The Challenges and Opportunities of Climate Change

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

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Santiago de Chile, Chile,

27 November 2014

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

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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

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?

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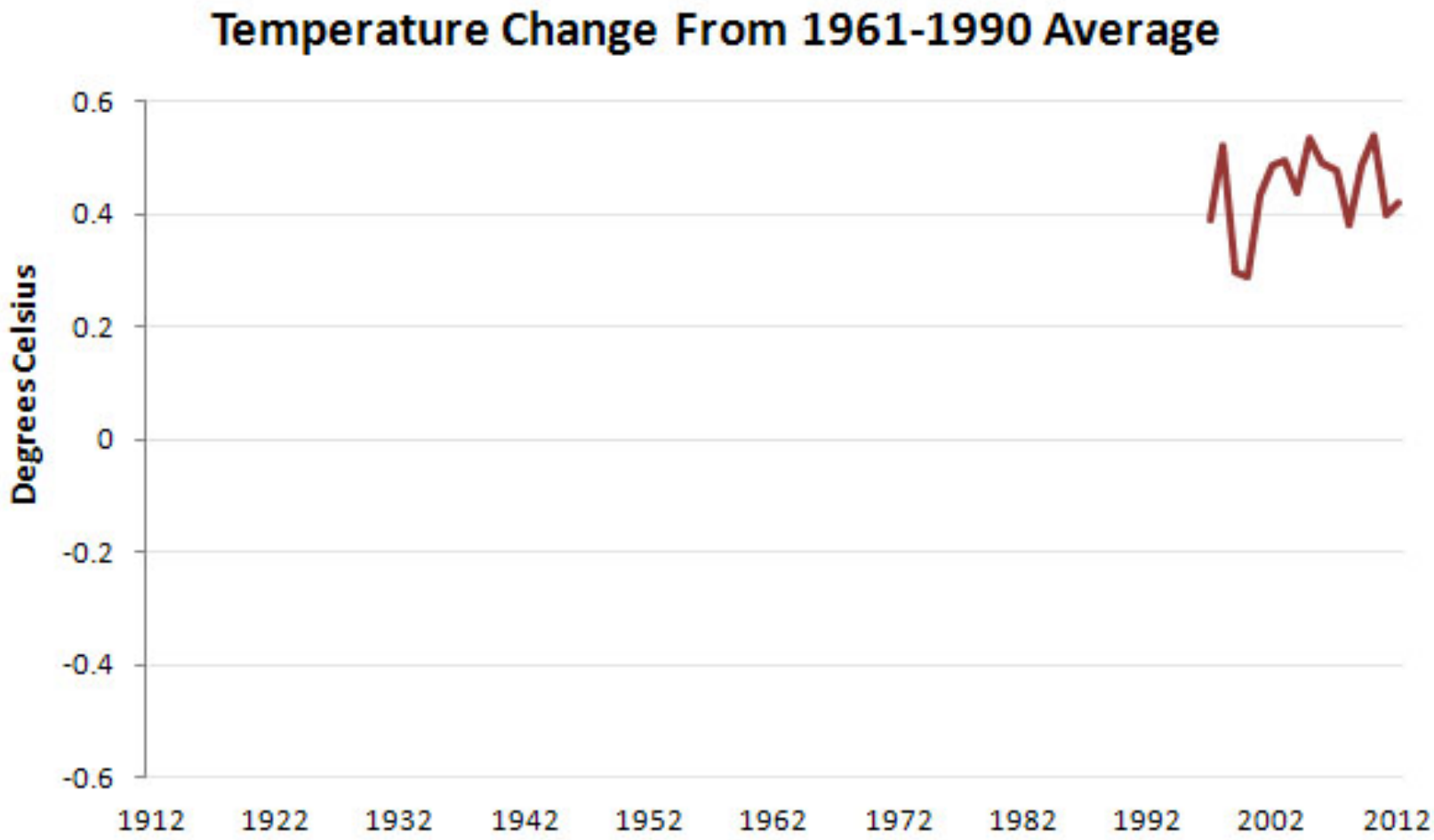
Key Messages

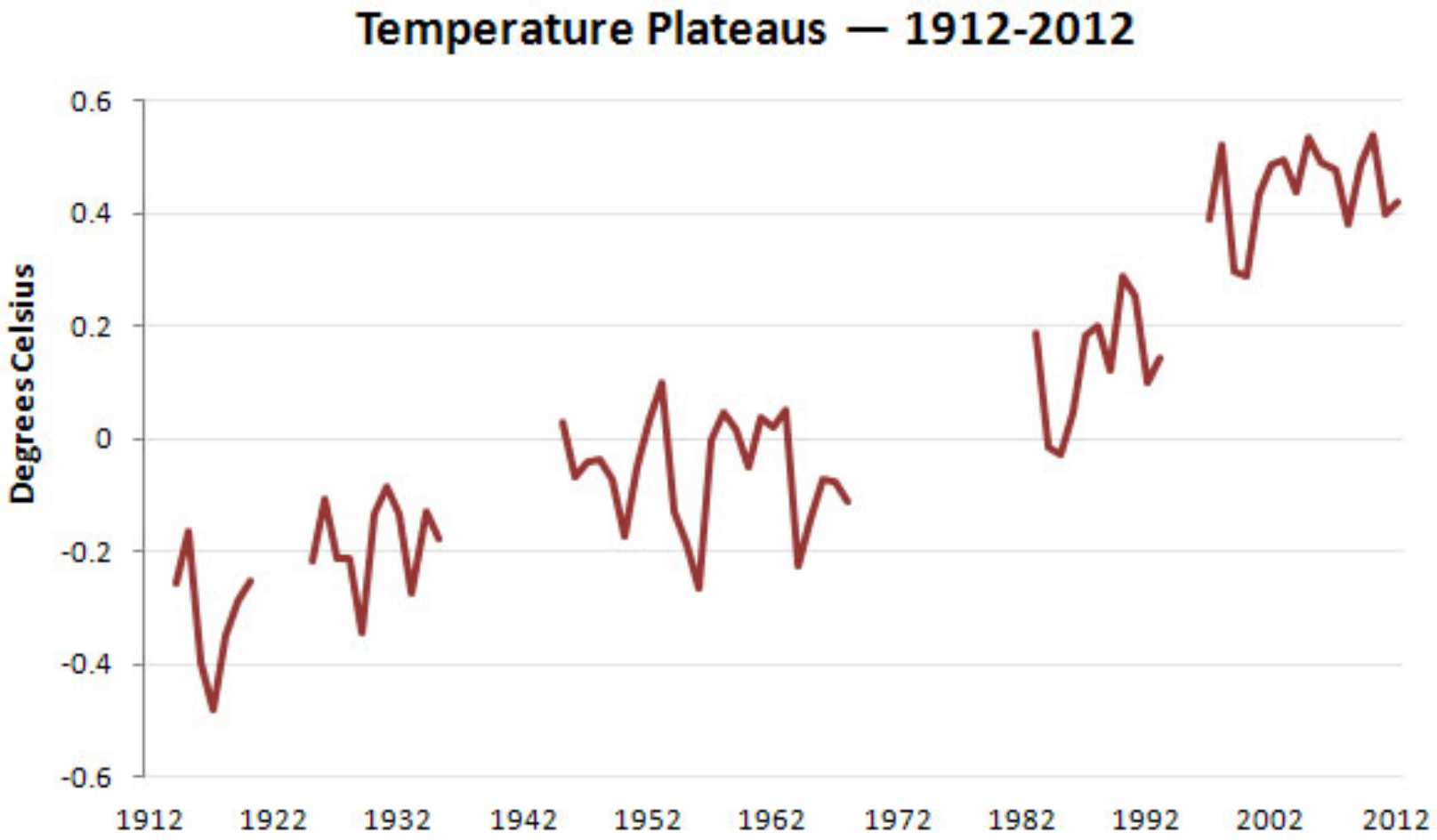
- **Human influence on the climate system is clear**
- **Continued emission of greenhouse gases will increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems**
- **While climate change is a threat to sustainable development, there are many opportunities to integrate 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



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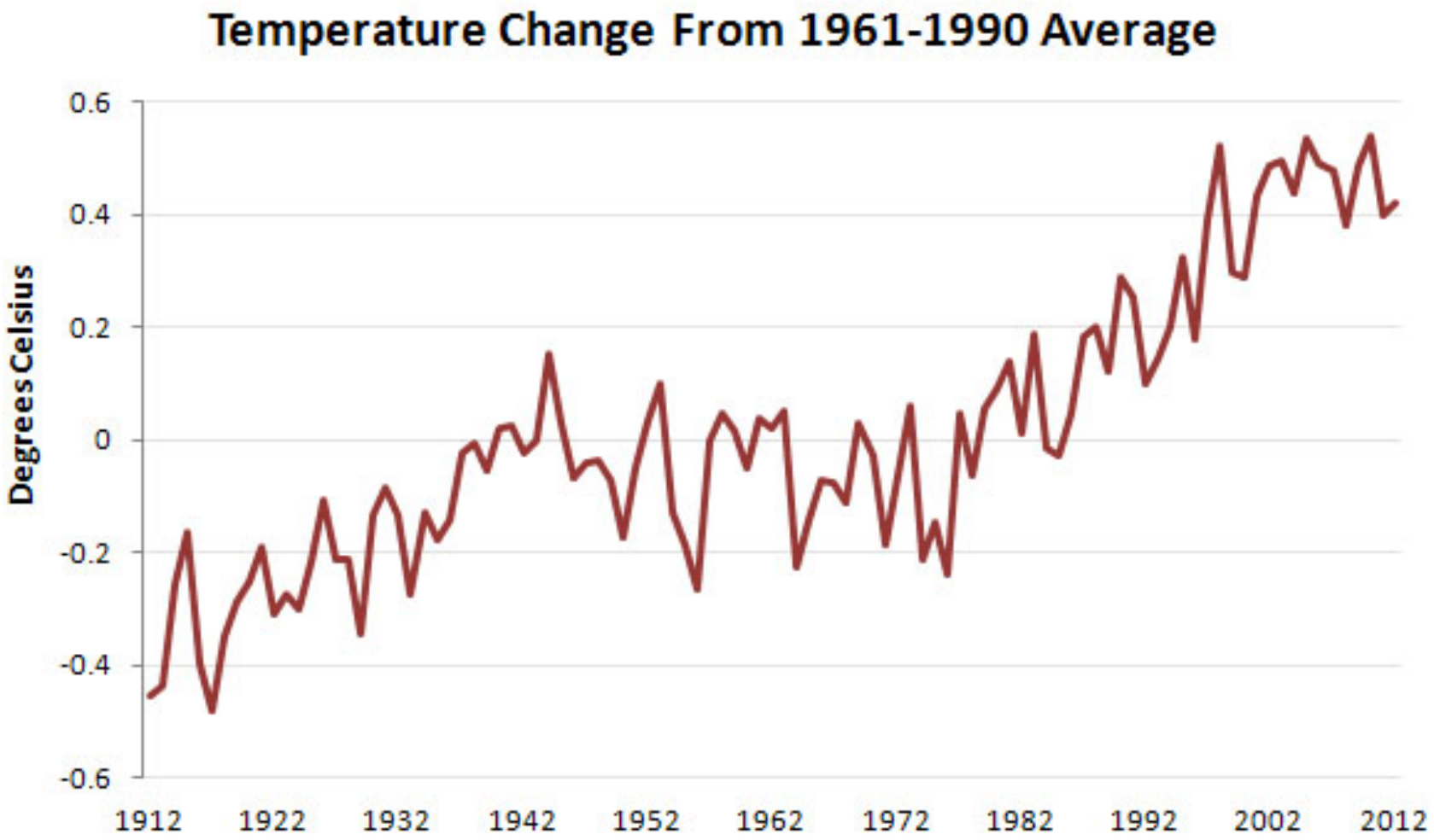

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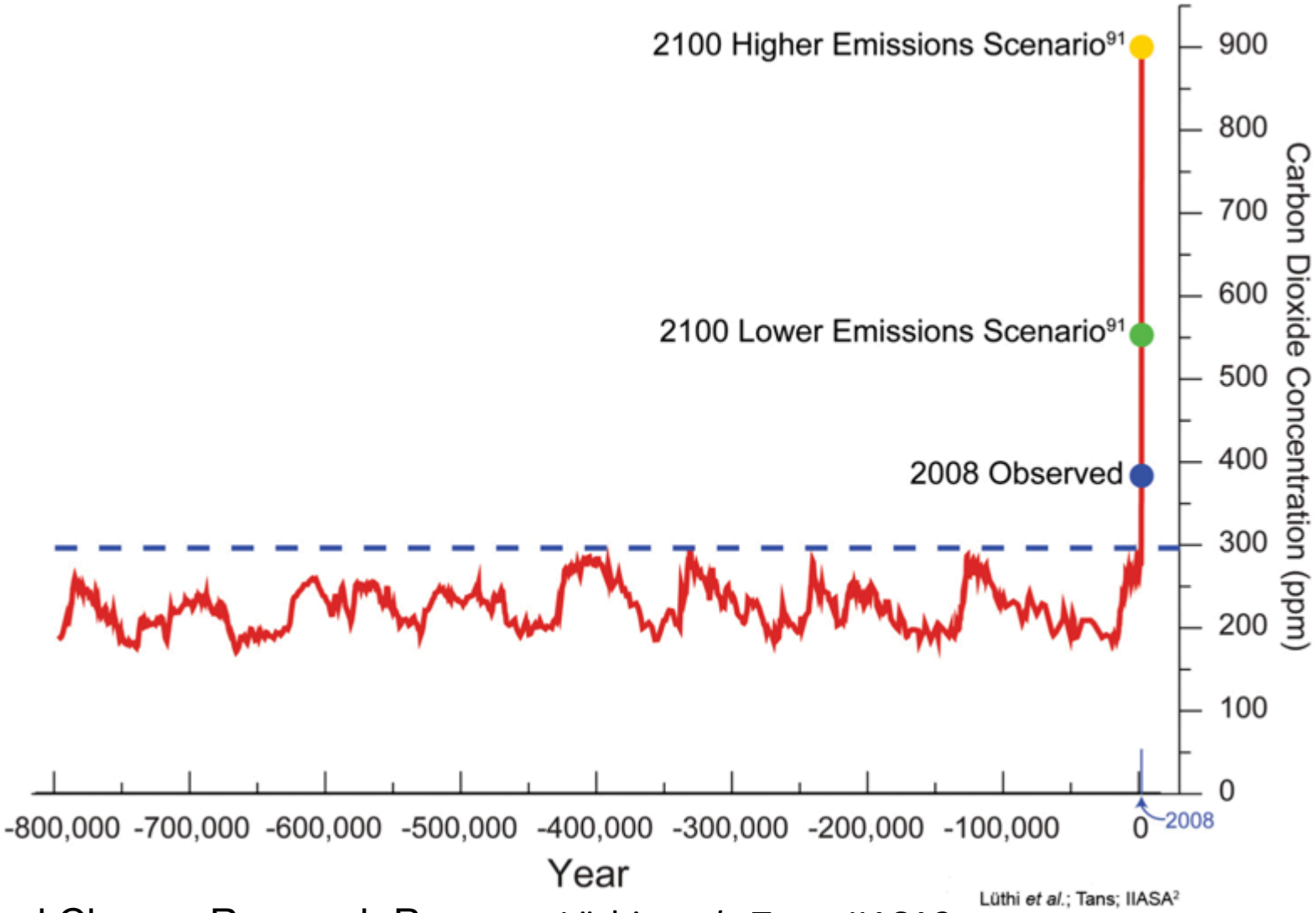
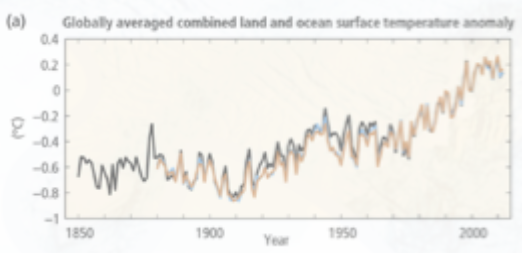
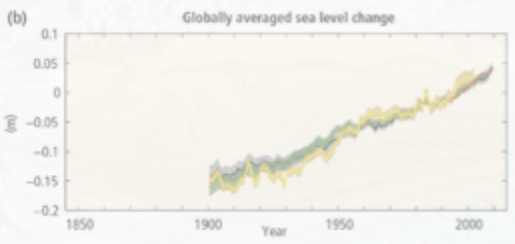
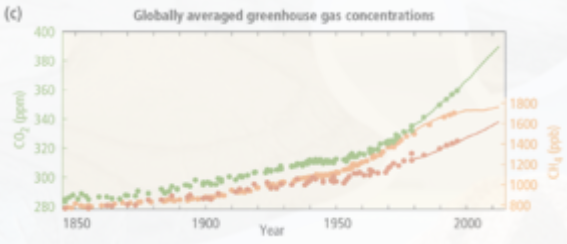
Atmospheric CO_2 over the last 800000 years

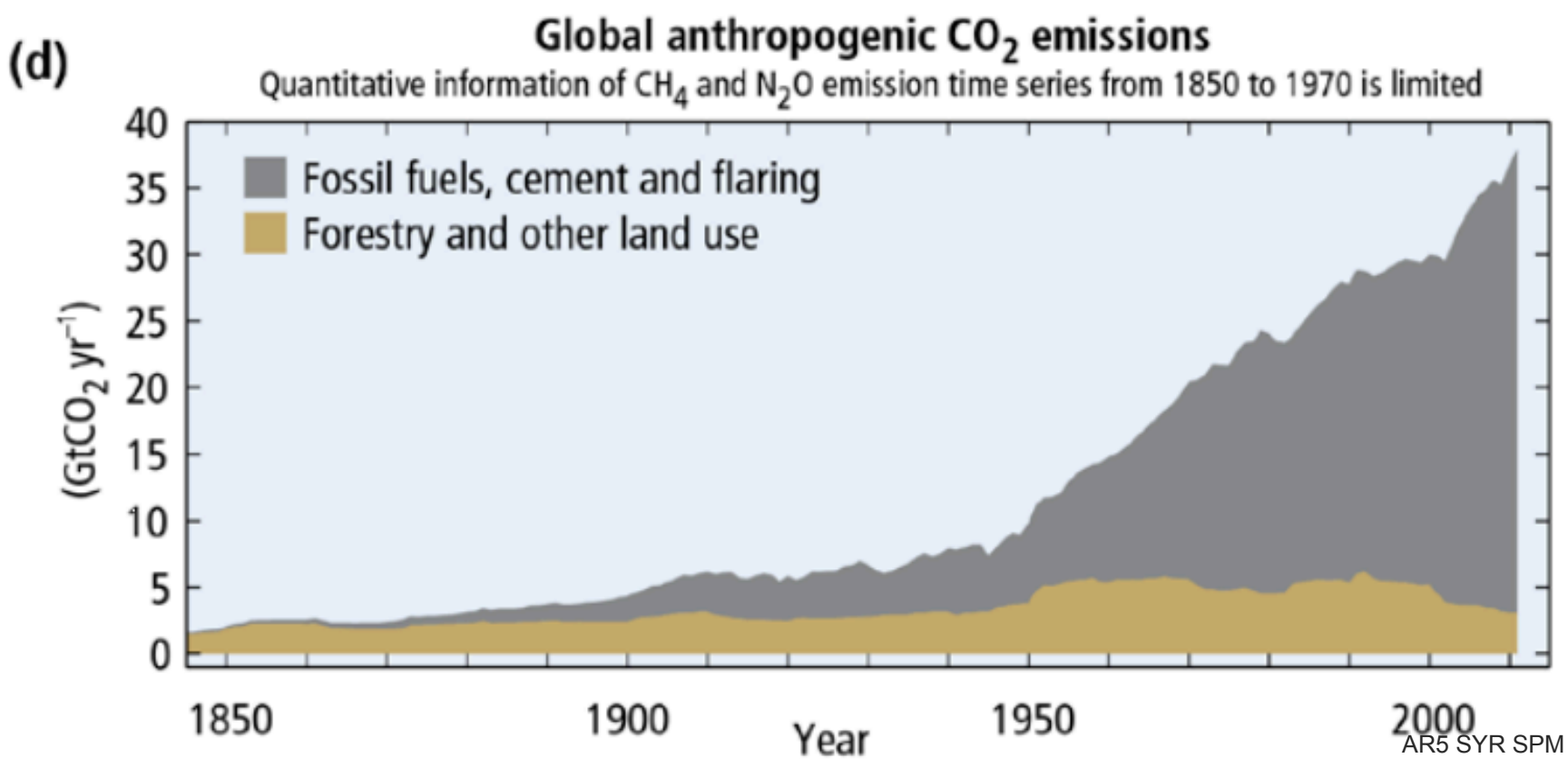


U.S. Global Change Research Program:Lüthi *et al.*; Tans; IIASA2


(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

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Sources of emissions

Energy production remains the primary driver of GHG emissions

2010 GHG emissions

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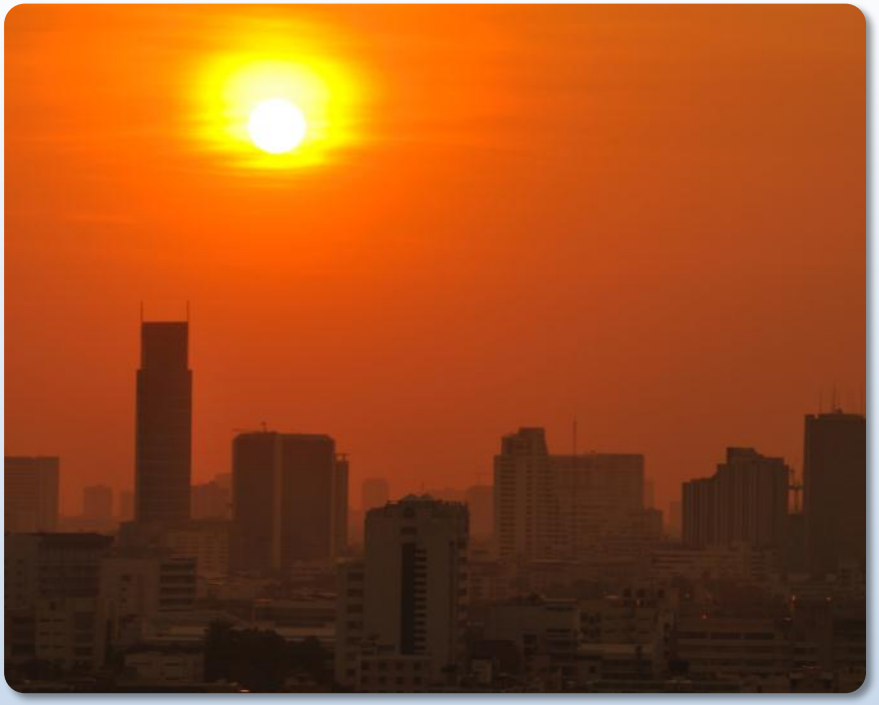
Since 1950, extreme hot days and heavy precipitation have become more common



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)

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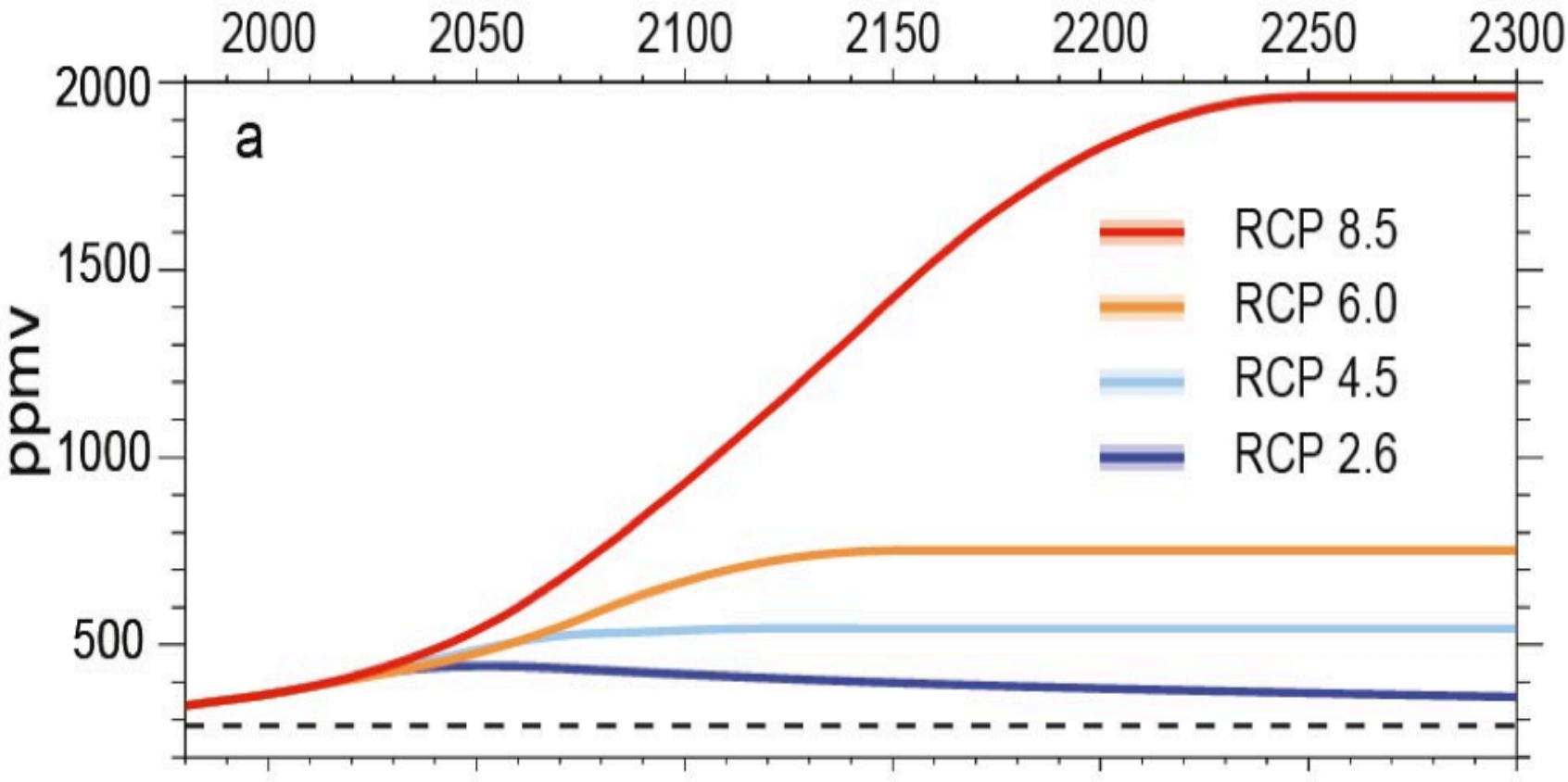
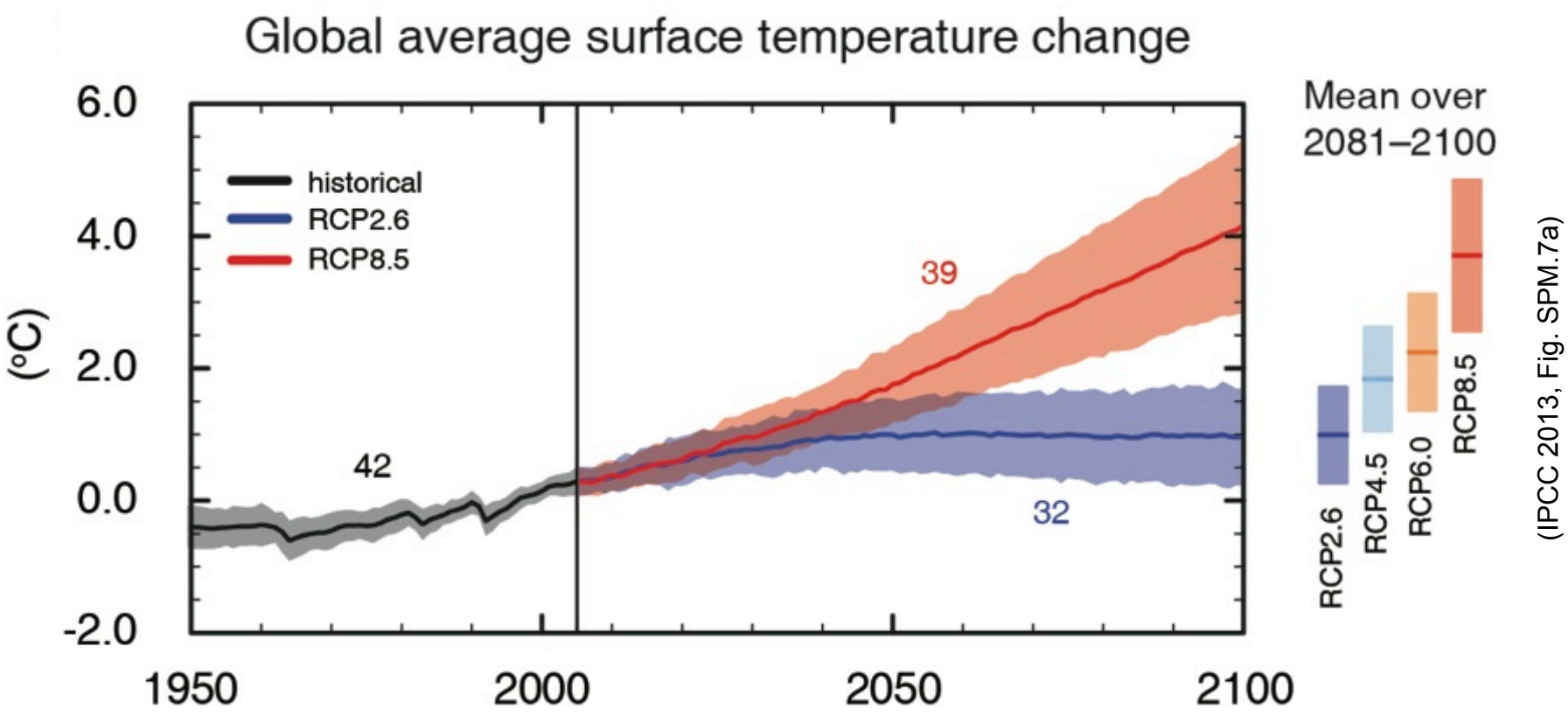
RCP Scenarios: Atmospheric CO_2 concentration



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

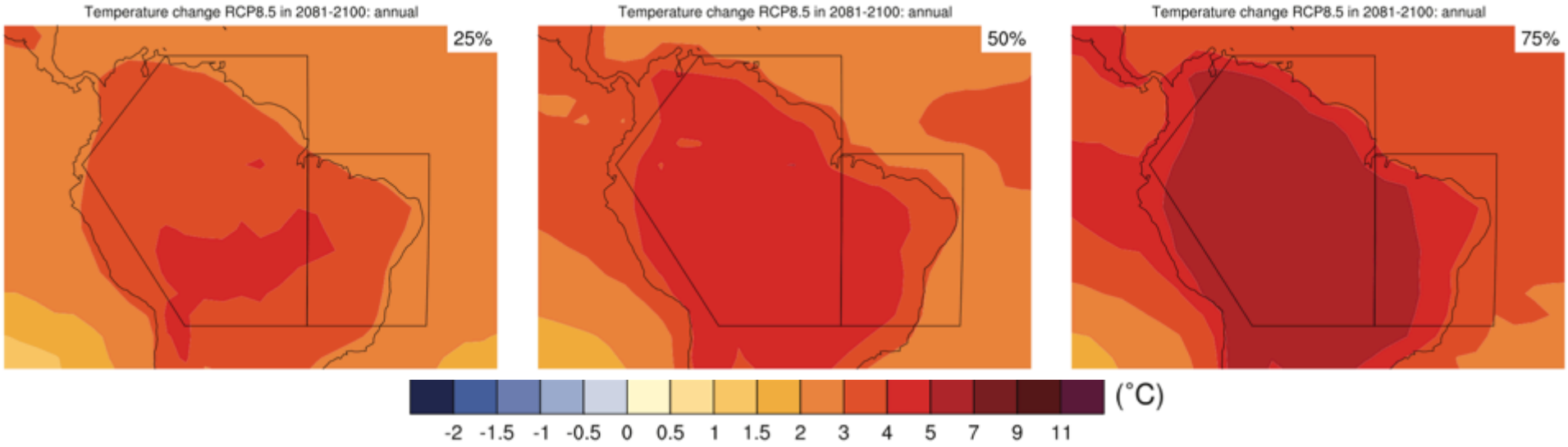
AR5, chapter 12. WGI- Adopted version / subject to final copyedit



(IPCC 2013, Fig. SPM.7a)

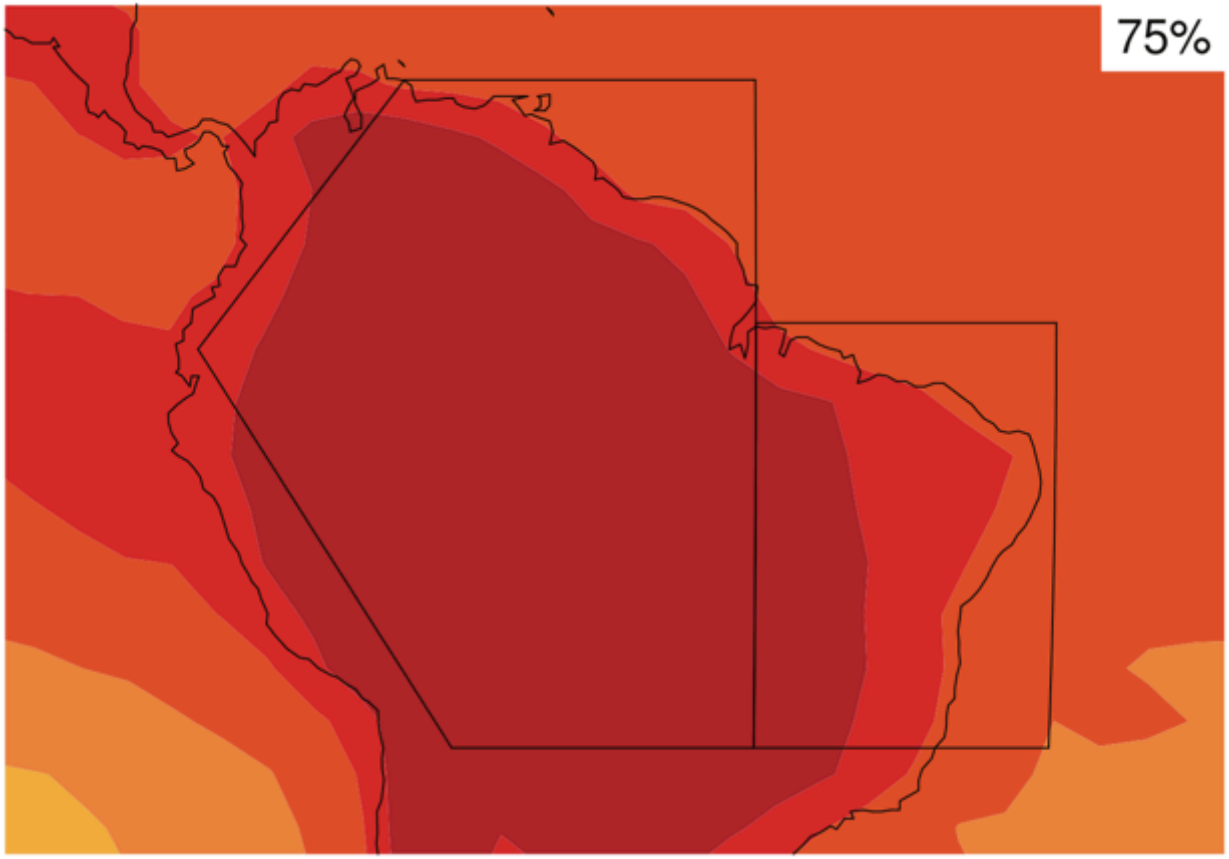
Only the lowest (RCP2.6) scenario maintains the global surface temperature increase above the pre-industrial level to less than 2°C with at least 66% probability

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



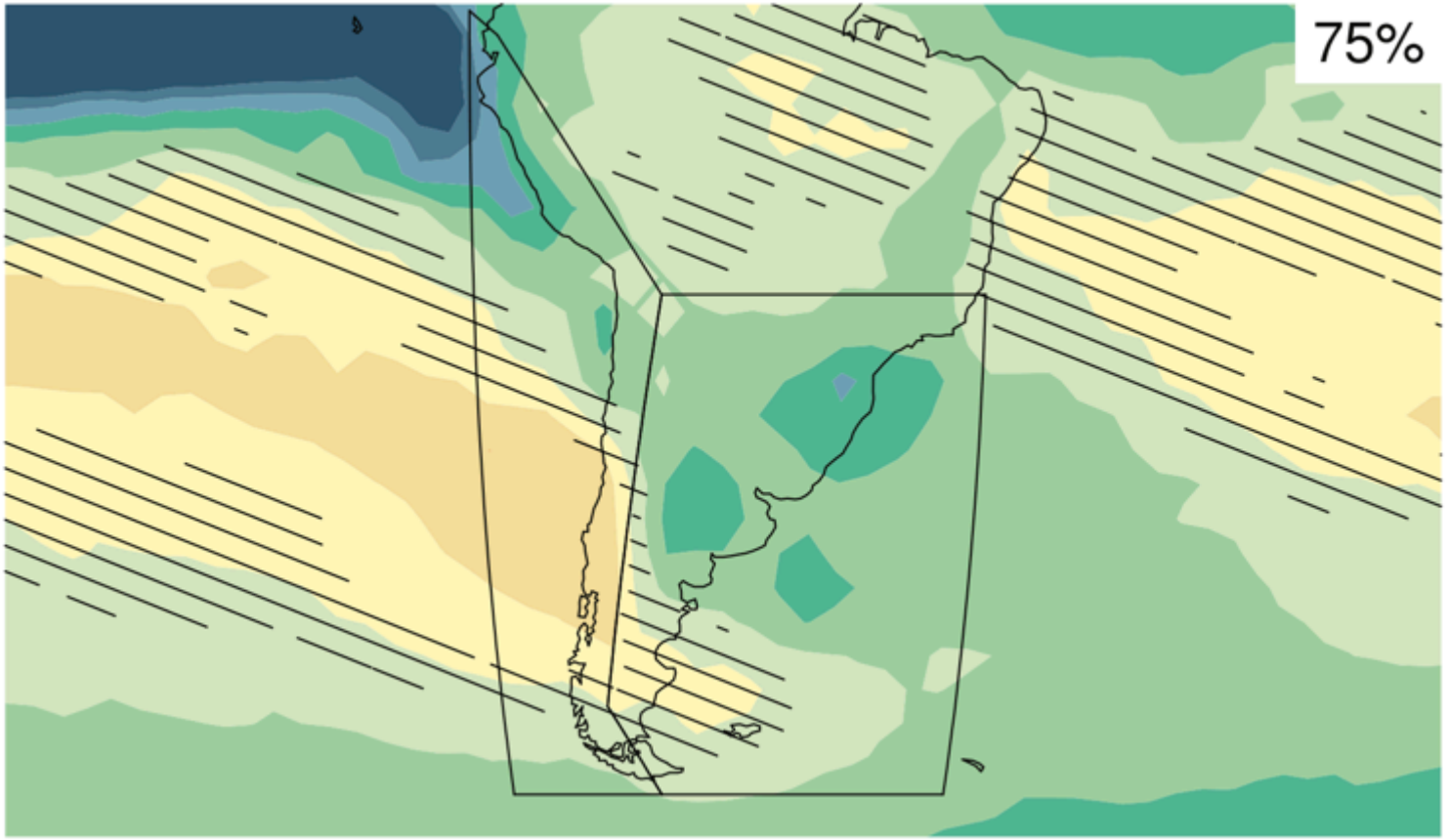
IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

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

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

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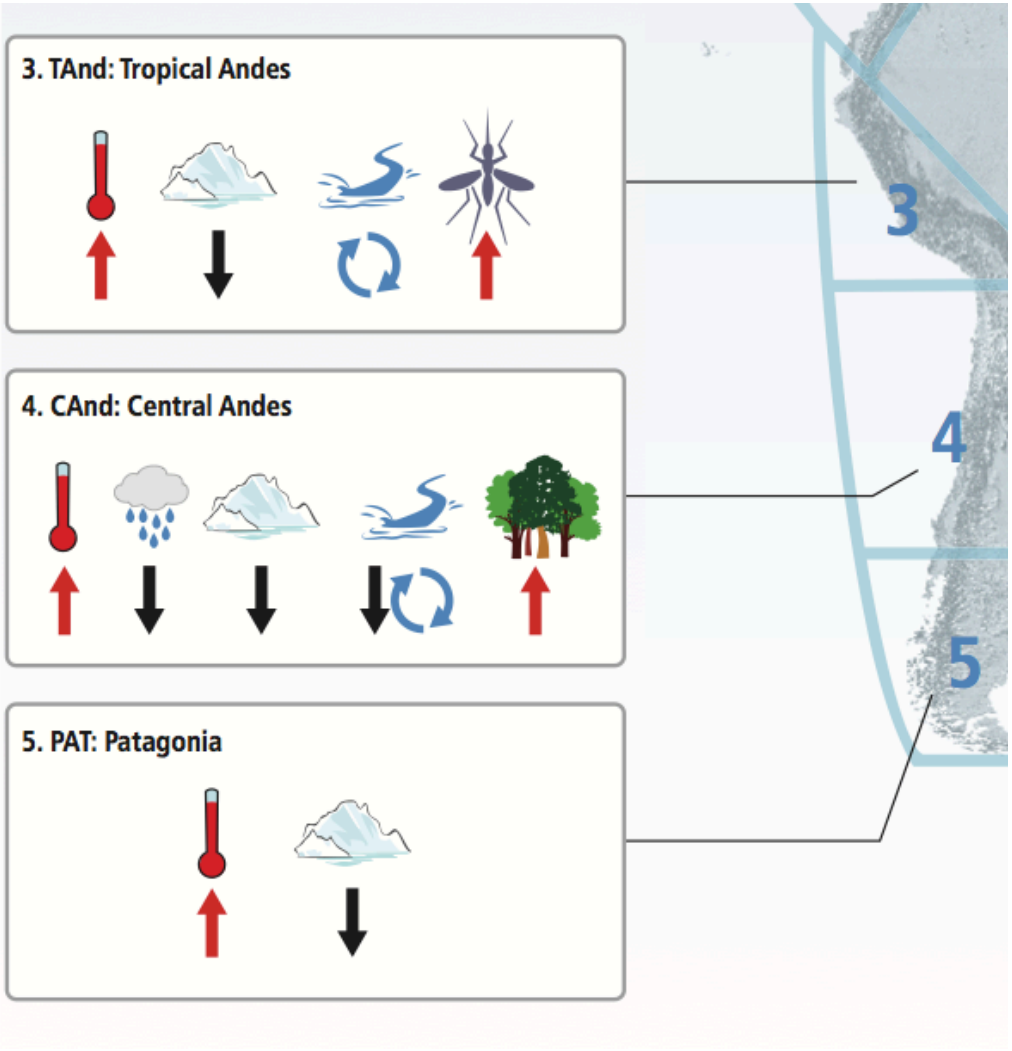
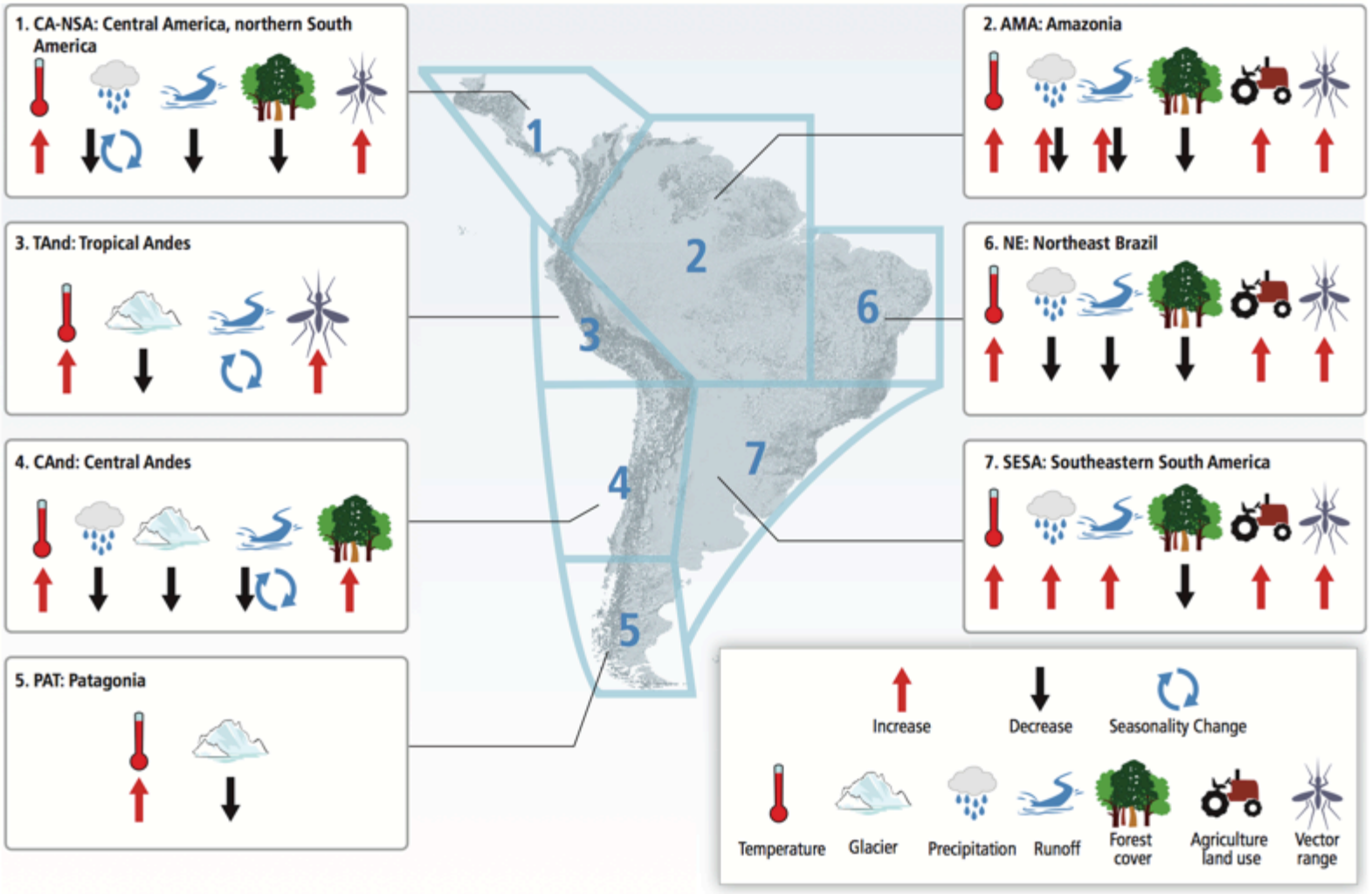
Summary of observed changes in climate and other environmental factors



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

Summary of observed changes in climate and other environmental factors



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

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ADAPTATION IS
ALREADY OCCURRING
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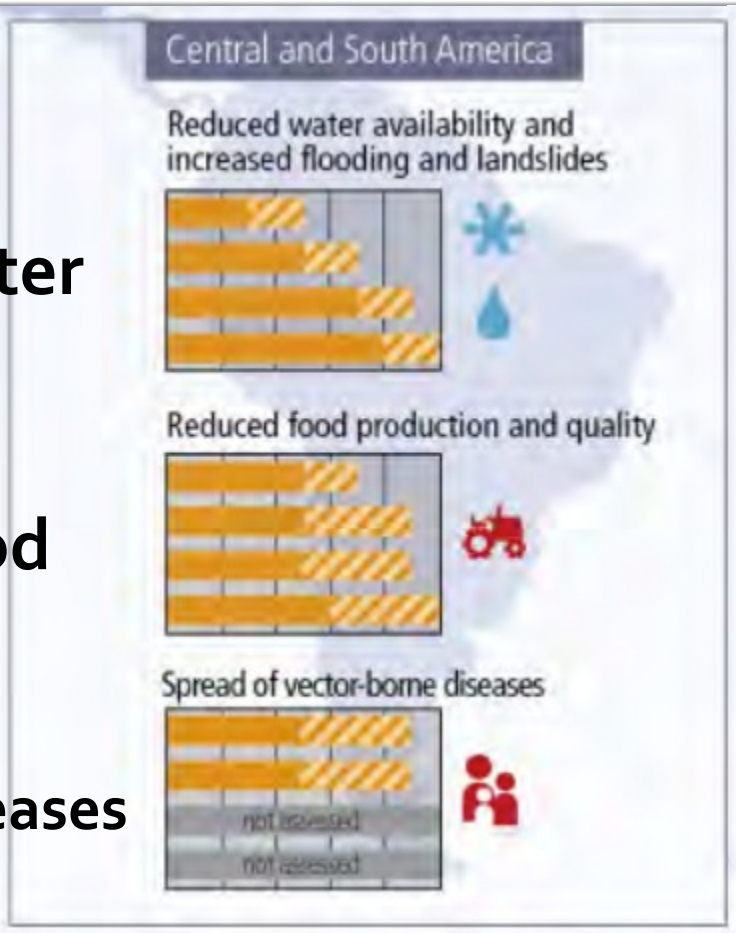
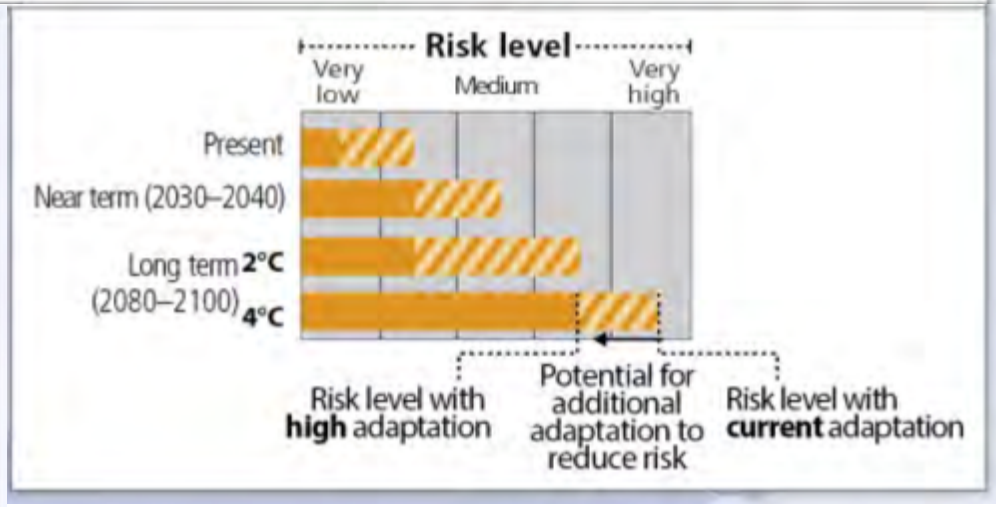
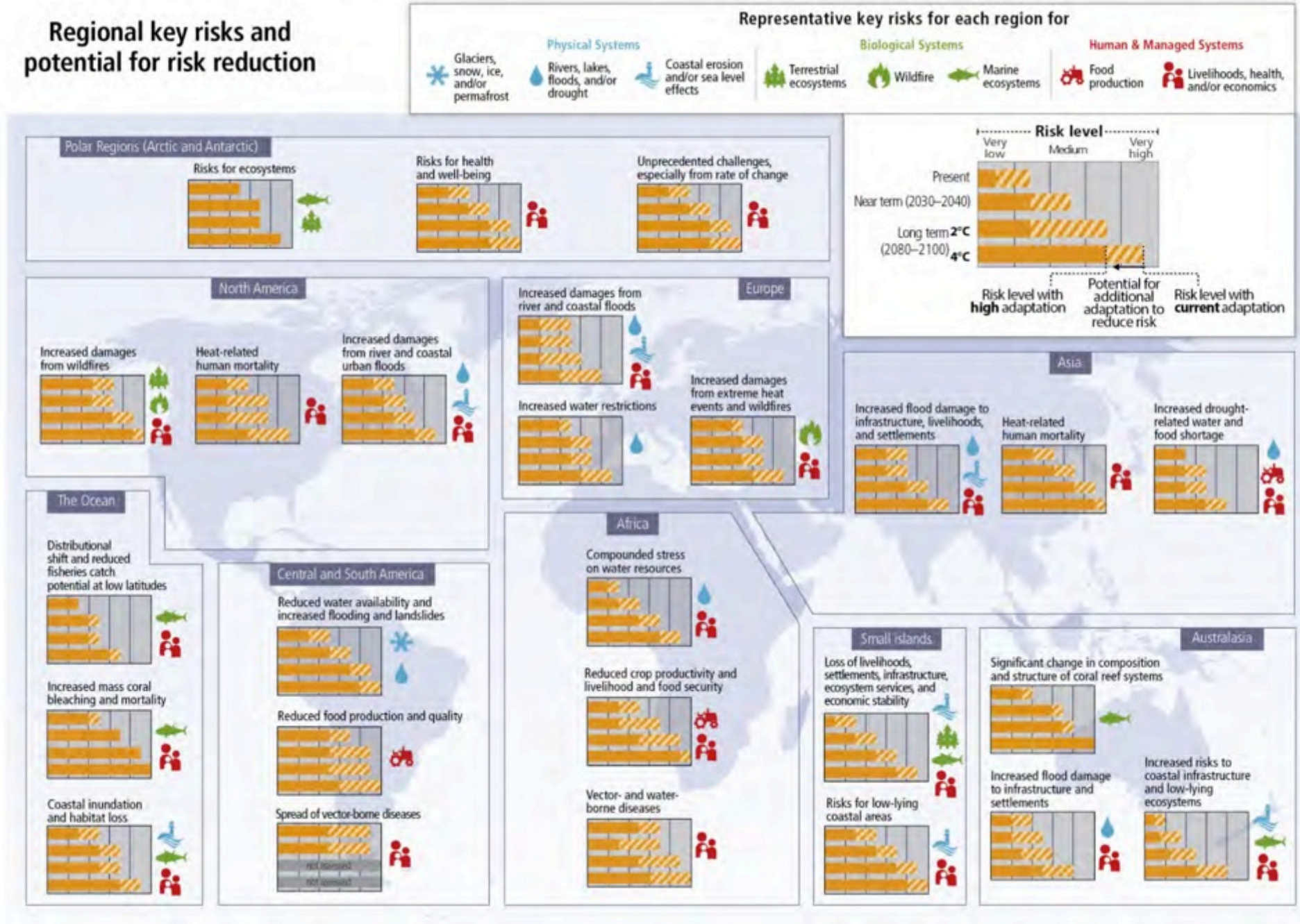
Regional key risks and potential for risk reduction through adaptation





IPCC, AR5, SPM, Figure SPM.8

Regional key risks and potential for risk reduction



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RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS
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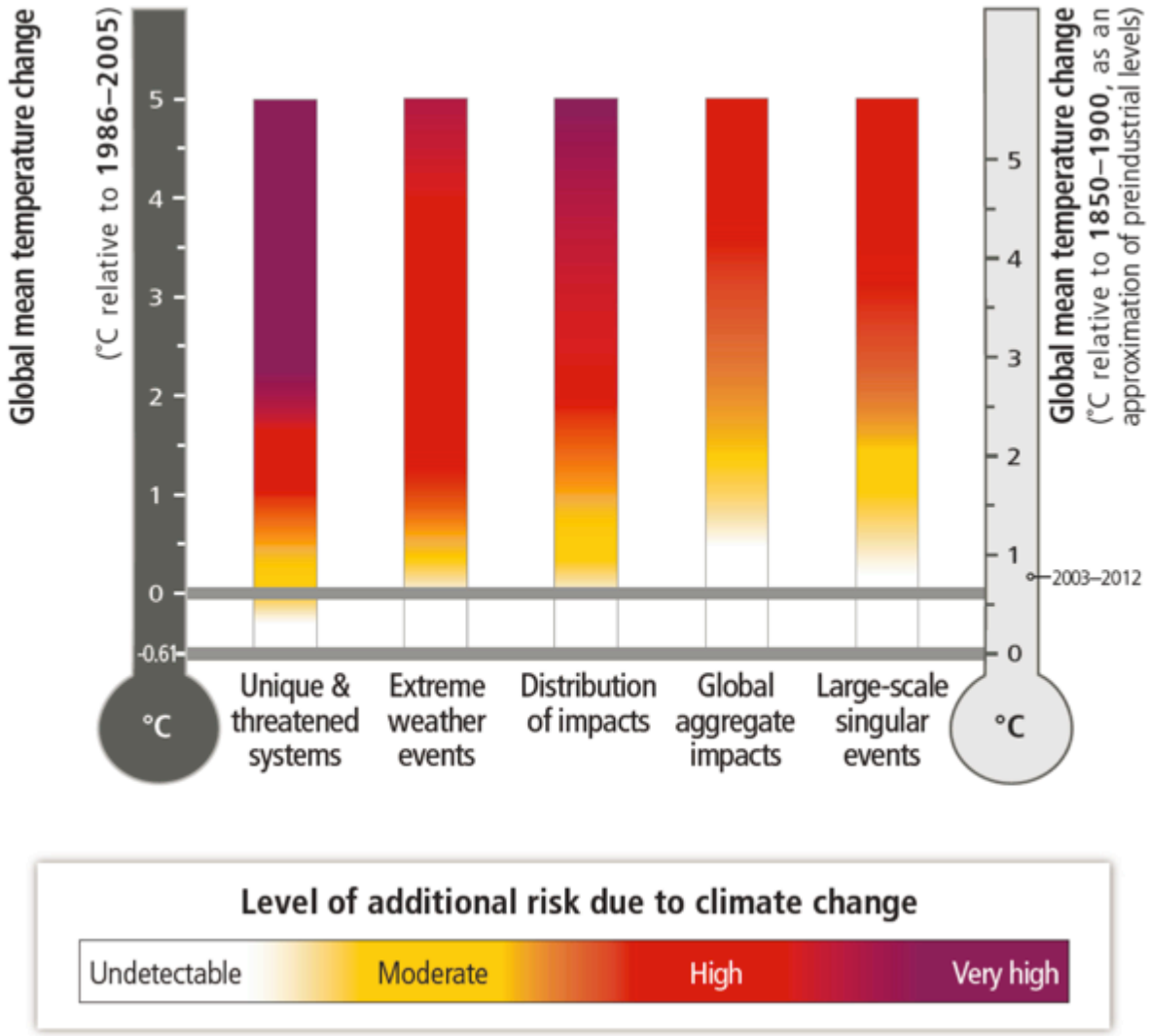
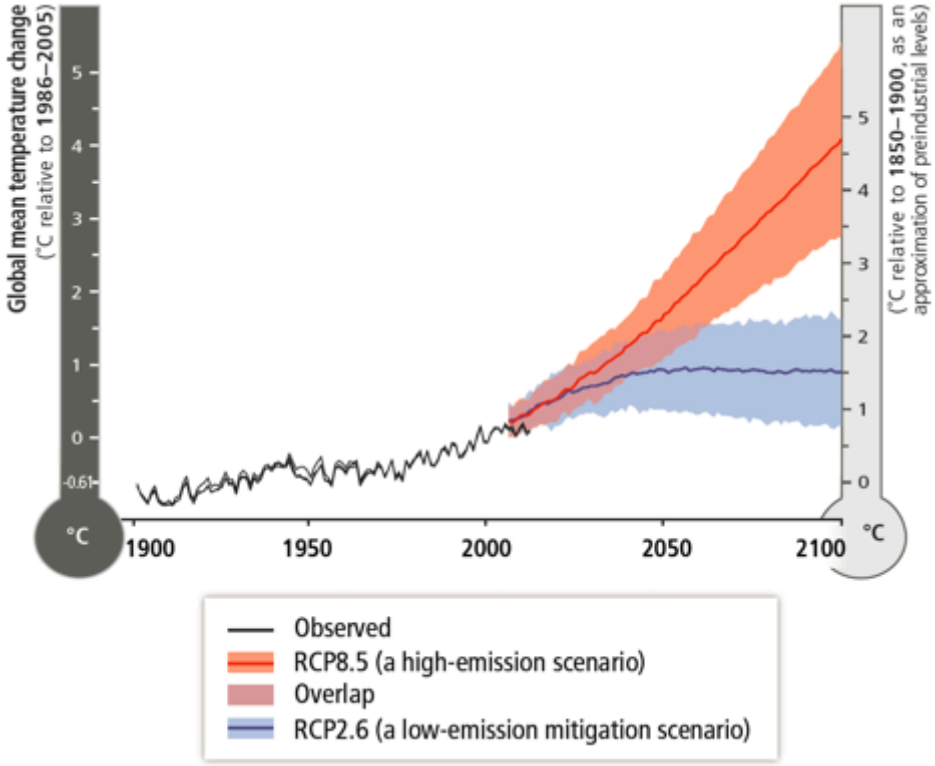
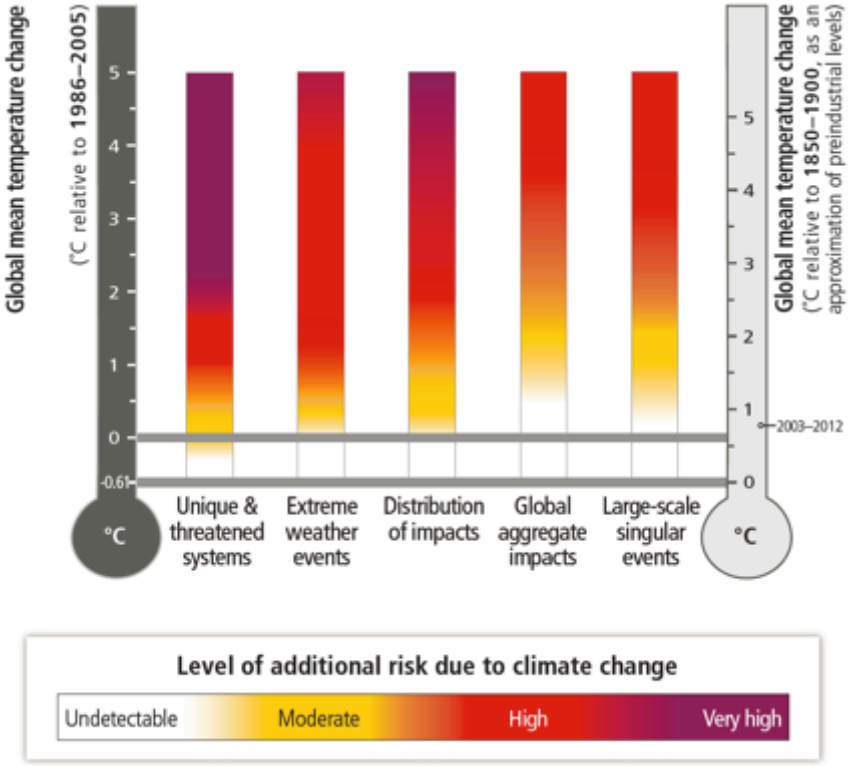


AR5, WGII, Box SPM.1 Figure 1





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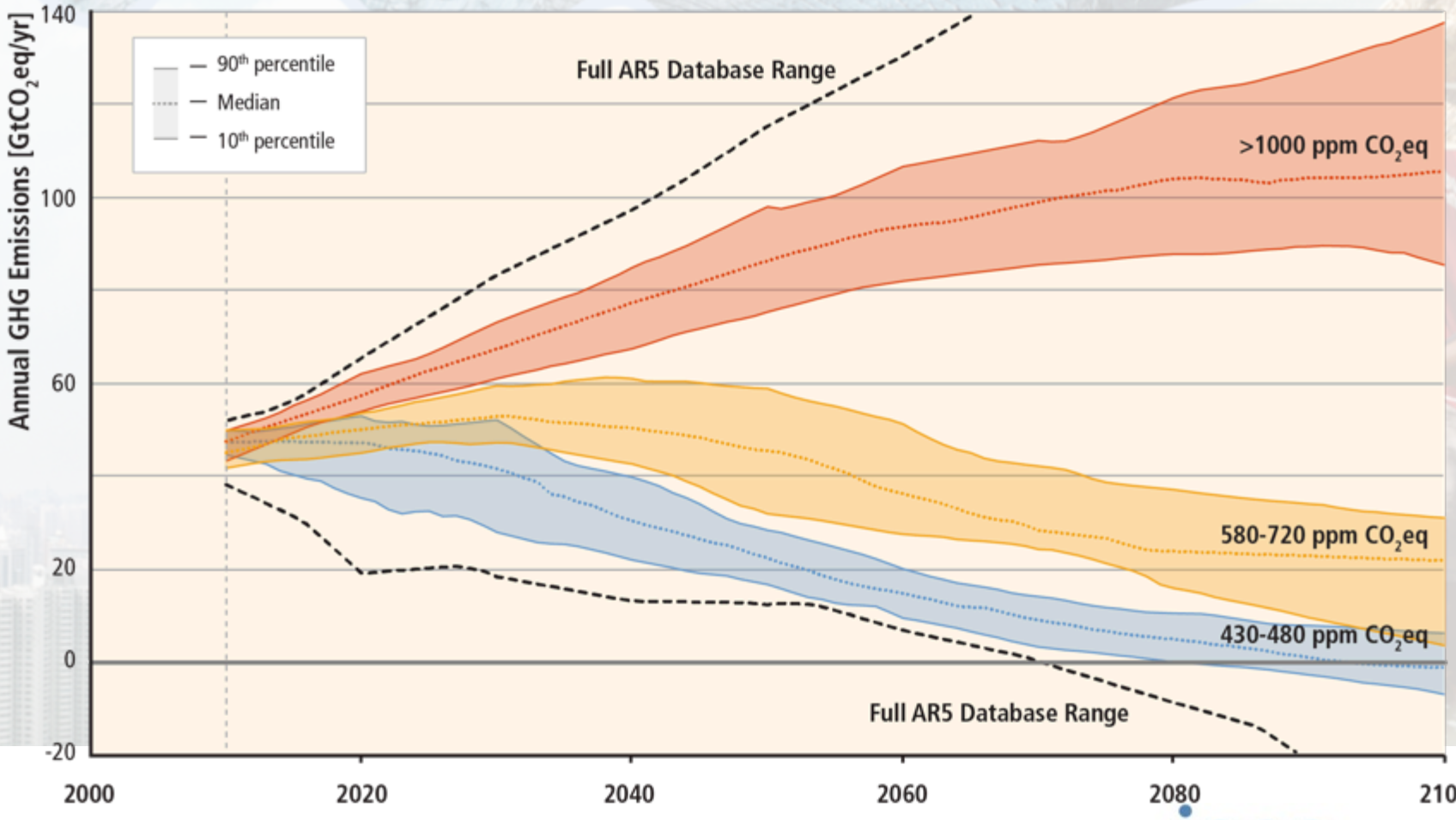
Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.



Based on Figure 6.7

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IPCC AR5 Synthesis Report

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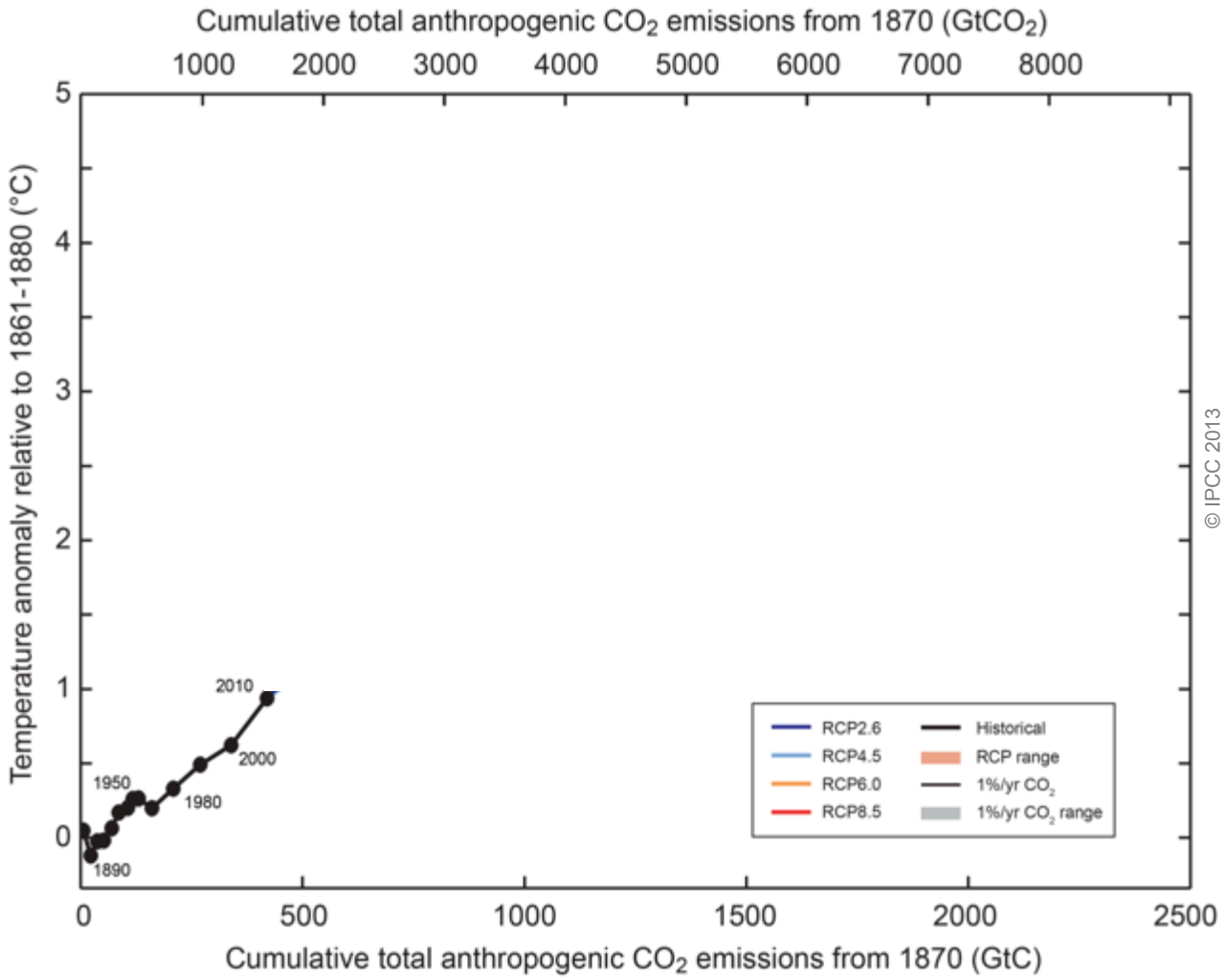


Fig. SPM.10

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

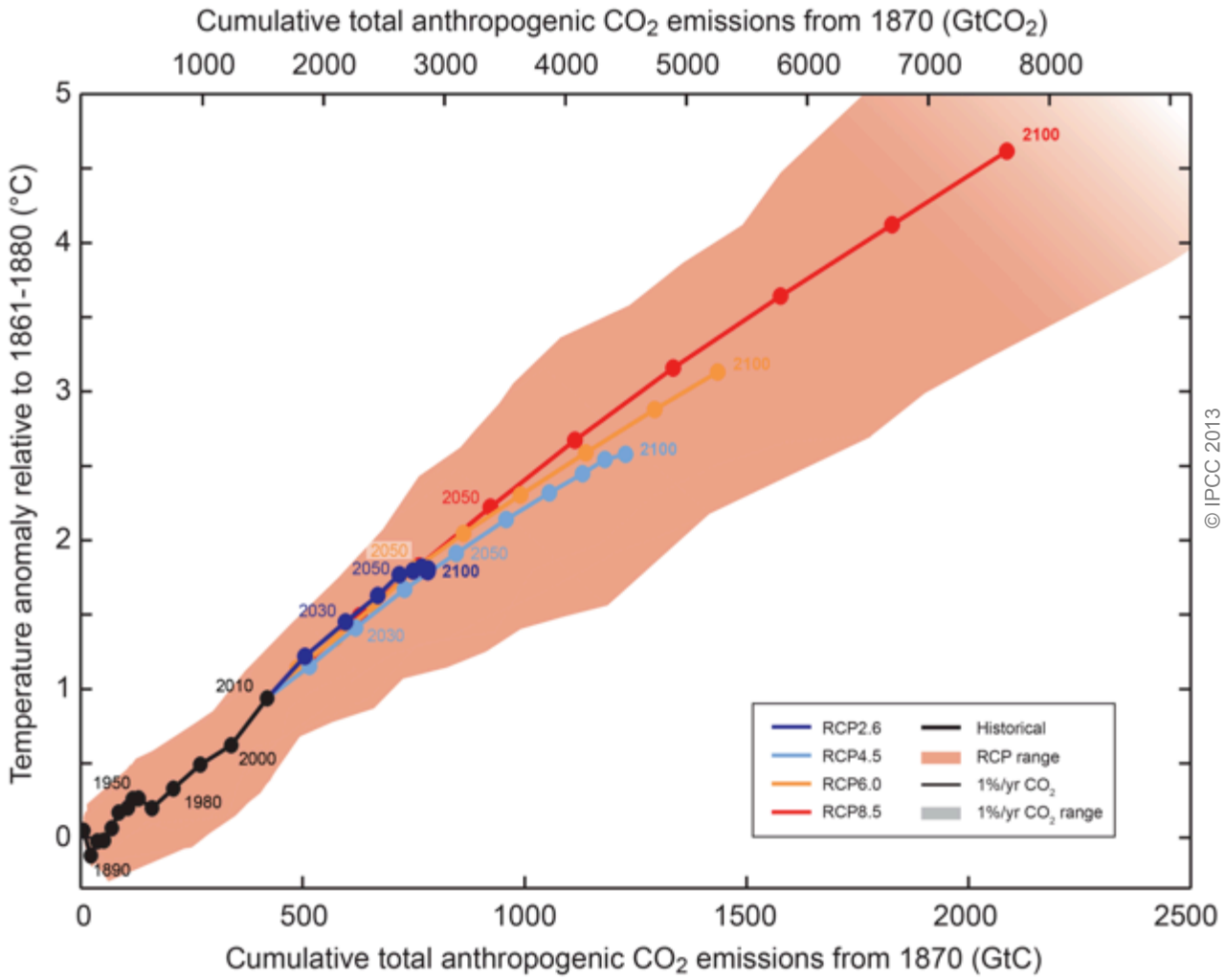
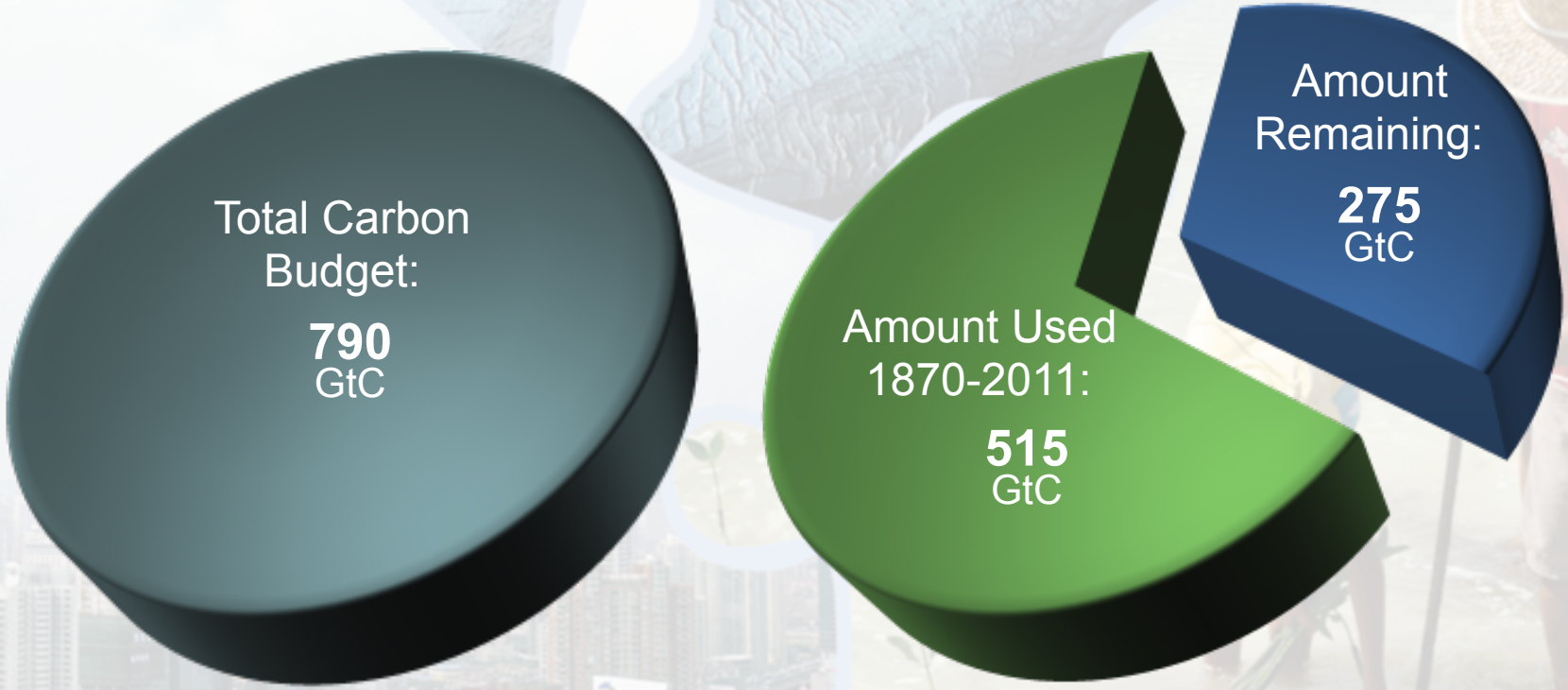


Fig. SPM.10

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



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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

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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

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Ambitious Mitigation Is Affordable

- ➜ Economic growth reduced by ~ 0.06%
  (BAU growth 1.6 - 3%/year)
- ➜ 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

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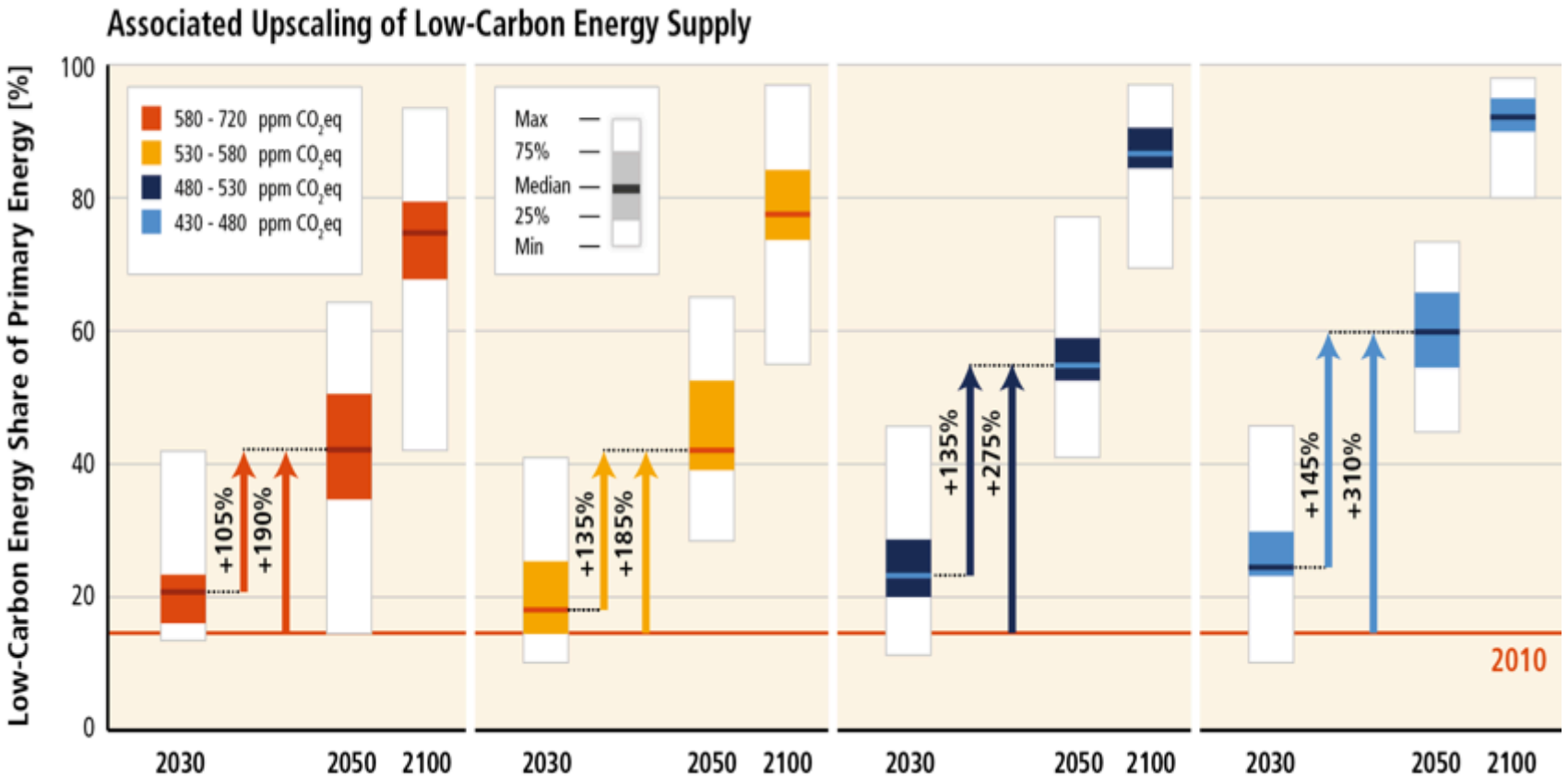
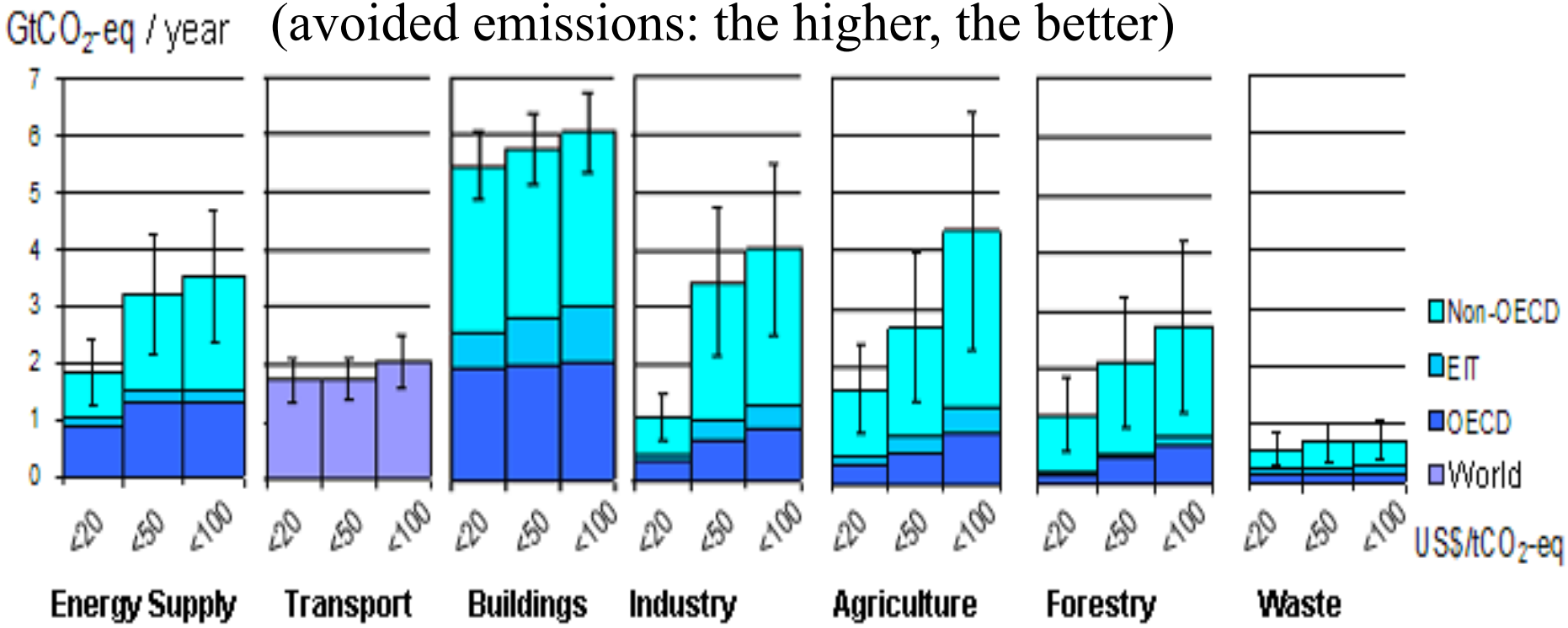
Mitigation requires major technological and institutional changes including the upscaling of low- and zero carbon energy



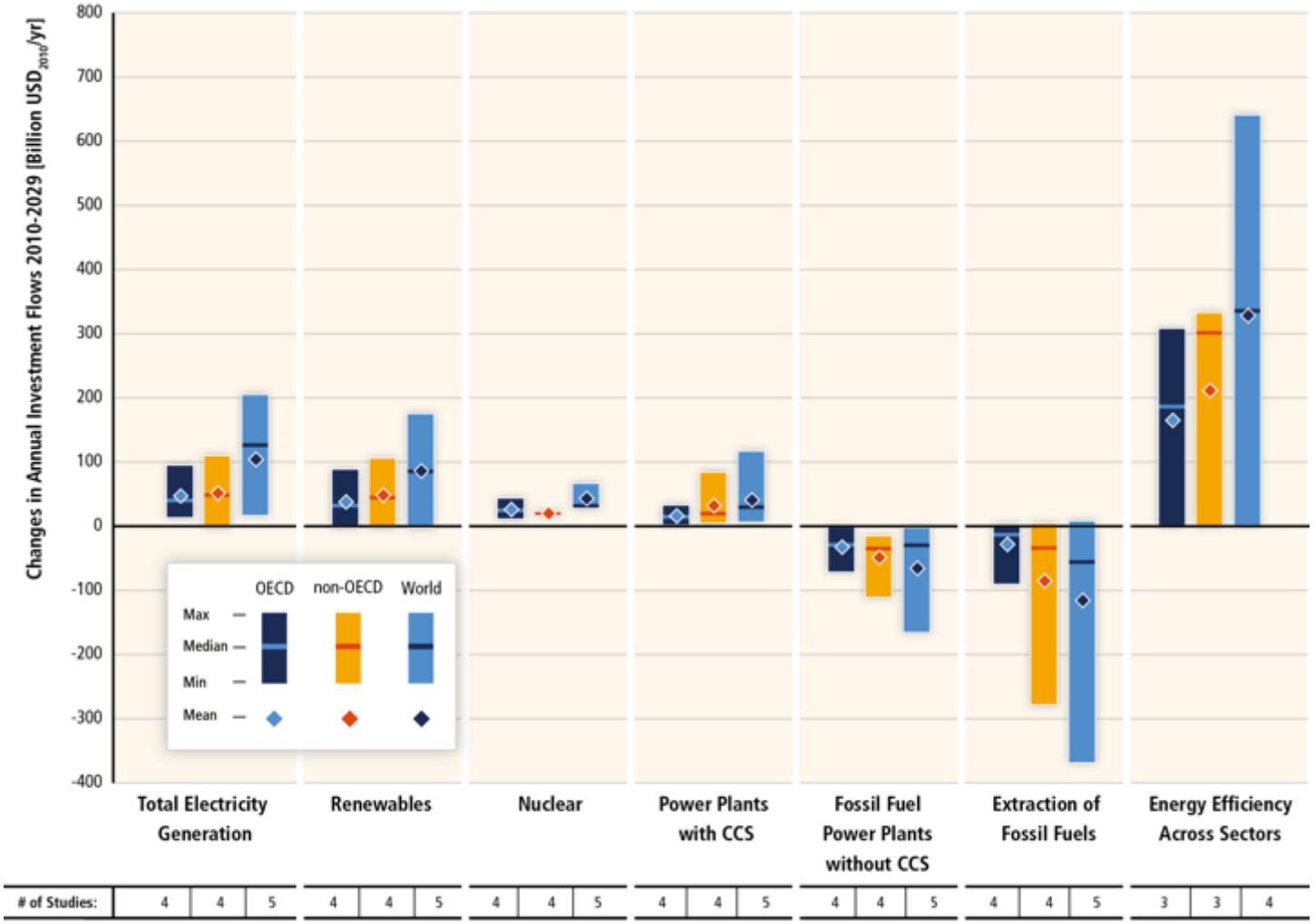
All sectors and regions have the potential to contribute by 2030



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.

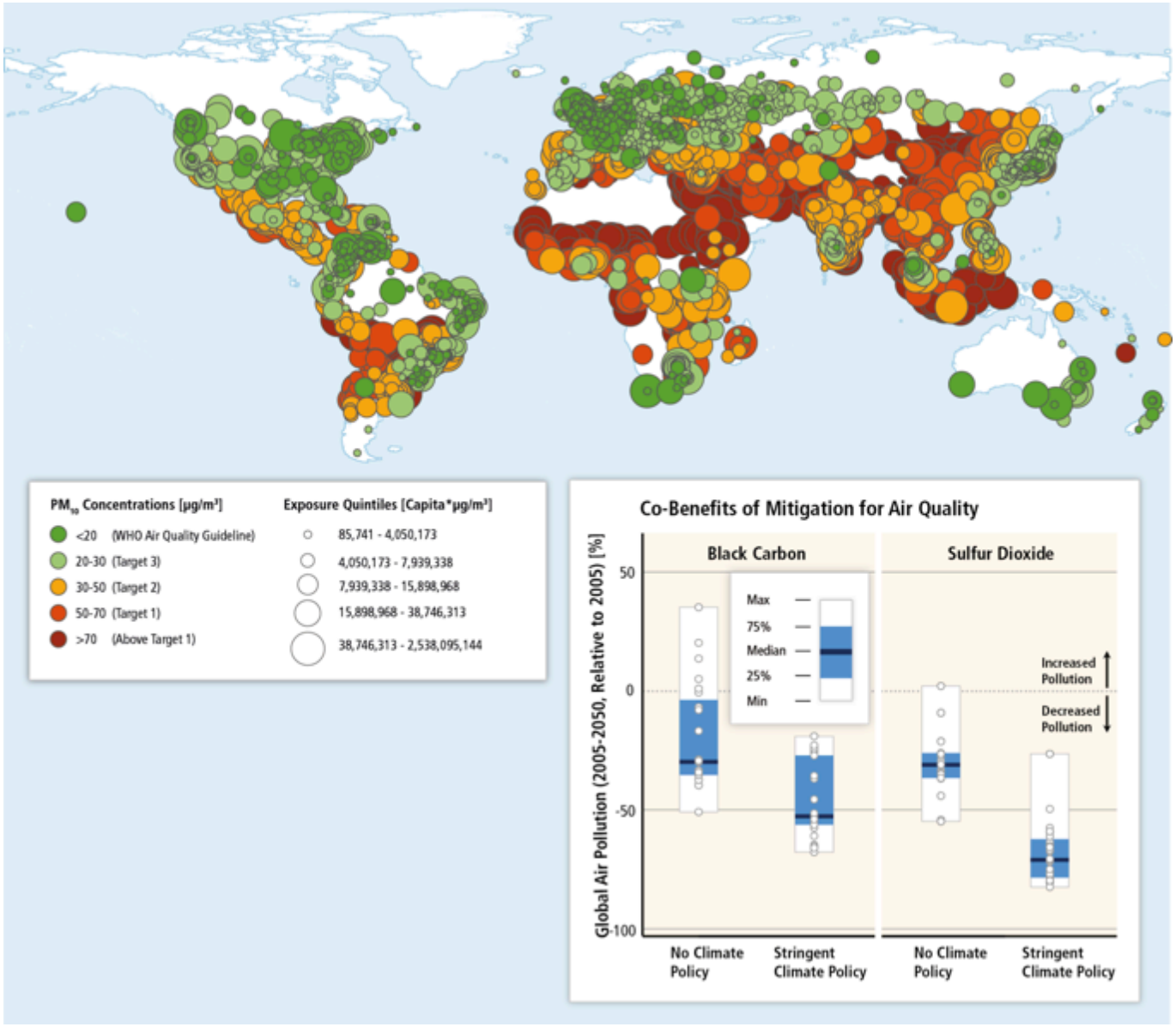


Since AR4, there has been an increased focus on policies designed to integrate multiple objectives, increase co-benefits and reduce adverse side-effects.

- **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.

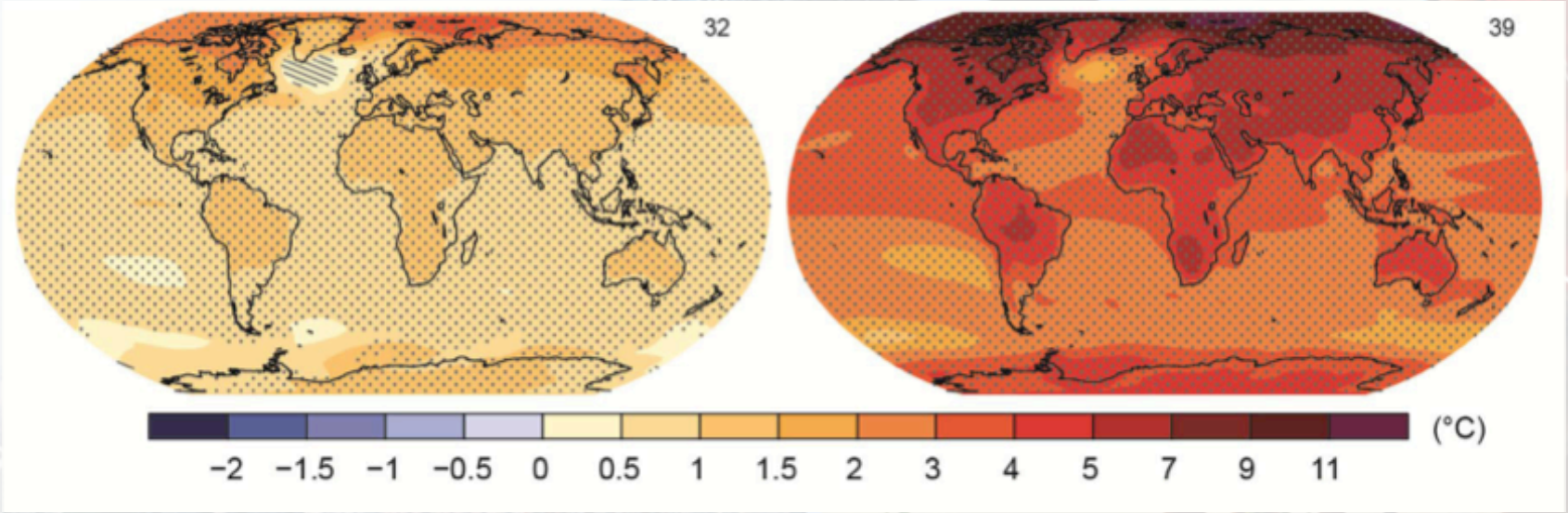


Mitigation can result in large co-benefits for human health and other societal goals.

The Choices we Make Will Create Different Outcomes (and affect prospects for effective adaptation)

With substantial mitigation

Without additional mitigation



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

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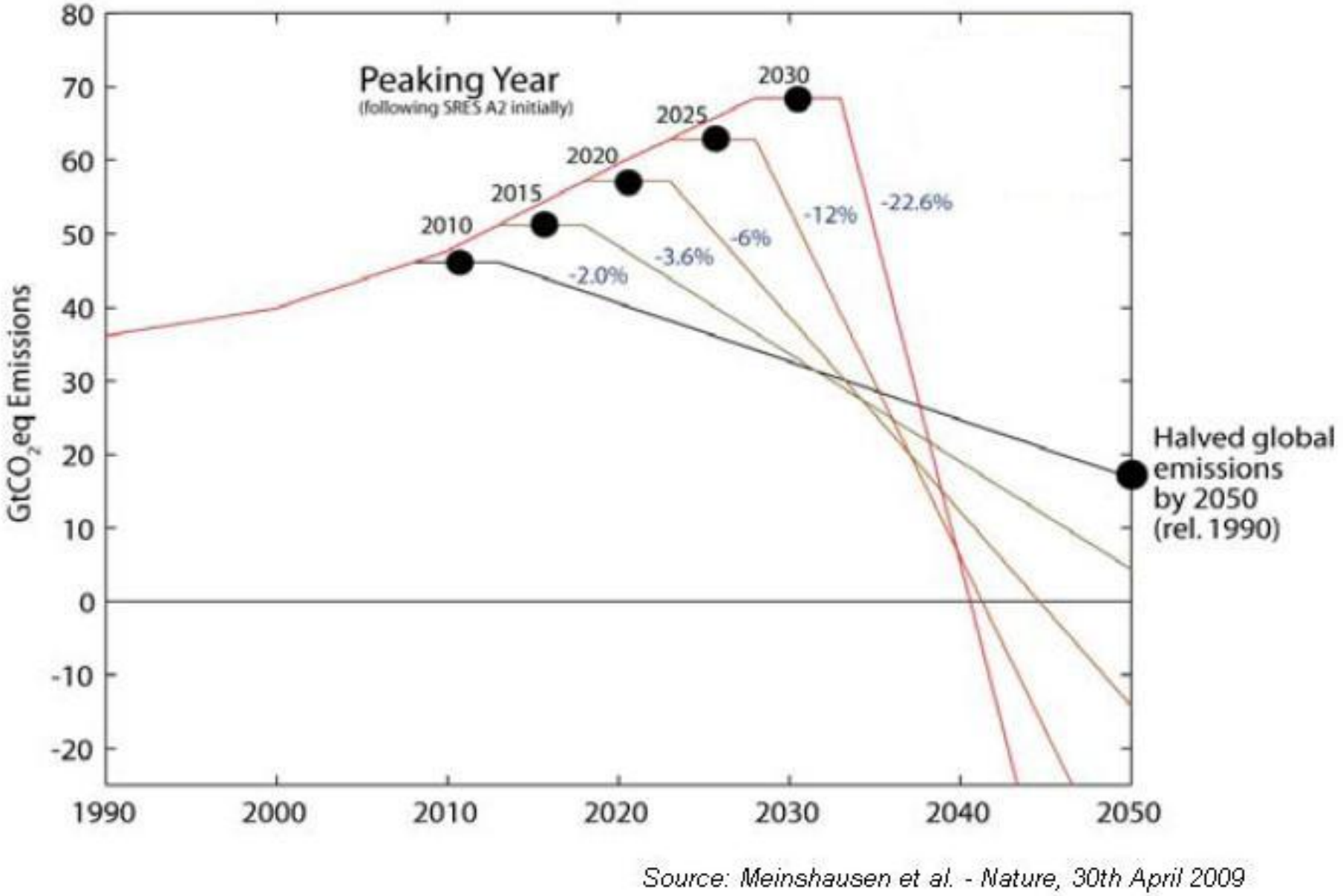
The more we wait, the more difficult it will be



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

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**