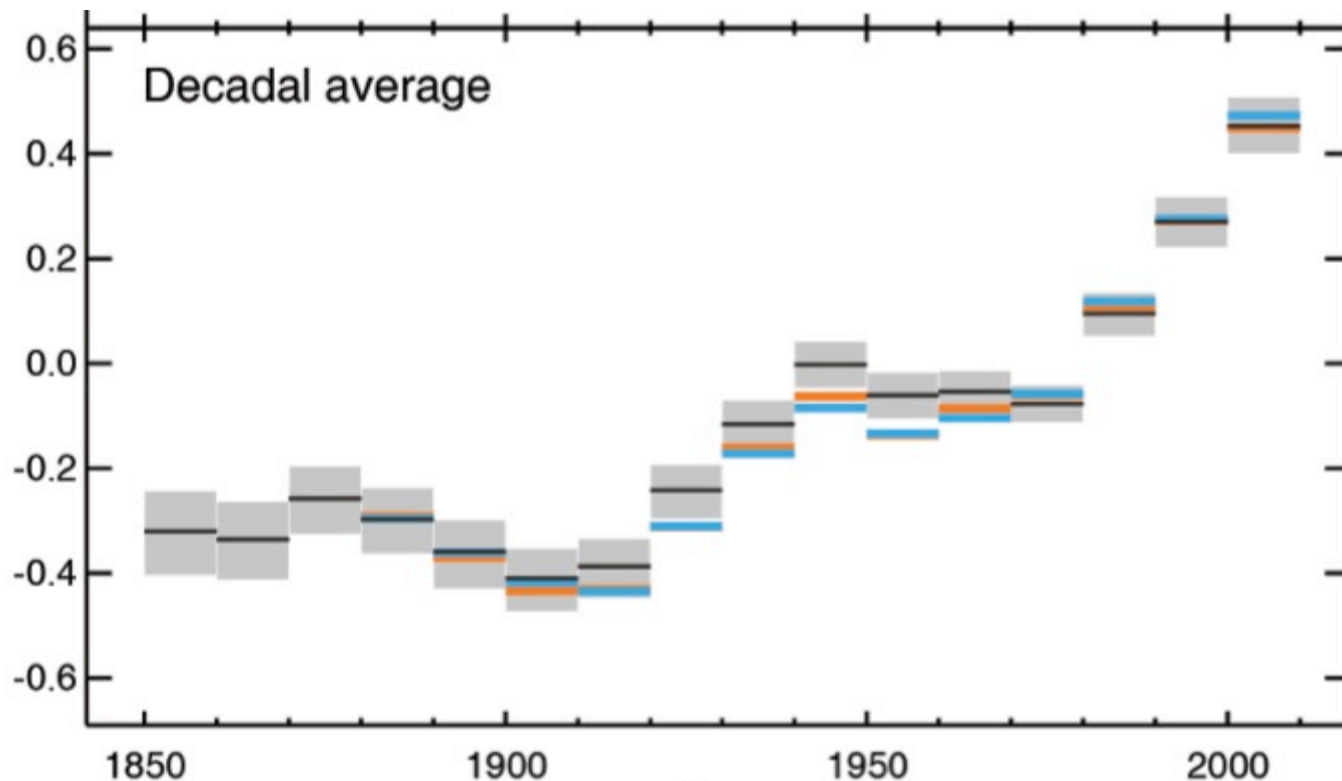
What is happening in the climate system?

Evolution de la température moyenne en surface 1901-2012: +0.89°C



(IPCC 2013, Fig. SPM.1b)

Le réchauffement du système climatique est sans équivoque



(IPCC 2013, Fig. SPM.1a)

Chacune des trois dernières décennies a été successivement plus chaude à la surface de la Terre que toutes les décennies précédentes depuis 1850

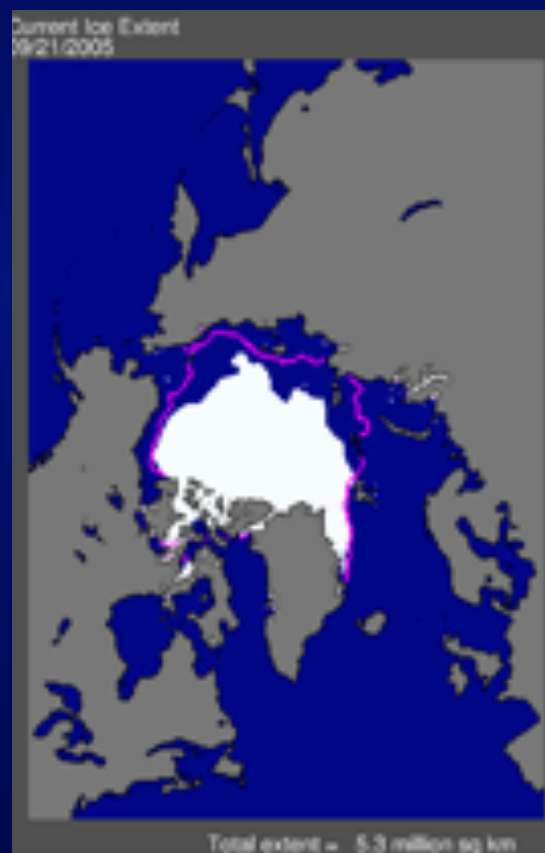
Dans l'hémisphère nord, la période 1983–2012 a probablement été la période de 30 ans la plus chaude des 1400 dernières années (degré de confiance moyen).

Extension of the Arctic ice cap

September 1979

September 2005

September 2007



The pink line indicates the average ice cap extension since 1979

Plateau Glacier (1961) (Alaska)



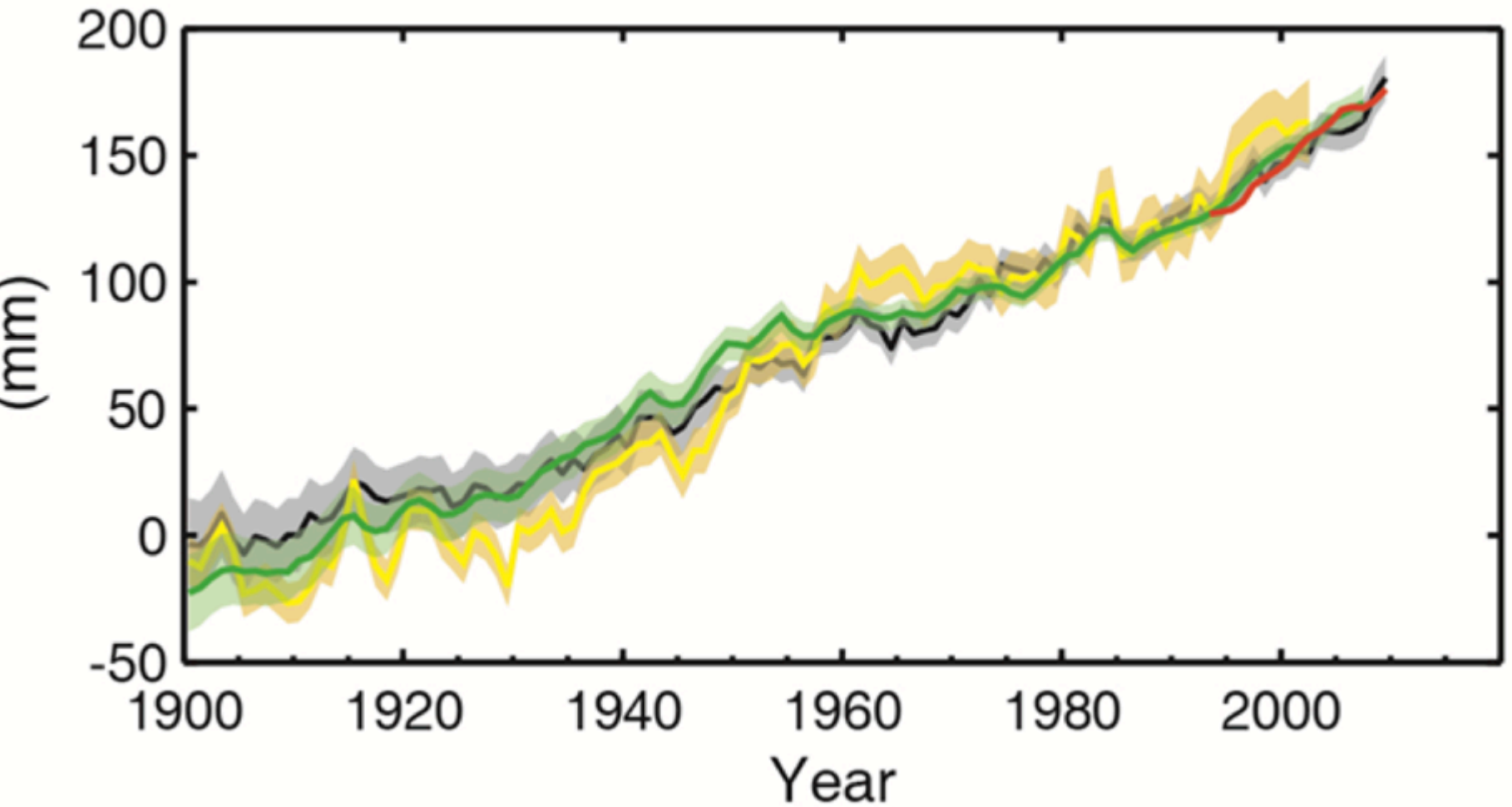
http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Plateau Glacier (2003) (Alaska)

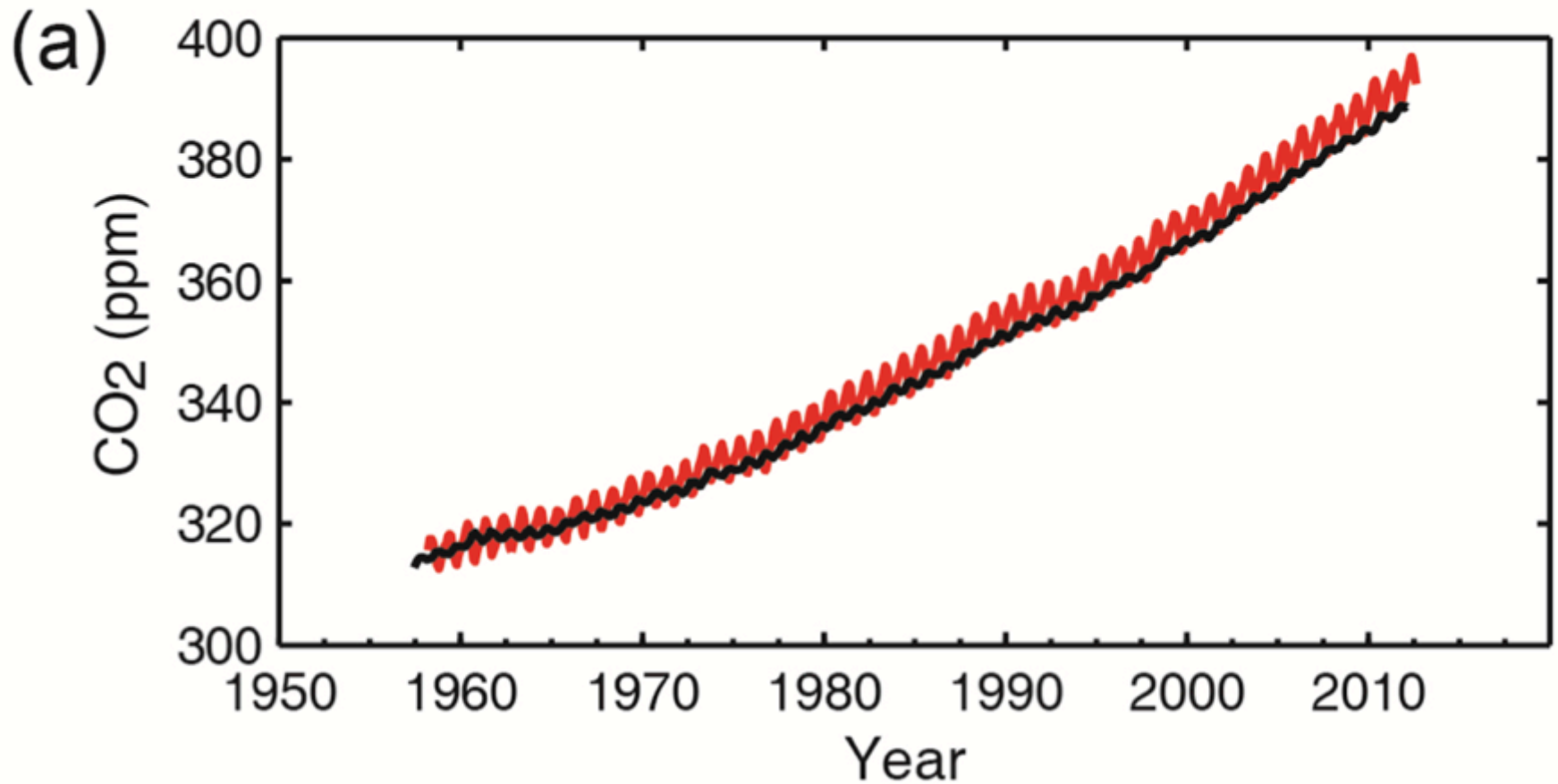


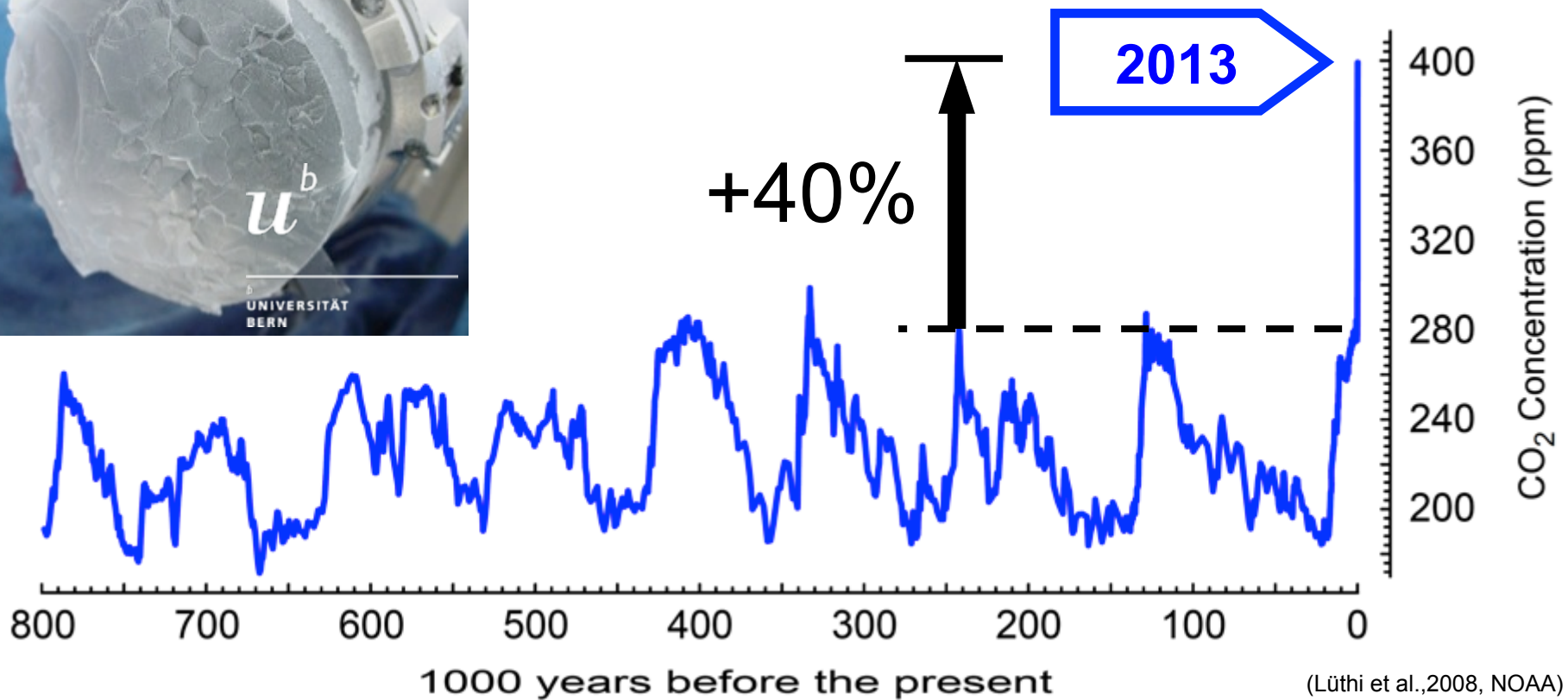
http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Change in average sea-level change



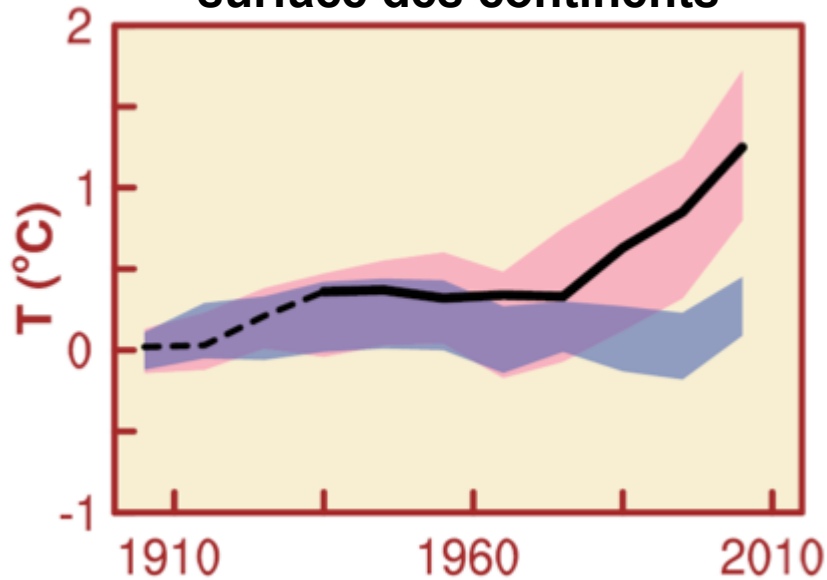
Atmospheric CO₂ concentration



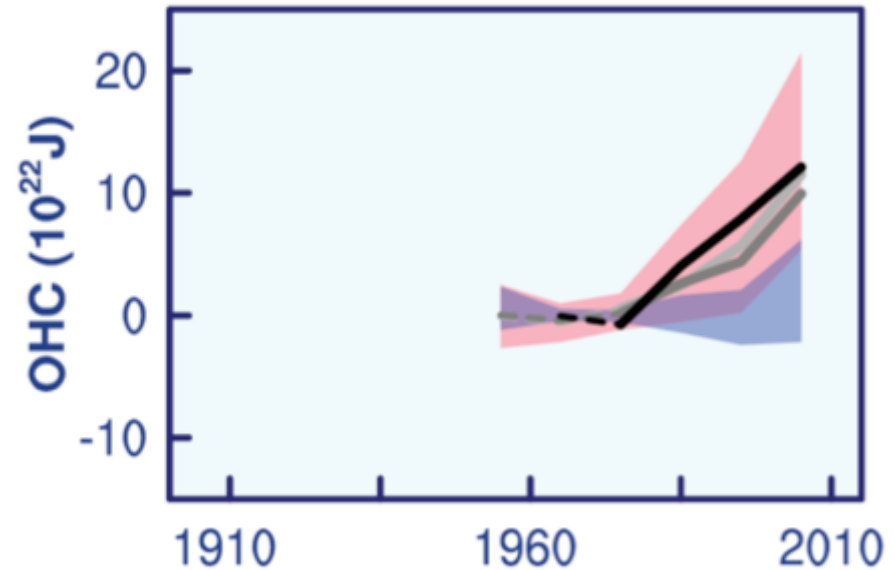


The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years.

Température moyenne surface des continents



Contenu thermique des océans



(IPCC 2013, Fig. SPM.6)

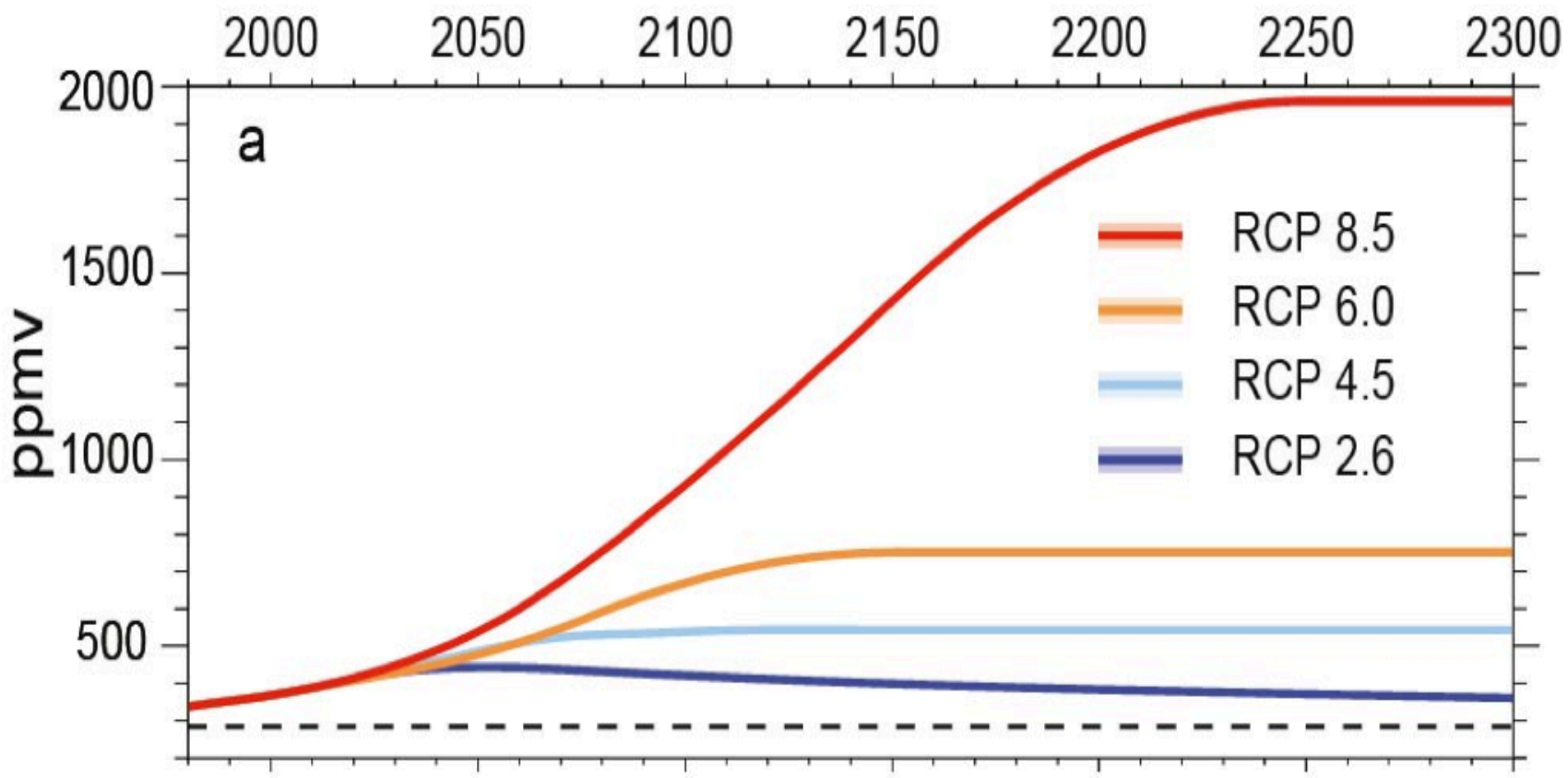
Noir: observations

Bleu: simulations avec seuls facteurs naturels

Rose: simulations avec facteurs naturels & humains

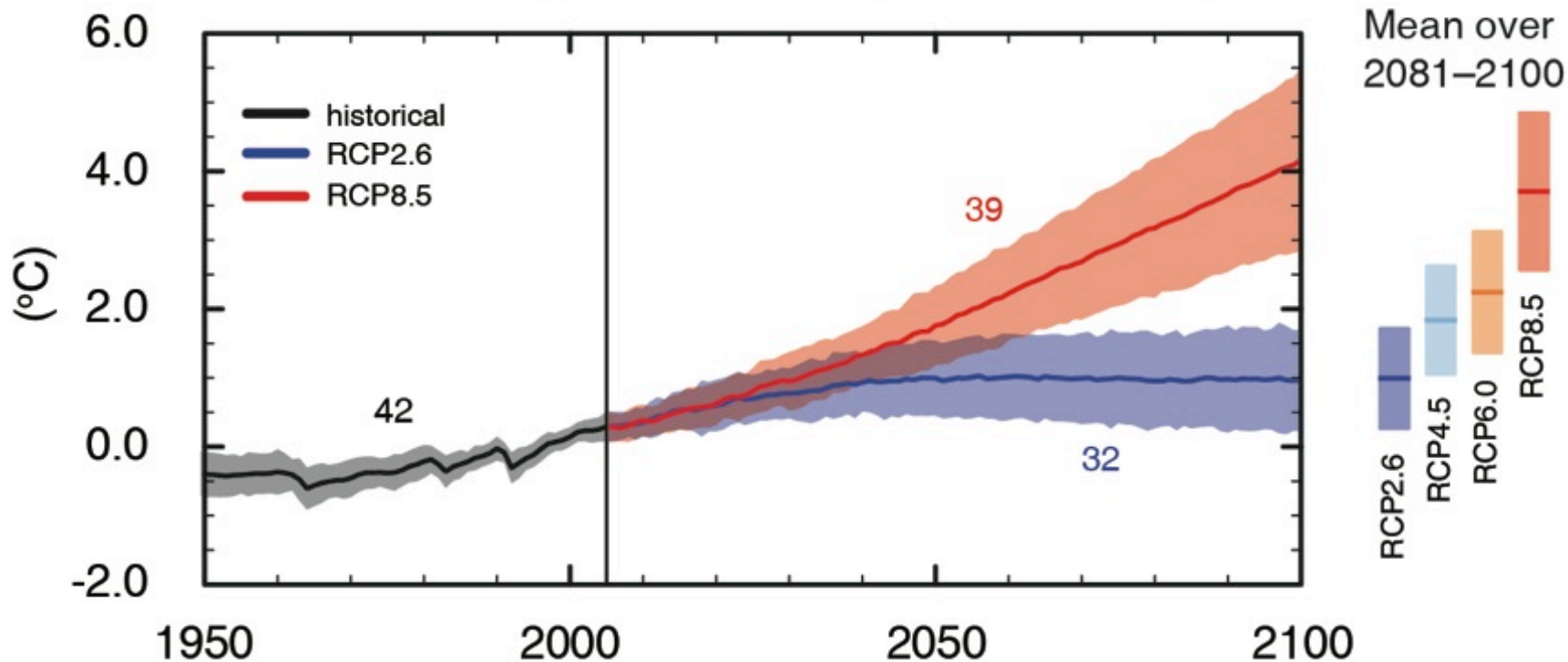
L'influence humaine sur le système climatique est sans équivoque; Il est *extrêmement probable* (95%) que l'influence humaine a été la cause principale du réchauffement depuis le milieu du 20^{ème} siècle

RCP Scenarios: Atmospheric CO₂ concentration



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

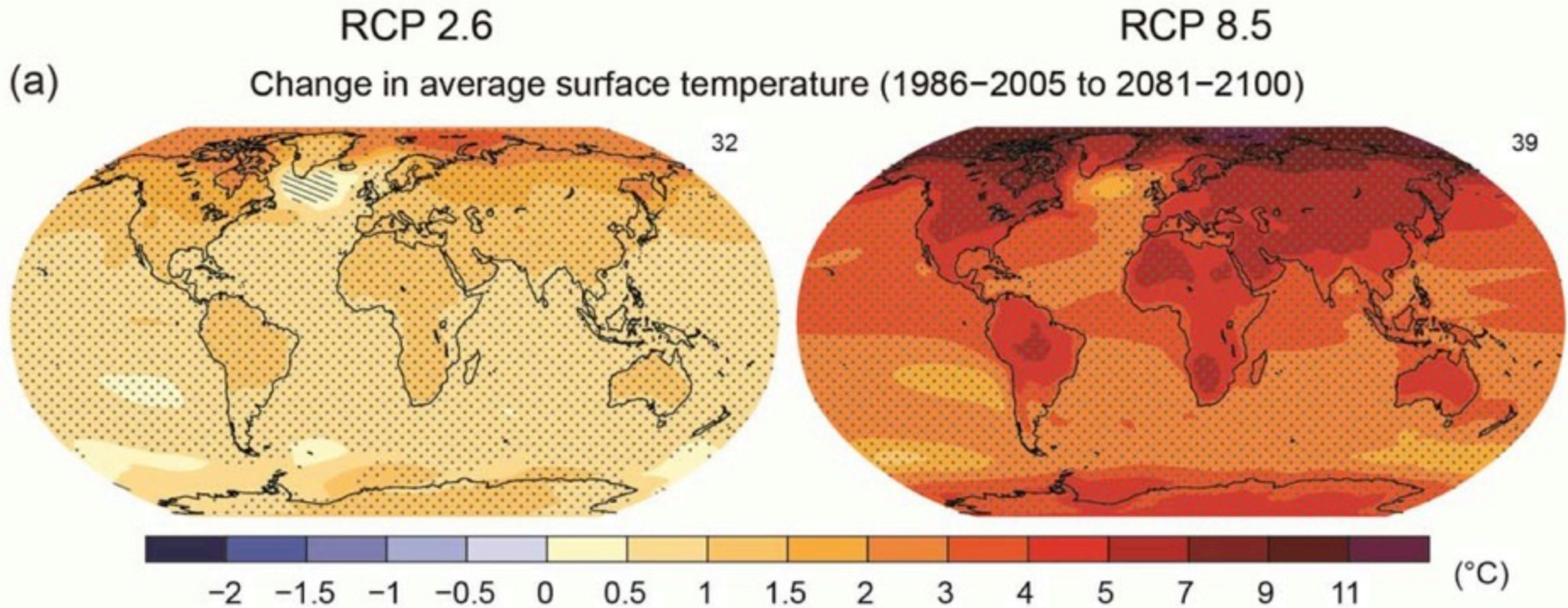
Global average surface temperature change



(IPCC 2013, Fig. SPM.7a)

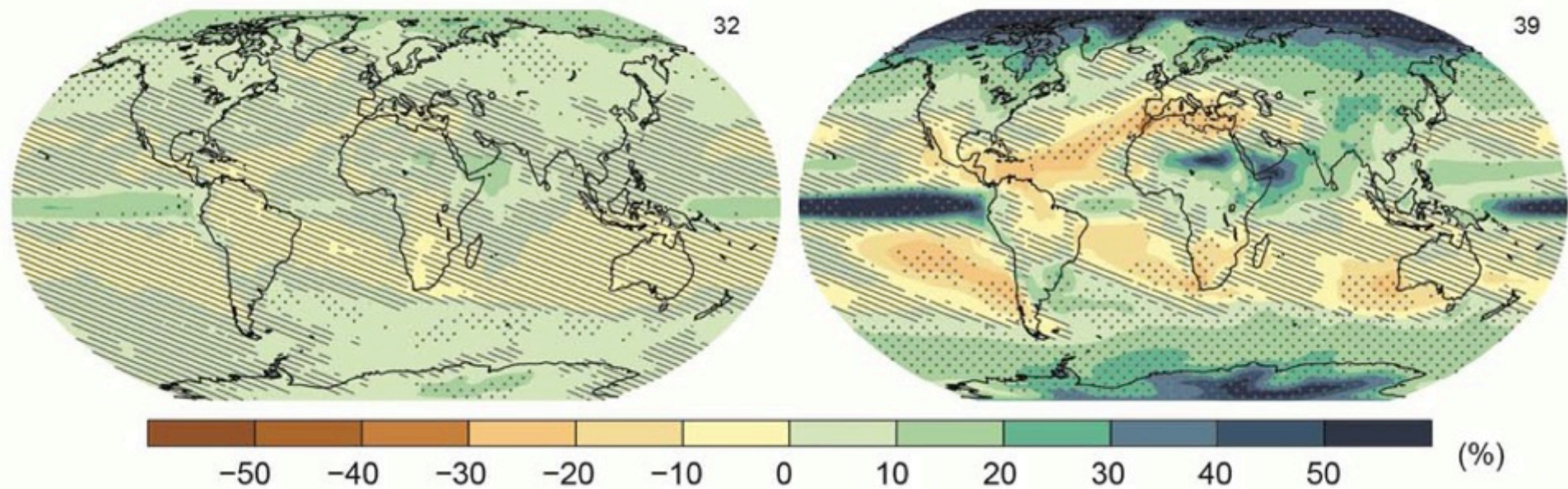
Only the lowest (RCP2.6) scenario maintains the global surface temperature increase above the pre-industrial level to less than 2°C with at least 66% probability

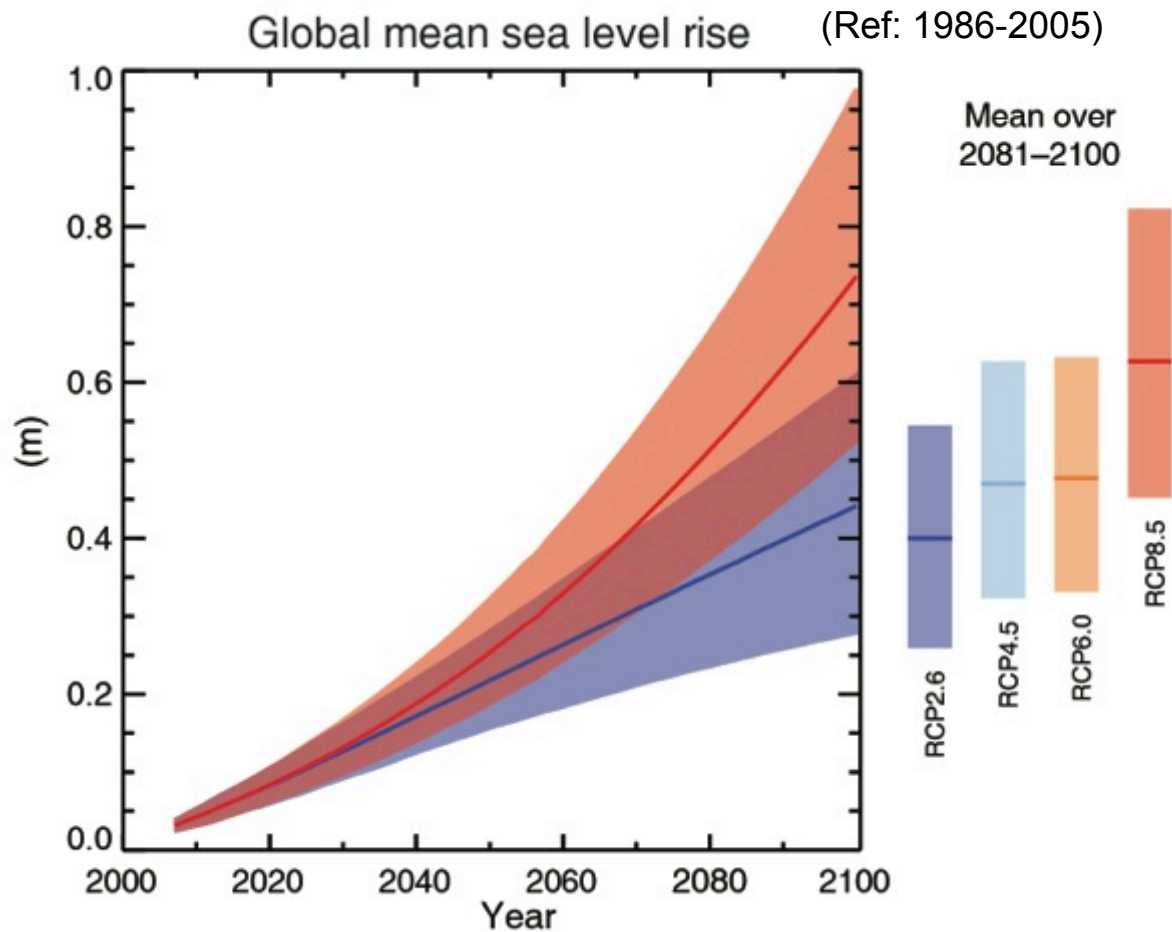
Surface temperature projections



(b)

Change in average precipitation (1986–2005 to 2081–2100)

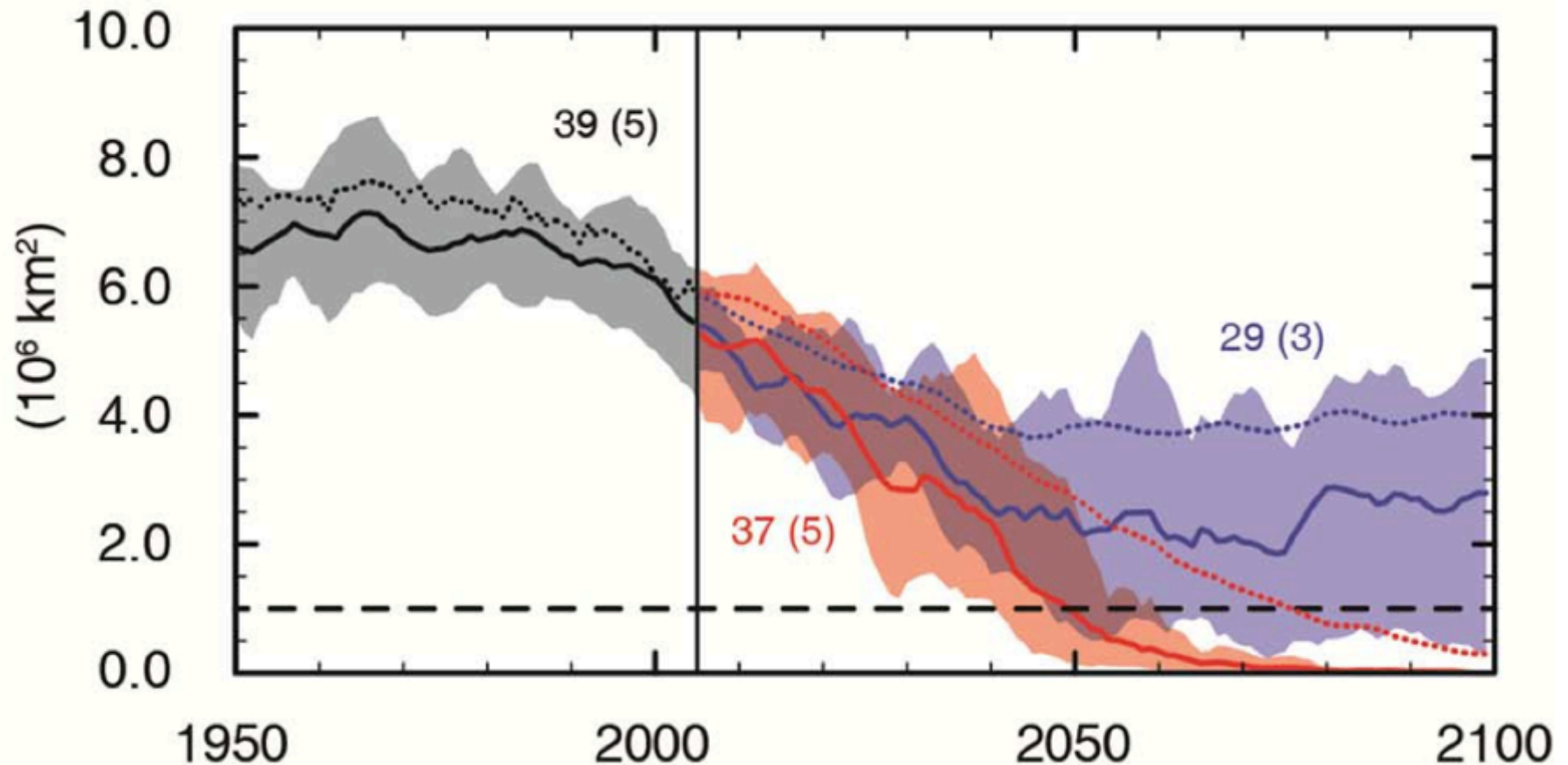




(IPCC 2013, Fig. SPM.9)

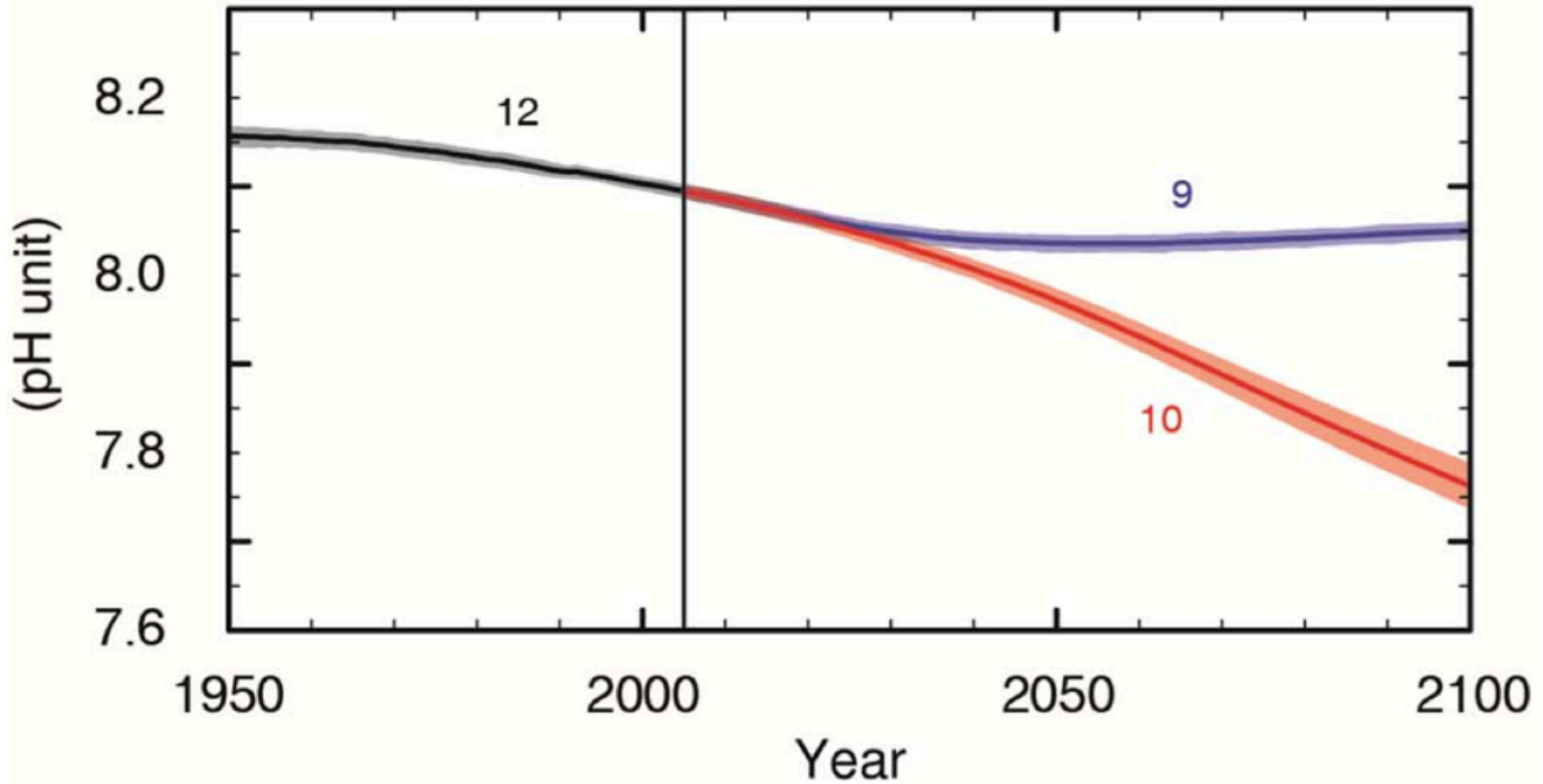
Le niveau moyen des mers continuera à s'élever au cours du XXI^e siècle

Extension de la glace de mer en Arctique



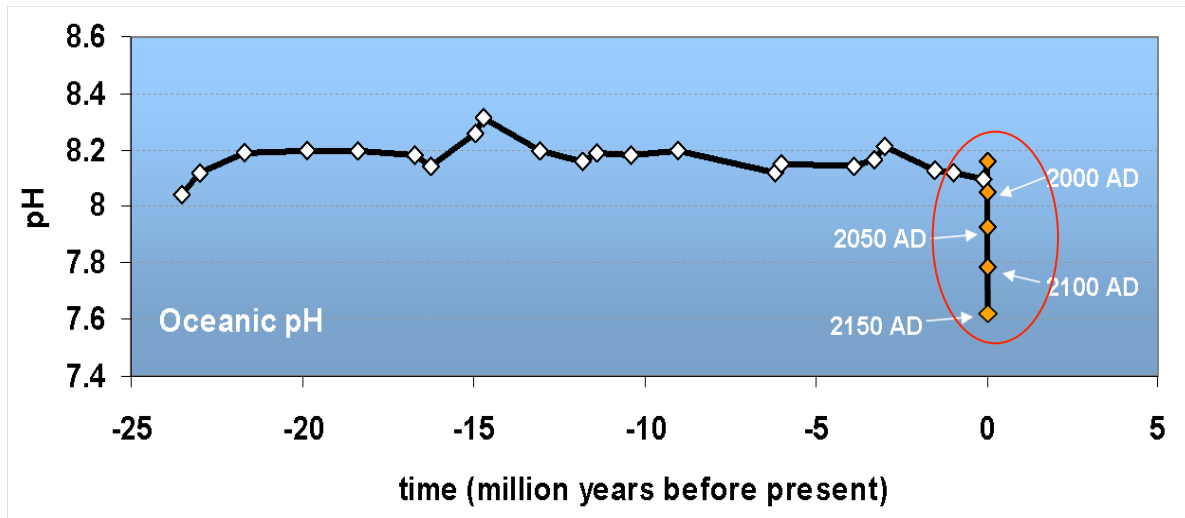
Global ocean surface pH (projections)

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

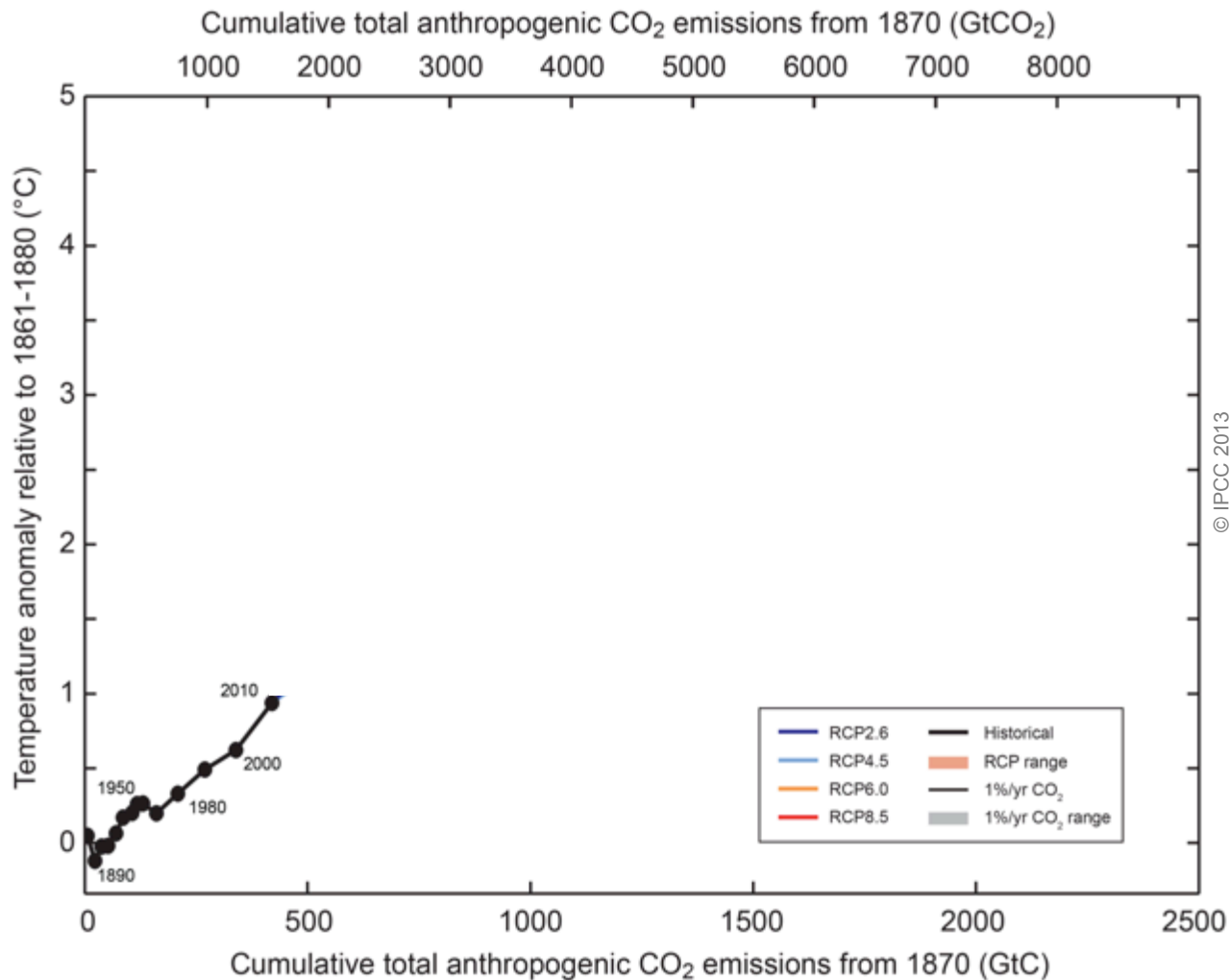
Since 1950, **extreme hot days** and **heavy precipitation** have become more common



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

Extreme weather and climate events

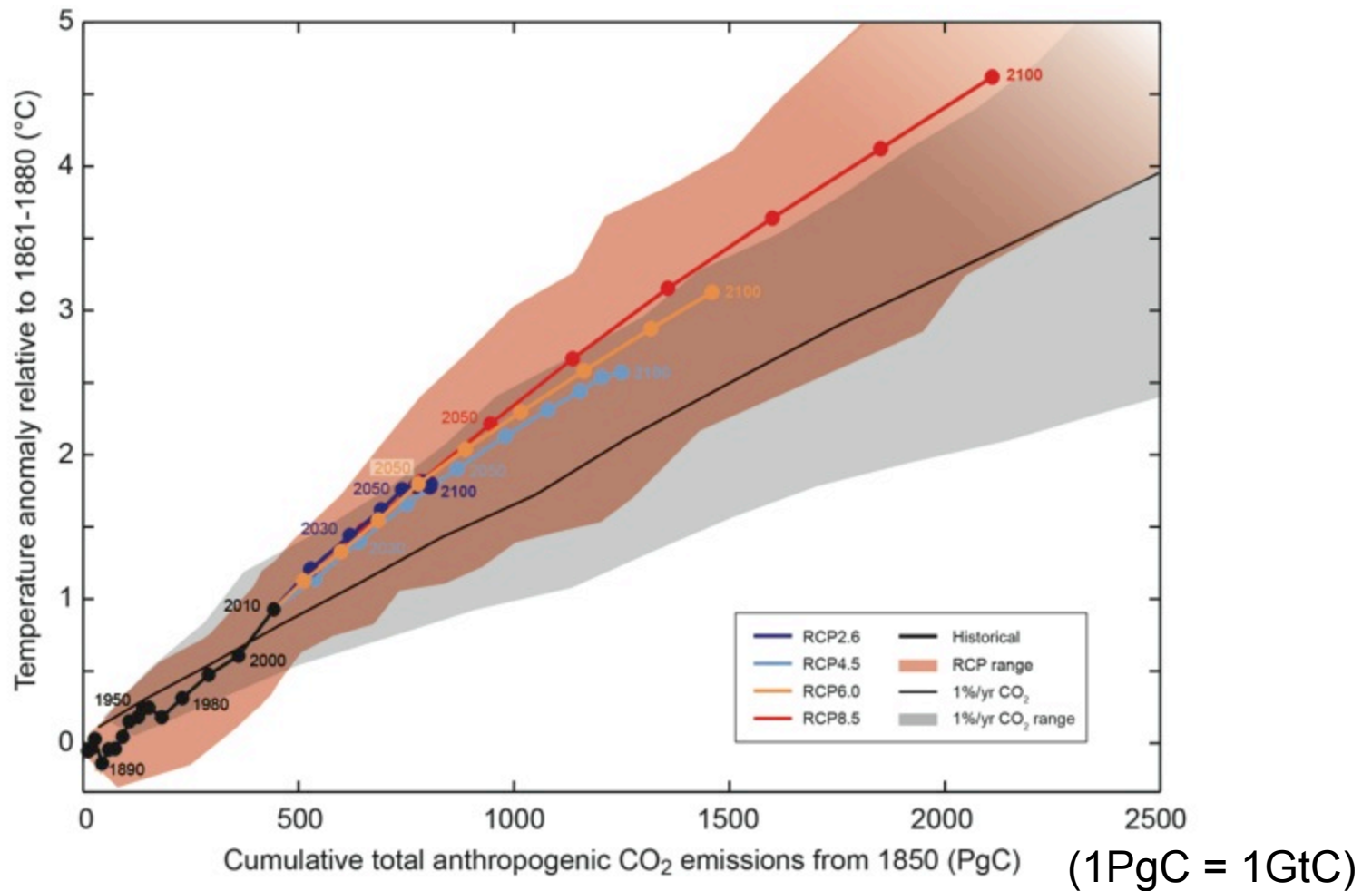
Phenomenon and direction of trend	Assessment that changes occurred (typically since 1950 unless otherwise indicated)	Assessment of a human contribution to observed changes	Likelihood of further changes	
			Early 21st century	Late 21st century
Warmer and/or fewer cold days and nights over most land areas	<i>Very likely</i>	Very likely	<i>Likely</i>	Virtually certain
Warmer and/or more frequent hot days and nights over most land areas	<i>Very likely</i>	Very likely	<i>Likely</i>	Virtually certain
Warm spells/heat waves. Frequency and/or duration increases over most land areas	Medium confidence on a global scale Likely in large parts of Europe, Asia and Australia	Likely	Not formally assessed	Very likely
Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation	<i>Likely more land areas with increases than decreases</i>	Medium confidence	<i>Likely over many land areas</i>	Very likely over most of the mid-latitude land masses and over wet tropical regions
Increases in intensity and/or duration of drought	Low confidence on a global scale Likely changes in some regions	Low confidence	<i>Low confidence</i>	Likely (medium confidence) on a regional to global scale
Increases in intense tropical cyclone activity	Low confidence in long term (centennial) changes Virtually certain in North Atlantic since 1970	Low confidence	<i>Low confidence</i>	More likely than not in the Western North Pacific and North Atlantic
Increased incidence and/or magnitude of extreme high sea level	<i>Likely (since 1970)</i>	Likely	<i>Likely</i>	Very likely



© IPCC 2013

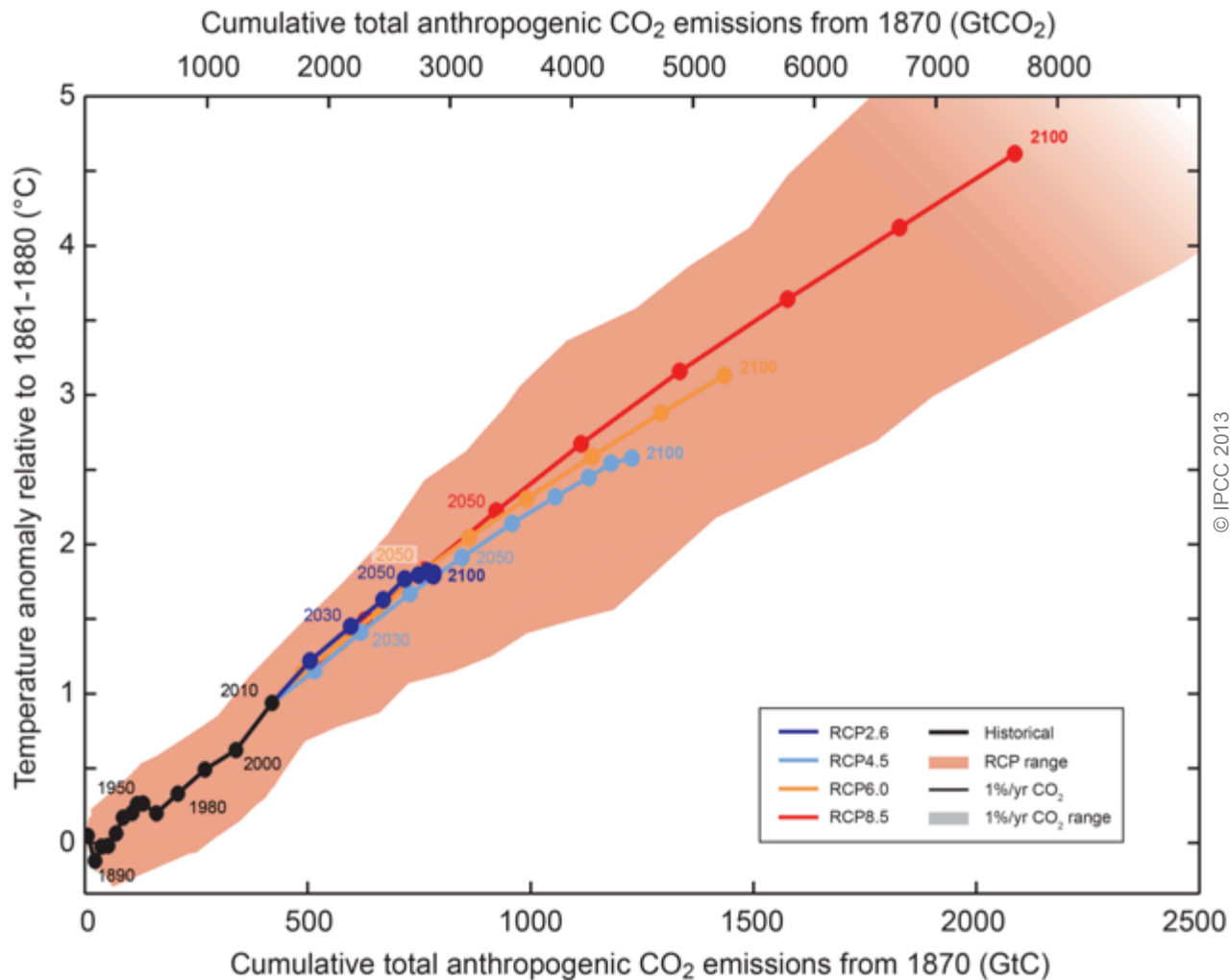
Fig. SPM.10

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



(IPCC 2013, Fig. SPM.10)

Le total des émissions de CO₂ cumulées détermine dans une large mesure la moyenne globale du réchauffement en surface vers la fin du XXI^{ème} siècle et au delà



© IPCC 2013

Fig. SPM.10

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



What are the risks?

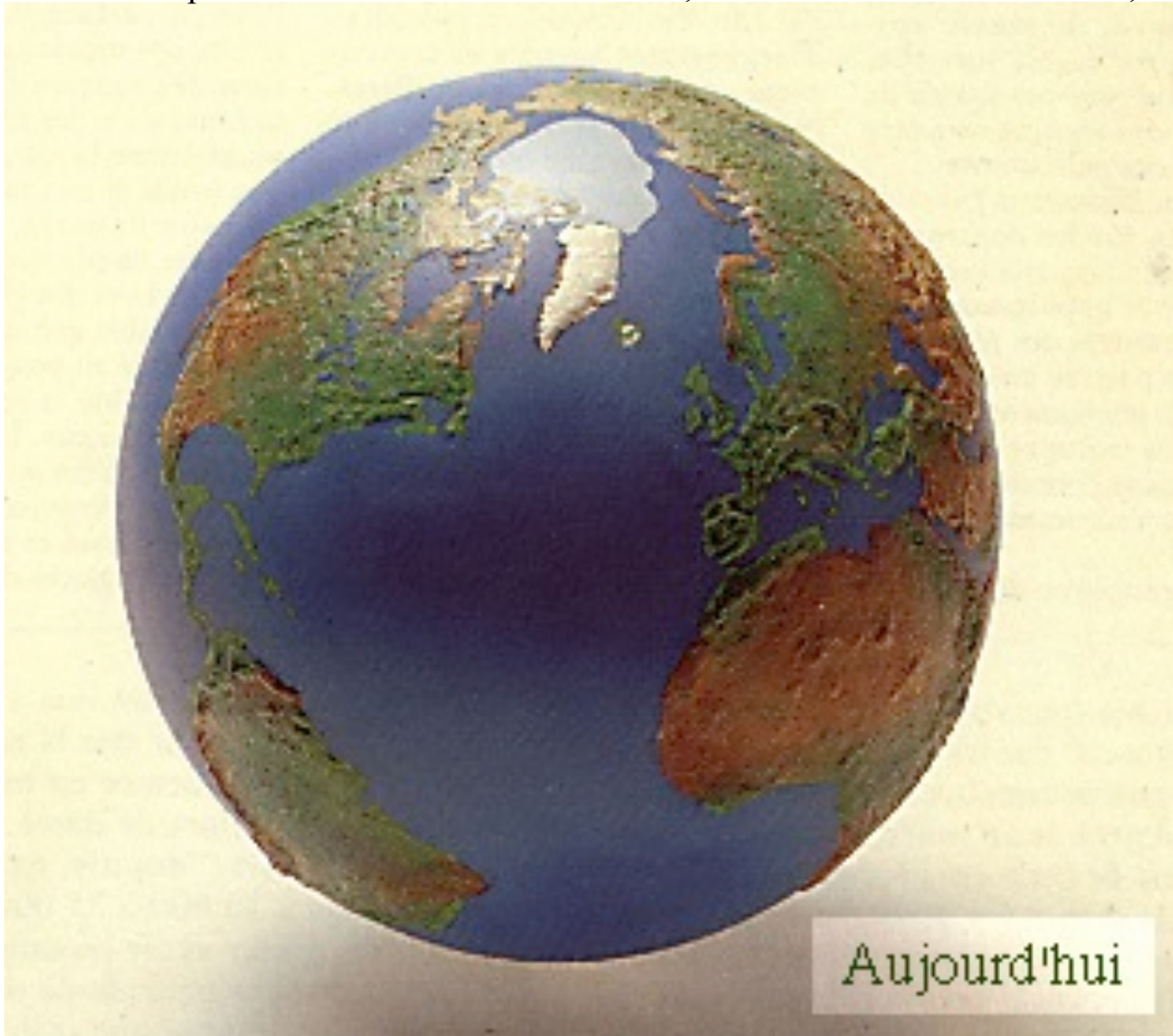
18-20000 years ago (Last Glacial Maximum)

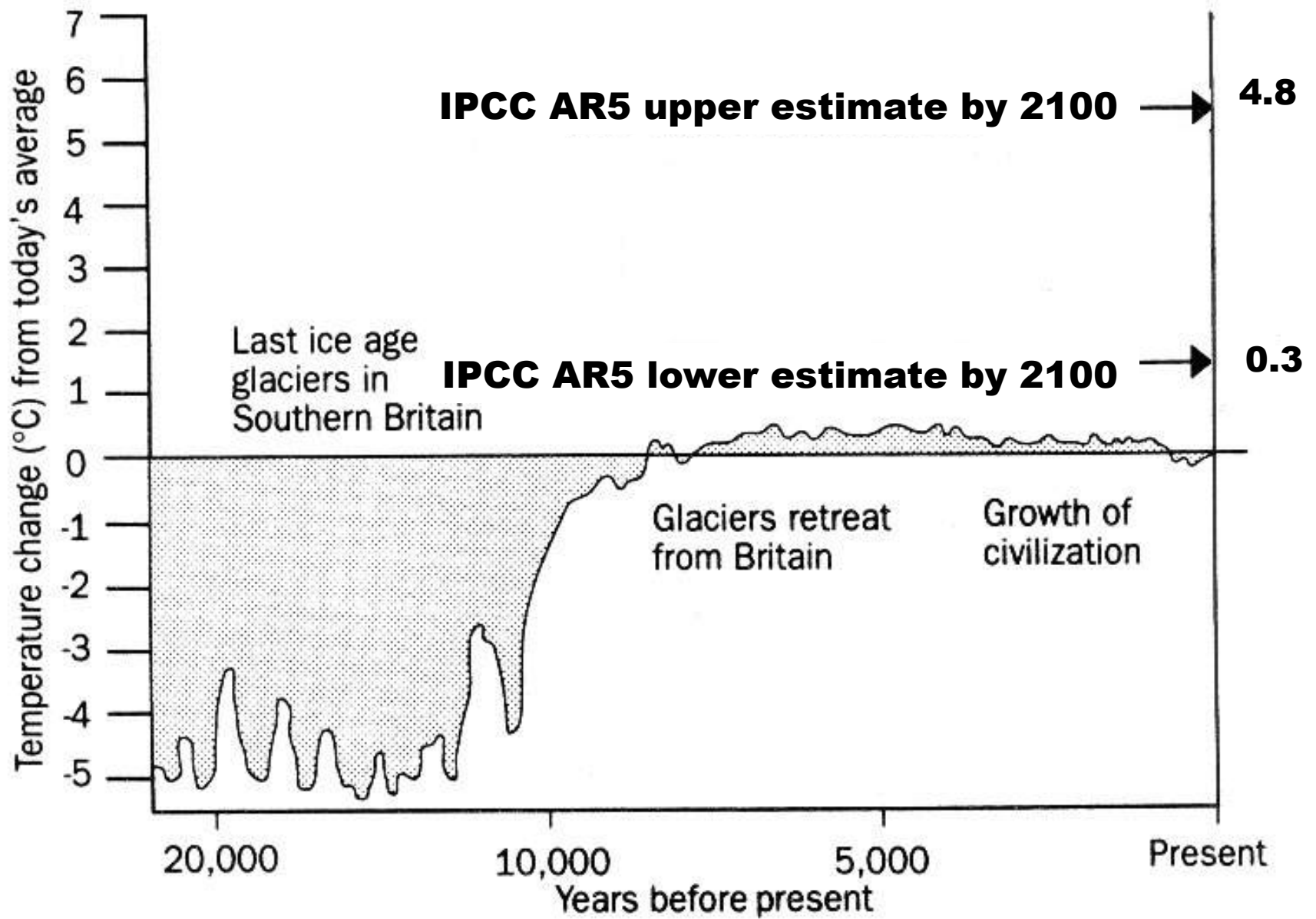
With permission from Dr. S. Jousaume, in « Climat d'hier à demain », CNRS éditions.



Today, with +4-5°C globally

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



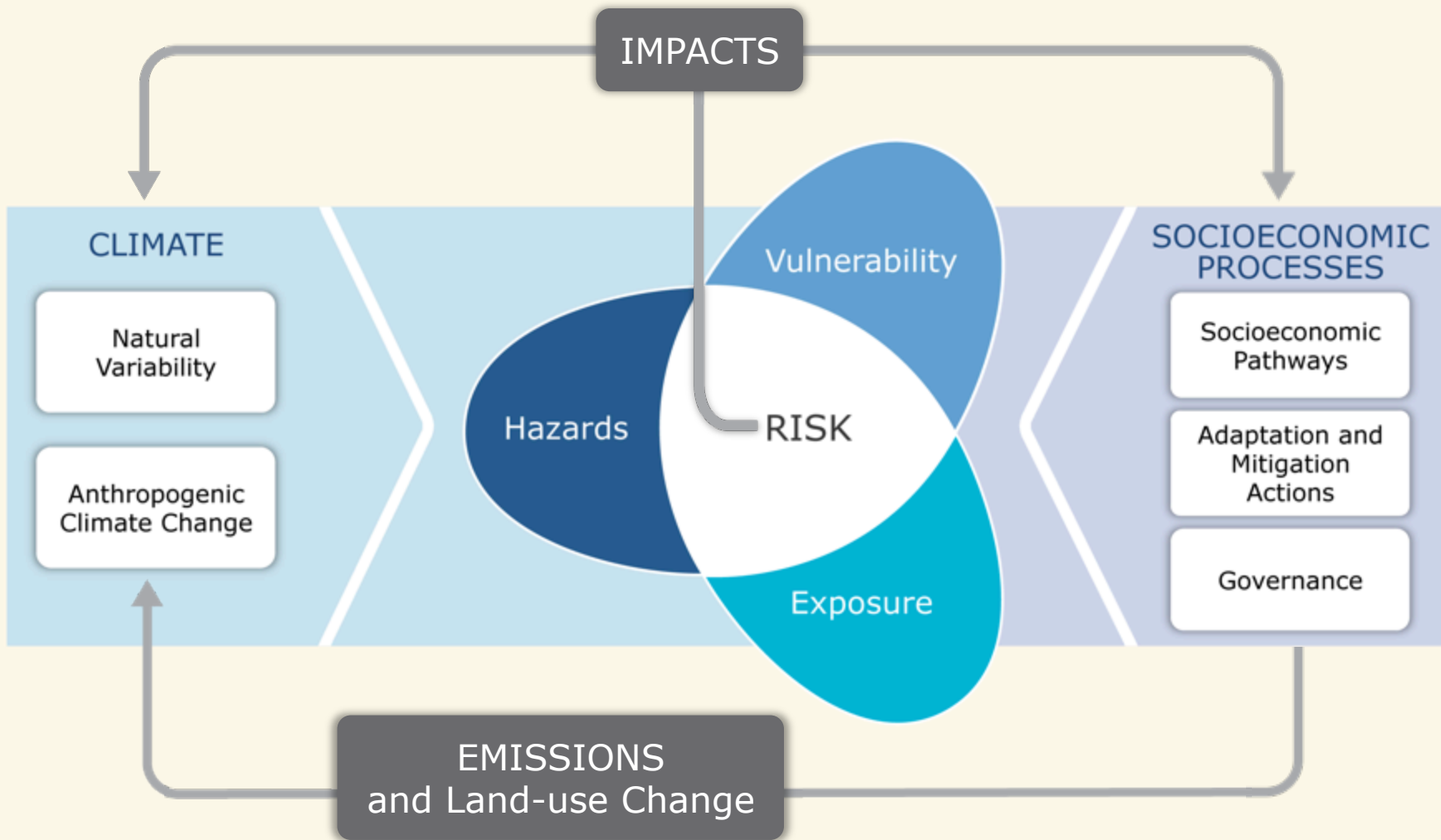


Adapted from: International Geosphere Biosphere Programme Report no.6, Global Changes of the Past, July 1988

THE WORKING GROUP II

CONTRIBUTION TO THE IPCC'S FIFTH ASSESSMENT REPORT





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





VULNERABILITY AND EXPOSURE

AROUND THE WORLD

A photograph of a city street completely flooded with water. The water is dark and reflects the surrounding buildings and sky. On the left, a tall brick building with many windows lines the street. On the right, another brick building with a modern glass and metal facade is visible. In the distance, a person in a red jacket is wading through the water, and a dark car is partially submerged. The sky is overcast and grey.

VULNERABILITY AND EXPOSURE

AROUND THE WORLD



**WIDESPREAD
OBSERVED IMPACTS**

A CHANGING WORLD

An underwater photograph of a coral reef. The water is a deep, dark green. In the foreground, there is a dense field of coral. A prominent feature is a large, white, fan-shaped coral structure in the center. The surrounding coral is mostly brown and appears to be dead or bleached. The text "WIDESPREAD OBSERVED IMPACTS" is written in white, bold, sans-serif font in the upper left. Below it is a horizontal line, and then "A CHANGING WORLD" is written in a larger, white, bold, sans-serif font. In the bottom right corner, the IPCC logo is visible, consisting of the letters "ipcc" in a stylized font, with "INTERGOVERNMENTAL PANEL ON climate change" written in smaller text below it.

WIDESPREAD OBSERVED IMPACTS

A CHANGING WORLD

(A)



Confidence in attribution to climate change

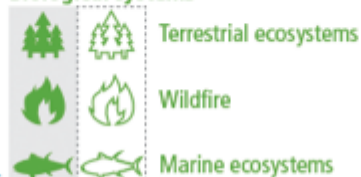


Observed impacts attributed to climate change for

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)





ADAPTATION IS ALREADY OCCURRING



**ADAPTATION IS
ALREADY OCCURRING**



CLIMATE CHANGE

REDUCING AND MANAGING RISKS

ipcc

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

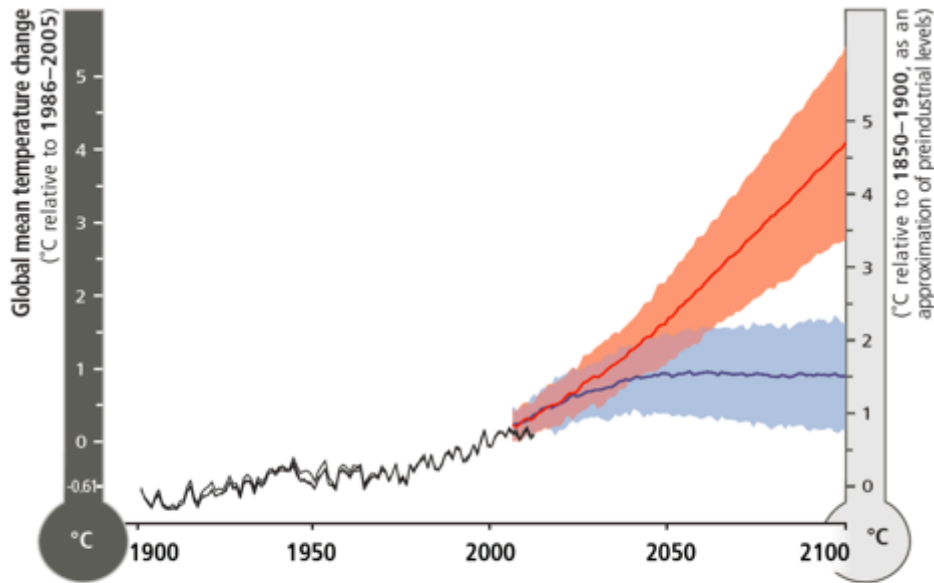


INCREASING MAGNITUDES
OF WARMING INCREASE
THE LIKELIHOOD OF

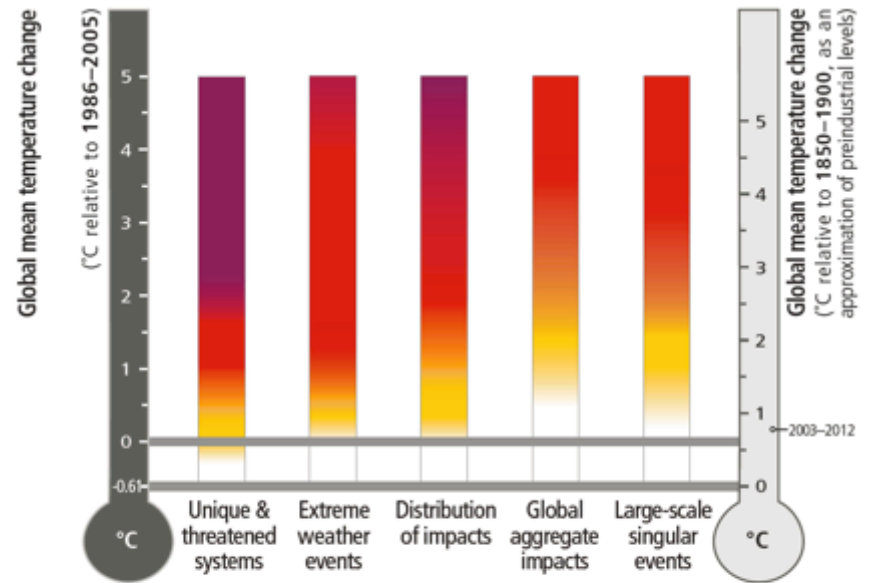
**SEVERE AND
PERVASIVE IMPACTS**

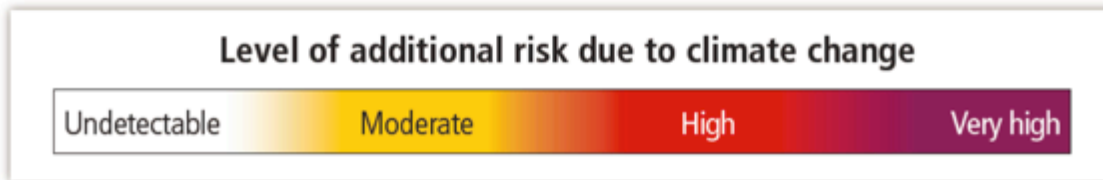
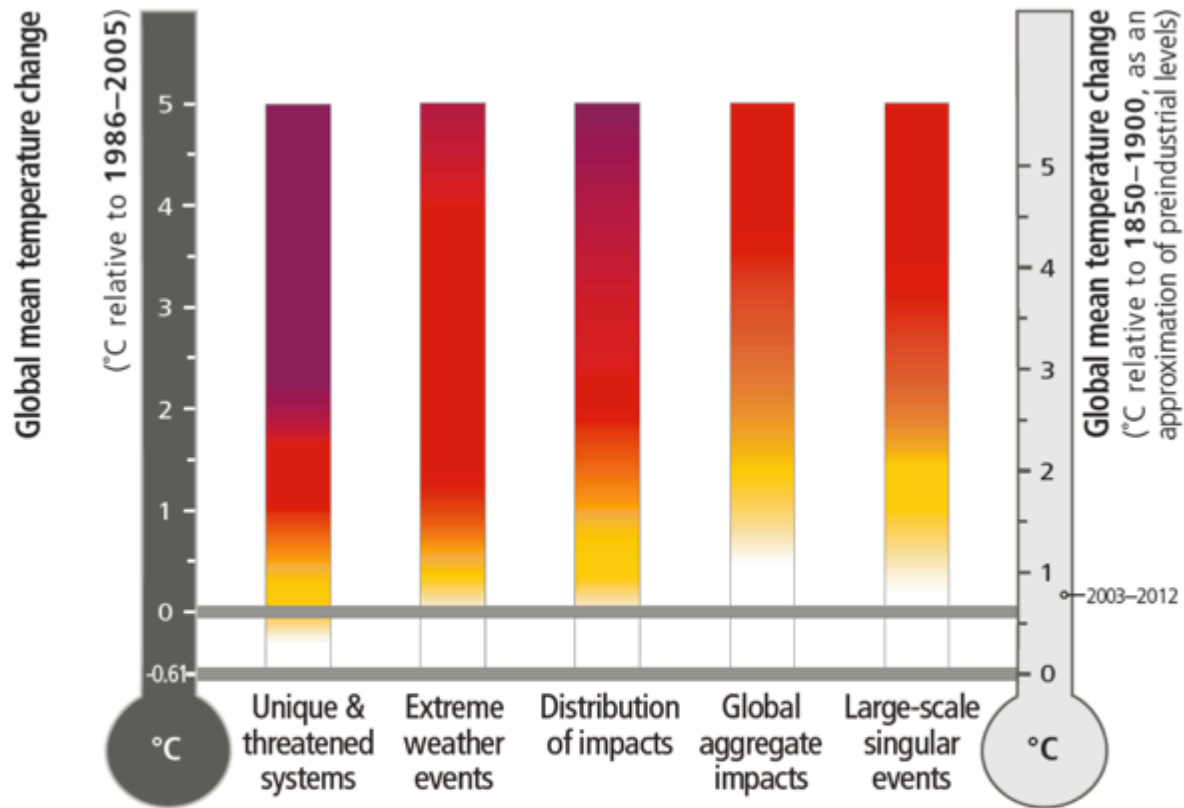


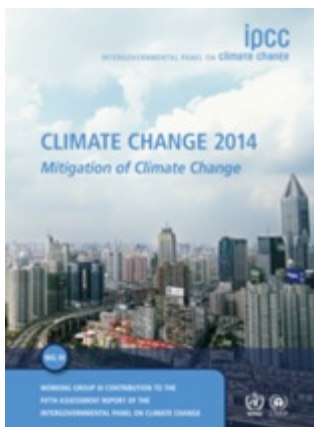
RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS



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

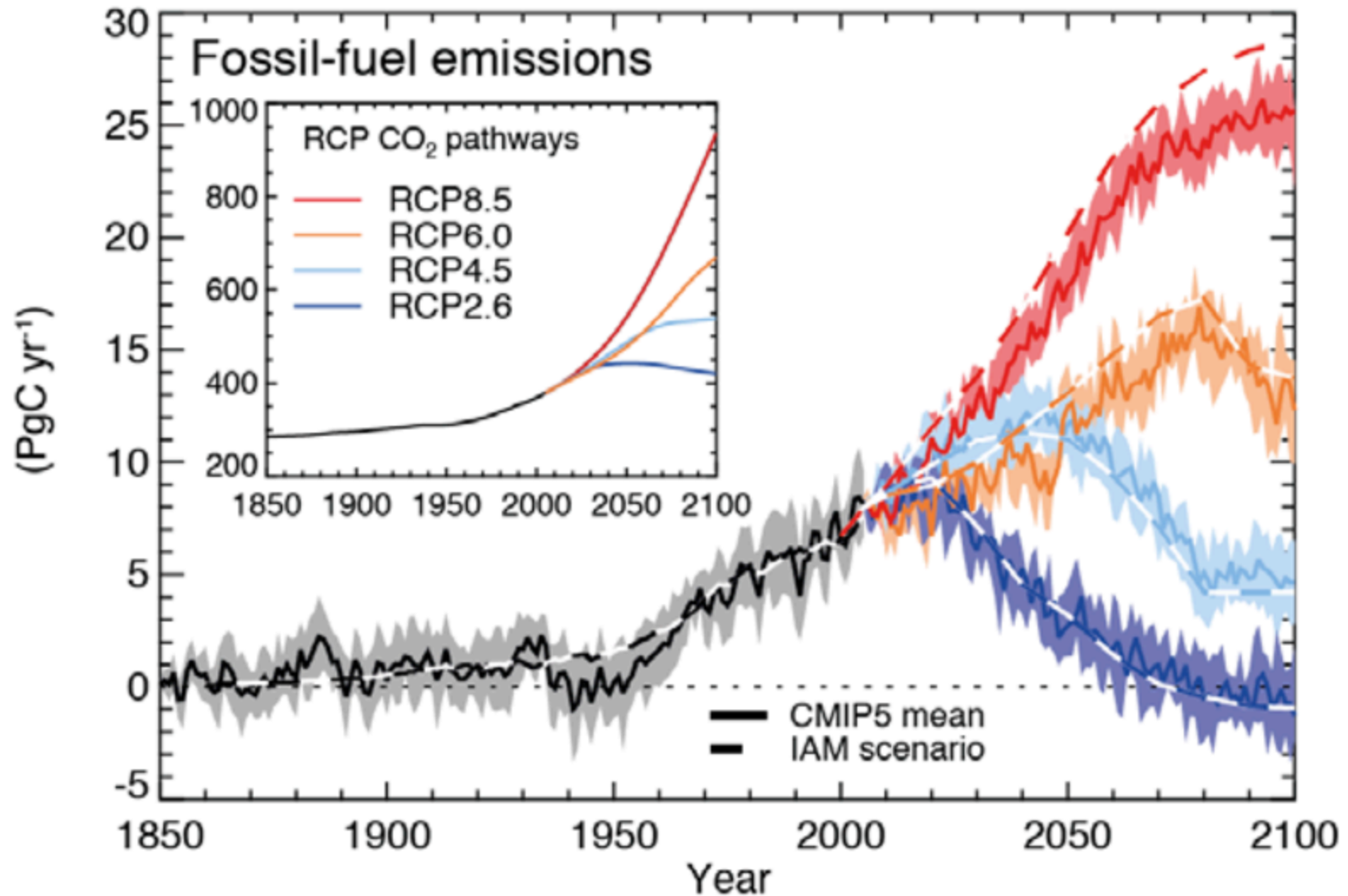






What can be done?

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



Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **Many scenario studies confirm that it is technically and economically feasible to keep the warming below 2°C, with more than 66% probability (“likely chance”).** This would imply limiting atmospheric concentrations to 450 ppm CO₂-eq by 2100.
- **Such scenarios for an above 66% chance of staying below 2°C imply reducing by 40 to 70% global GHG emissions compared to 2010 by mid-century, and reach zero or negative emissions by 2100.**

Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **These scenarios are characterized by rapid improvements of energy efficiency and a near quadrupling of the share of low-carbon energy supply (renewables, nuclear, fossil and bioenergy with CCS), so that it reaches 60% by 2050.**
- **Keeping global temperature increase below 1.5°C would require even lower atmospheric concentrations (<430 ppm CO₂eq) to have a little more than 50% chance.** There are not many scenario studies available that can deliver such results, **requiring even faster reductions** in the medium term, **indicating how difficult this is.**

Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **Average global macro-economic costs of such reduction pathways that minimize costs over the century are modest compared to expected economic growth.** The assumptions used for this “ideal” cost-effective approach include mitigation action starting **immediately in all countries**, a **global carbon price** and **all key technologies available**. With those assumptions, the global macro-economic costs of a 2°C scenario are limited: an average annual reduction of consumption of about 0.04-0.14 percentage points (from a baseline increase of consumption of 1.6-3% per year).

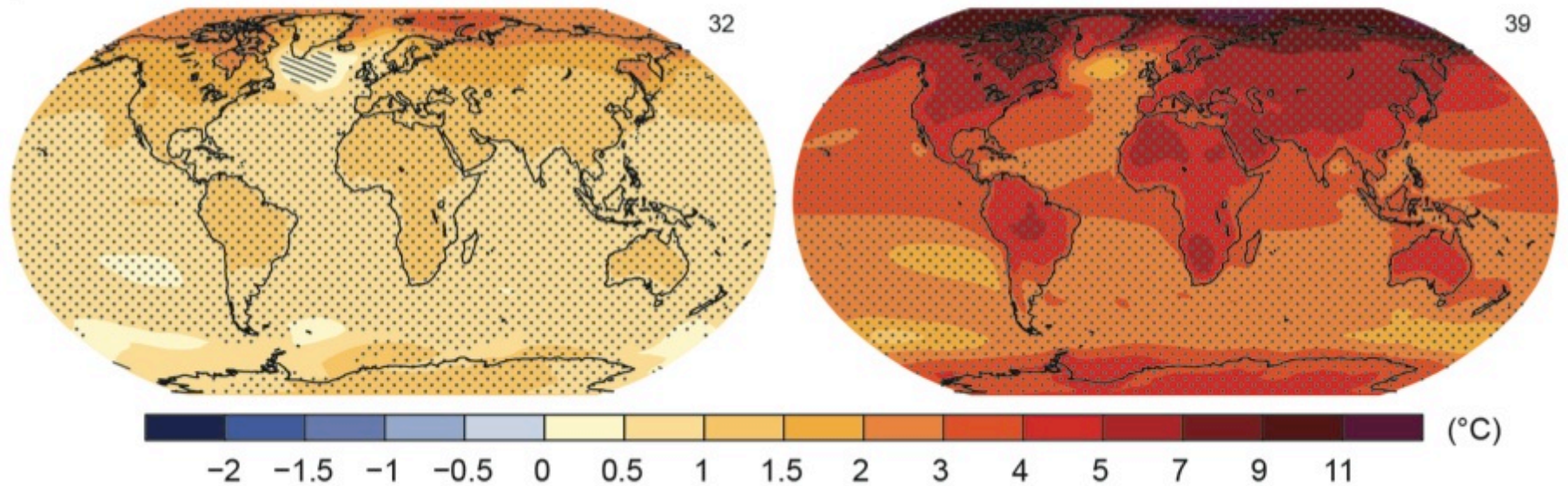
Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **There are also benefits from avoided climate change impacts and co-benefits in other areas, such as reduced health and ecosystem damages due to air pollution, improved energy security, food security, or employment. There is also a wide range of possible adverse side effects from climate policy that have not been well-quantified.**

RCP2.6

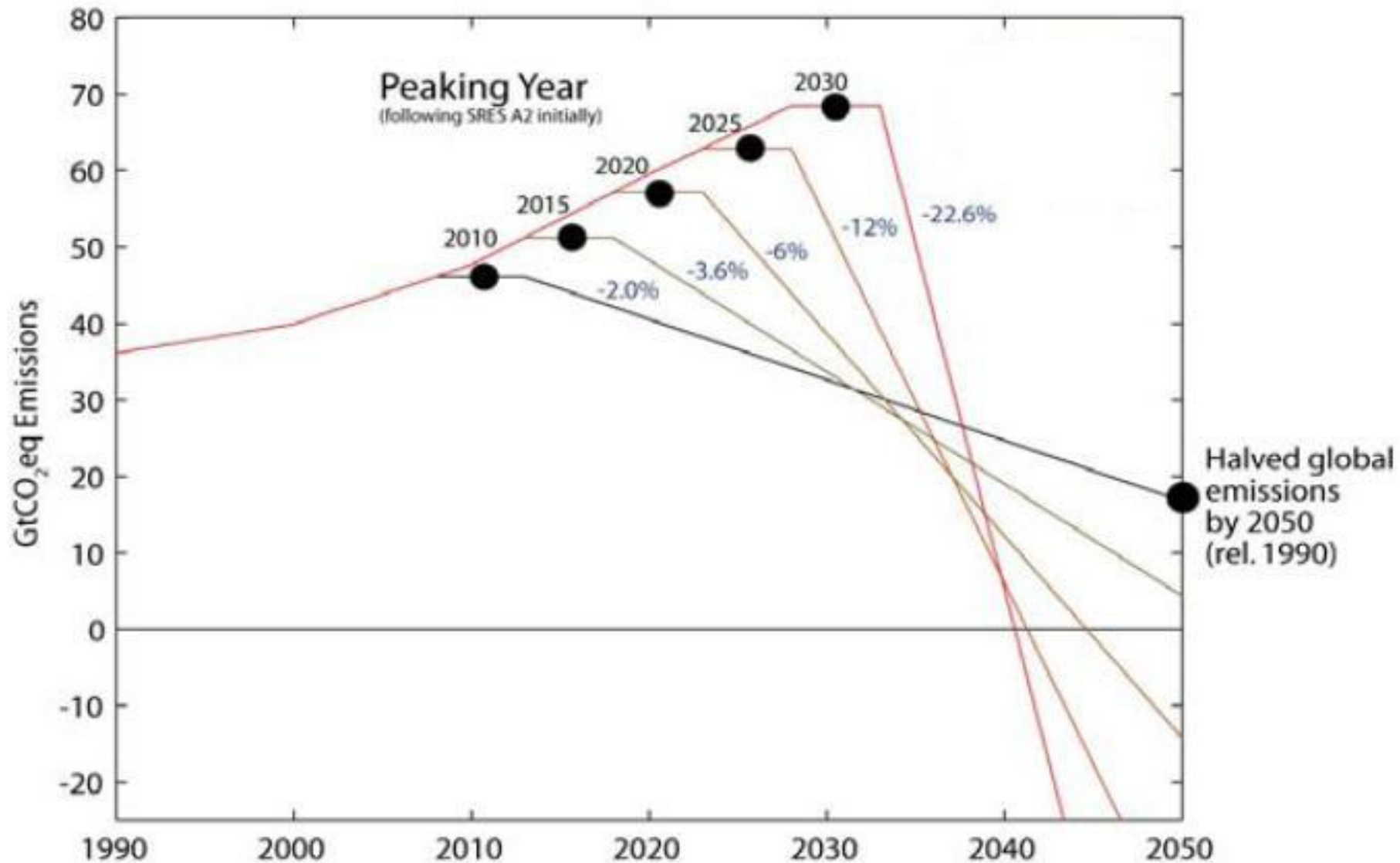
RCP8.5

Change in average surface temperature (1986–2005 to 2081–2100)



We have a choice.

The more we wait, the more difficult it will be



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

Pour en savoir plus :

- www.ipcc.ch : GIEC ou IPCC
- www.climate.be/vanyp : beaucoup de mes dias et d'autres documents
- www.climate.be/pendules : ressources faciles d'accès pour « remettre les pendules à l'heure »
- www.climate.be/desintox : réponses à la désinformation
- **On Twitter: @JPvanYpersele**