# The Challenges and Opportunities of Climate Change

## *An Overview Based on the IPCC Fifth Assessment Report (AR5)*


**Jean-Pascal van Ypersele**

**IPCC Vice-Chair**

**Twitter: @JPvanYpersele**


**UnB (Universidade de Brasília), Brasília, Brazil,**

**24 November 2014**


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


ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

# 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 Organizatior

UNEP= United Nations Environment Programme

# Strengths of the IPCC

- ✓ **Mobilisation of thousands of multi-disciplinary experts worldwide**
- ✓ **Policy-relevant findings (but not policy-prescriptive)**
- ✓ **Widely used methodological reports**
- ✓ **Assessments relying on peer reviewed literature**
- ✓ **Review process involving experts and Governments**
- ✓ **Media attention and outreach activities**

# AR5 is the best ever

- Better integration of Mitigation and Adaptation
- Improved risk-management approach
- Evolving away from the non-mitigation SRES scenarios (SRES= Special Report on Emission Scenarios, 2000)
- Special effort to provide regional information when available
- Sustainable development & equity aspects
- More comprehensive treatment of economic aspects, and of cross-cutting issues
- Emerging issues handled (acidification, …)
- Better handling & communication of uncertainties




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

**What are the risks?**

**What can be done?**

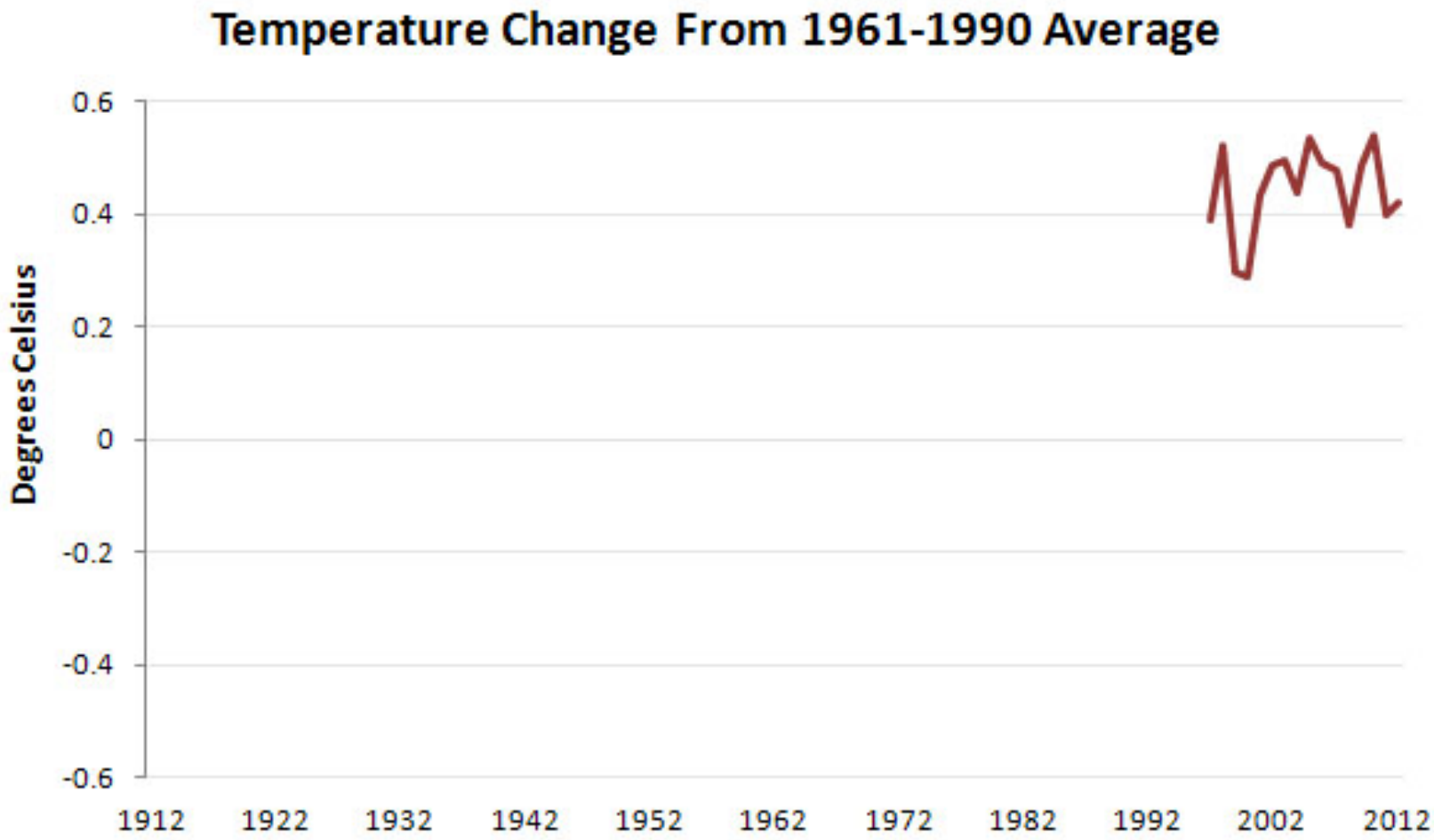
ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

# Key Messages

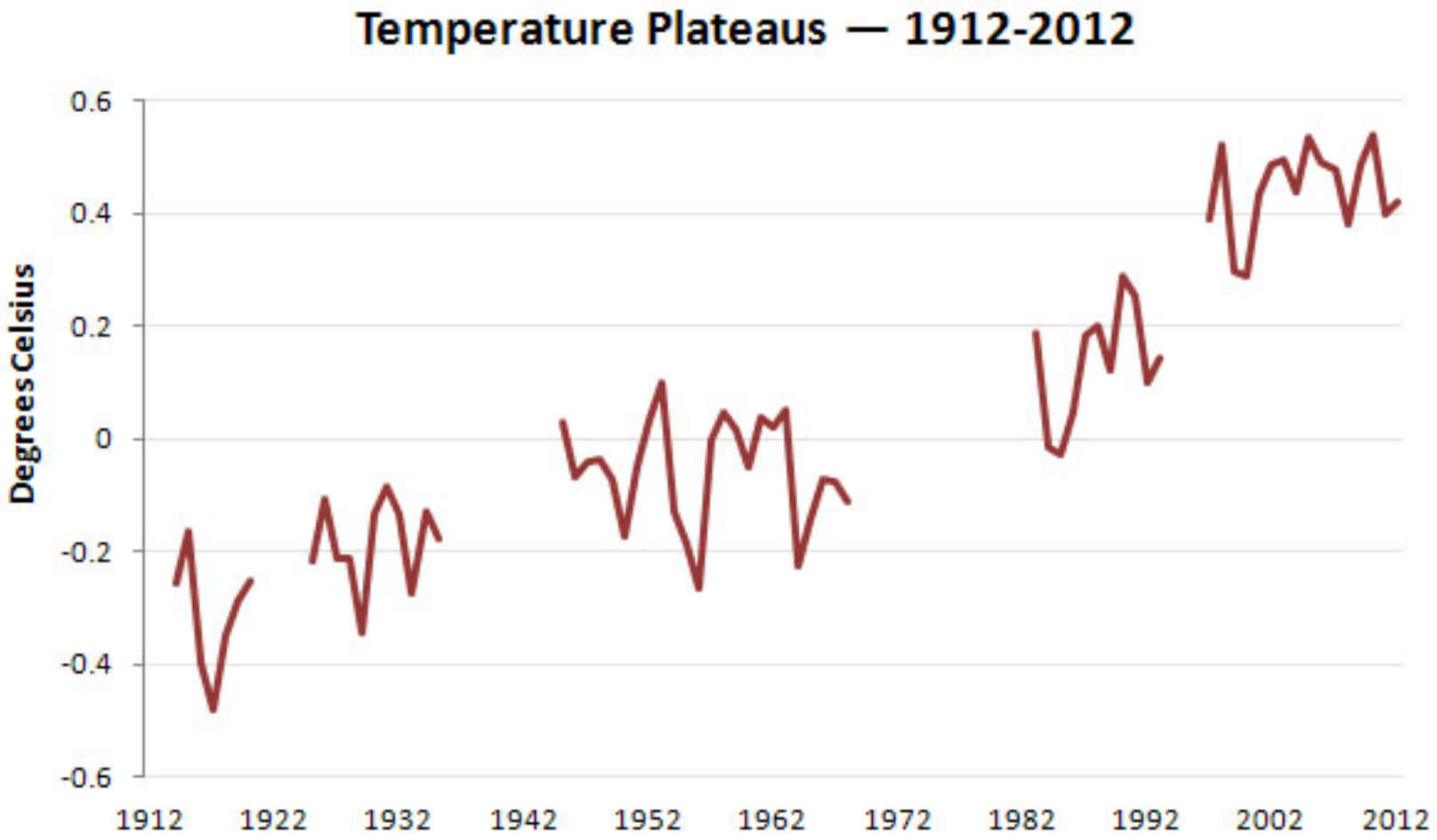
- Human influence on the climate system is clear
- Continued emission of greenhouse gases will increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems
- While climate change is a threat to sustainable development, there are many opportunities to integrate mitigation,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

AR5 WGI SPM, AR5 WGII SPM, AR5 WGIII SPM



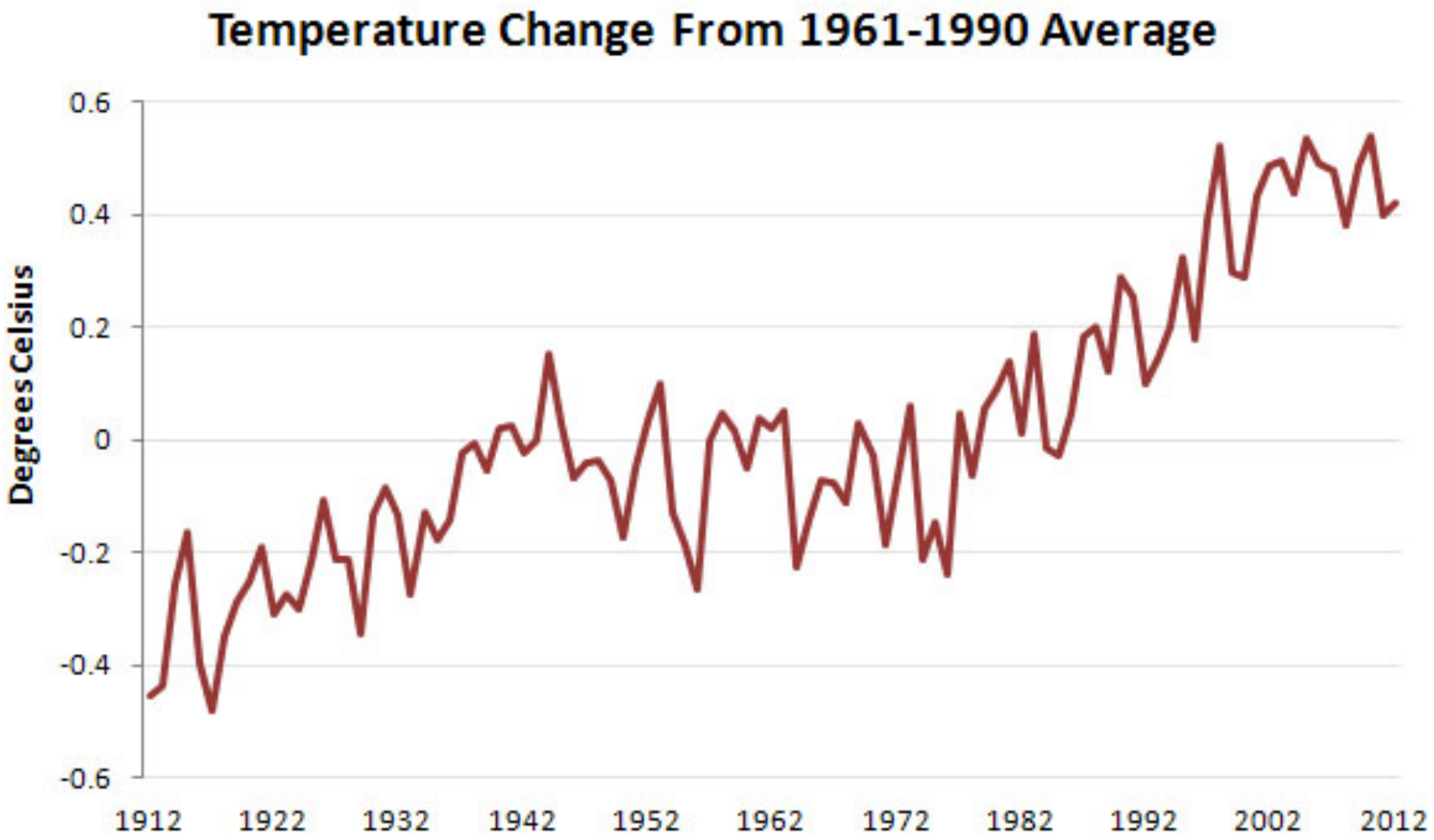

http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

# Lying With Statistics, Global Warming Edition



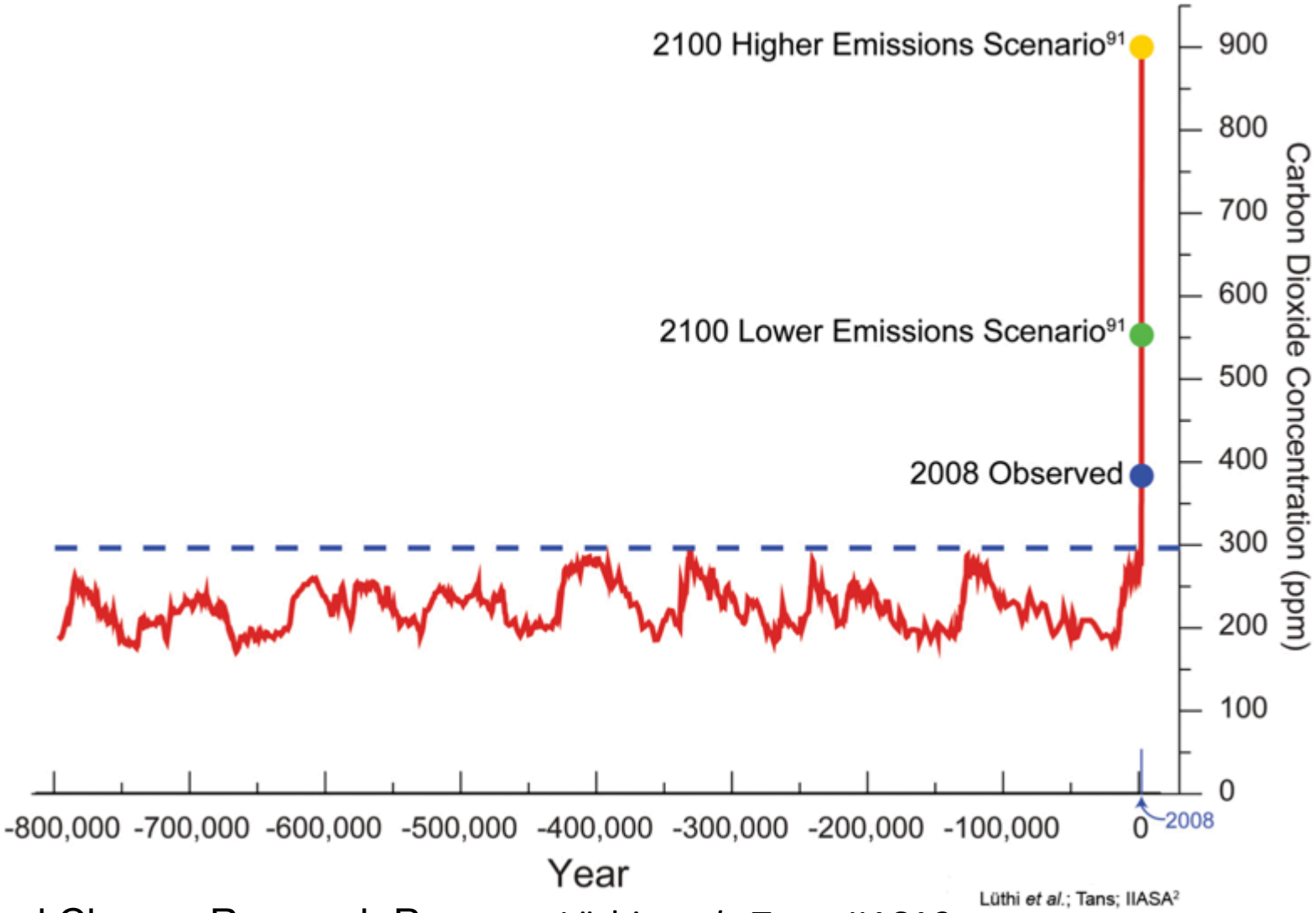

http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

# Lying With Statistics, Global Warming Edition

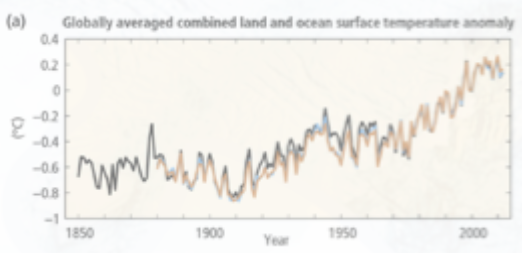


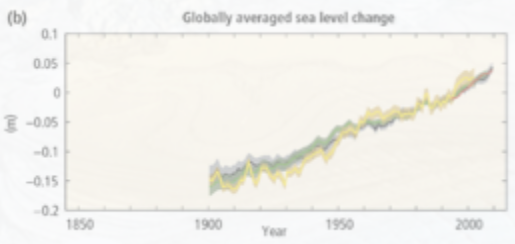

http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

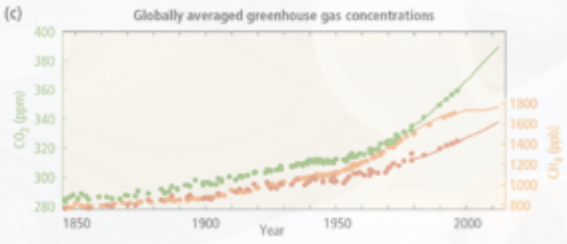
# Atmospheric $CO_2$ over the last 800000 years

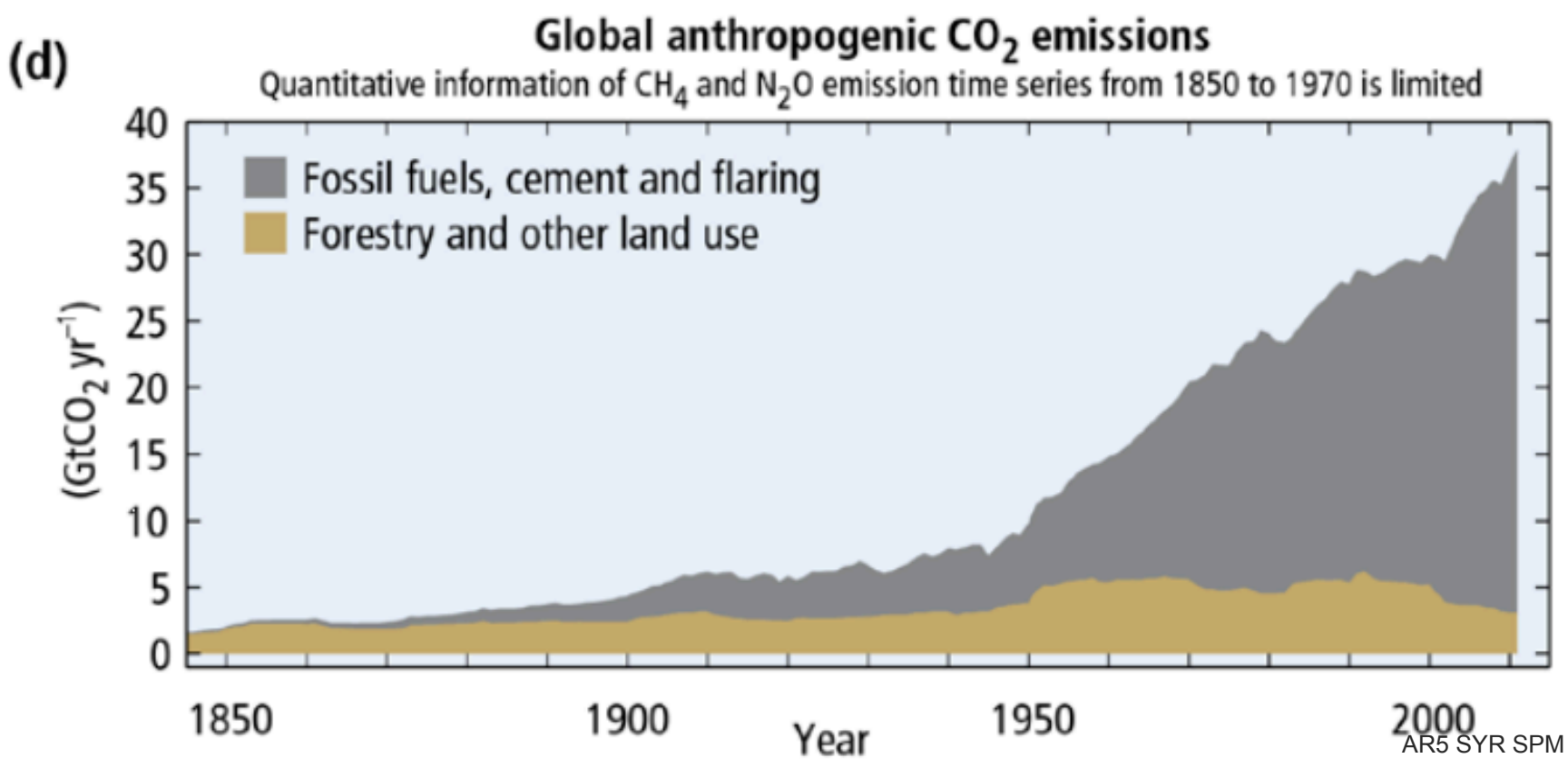



U.S. Global Change Research Program:Lüthi *et al.*; Tans; IIASA2


(a)
Globally averaged combined land and ocean surface temperature anomaly
(°C)
Year


(b)
Globally averaged sea level change
(m)
Year


(c)
Globally averaged greenhouse gas concentrations
Year


(d)
Global anthropogenic $CO_2$ emissions
Quantitative information of $CH_4$ and $N_2O$ emission time series from 1850 to 1970 is limited
Fossil fuels, cement and flaring
Forestry and other land use
$(GtCO_2\ yr^{-1})$
Year

AR5 SYR SPM

# Sources of GHG emissions in 2010

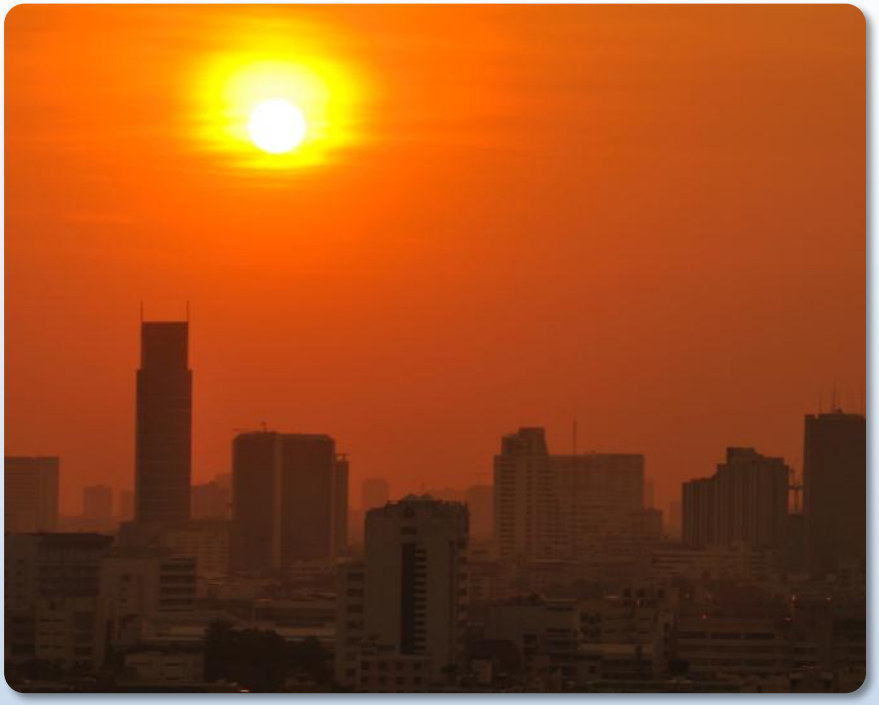
## Energy production remains the primary driver of GHG emissions


AR5 WGIII SPM



ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

# 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

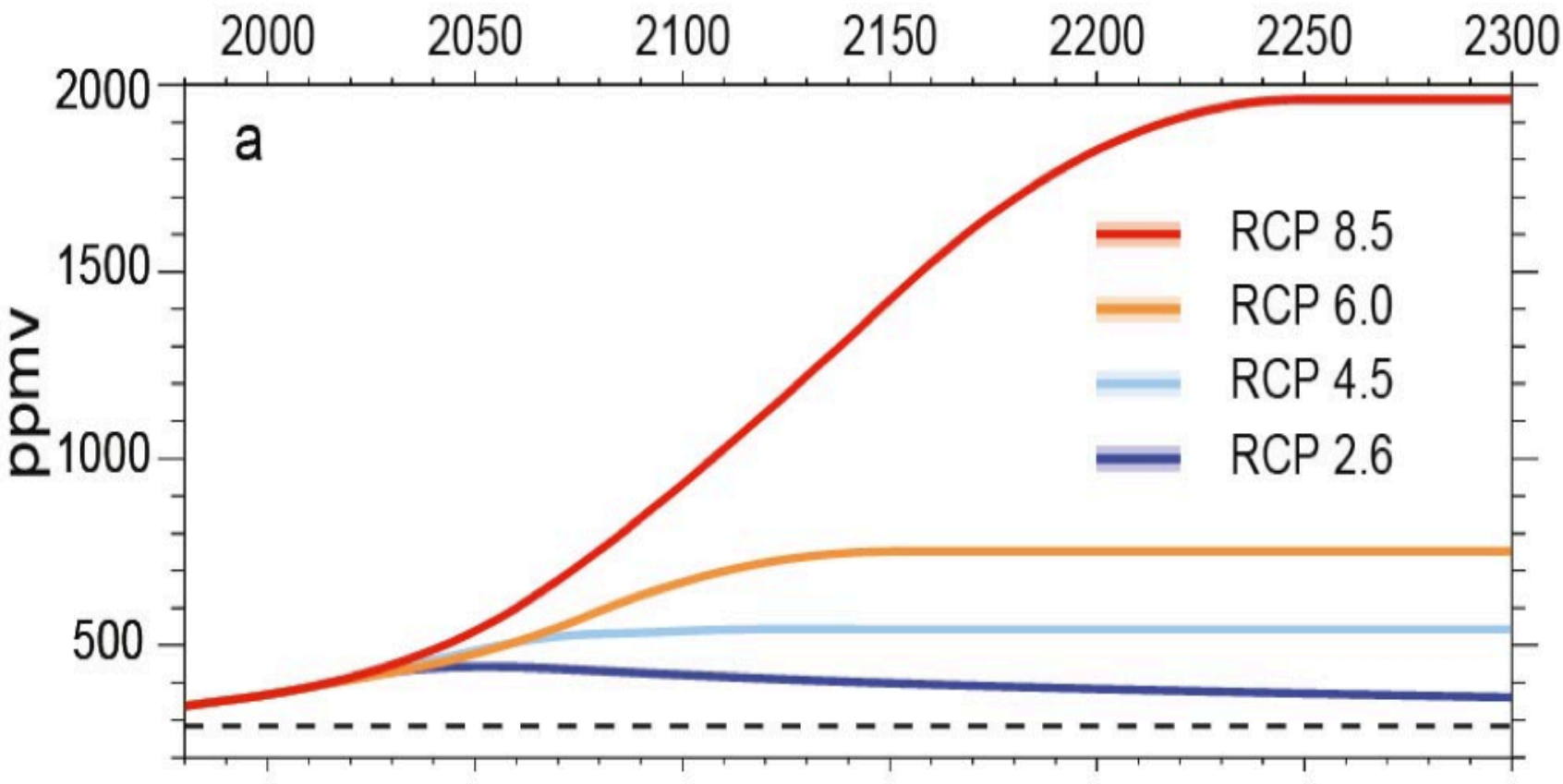
# Impacts are already underway

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



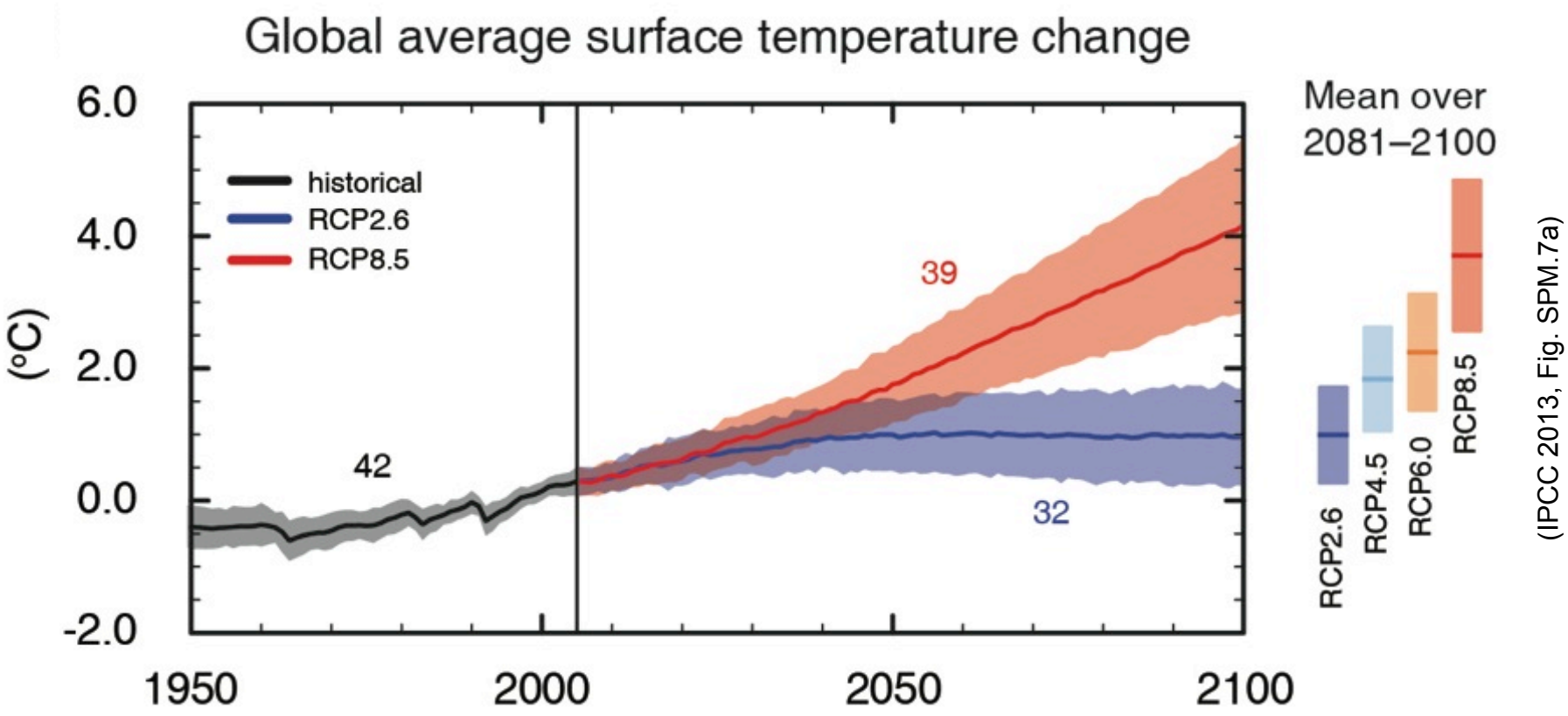

AR5 WGII SPM

# RCP Scenarios: Atmospheric $CO_2$ concentration




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

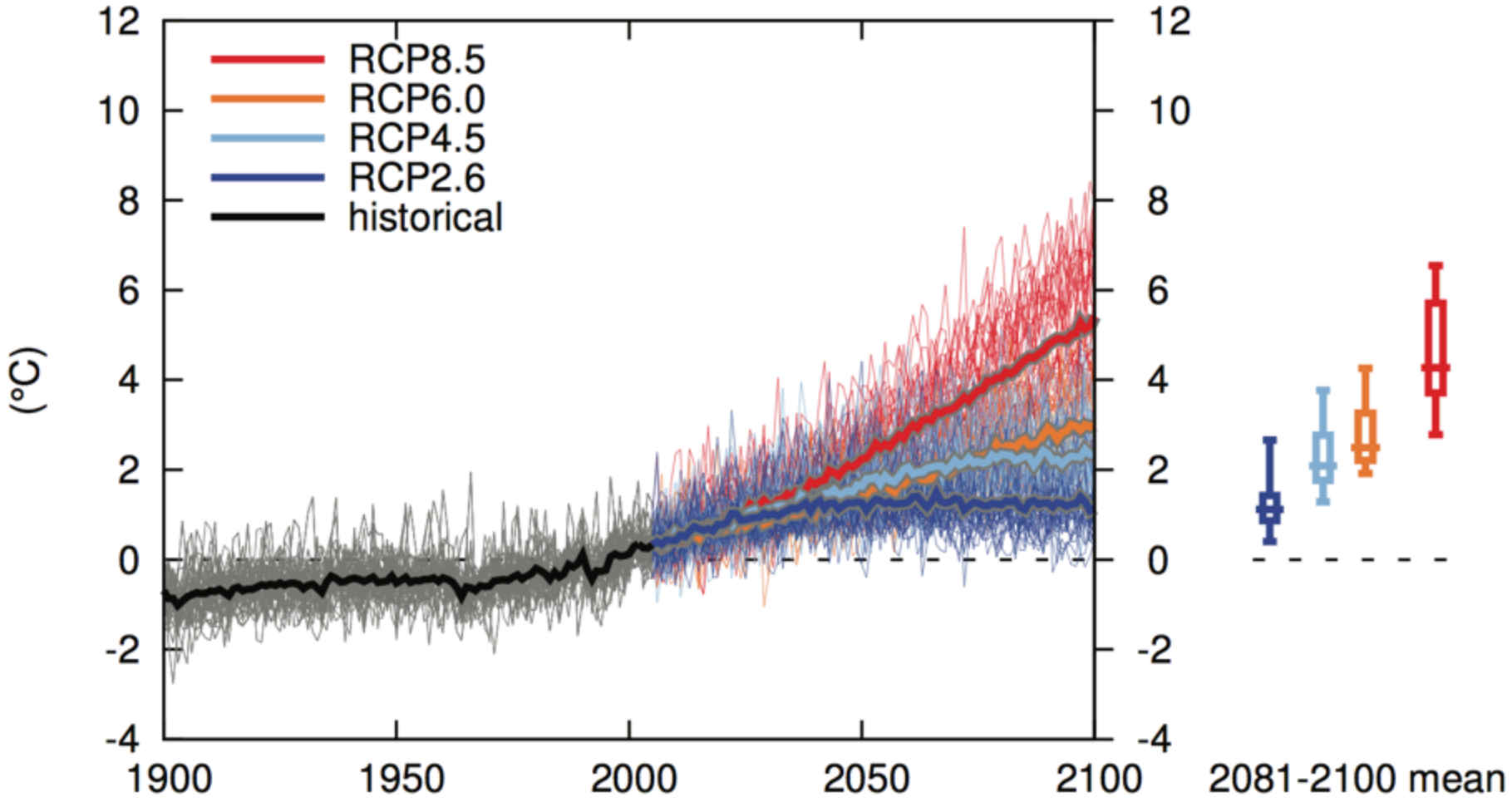
AR5 WGI, chapter 12.




(IPCC 2013, Fig. SPM.7a)

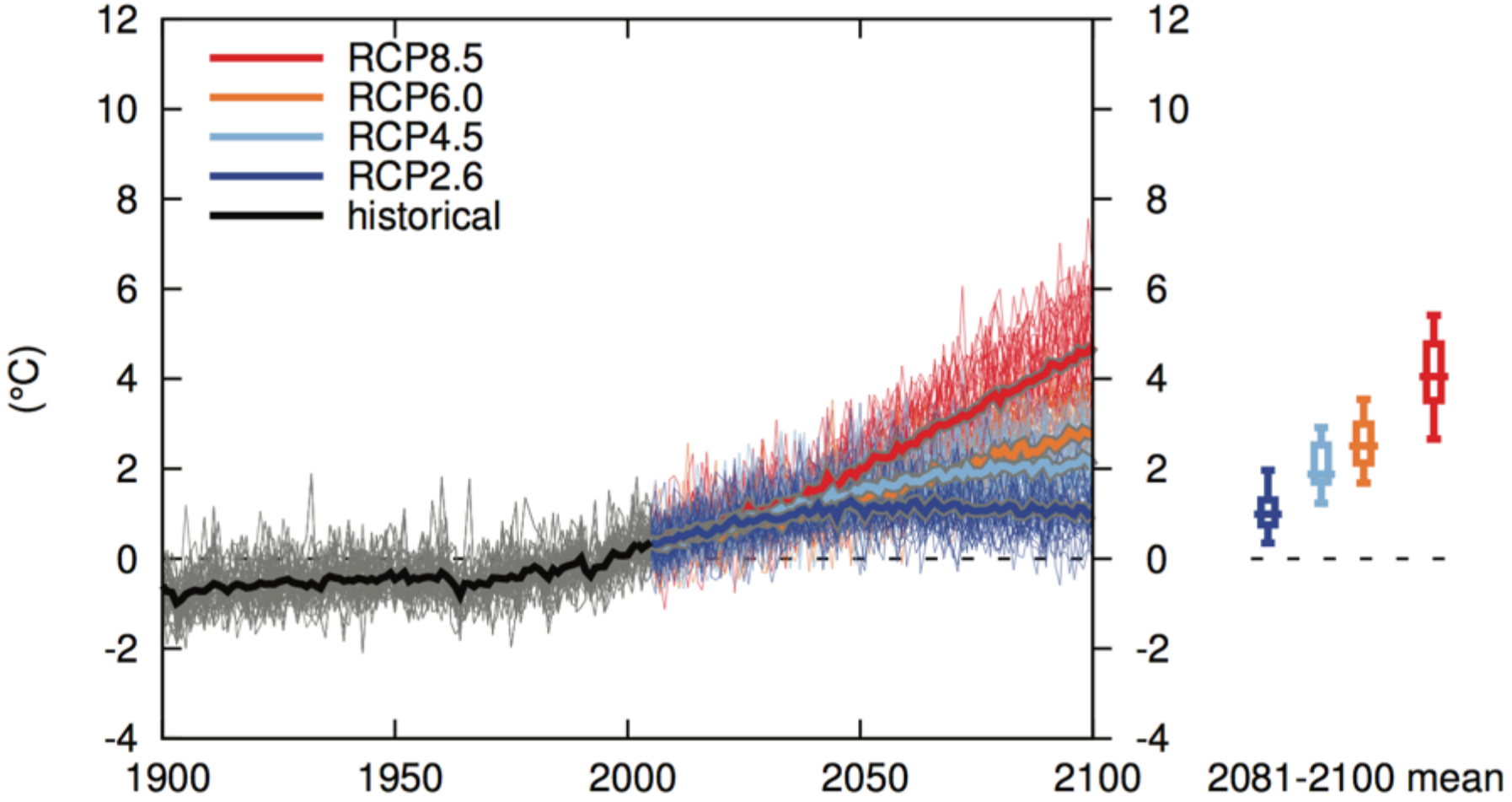
Only the lowest (RCP2.6) scenario maintains the global surface temperature increase above the pre-industrial level to less than 2°C with at least 66% probability

# Temperature change Amazon annual



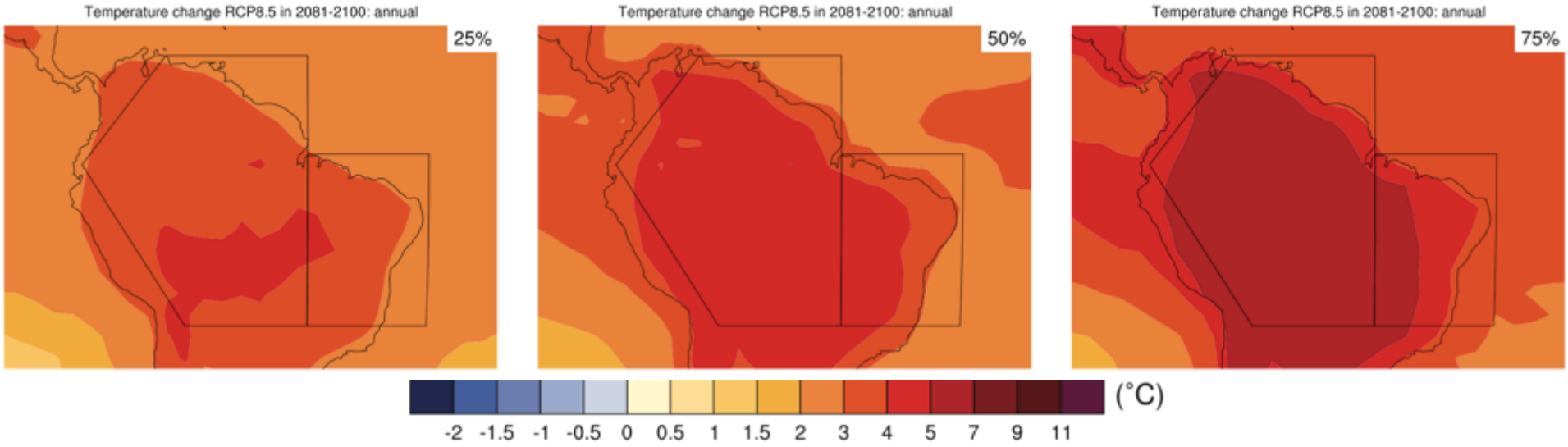

IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Temperature change North-East Brazil annual



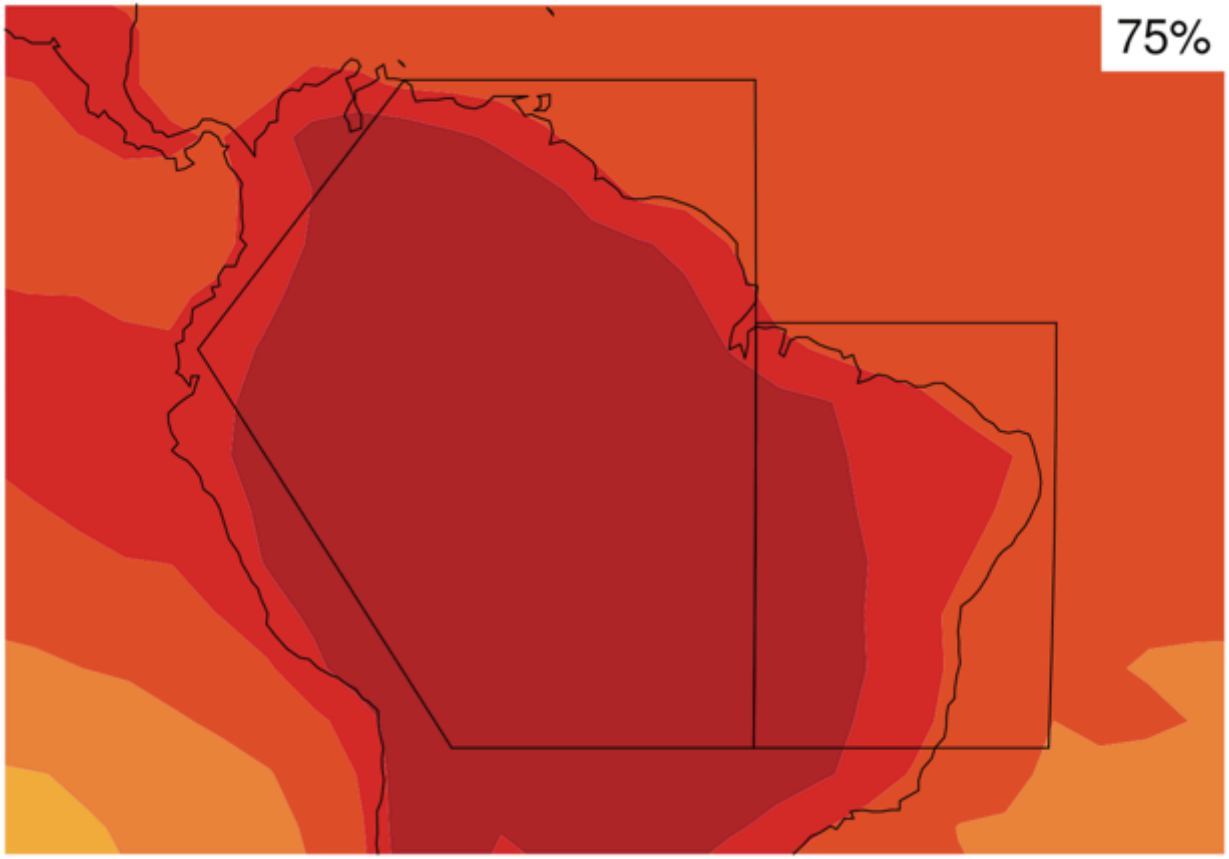

IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Maps of temperature changes in 2081–2100, with respect to 1986–2005 in the RCP8.5 scenario



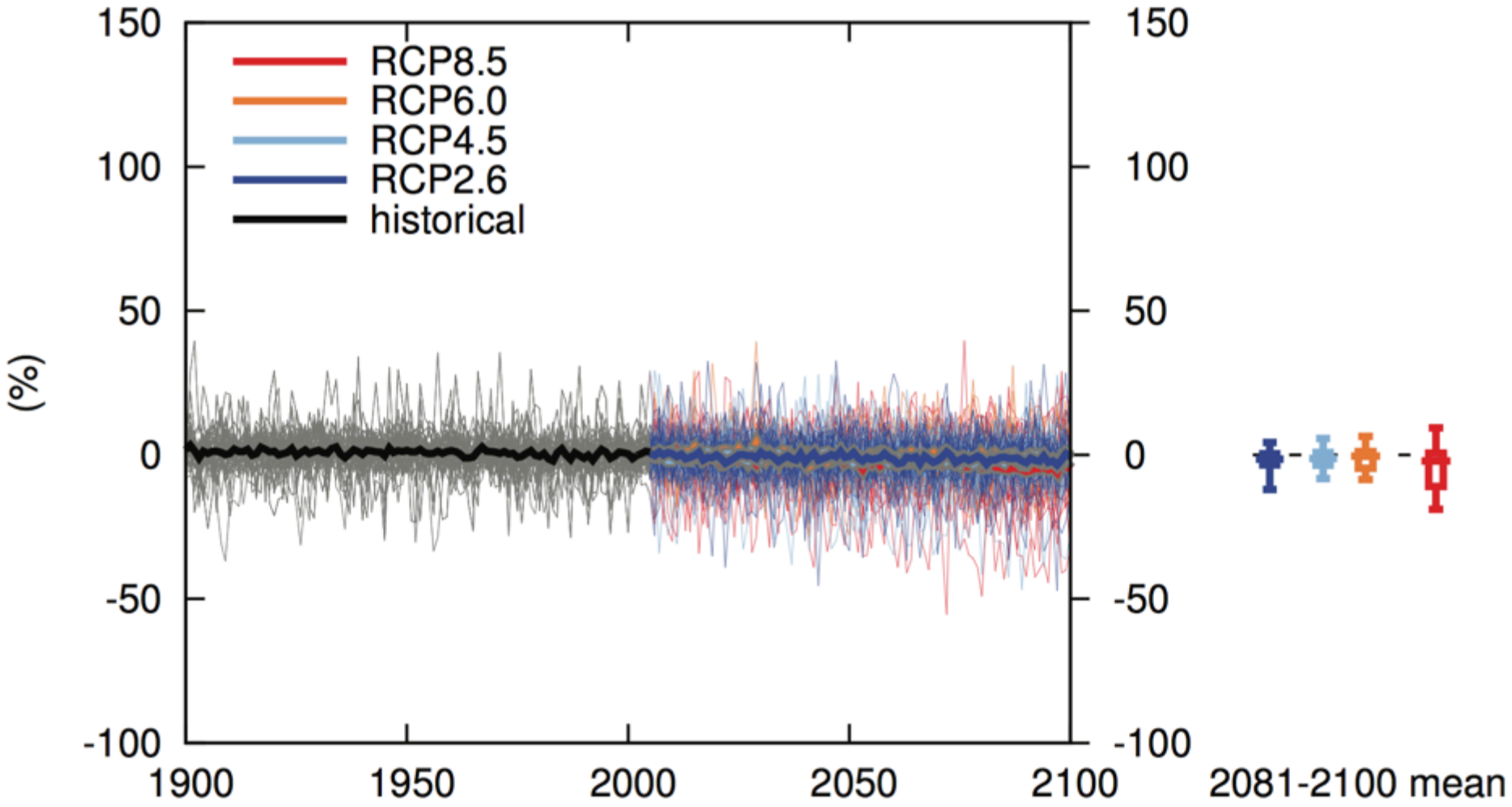

IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Map of temperature changes in 2081–2100, with respect to 1986–2005 in the RCP8.5 scenario



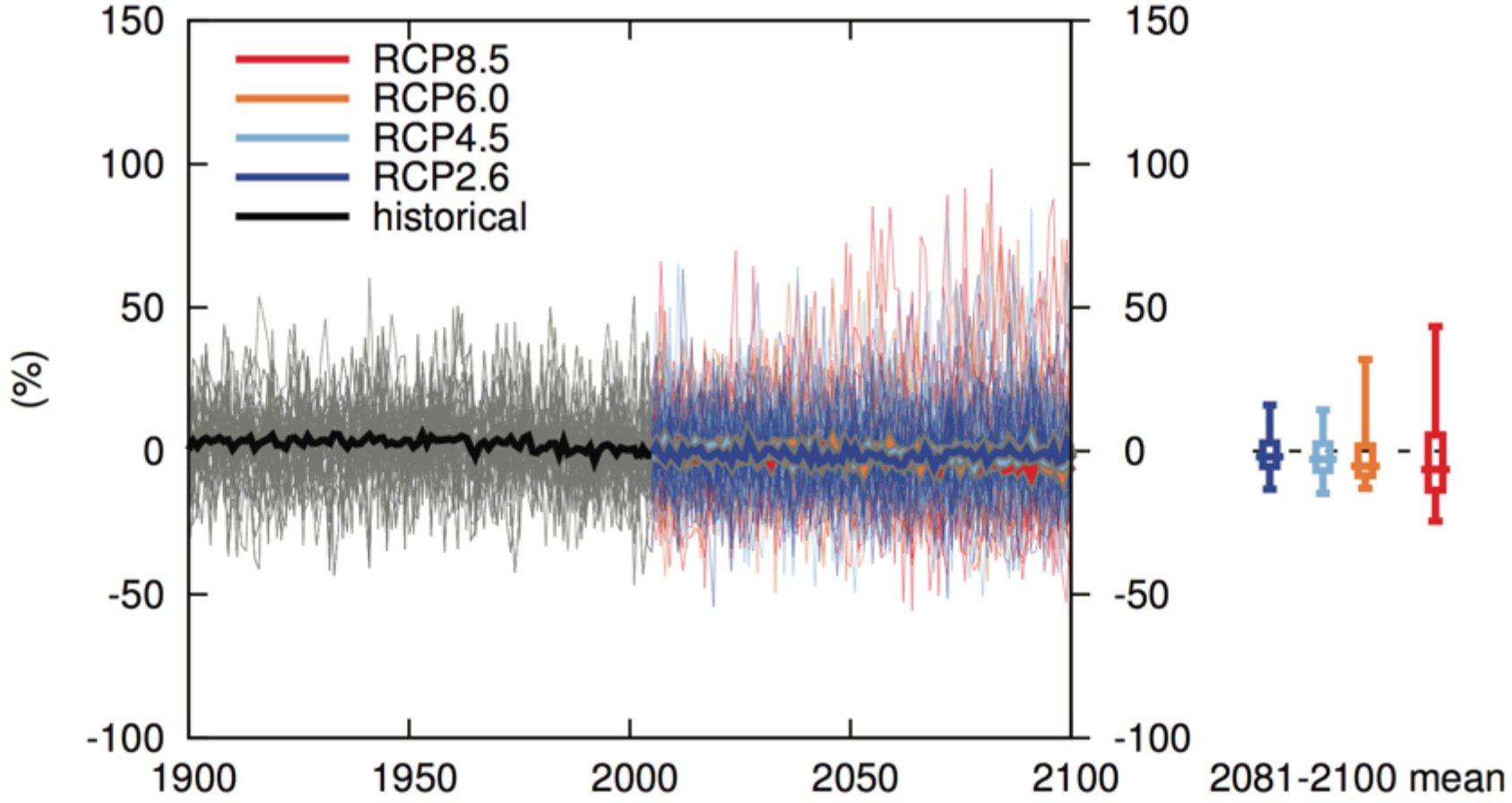

IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Precipitation change Amazon annual




IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

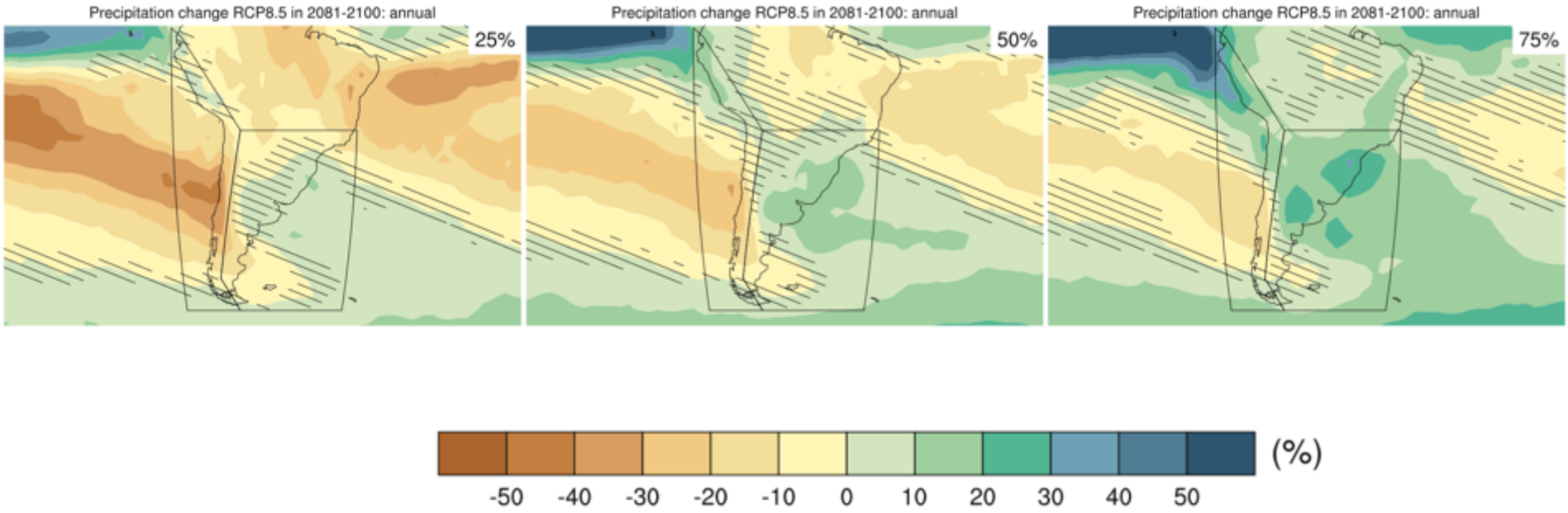
# Precipitation change North-East Brazil annual




ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

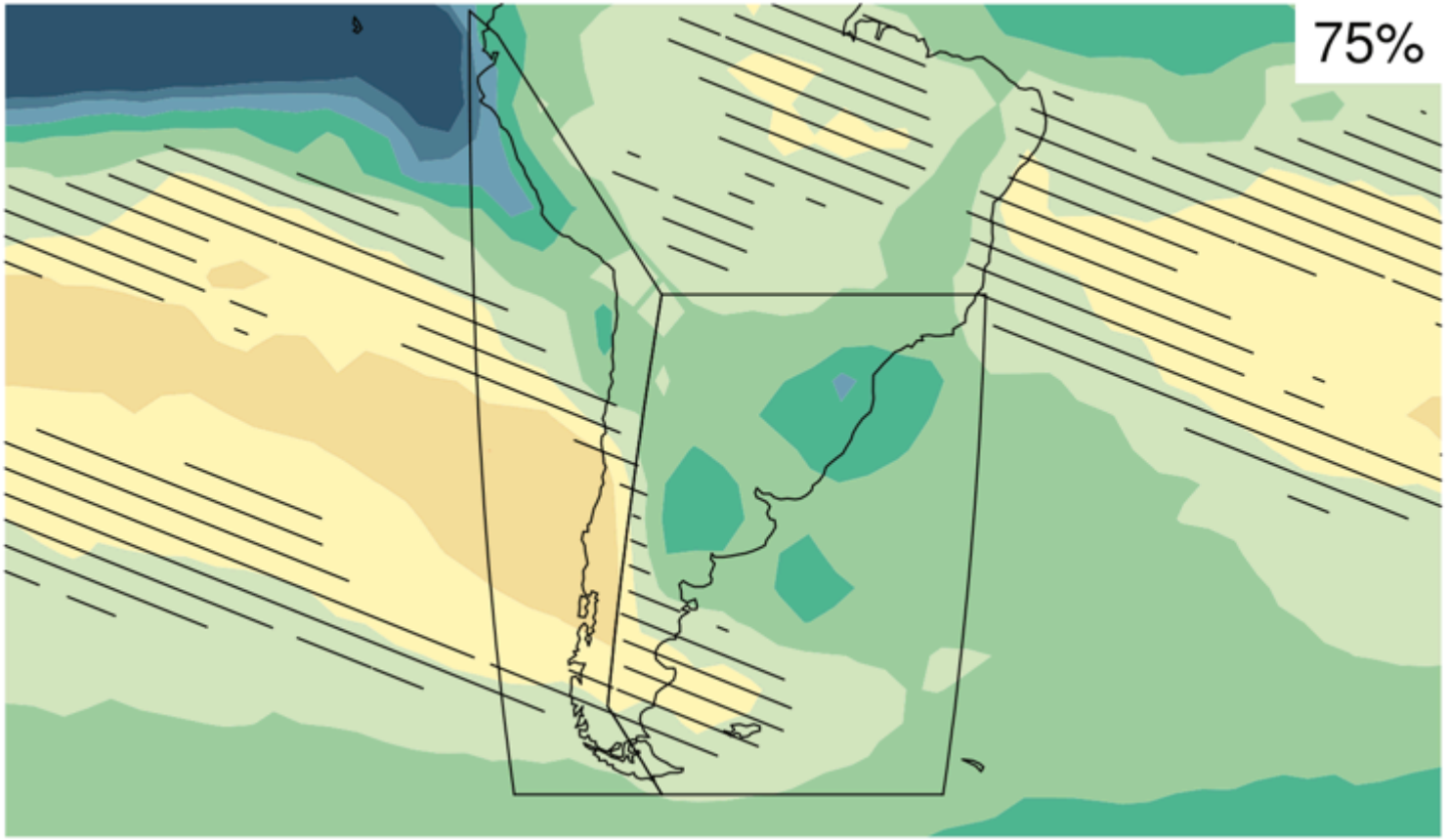
IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Maps of precipitation changes in 2081–2100, with respect to 1986–2005 in the RCP8.5 scenario




IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Map of precipitation changes in 2081–2100, with respect to 1986–2005 in the RCP8.5 scenario




IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

# Potential Impacts of Climate Change

Food and water shortages

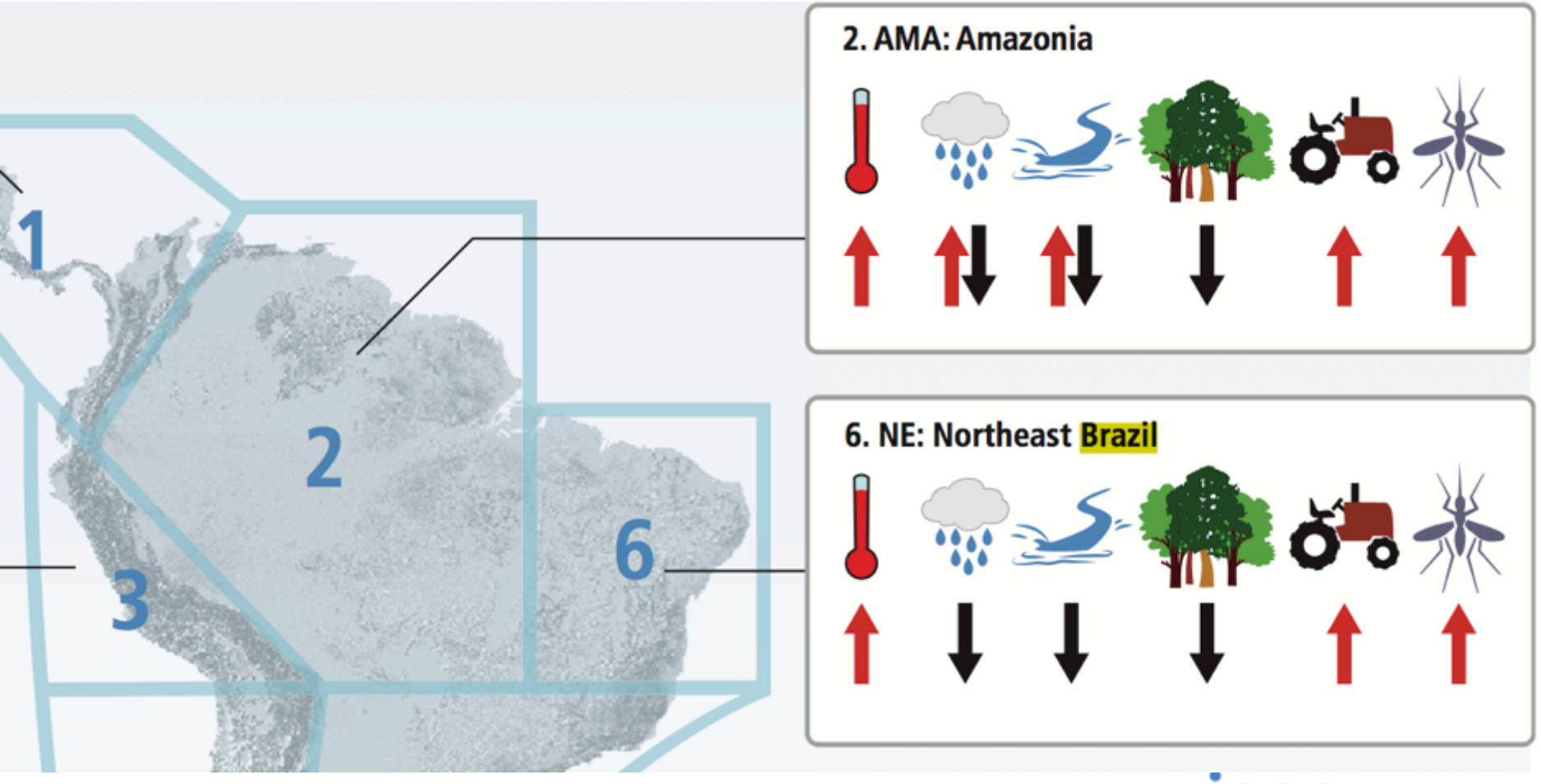
Increased displacement of people

Increased poverty

Coastal flooding

AR5 WGII SPM

# Summary of observed changes in climate and other environmental factors

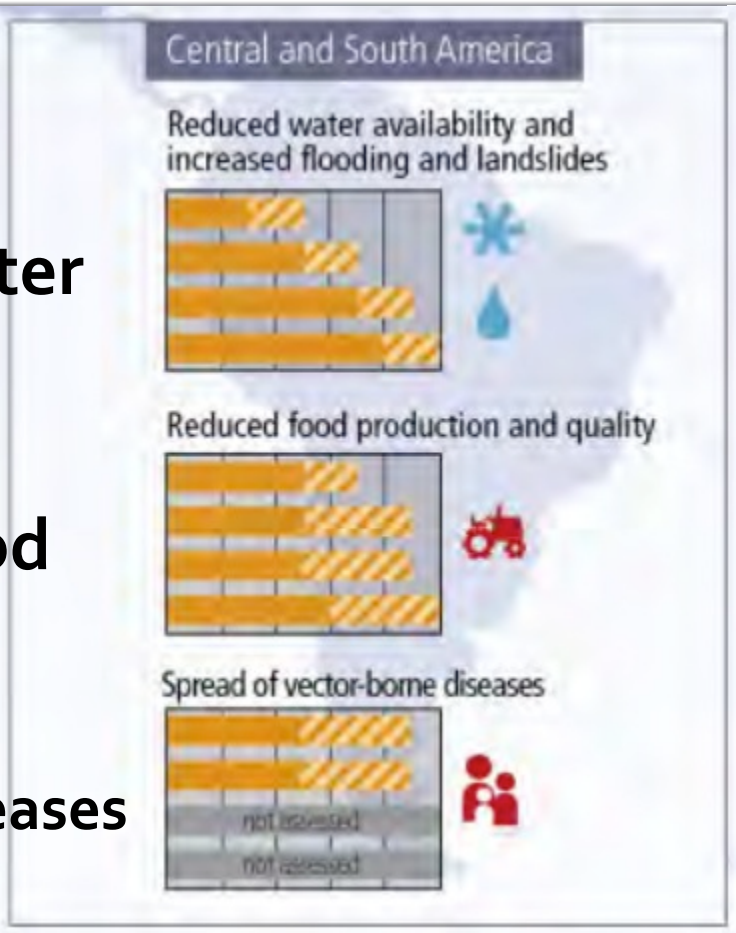


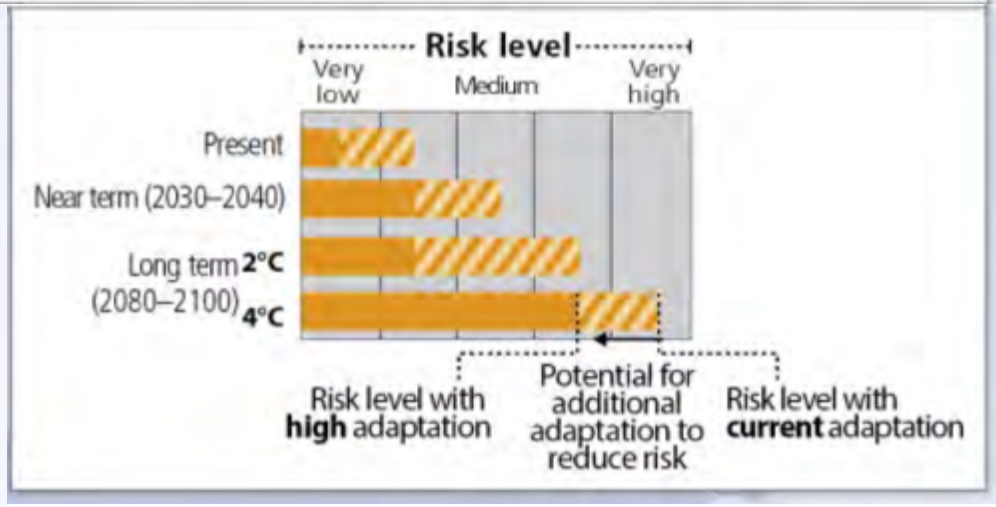

IPCC, AR5, WGII, Chap. 27, Figure 27-7, p.1543

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP


ADAPTATION IS
ALREADY OCCURRING
ipcc
INTERGOVERNMENTAL PANEL ON climate change

# Regional key risks and potential for risk reduction through adaptation

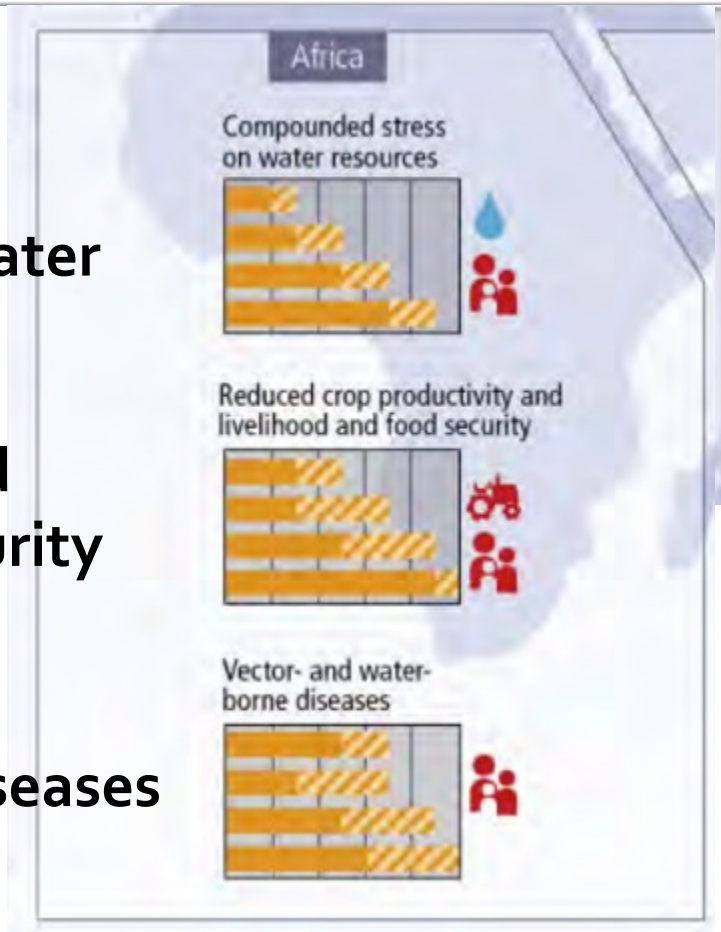

IPCC, AR5, SPM, Figure SPM.8

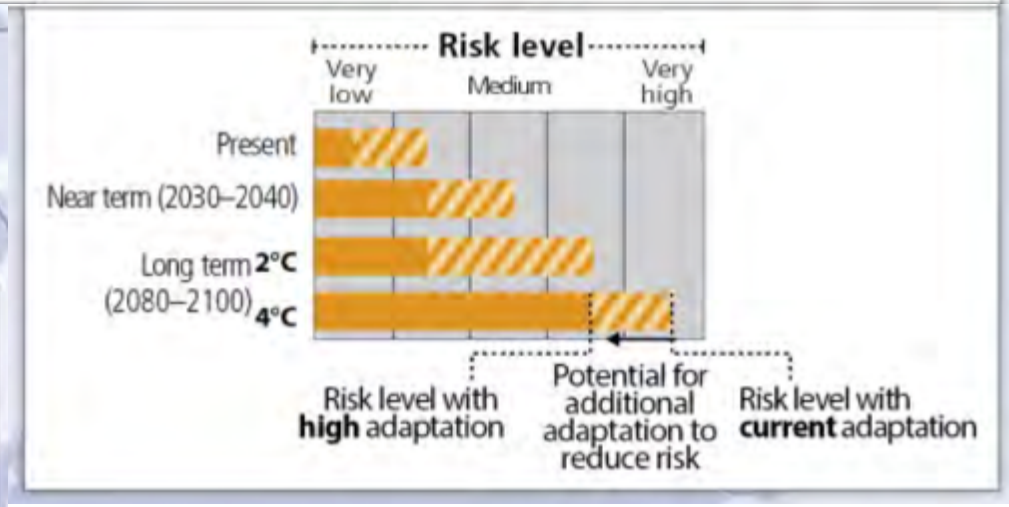
# Regional key risks and risk reduction through adaptation


Water

Food security

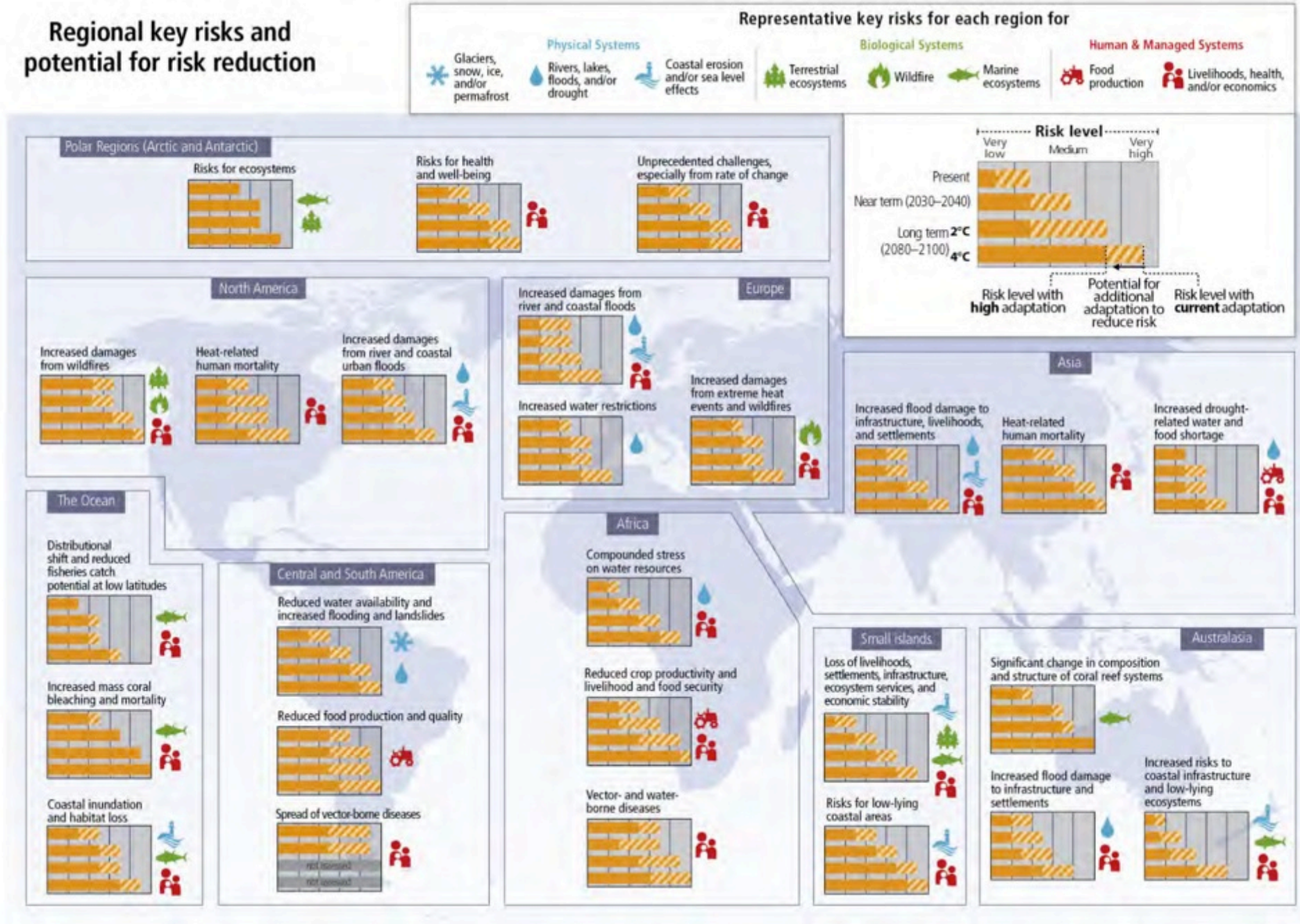
Diseases



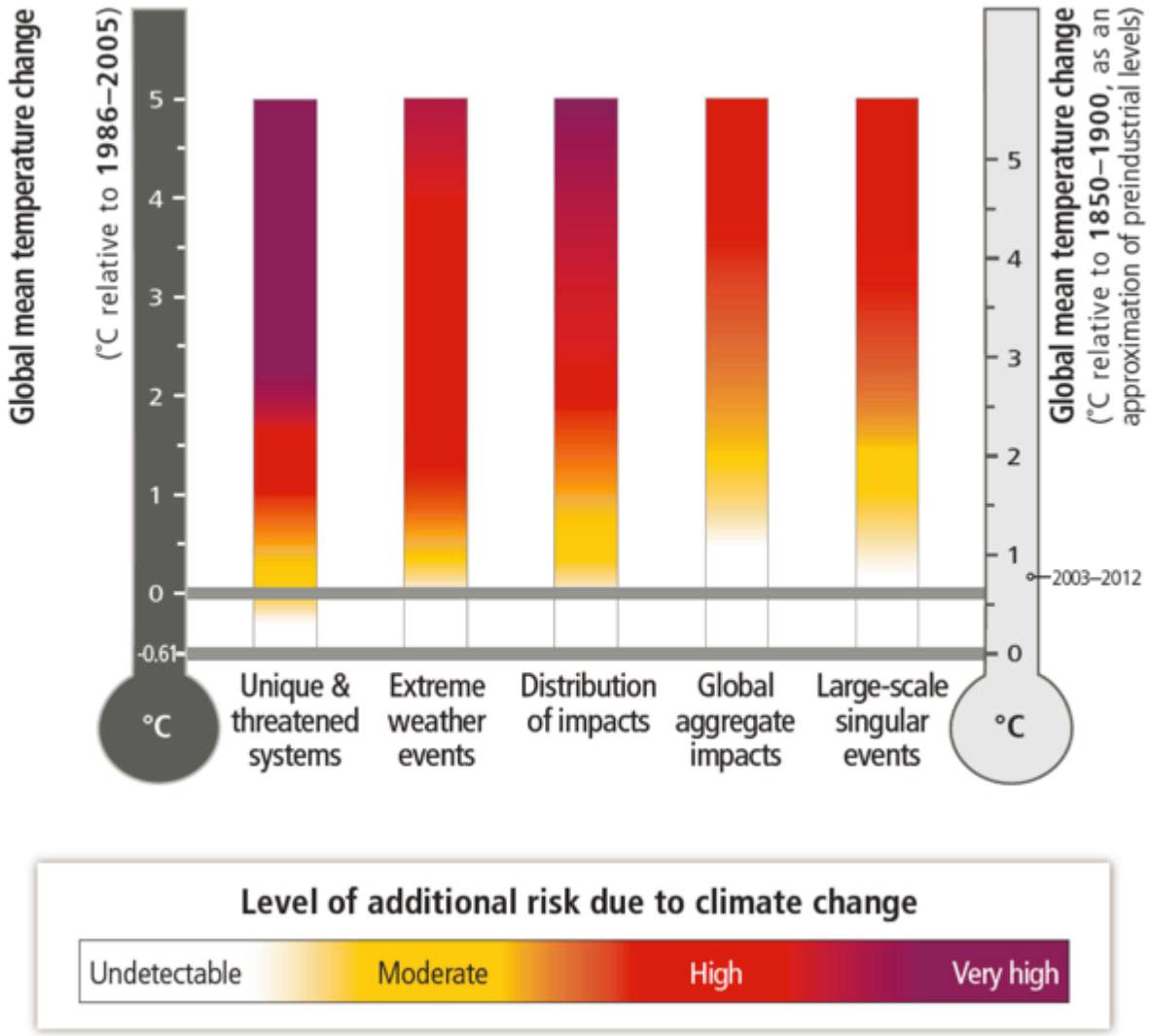

IPCC, AR5, SPM, Figure SPM.8

# Regional key risks and potential for risk reduction

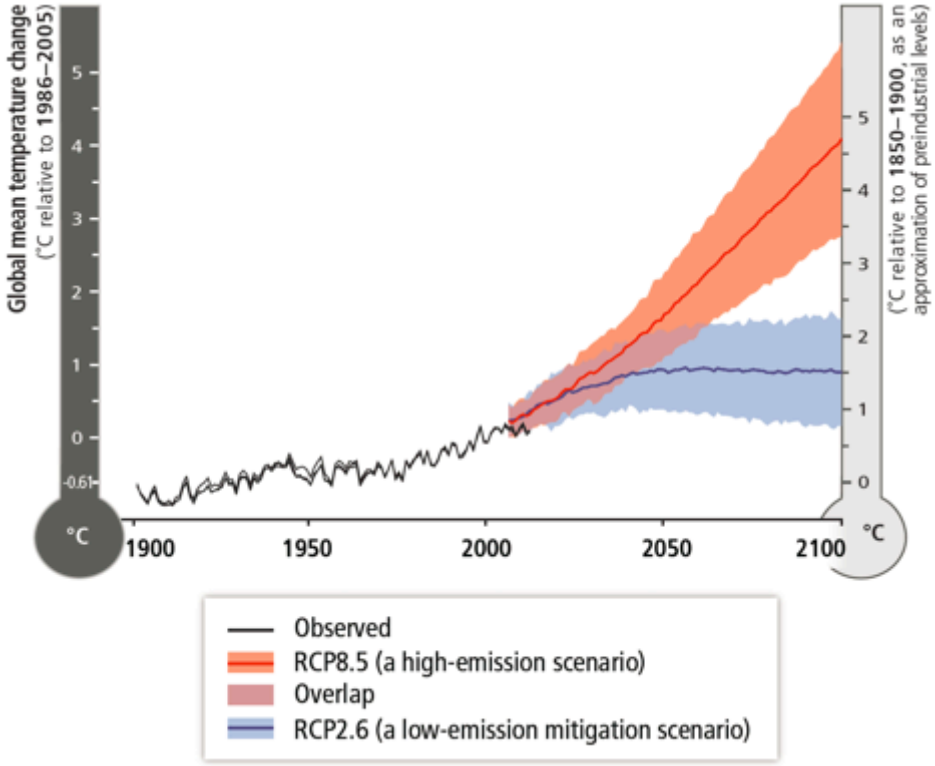


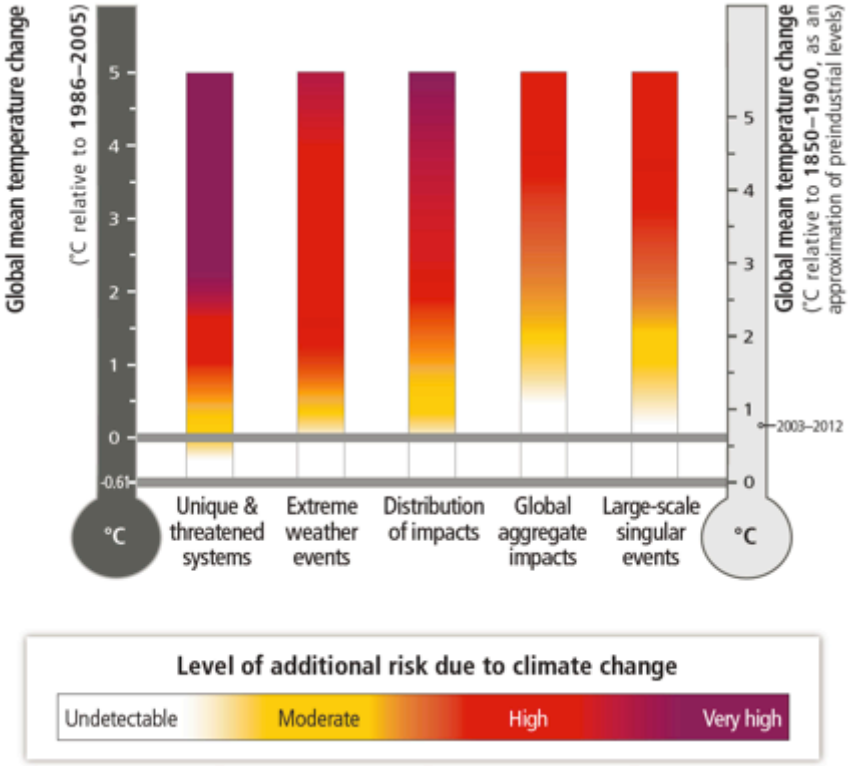

IPCC, AR5, SPM, Figure SPM.8


RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS
ipcc
INTERGOVERNMENTAL PANEL ON Climate change



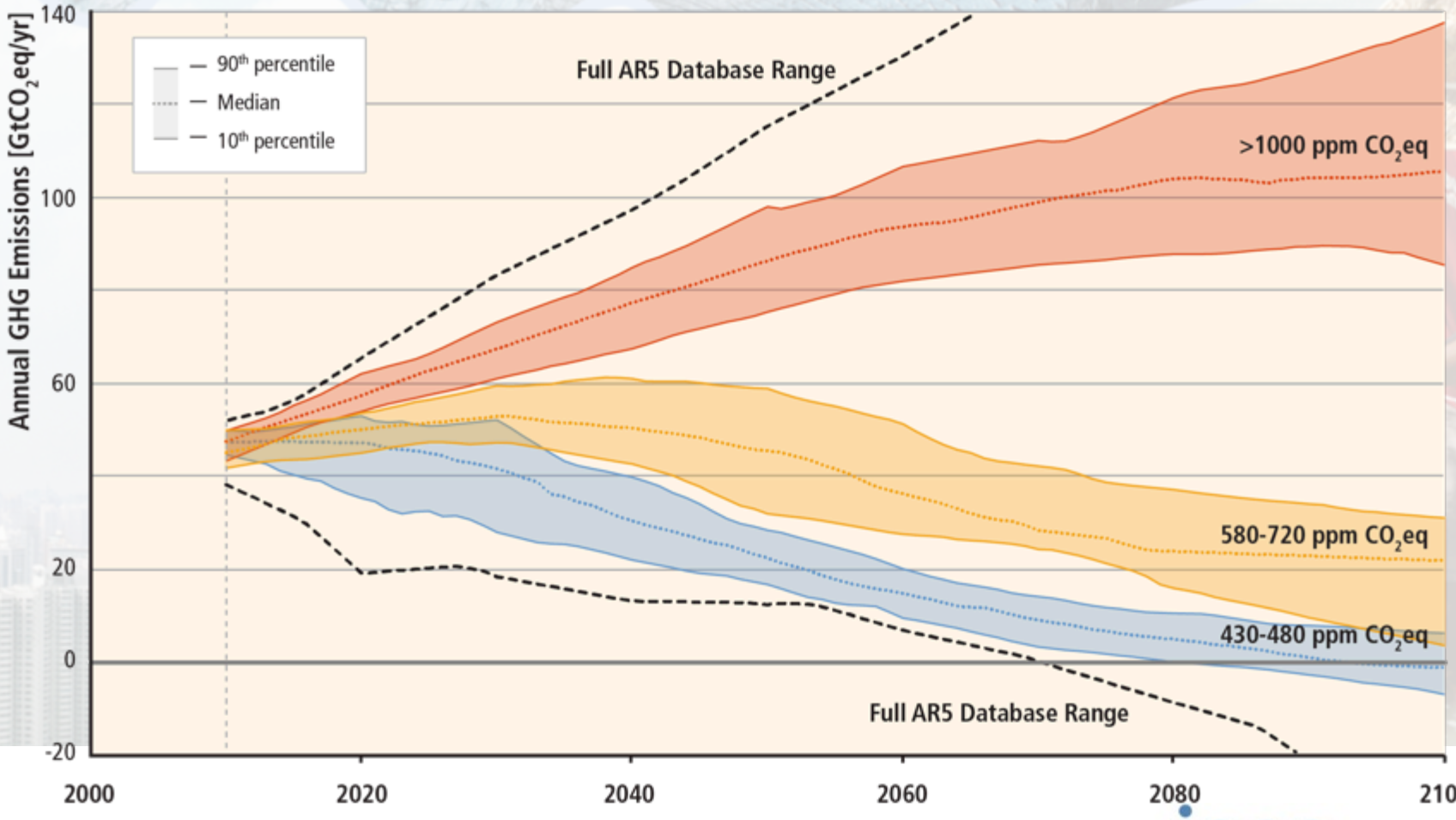

AR5, WGII, Box SPM.1 Figure 1




ipcc
INTERGOVERNMENTAL PANEL ON climate change

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




Based on Figure 6.7

AR5 WGIII SPM

IPCC AR5 Synthesis Report

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

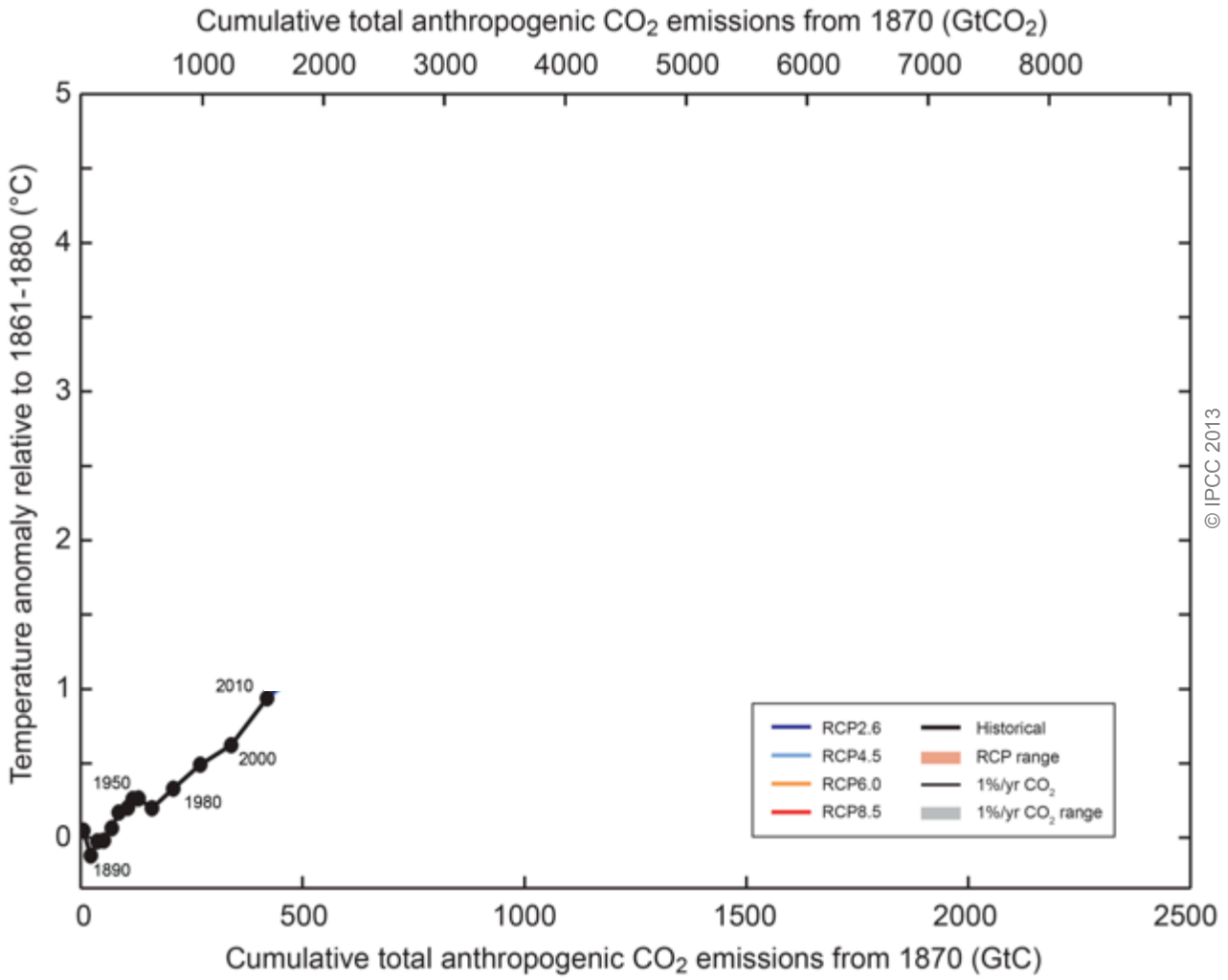



Fig. SPM.10

Cumulative emissions of $CO_2$ largely determine global mean surface warming by the late 21st century and beyond.

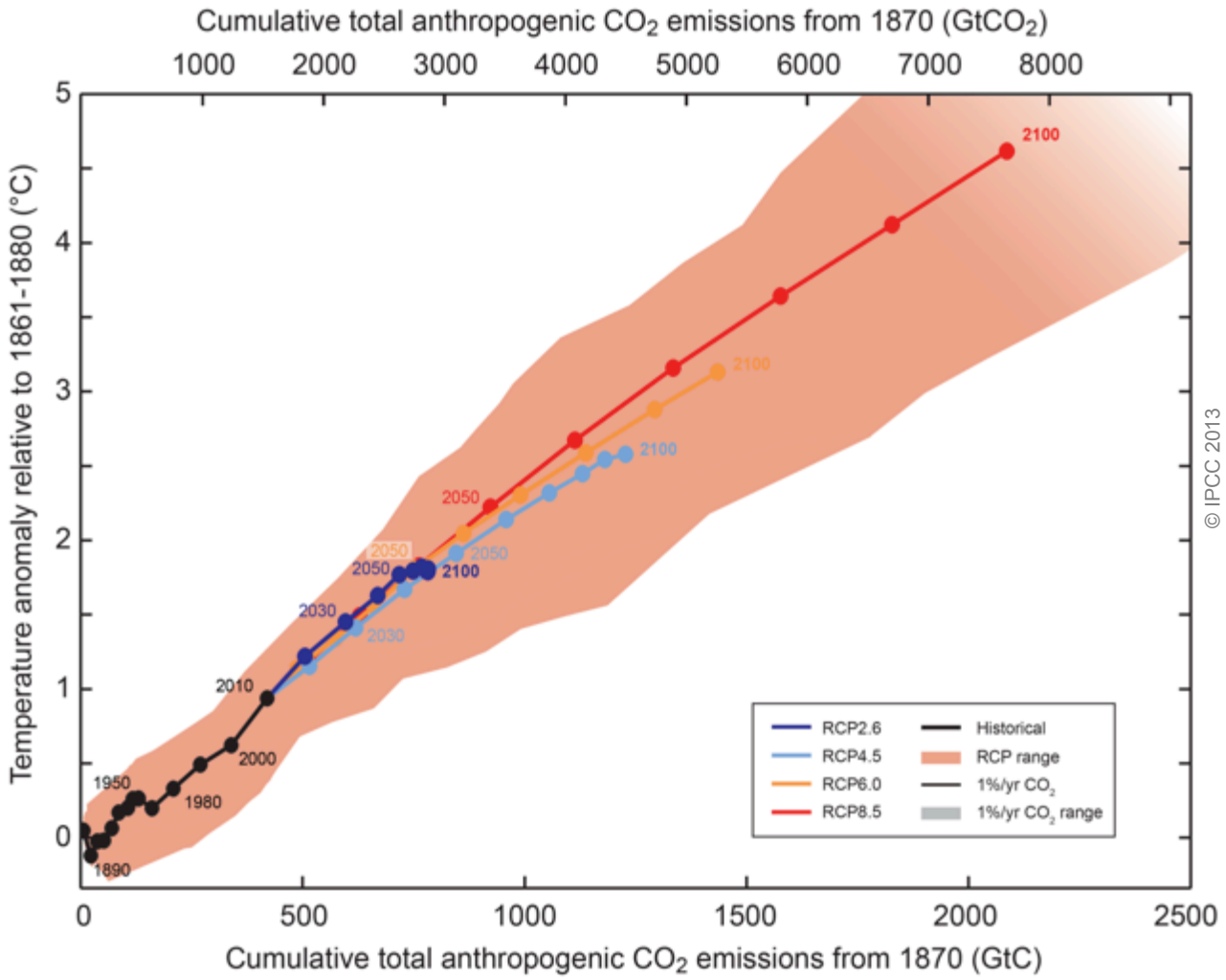
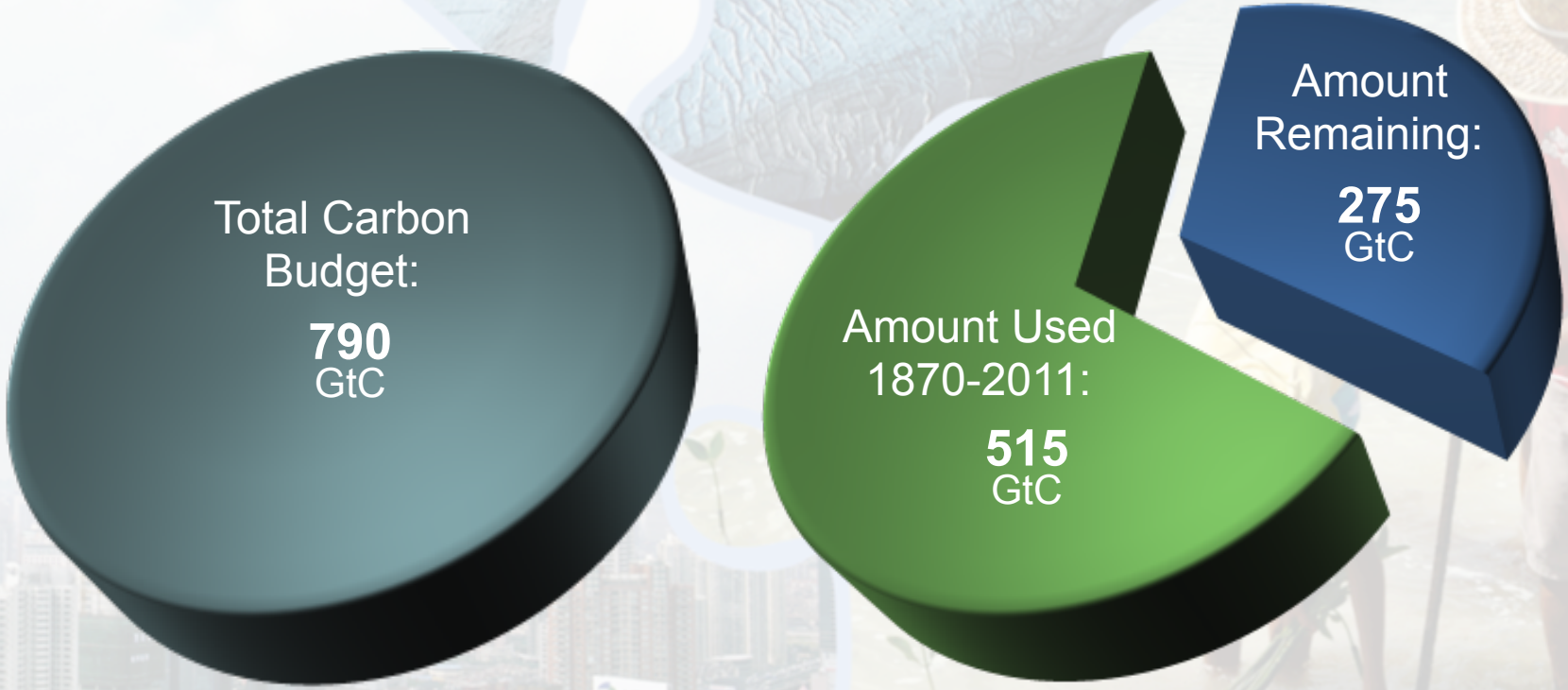



Fig. SPM.10

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

# The window for action is rapidly closing

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




AR5 WGI SPM

# Limiting Temperature Increase to 2˚C

Measures exist to achieve the substantial emissions reductions required to limit likely warming to 2°C

A combination of adaptation and substantial, sustained reductions in greenhouse gas emissions can limit climate change risks

Implementing reductions in greenhouse gas emissions poses substantial technological, economic, social, and institutional challenges

But delaying mitigation will substantially increase the challenges associated with limiting warming to 2°C

AR5 WGI SPM, AR5 WGII SPM,AR5 WGIII SPM



ipcc INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

# Mitigation Measures

## More efficient use of energy

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

- Many of these technologies exist today

## 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

# Ambitious Mitigation Is Affordable

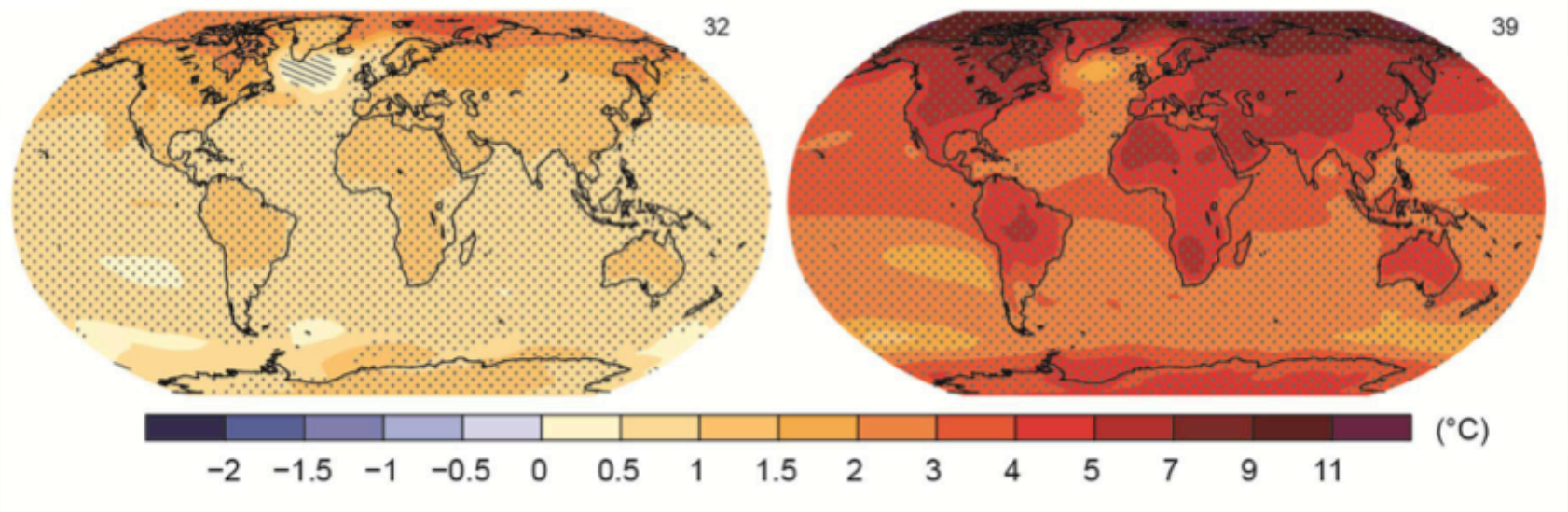
- ➜ Economic growth reduced by ~ 0.06%
  (BAU growth 1.6 - 3%)
- ➜ This translates into delayed and not forgone growth
- ➜ Estimated cost does not account for the benefits of reduced climate change
- ➜ Unmitigated climate change would create increasing risks to economic growth and efforts to eradicate poverty

AR5 WGI SPM, AR5 WGII SPM

# The Choices We Make Will Create Different Outcomes (and increase prospects for effective adaptation)

With substantial mitigation

Without additional mitigation




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

AR5 WGI SPM

# Useful links:

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