

# ***After Paris COP21: The New Climate Policy Momentum***

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**« Energy Scenarios: Which Research in Physics? »,**

**Les Houches, 7 March 2016**

**Thanks to the Belgian Federal Science Policy Office (BELSPO)  
and to my team at the Université catholique de Louvain for their support**

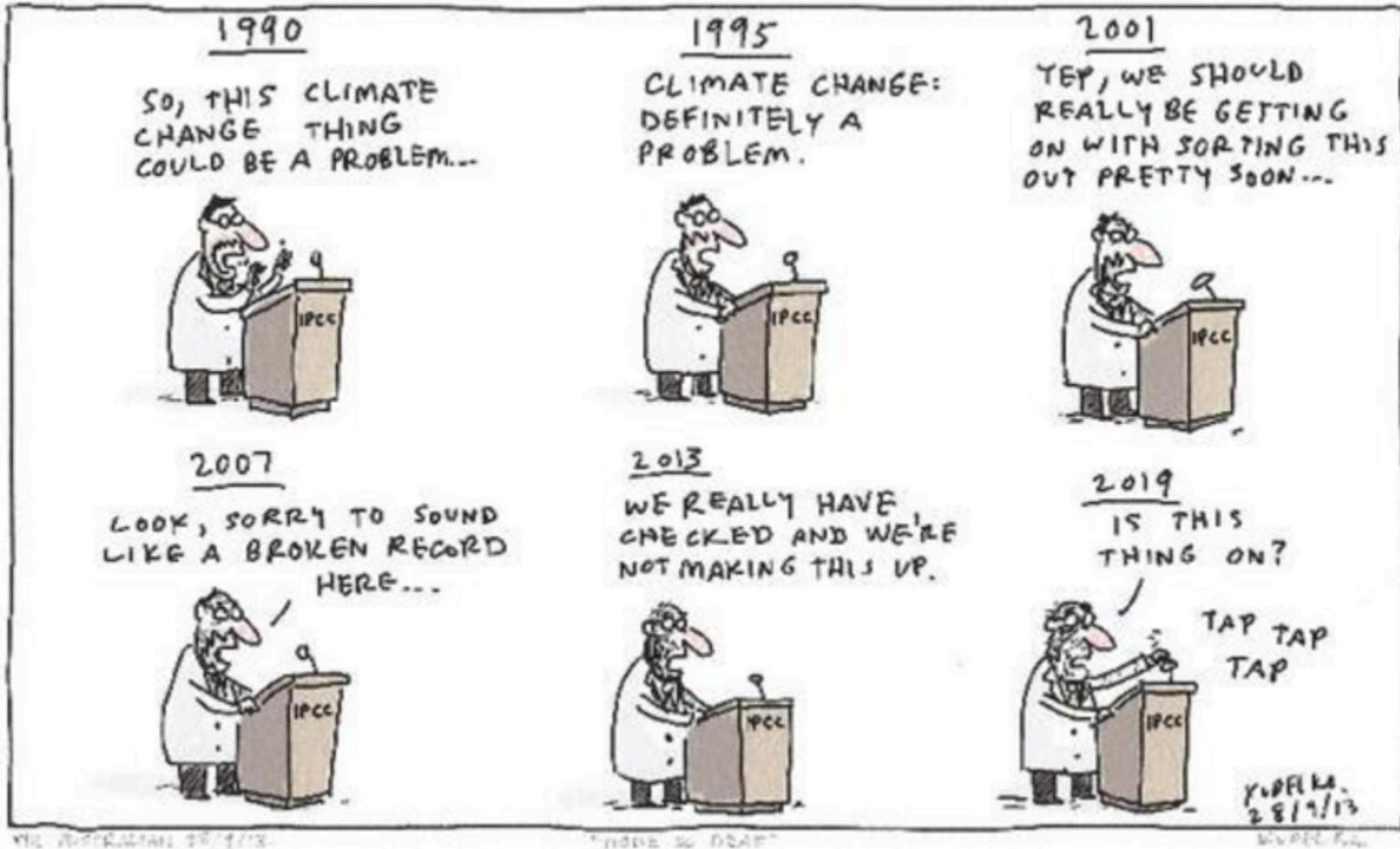
# Plan

- Key IPCC AR5 messages
- COP21
- What's next?

# Plan

- Key IPCC AR5 messages

# None So Deaf



THE ASSOCIATION OF 1/13

"NONE SO DEAF"

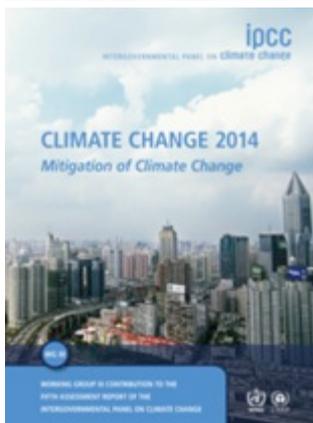
K. KUDEJKA 28/9/13



**What is happening in the climate system?**



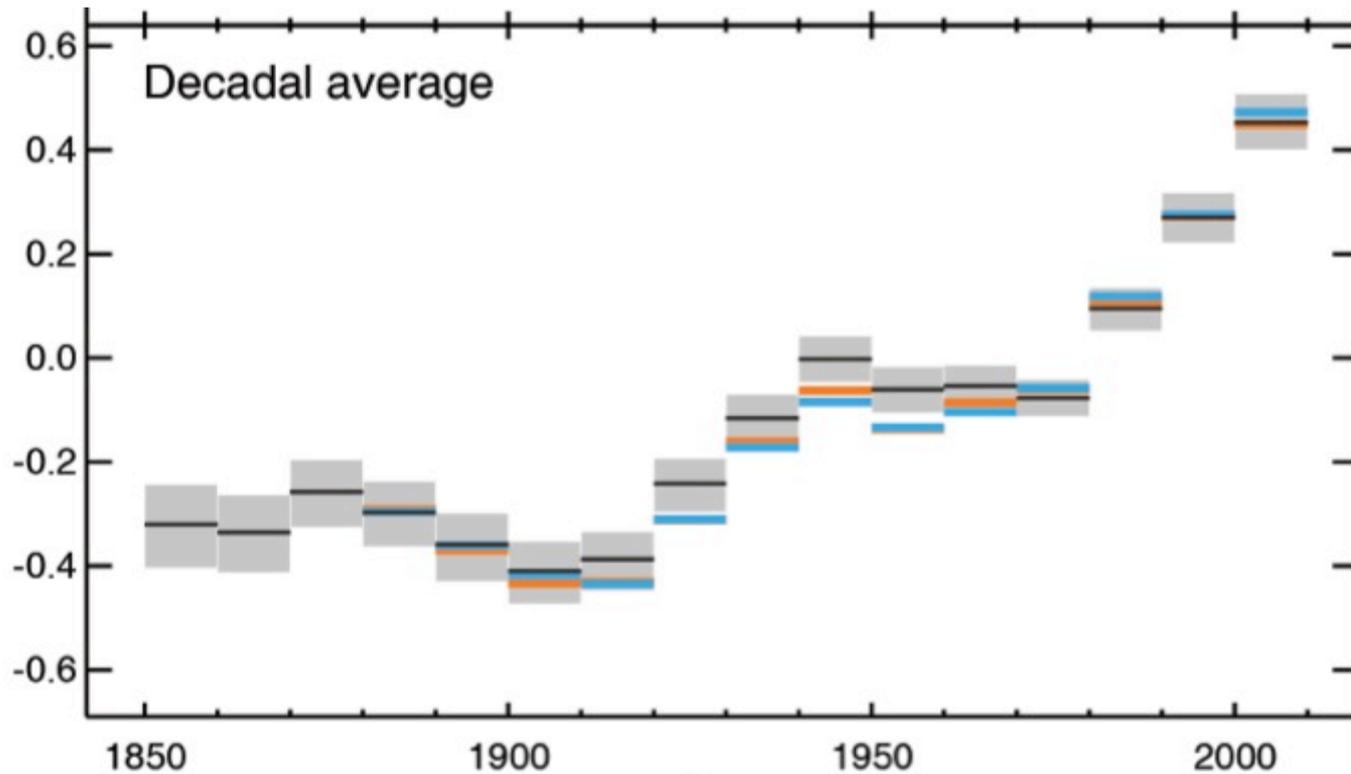
**What are the risks?**



**What can be done?**

# Key messages from IPCC AR5

- **Human influence on the climate system is clear**
- **Continued emissions of greenhouse gases will increase the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems**
- **While climate change is a threat to sustainable development, there are many opportunities to integrate mitigation, adaptation, and the pursuit of other societal objectives**
- **Humanity has the means to limit climate change and build a more sustainable and resilient future**



(IPCC 2013, Fig. SPM.1a)

**Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.**

**In the Northern Hemisphere, 1983–2012 was *likely* the warmest 30-year period of the last 1400 years (*medium confidence*).**

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

# Plateau Glacier (1961) (Alaska)



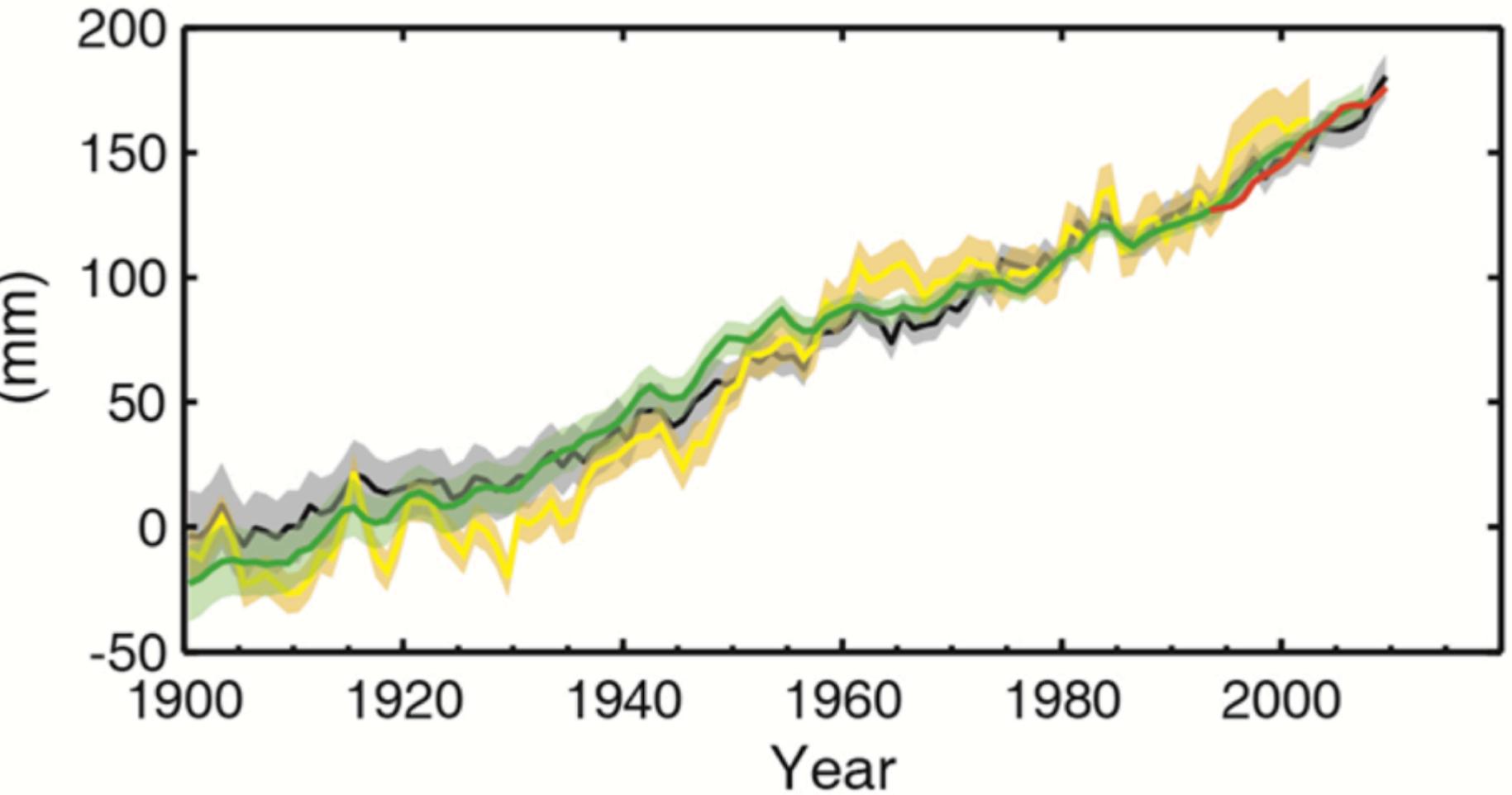
[http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm\\_ven=Email&cm\\_cat=ENVIRONMENT\\_us\\_share](http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share)

# Plateau Glacier (2003) (Alaska)

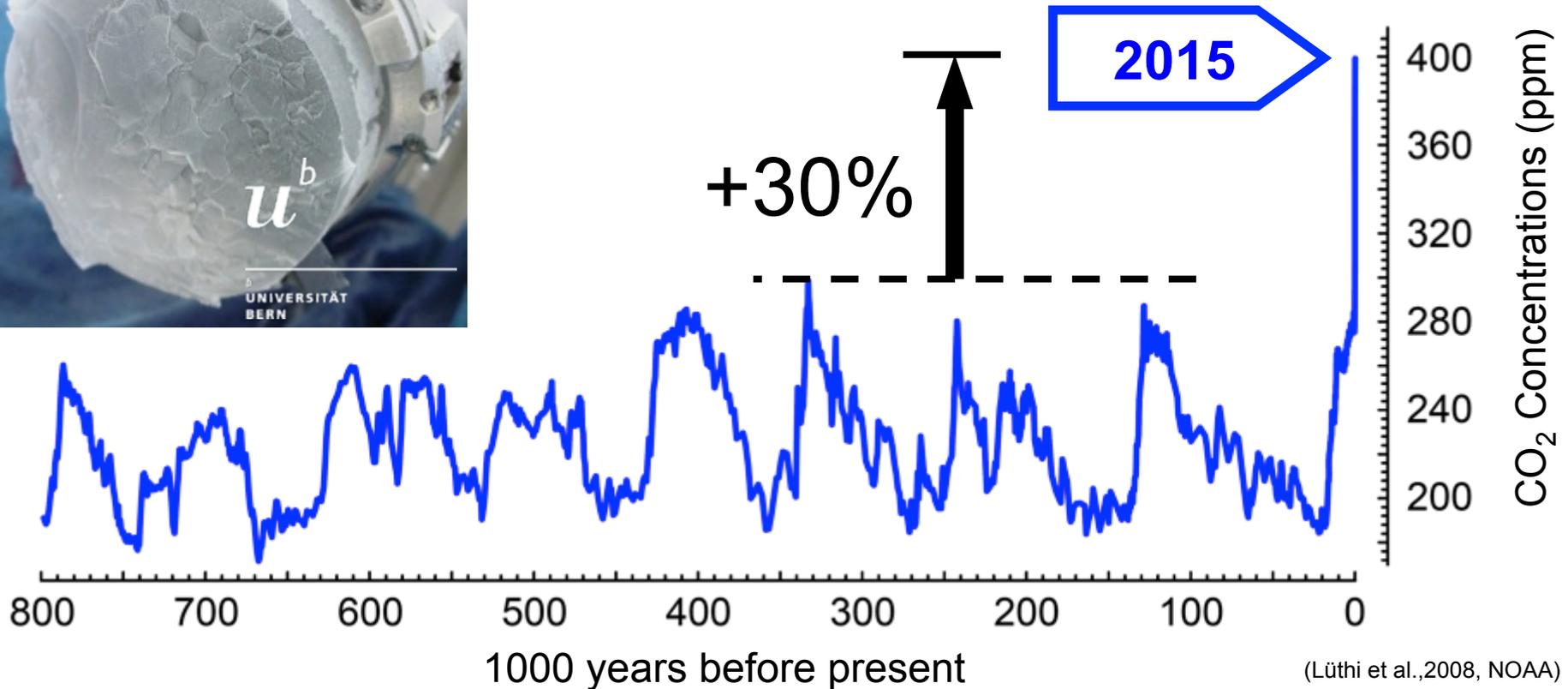


[http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm\\_ven=Email&cm\\_cat=ENVIRONMENT\\_us\\_share](http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share)

# Change in average sea-level change



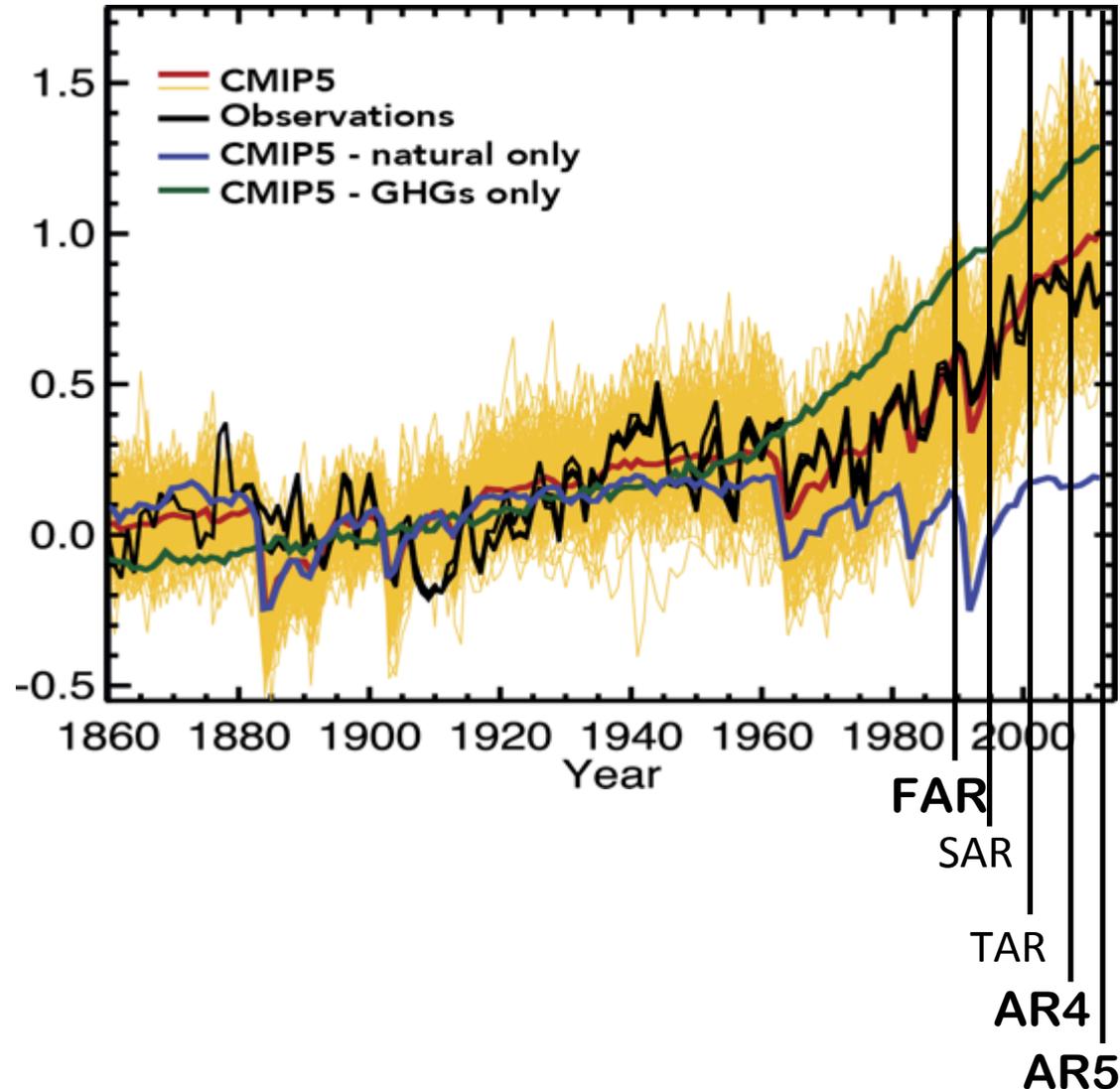
# Atmospheric concentrations of CO<sub>2</sub>



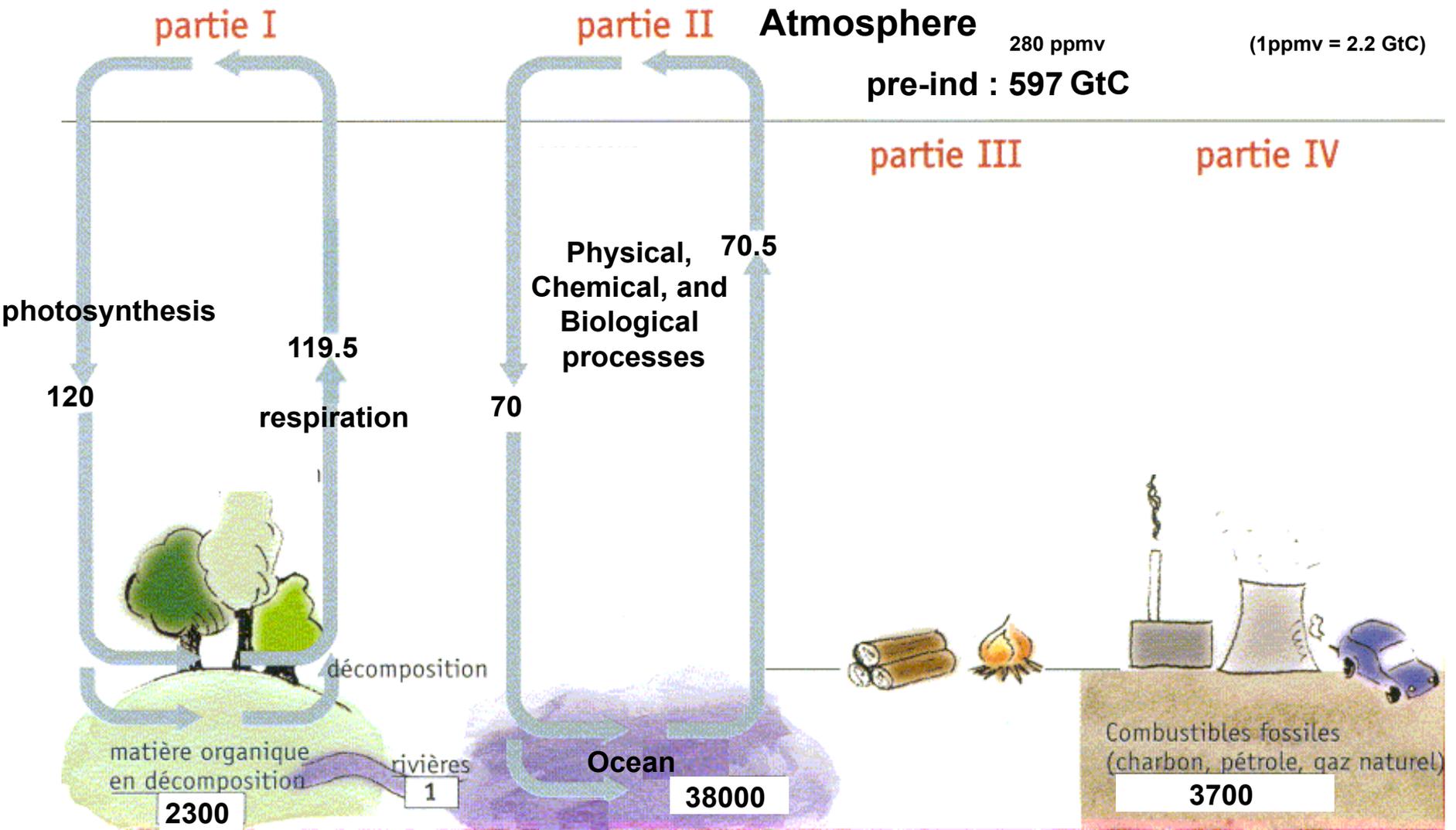
**The concentrations of CO<sub>2</sub> have increased to levels unprecedented in at least the last 800,000 years.**

# 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... »



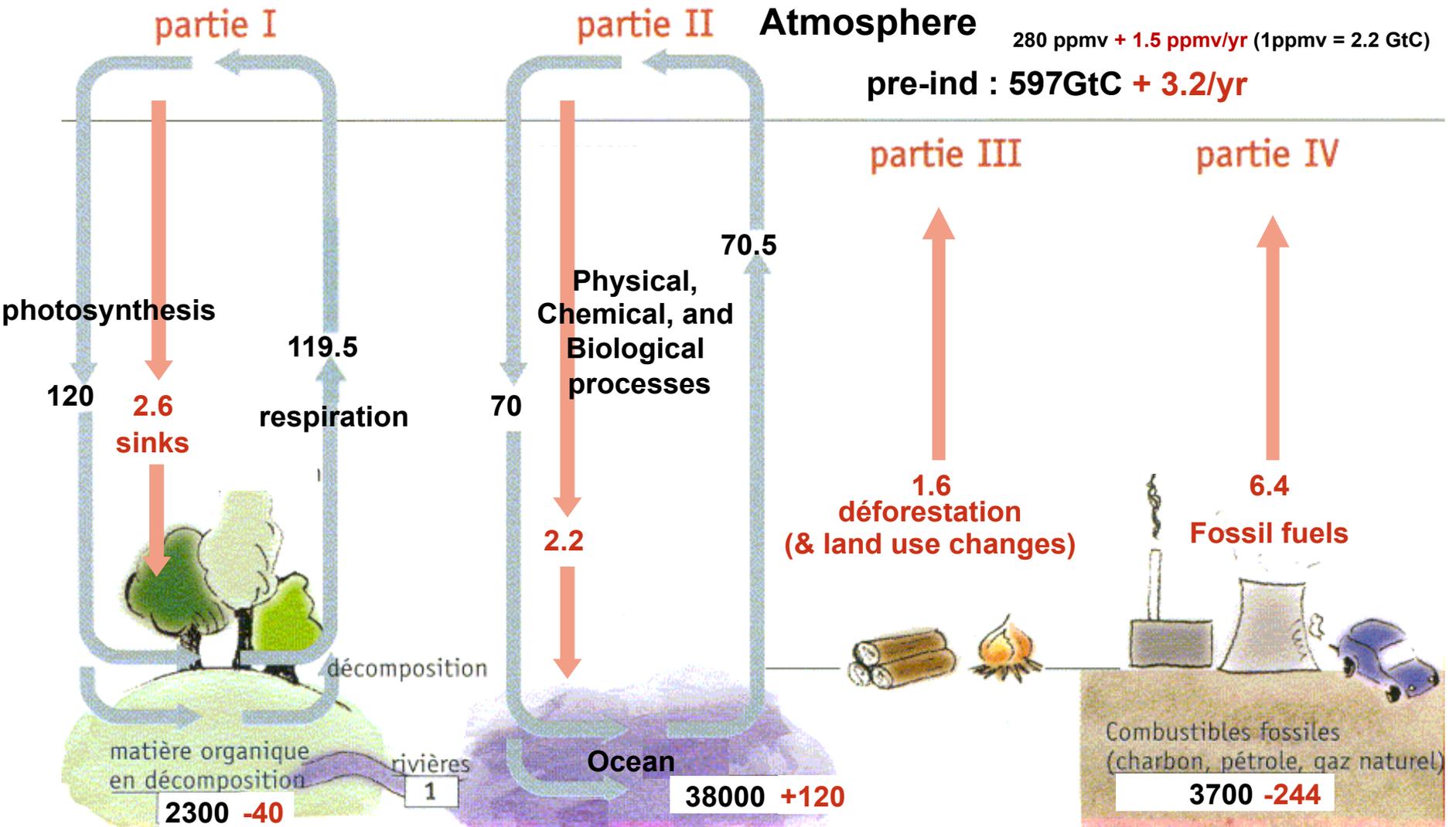
# Carbon cycle: unperturbed fluxes



Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get GtCO<sub>2</sub>)

# Carbon cycle: perturbed by human activities

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

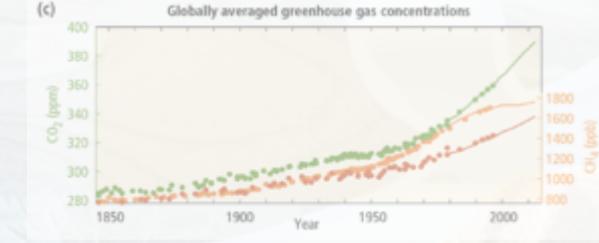
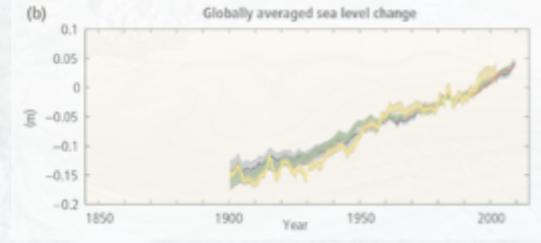
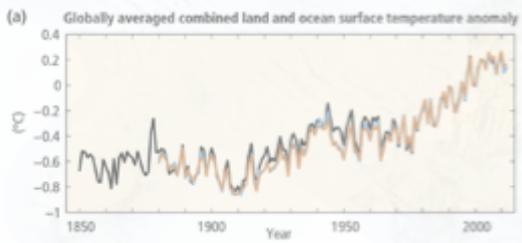


Units: GtC (billions tons of carbon) or GtC/year

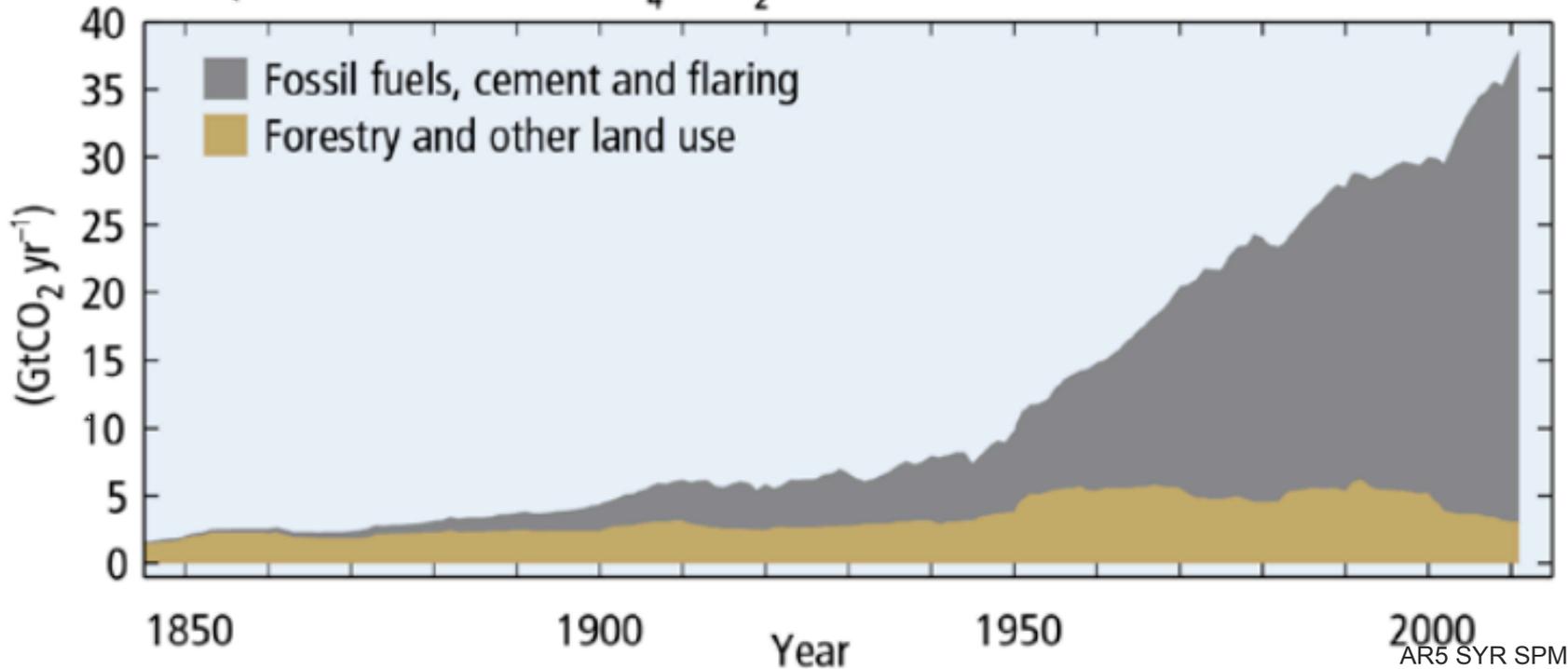
Stocks!

# **The carbon cycle is policy-relevant**

- CO<sub>2</sub> 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)**

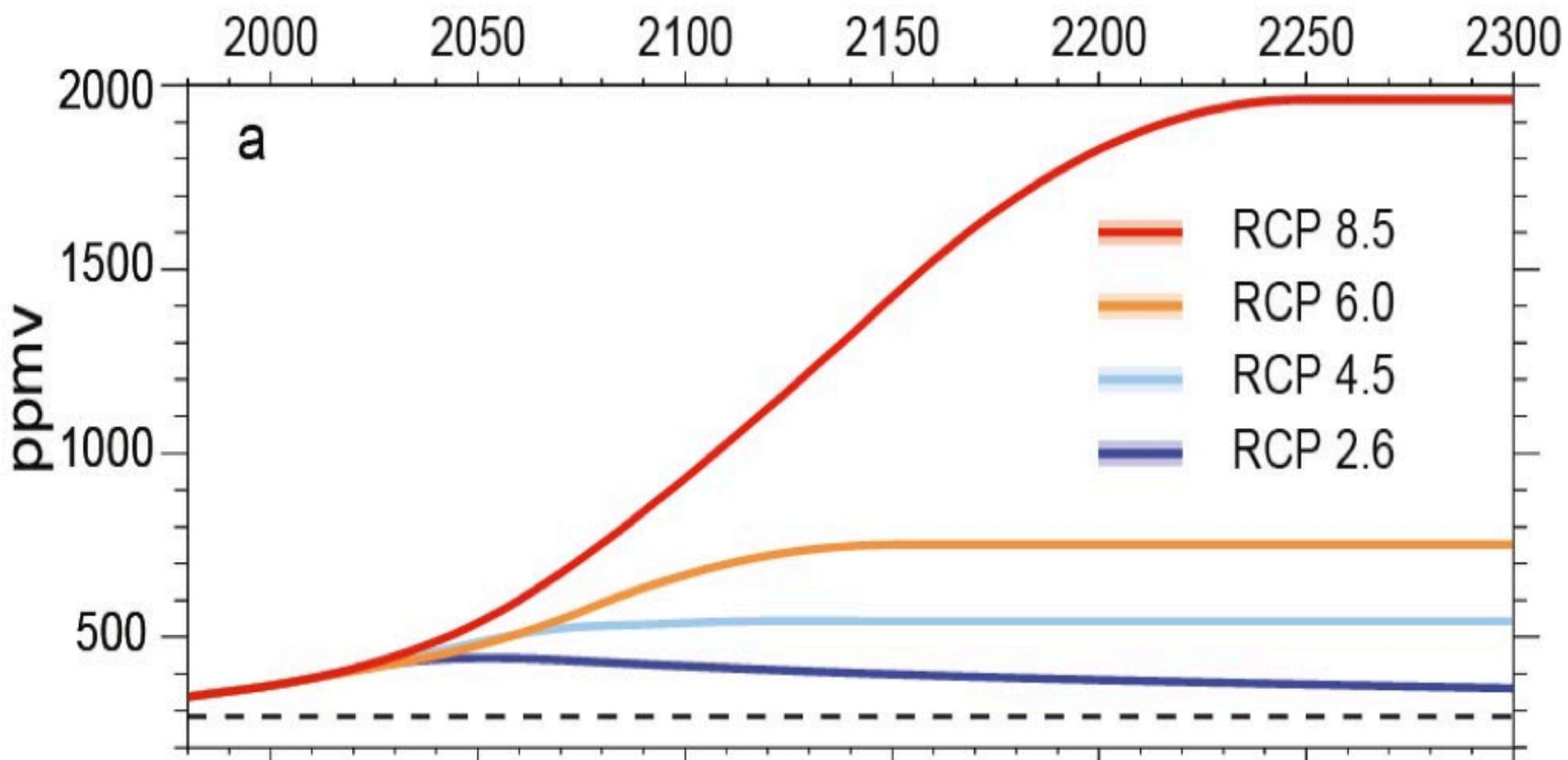


**(d) Global anthropogenic CO<sub>2</sub> emissions**  
 Quantitative information of CH<sub>4</sub> and N<sub>2</sub>O emission time series from 1850 to 1970 is limited



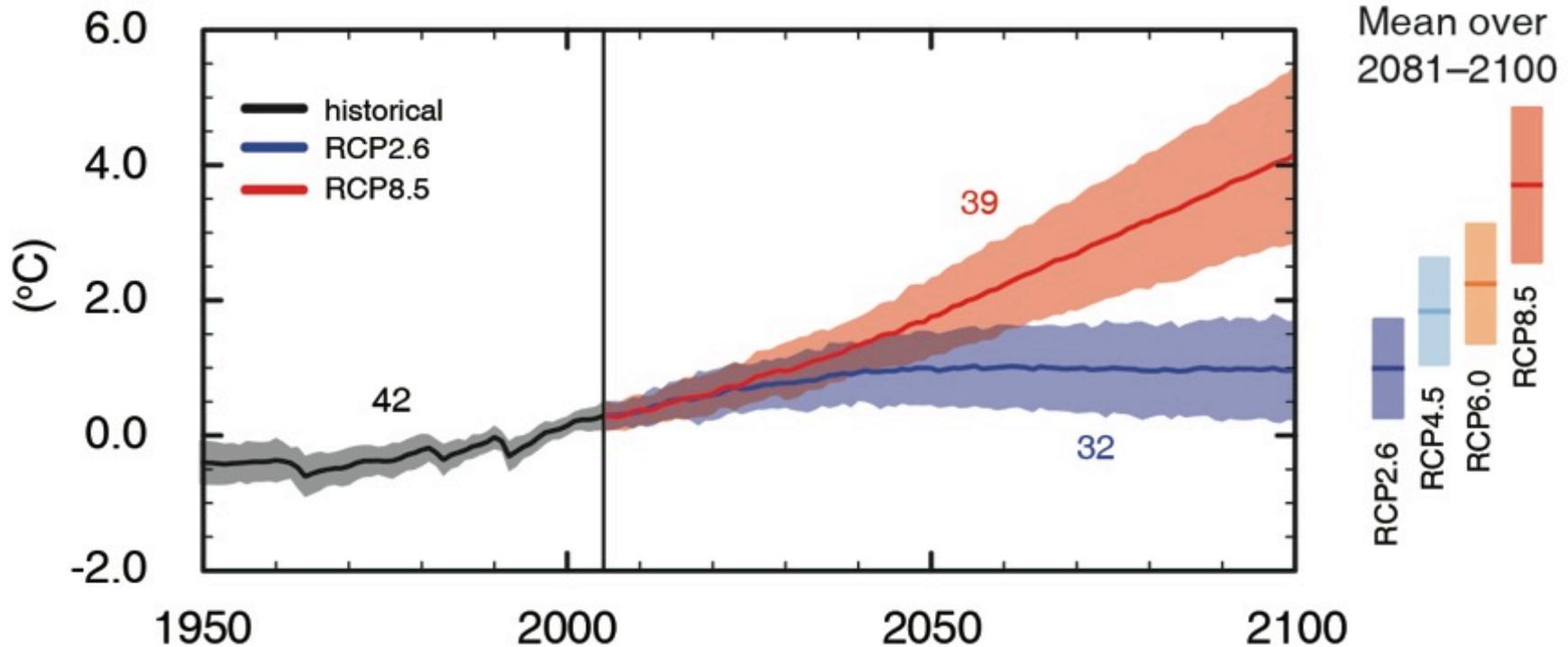
AR5 SYR SPM

# RCP Scenarios: Atmospheric CO<sub>2</sub> 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**

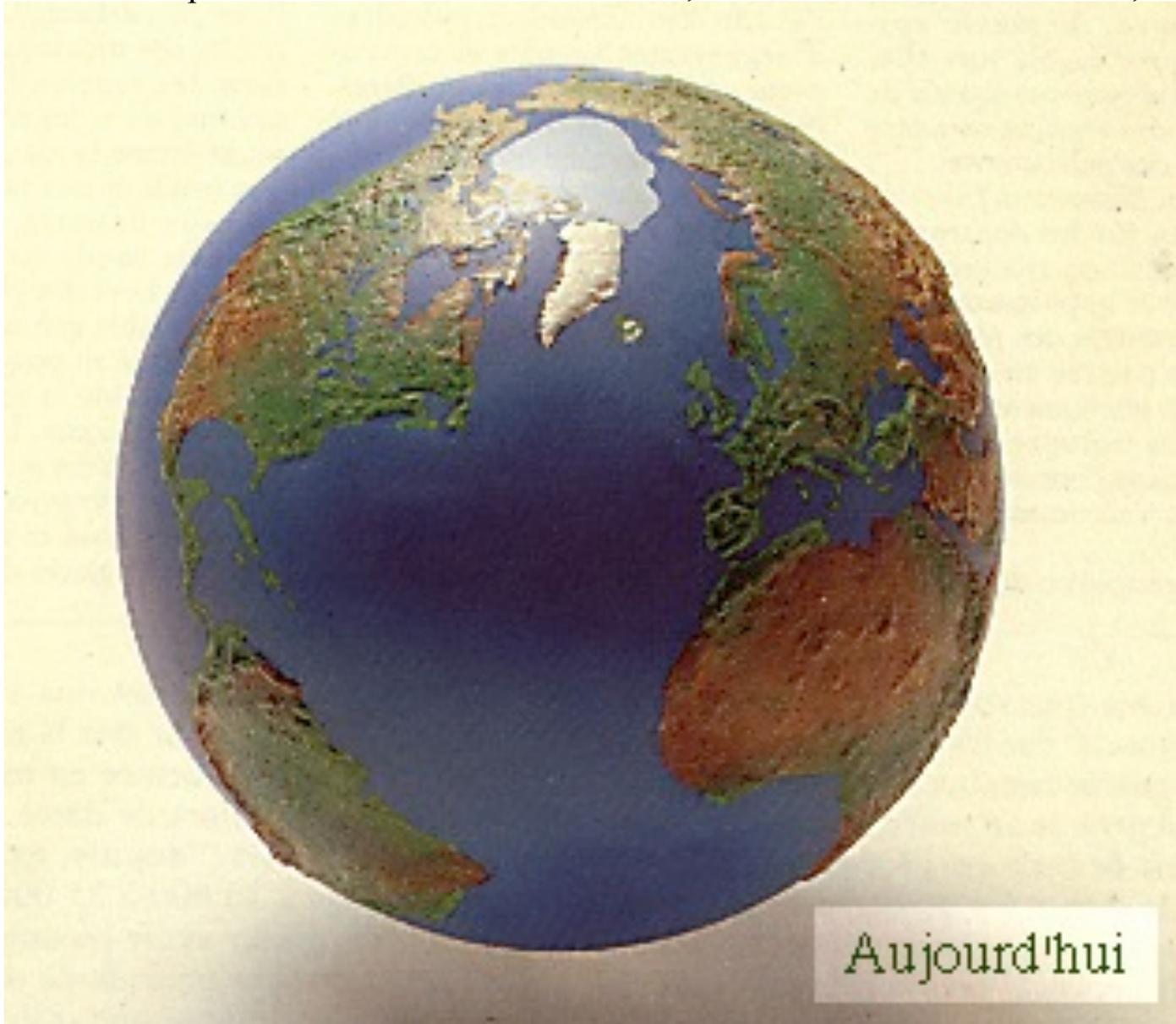
# 18-20000 years ago (Last Glacial Maximum)

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



# Today, with +4-5°C globally

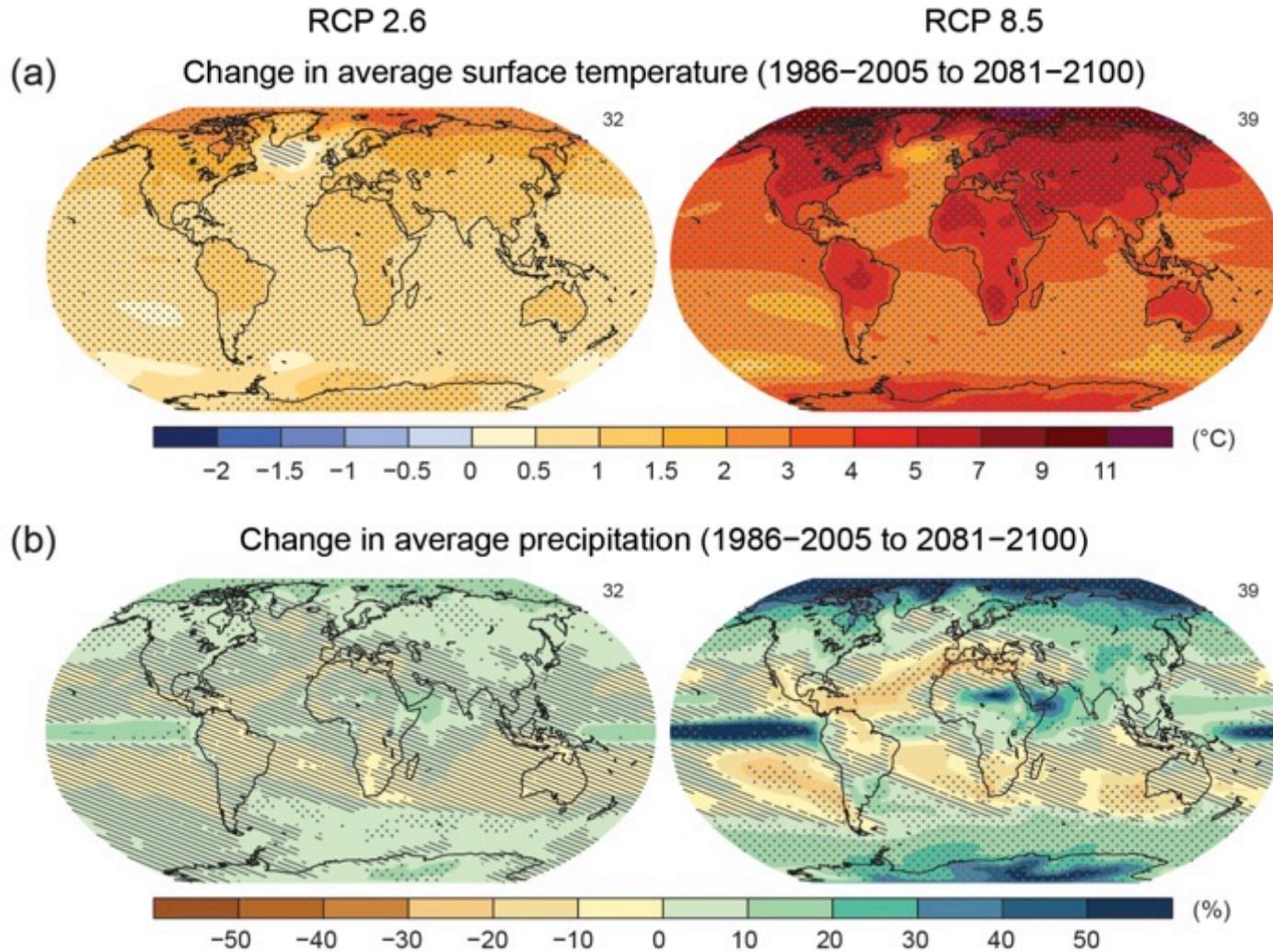
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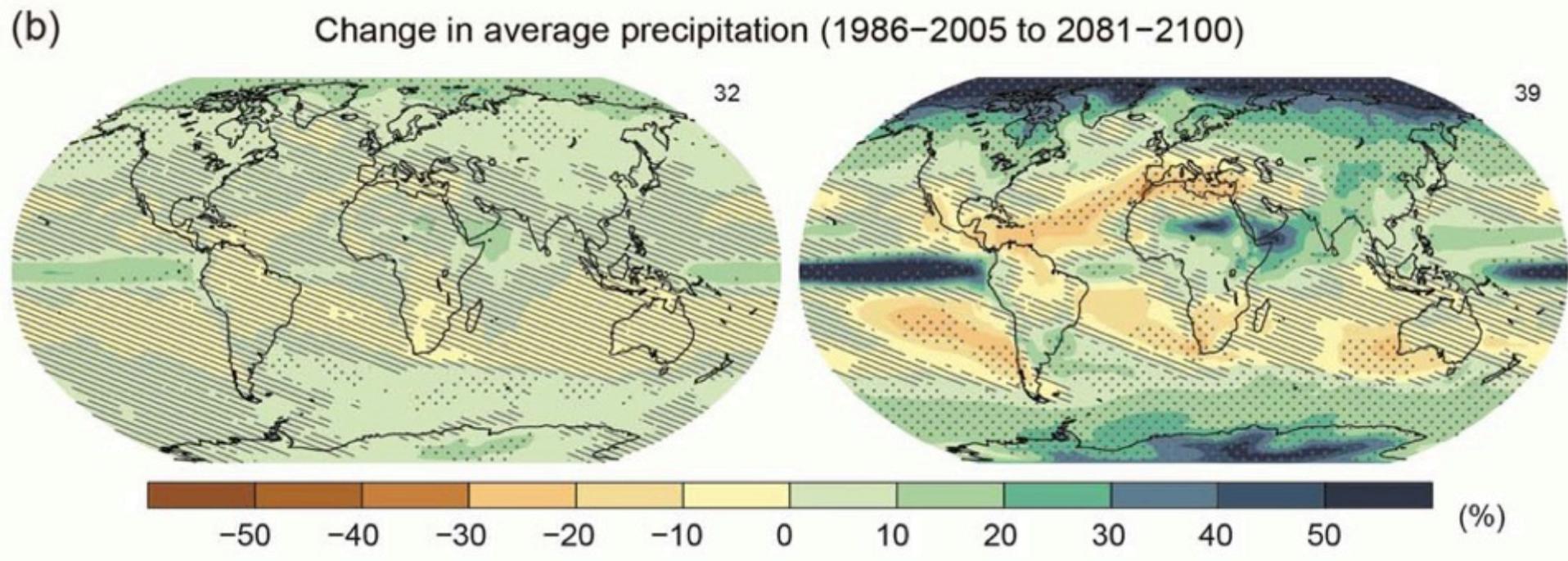
# Figure SPM.8a,b

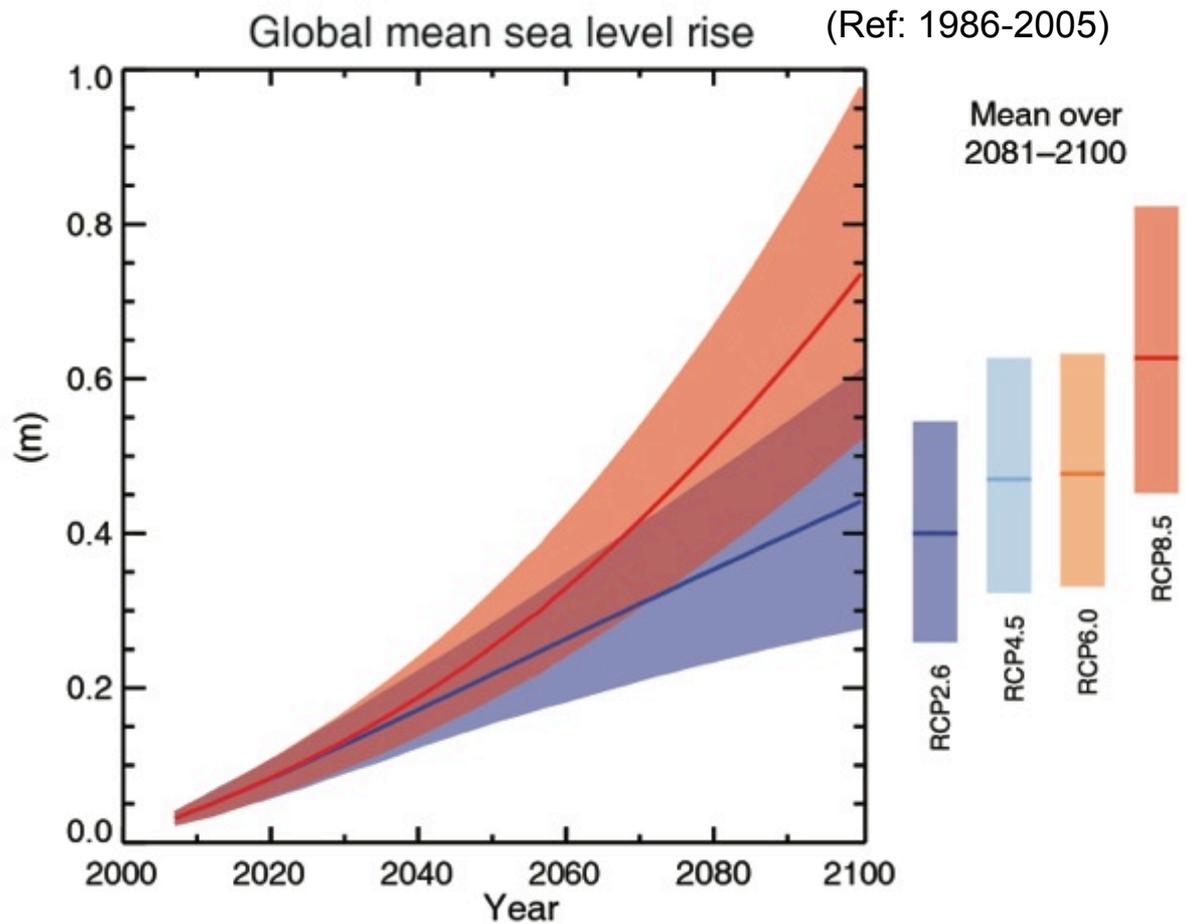
Maps of CMIP5 multi-model mean results

All Figures © IPCC 2013



# Annual rainfall projections

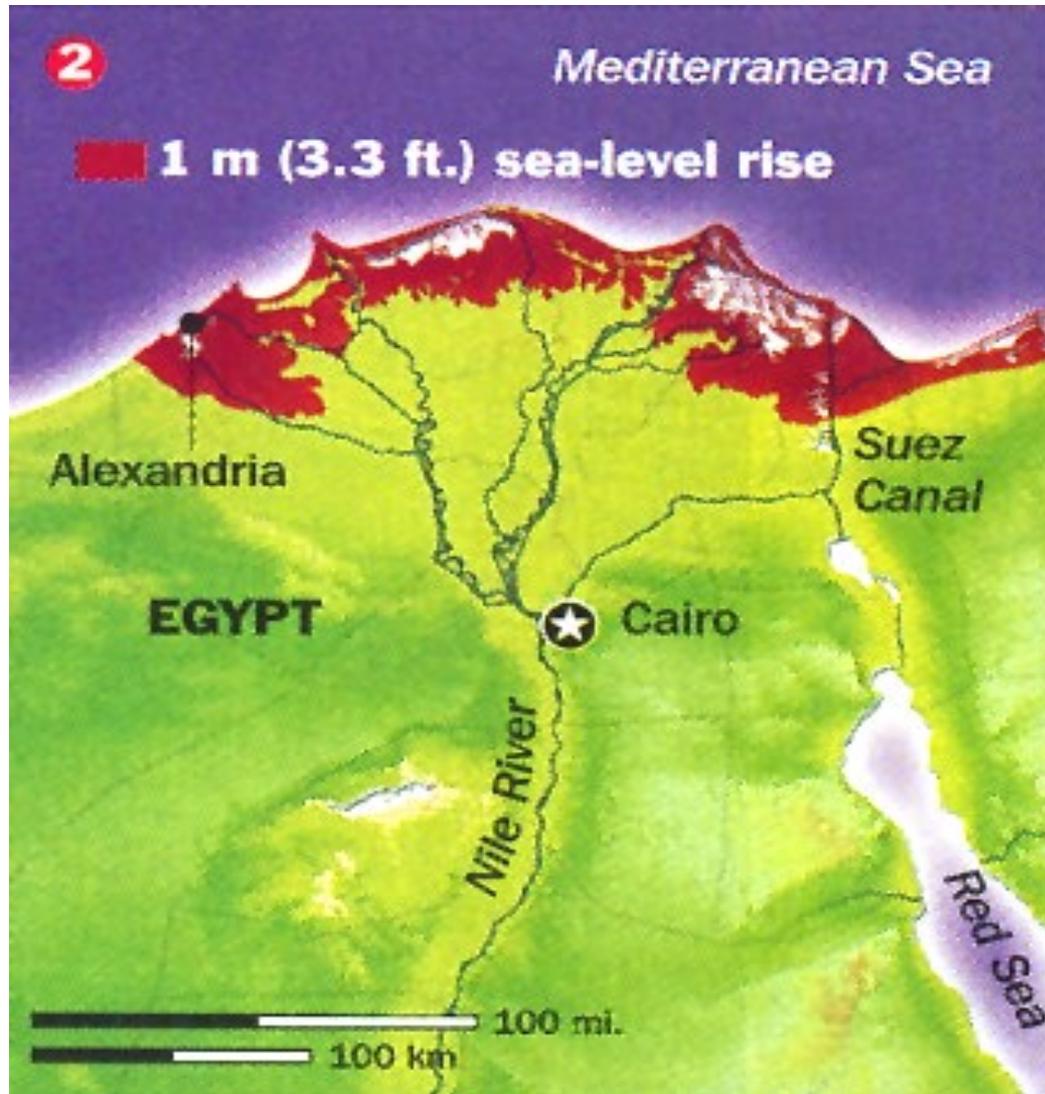




(IPCC 2013, Fig. SPM.9)

Sea level due to continue to increase

# Effects on Nile Delta, where more than 10 million people live less than 1 m above sea level



(Time 2001)

# Impacts are already underway

- **Tropics to the poles**
- **On all continents and in the ocean**
- **Affecting rich and poor countries (but the poor are more vulnerable everywhere)**



AR5 WGII SPM

# Potential Impacts of Climate Change



Food and water shortages



Increased displacement of people



Increased poverty



Coastal flooding

AR5 WGII SPM

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





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# ADAPTATION IS ALREADY OCCURRING

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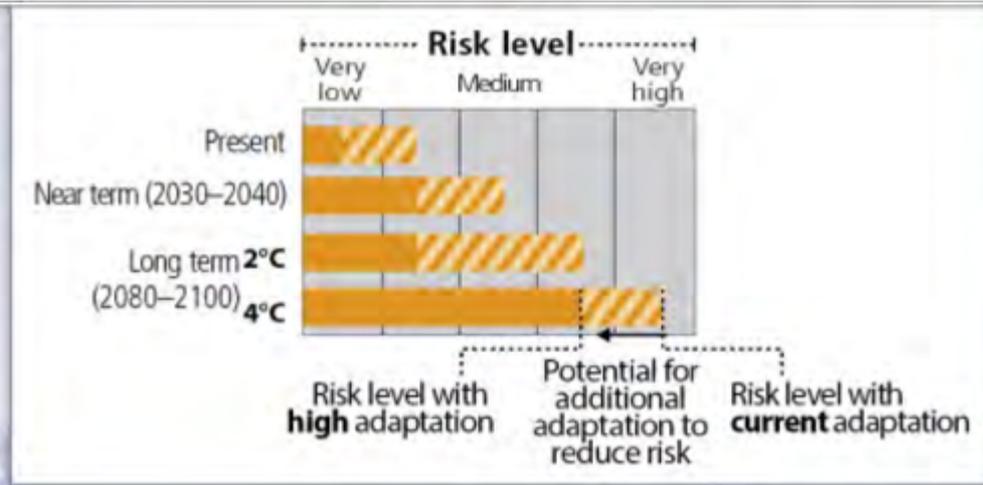
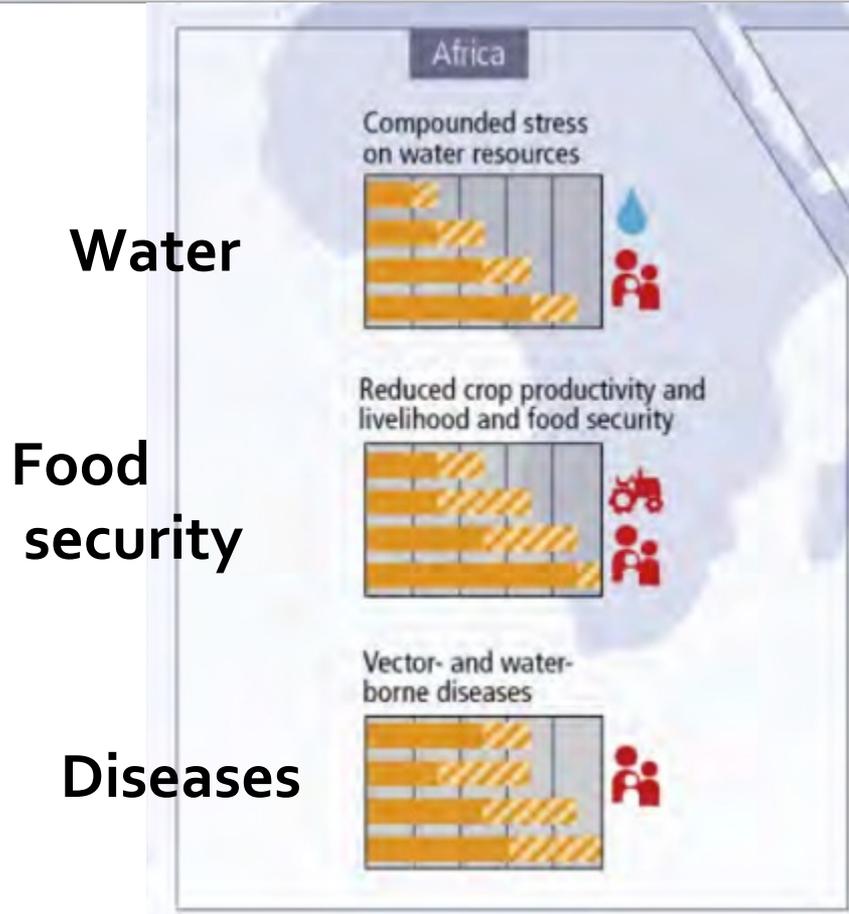
# Flood risk adaptation in Bangladesh (example): cyclone shelters, awareness raising, forecasting and warning



photo: Dr Thorsten Klose/German Red Cross (2010), evaluation of the Community Based Disaster Preparedness Programme run by the Red Cross in 1996-2002

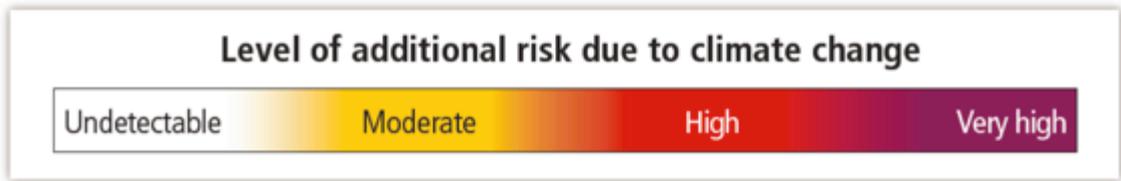
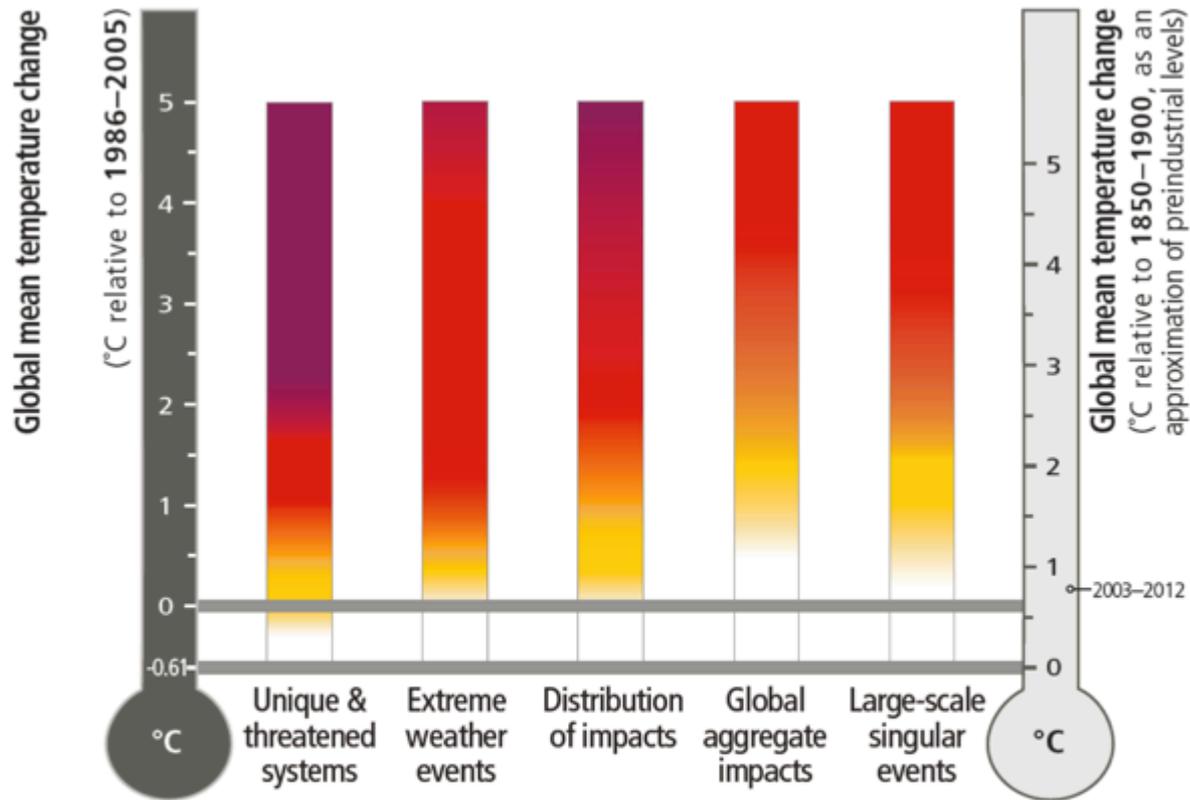
# Regional key risks and risk reduction through adaptation

Representative key risks for each region for

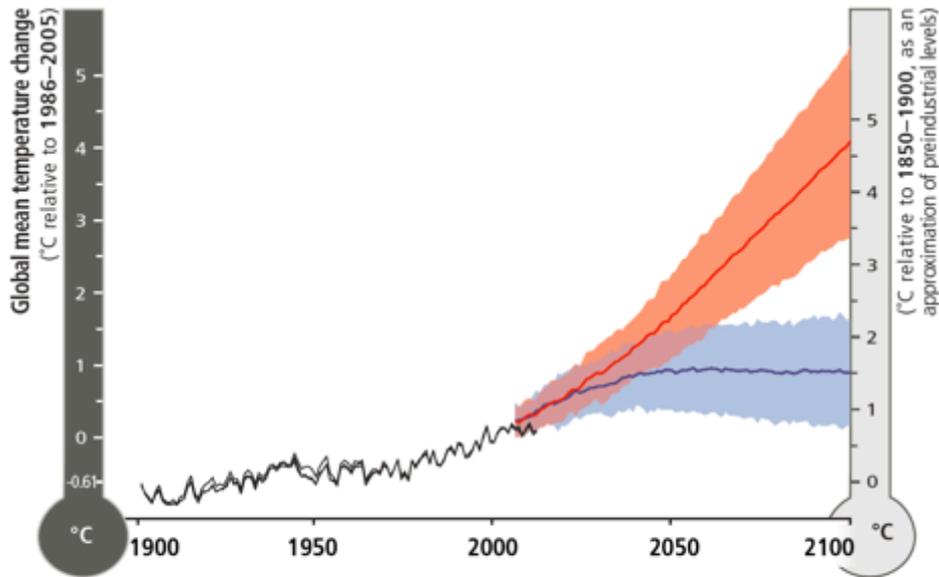




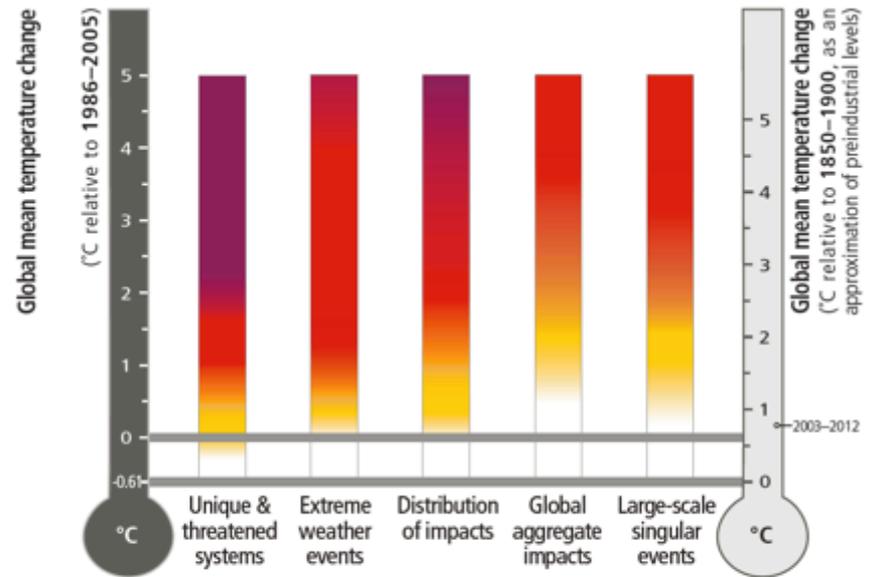
RISKS OF  
CLIMATE CHANGE  
**INCREASE**  
WITH CONTINUED  
HIGH EMISSIONS



AR5, WGII, Box SPM.1 Figure 1



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



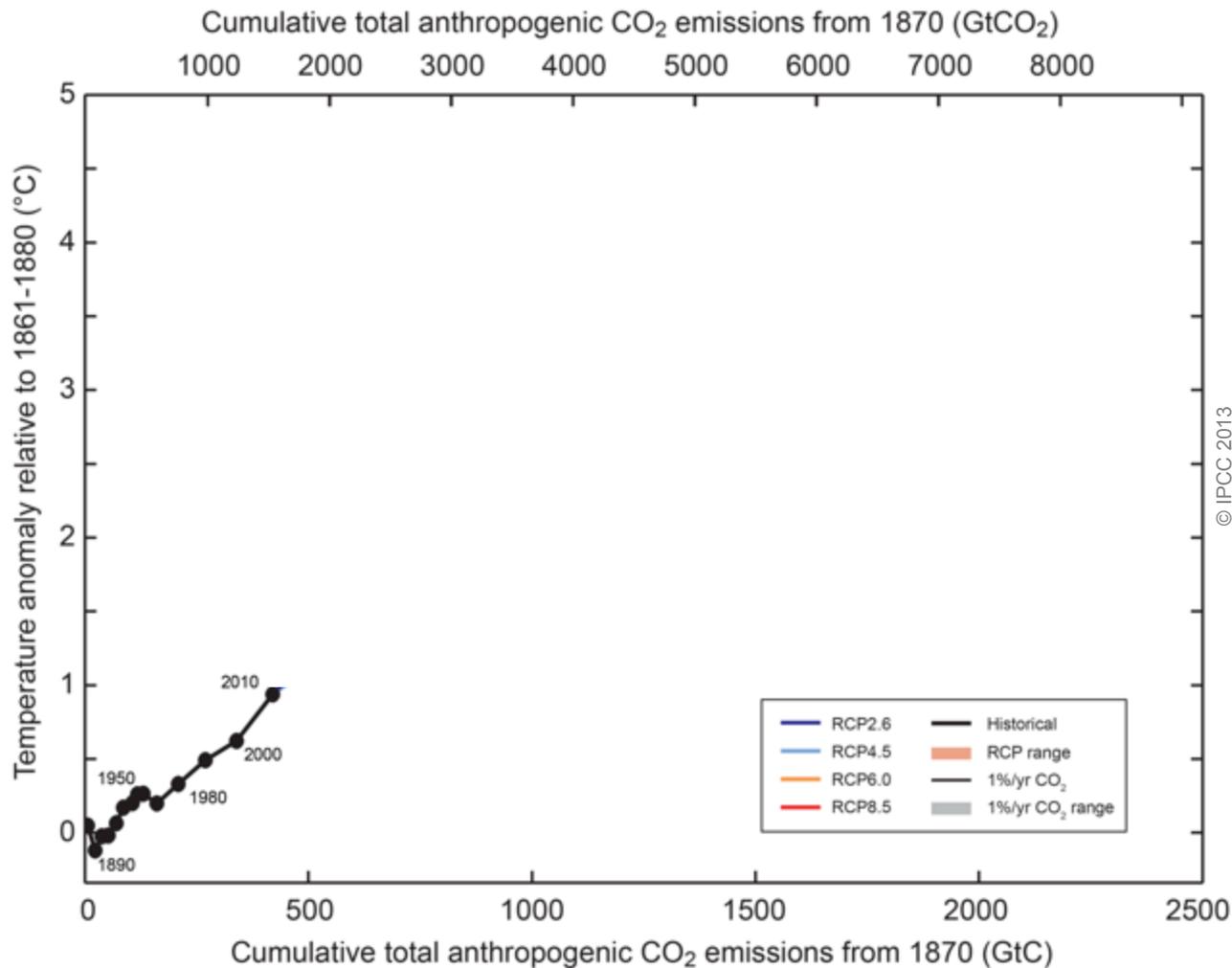
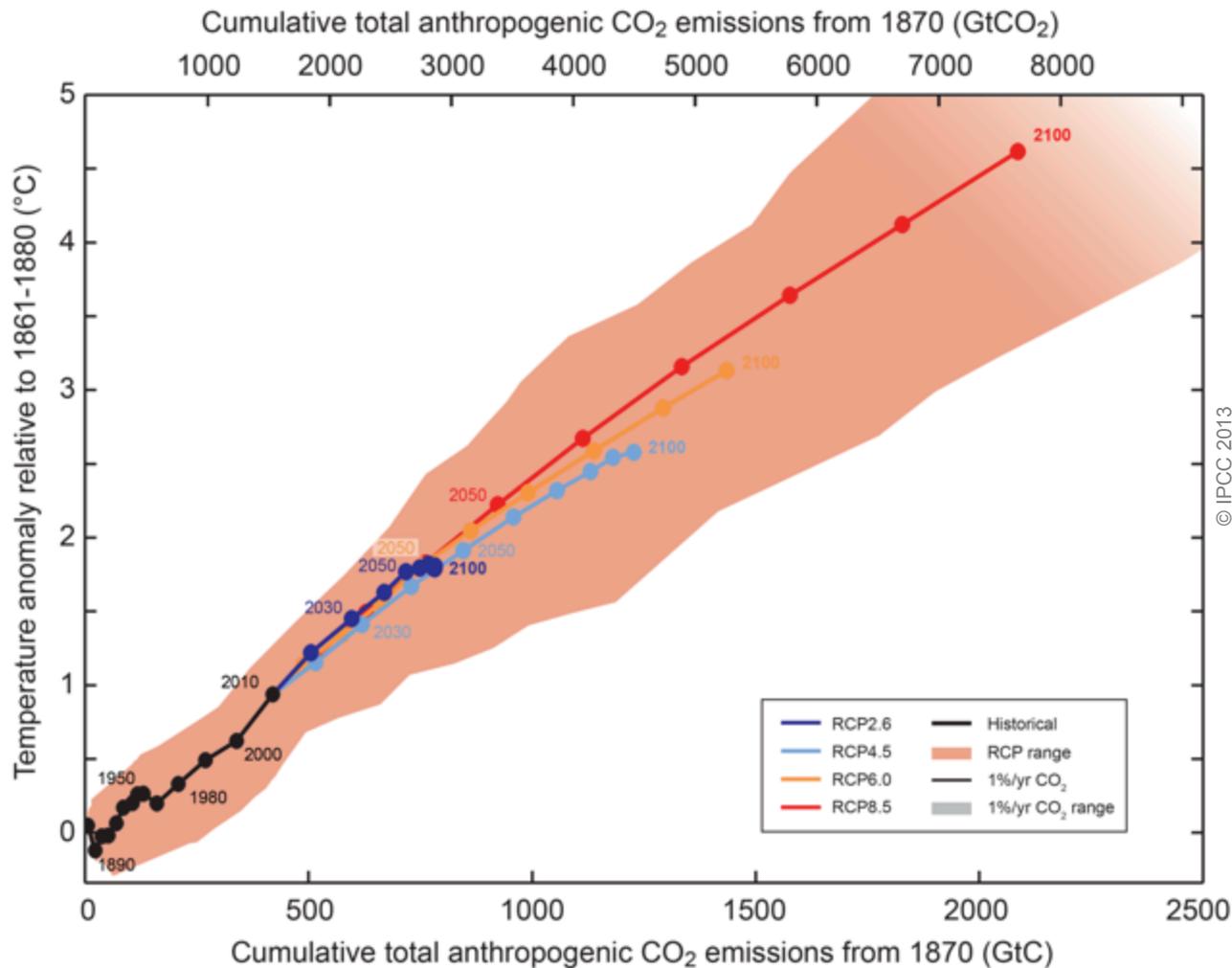


Fig. SPM.10

Cumulative emissions of CO<sub>2</sub> largely determine global mean surface warming by the late 21st century and beyond.



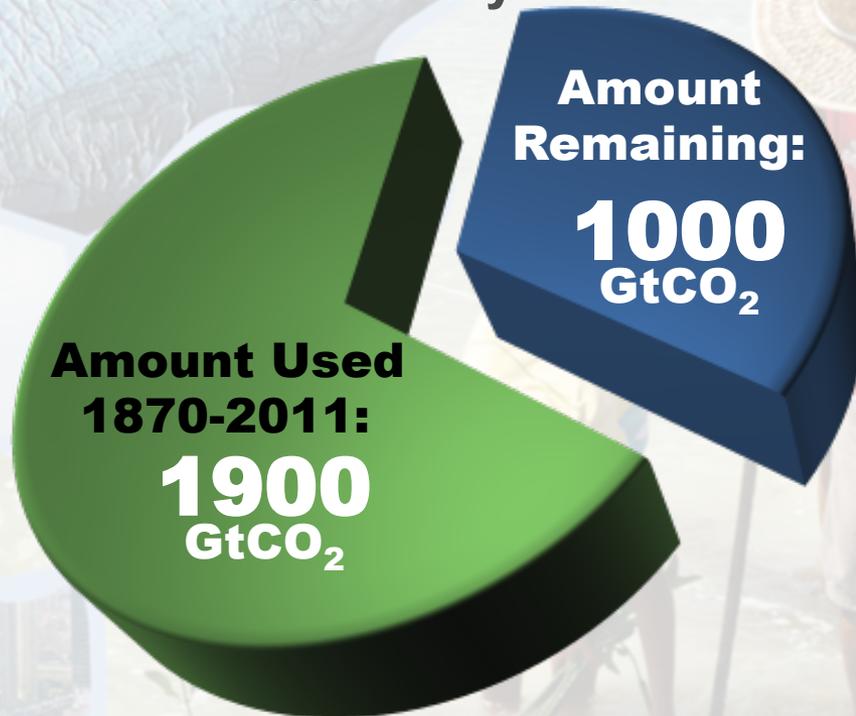
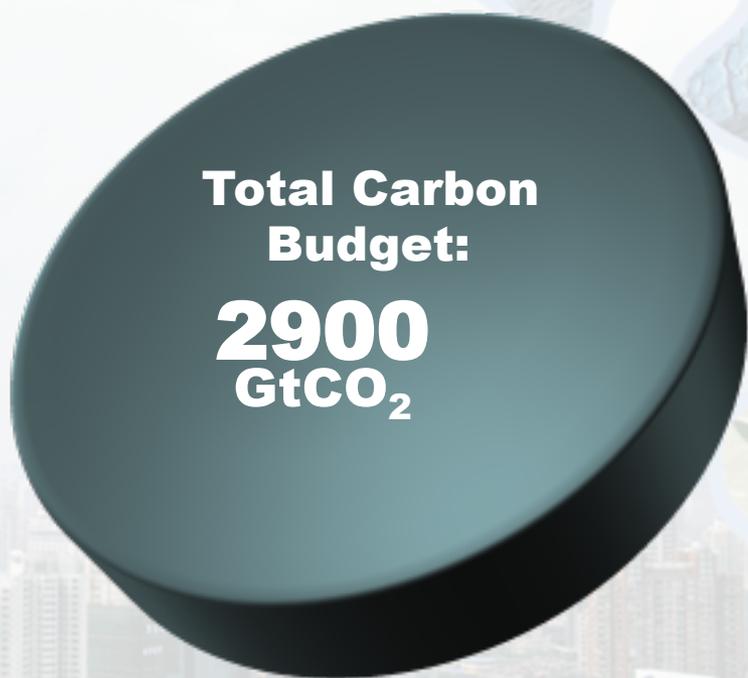
© IPCC 2013

Fig. SPM.10

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

# The window for action is rapidly closing

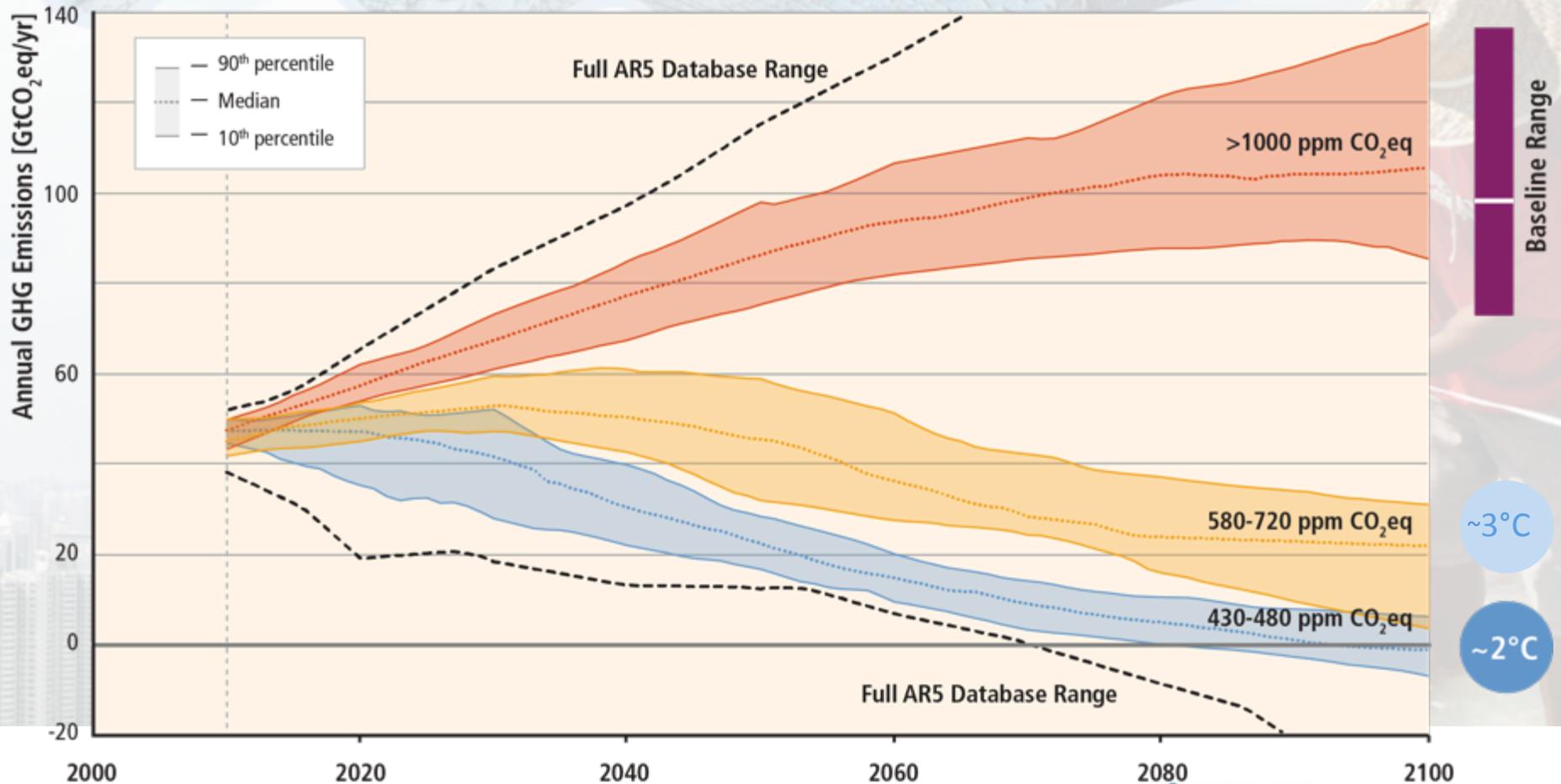
65% of the carbon budget compatible with a 2°C goal is already used  
NB: this is with a probability greater than 66% to stay below 2°C



**NB: Emissions in 2011: 38 GtCO<sub>2</sub>/yr**

AR5 WGI SPM

# Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.



Based on Figure 6.7

# Can temperature rise still be kept below 1.5 or 2°C (over the 21<sup>st</sup> 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 CO<sub>2</sub>-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 21<sup>st</sup> 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 CO<sub>2</sub>eq) 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.**

# Mitigation Measures



More efficient use of energy



**Greater use of low-carbon and no-carbon energy**

- Many of these technologies exist today
- But worldwide investment in **research** in support of GHG mitigation is small...



**Improved carbon sinks**

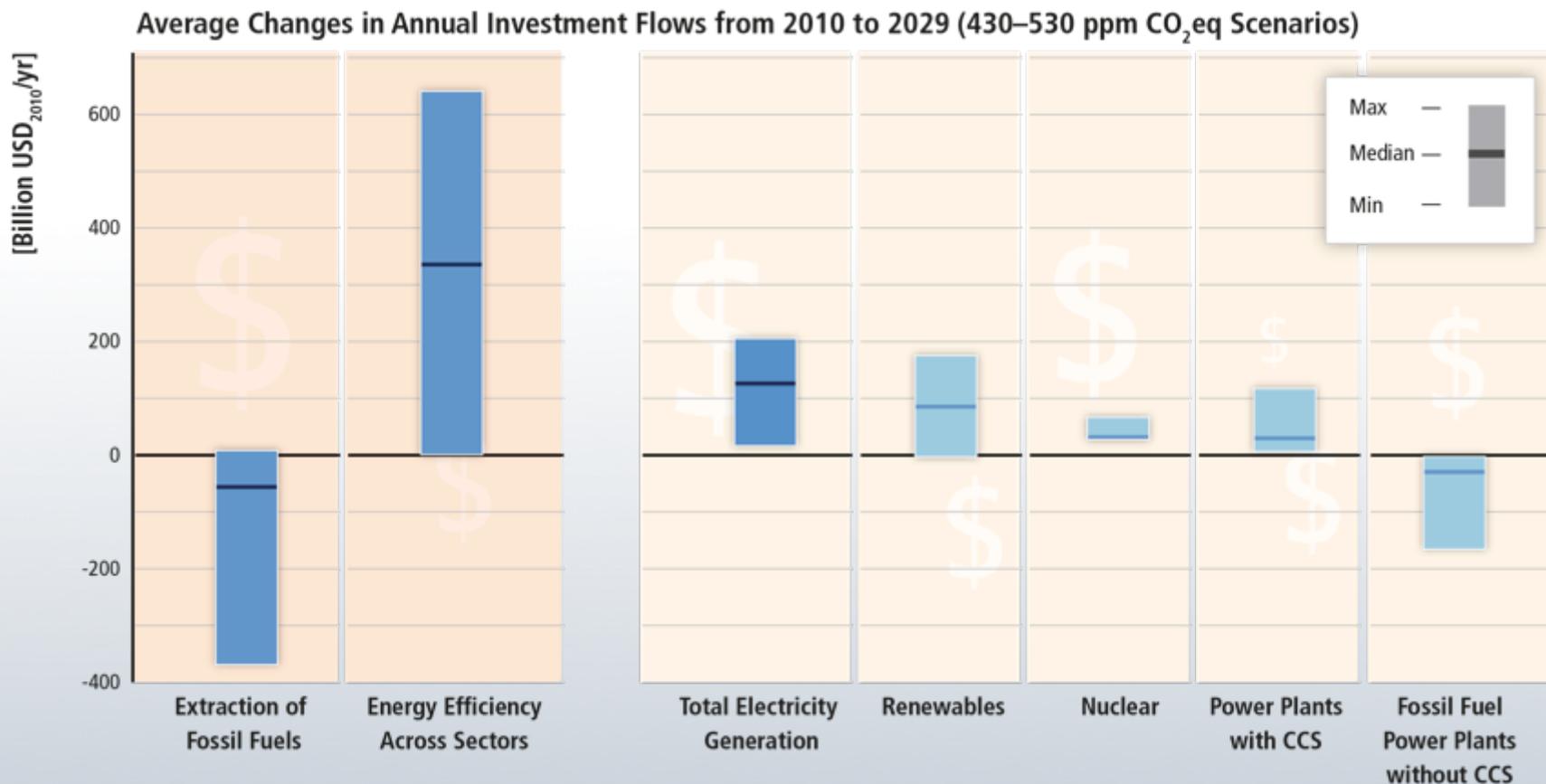
- **Reduced deforestation** and improved forest management and planting of new forests
- **Bio-energy with carbon capture and storage**



Lifestyle and behavioural changes

AR5 WGIII SPM

# Substantial reductions in emissions require significant changes in investment patterns and appropriate policies.



Based on Figure SPM.9

- **Substantial reductions in emissions would require large changes in investment patterns e.g., from 2010 to 2029, in billions US dollars/year:**  
(mean numbers rounded, IPCC AR5 WGIII Fig SPM 9 for 430-530 ppm CO<sub>2eq</sub> )
- **energy efficiency: +330**
- **renewables: + 90**
- **power plants w/ CCS: + 40**
- **nuclear: + 40**
- **power plants w/o CCS: - 60**
- **fossil fuel extraction: - 120**

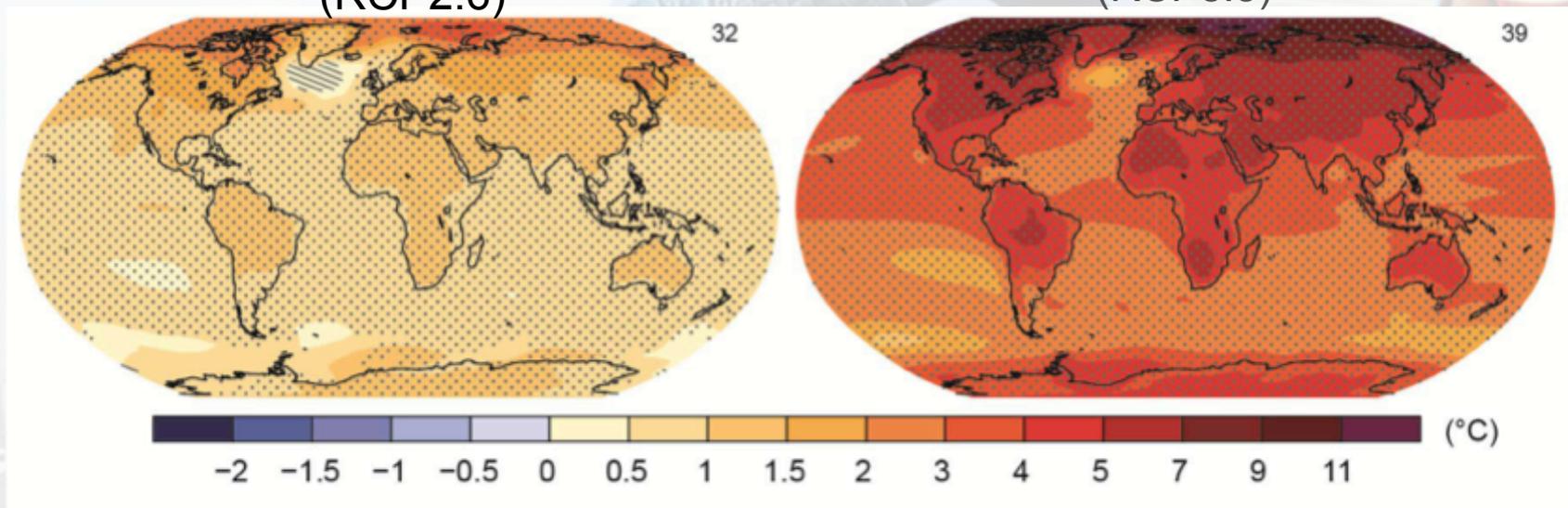
An aerial photograph of a city skyline, likely Hong Kong, featuring a complex highway interchange in the foreground and numerous high-rise buildings in the background. The image is overlaid with white text.

**Delaying additional mitigation  
to 2030 will substantially  
increase the challenges  
associated with limiting  
warming over the 21st century  
to below 2°C relative to pre-  
industrial levels.**

# The Choices Humanity Makes Will Create Different Outcomes (and affect prospects for effective adaptation)

With substantial  
mitigation  
(RCP2.6)

Without additional  
mitigation  
(RCP8.5)



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

AR5 WGI SPM

# **The Hidden IPCC Message:**

- **If it's possible and not enough happens, what is lacking?**
- ***Political will, at the appropriate scale***



**Isaac Cordal**

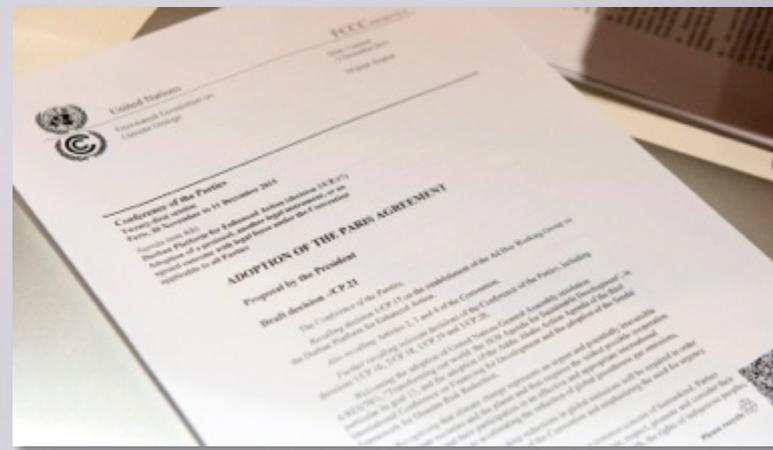
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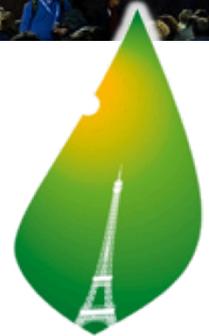
- COP21

# Sur les Changements Climatiques 2015

COP21/CMP11

Paris, France





- **196 Parties**
- **150 Heads of State & Government**
- **More than 30 000 participants**

# The Paris climate agreement: key points

The historic pact, approved by 196 countries, will take effect from 2020

## Temperatures

2100



- Keep warming “well below 2 degrees Celsius”. Continue all efforts to limit the rise in temperatures to 1.5 degrees Celsius”

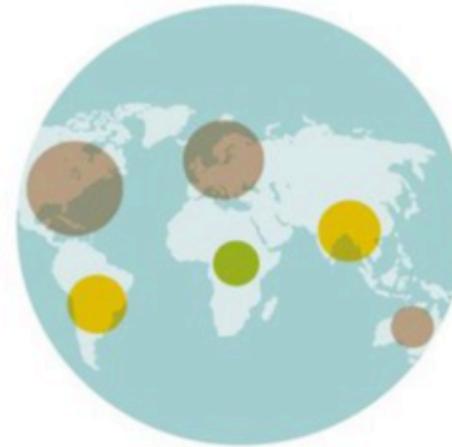
## Finance

2020-2025



- Rich countries must provide 100 billion dollars from 2020, as a “floor”
- Amount to be updated by 2025

## Differentiation



- Developed countries must continue to “take the lead” in the reduction of greenhouse gases
- Developing nations are encouraged to “enhance their efforts” and move over time to cuts

## Emissions objectives

2050



- Aim for greenhouse gases emissions to peak “as soon as possible”
- From 2050: rapid reductions to achieve a balance between emissions from human activity and the amount that can be captured by “sinks”

# The Paris climate agreement: key points

The historic pact, approved by 196 countries, will take effect from 2020

## Burden-sharing



- *Developed countries must provide financial resources to help developing countries*
- *Other countries are invited to provide support on a voluntary basis*

## Review mechanism

2023



- *A review every five years  
First world review: 2023*
- *Each review will inform countries in “updating and enhancing” their pledges*

## Climate damage



- *Vulnerable countries have won recognition of the need for “averting, minimising and addressing” losses suffered due to climate change*

# Paris Agreement Objectives

- Article 2:
  - ◆ (...) to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
    - ▶ Holding the increase in the global average temperature to **well below 2 °C** above pre-industrial levels and to **pursue efforts** to limit the temperature increase to **1.5 °C** above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
    - ▶ **Increasing the ability to adapt** (...) and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
    - ▶ Making **finance flows consistent** with a pathway towards low greenhouse gas emissions and climate-resilient development

# Paris Agreement: All Parties to Act

- Article 3:
  - ◆ As nationally determined contributions to the global response to climate change, **all Parties** are to undertake and communicate ambitious efforts (...) with the view to achieving the purpose of this Agreement as set out in Article 2.  
The efforts of all Parties will represent **a progression over time**, while recognizing the **need to support developing country** Parties for the effective implementation of this Agreement.

# Paris Agreement: Peak and Reduce, Balance Sinks and Sources

- Article 4:
  - ♦ 1. (...) Parties aim to reach **global peaking** of greenhouse gas emissions **as soon as possible**, recognizing that **peaking will take longer for developing country Parties**,
  - ♦ and to undertake **rapid reductions thereafter in accordance with best available science**,
  - ♦ so as to achieve a **balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century**, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty
  - ♦ 3. **Each Party's successive nationally determined contribution will represent a progression(...)**

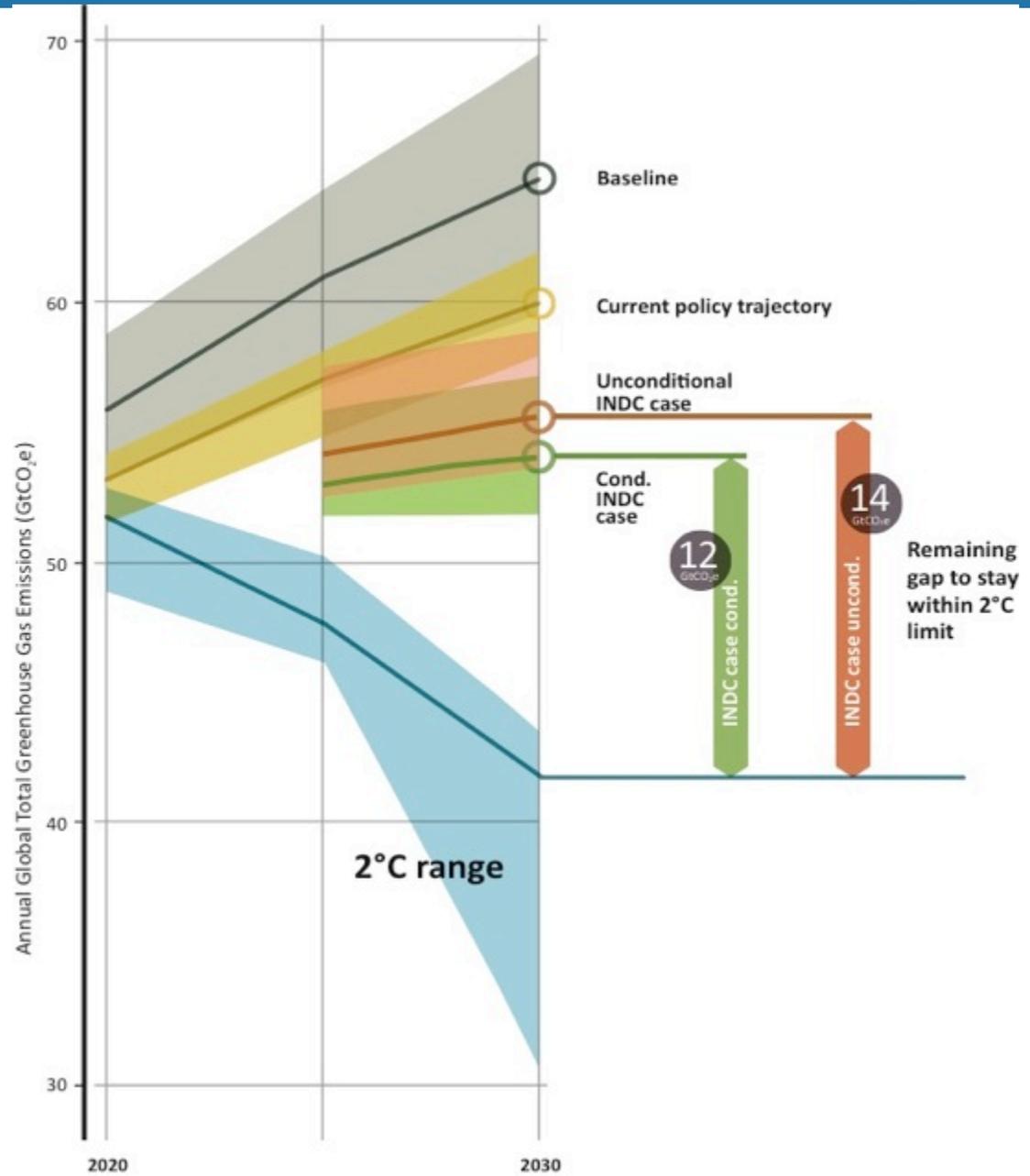
# Paris Agreement: Differentiation of Efforts

- Article 4 (cont.):
  - ◆ 4. Developed country Parties should continue taking the lead by undertaking economy-wide absolute emission reduction targets.
  - ◆ Developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.
  - ◆ **Each Party shall communicate a nationally determined contribution every five years**
  - ◆ Parties shall take into consideration in the implementation of this Agreement the concerns of Parties with economies most affected by the impacts of response measures, particularly developing country Parties.



# Intended Nationally Determined Contributions (INDCs)

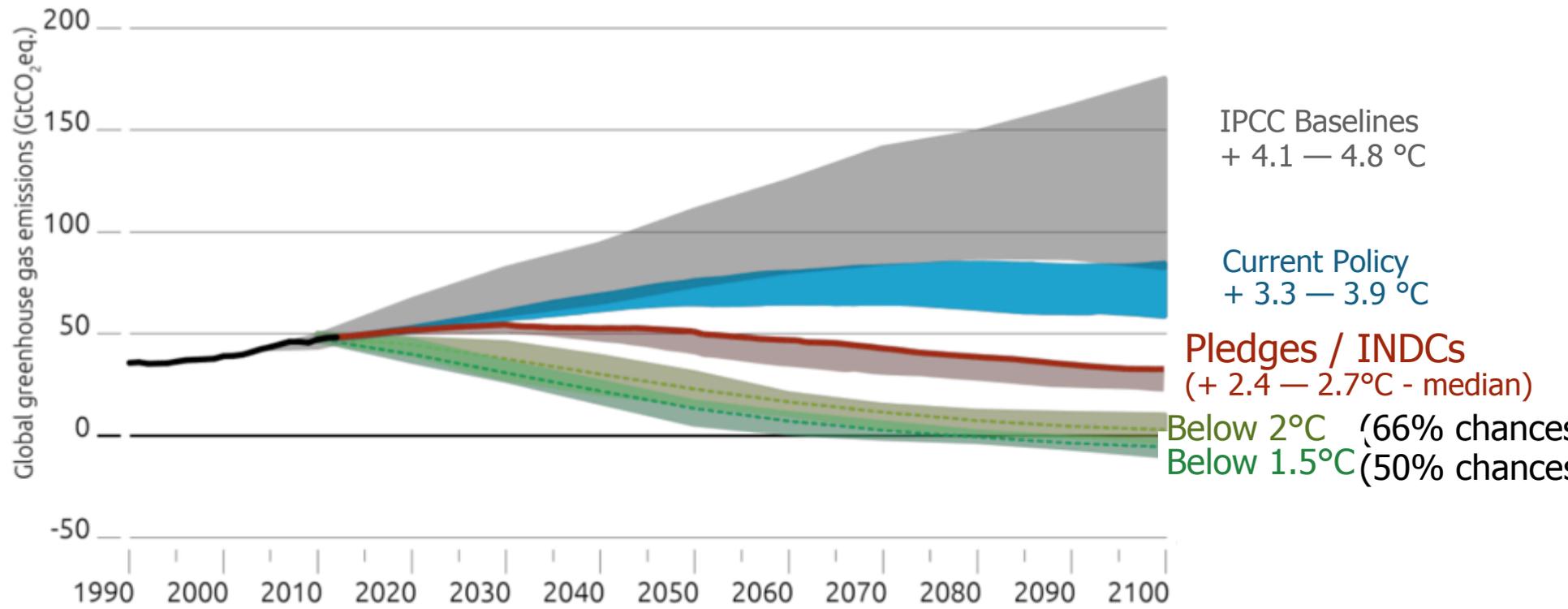
- UN emissions gap report
- a « gap » in 2030 of
  - ♦ 12 GtCO<sub>2</sub>eq if conditions set by some countries are met,
  - ♦ 14 GtCO<sub>2</sub>eq without those conditional contributions



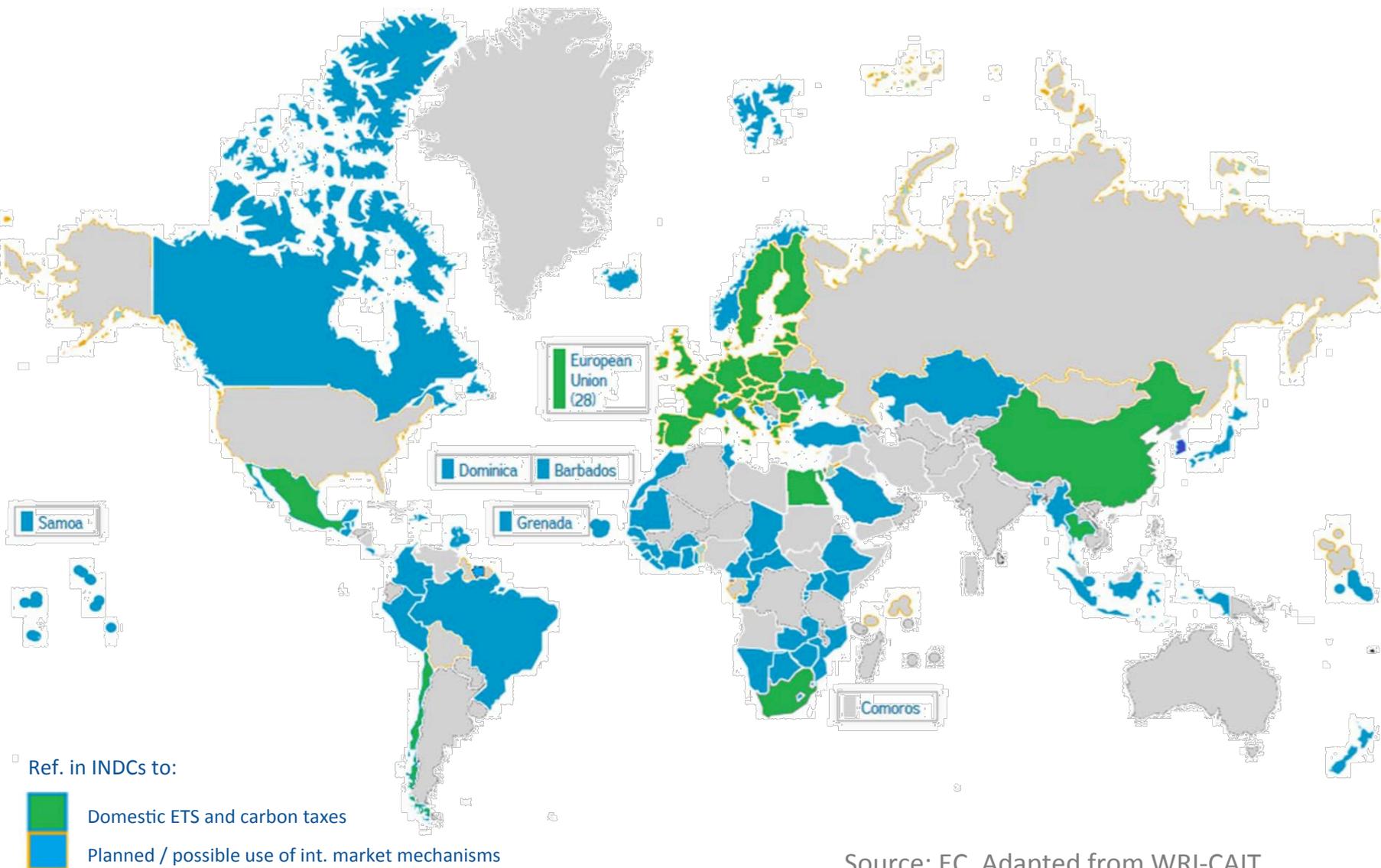
# Intended Nationally Determined Contributions

(INDCs)

- Analysis from [climateactiontracker.org](http://climateactiontracker.org) (december 2015)



# INDCs putting a price on Carbon



Source: EC, Adapted from WRI-CAIT

# Ambition Mechanism in the Paris Agreement



<http://ow.ly/VUfYe>

# Plan

- What's next?

*“Getting 196 Countries To Agree On Climate Change Was The Easy Part. Now comes the real work.”*

(C. Figueres, World Economic Forum 2016, Davos)



*“Today we celebrate, tomorrow we have to act.  
This is what the world expects from us.”*

(M. Arias Cañete, COP21)



I am trying to be coherent...



I am trying to be coherent...



# And the IPCC?



- AR6 to be ready in 2020 to 2022
- Many Special Reports to prioritize from, including one requested by COP21 on the 1.5°C pathways
- IPCC Plenary to decide in April 2016
- Scoping process will likely start in autumn
- Call for author nominations beginning 2017?

# IPCC Special reports proposals / clusters

- Ice / oceans (+ mountains?): 6 countries / 1 obs
- Scenarios / 1.5°C : 2 countries / UNFCCC / 1 expert meeting / 1 obs
- Drought / desertification : 2 countries / 1 obs
- Food / Agriculture : 1 country / 1 expert meeting / 1 obs + UE (AFOLU )
- Cost & economics: 2 countries
- Adaptation: 1 country / UNEP
- Communicating climate change information: 1 expert meeting
- Others...

# IPCC guidance for selecting special reports

- Origin of the request: IPCC's own initiative is a key element in formulating and choosing Special Reports; UNFCCC has priority over other Conventions and organisations;
- Relevance of the subject for policy considerations;
- Relevance to understanding of climate change;
- Enough information is available to provide an authoritative scientific/technical assessment on the topic, and not already available elsewhere;
- Issue merits explicit consideration outside the framework of Assessment Report;
- Issue requires input from more than one Working Group of the IPCC.

Source : IPCC decision framework for SR (...), last updated in 2008 (confirmed for AR6 at P41)  
[https://www.ipcc.ch/organization/organization\\_procedures.shtml](https://www.ipcc.ch/organization/organization_procedures.shtml)

# Take home messages

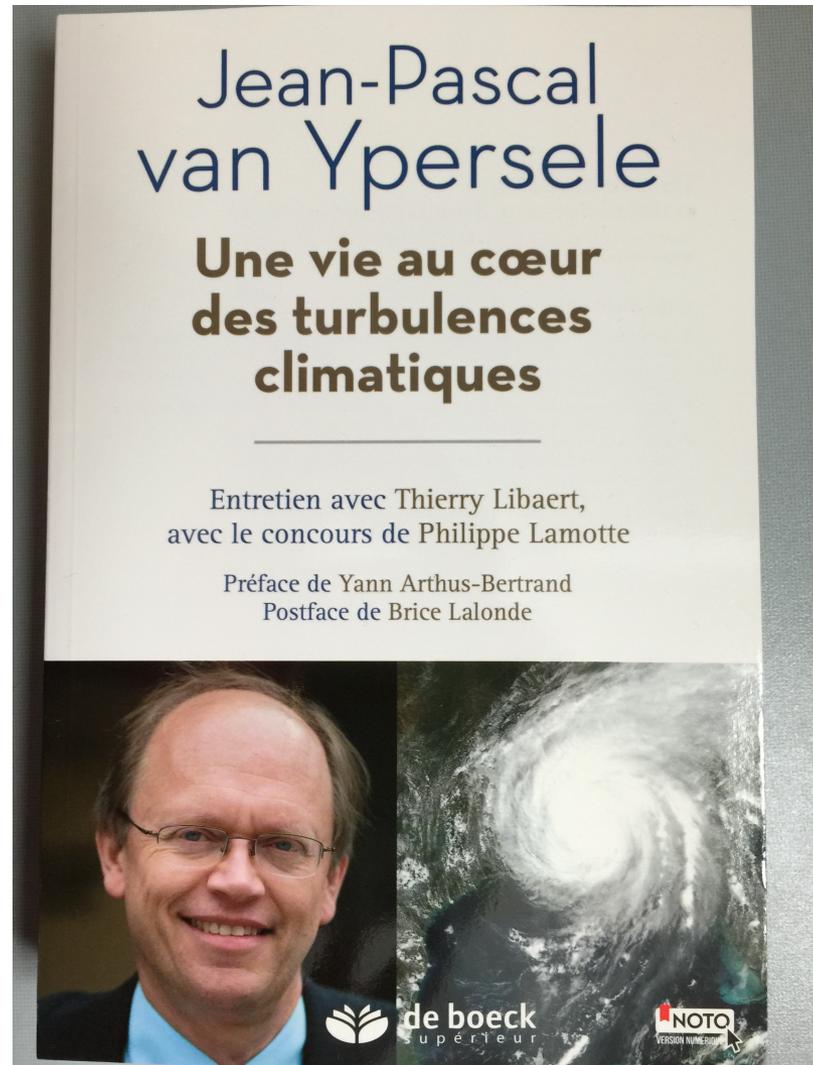
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- **The science is clearer than ever: urgent action is needed to maintain warming under +2°C, even more so for 1.5°C**
- **COP21 objectives are very ambitious and challenging**
- **A new momentum is there**
- **Scientists and IPCC have opportunity to serve and be policy-relevant**

**Publié chez De Boeck  
supérieur,  
octobre 2015**

**Sujets couverts:**

**La science du climat depuis  
la découverte de l'effet de  
serre, le rôle du GIEC, les  
risques pour les  
écosystèmes et l'humanité,  
les semeurs de confusion,  
les négociations climatiques,  
que faire ?**



# Useful links:

- [www.ipcc.ch](http://www.ipcc.ch) : IPCC (reports and videos)
- [www.climate.be/vanyp](http://www.climate.be/vanyp) : my slides and other documents
- [www.skepticalscience.com](http://www.skepticalscience.com): excellent responses to contrarians arguments
- **On Twitter: @JPvanYpersele  
and @IPCC\_CH**