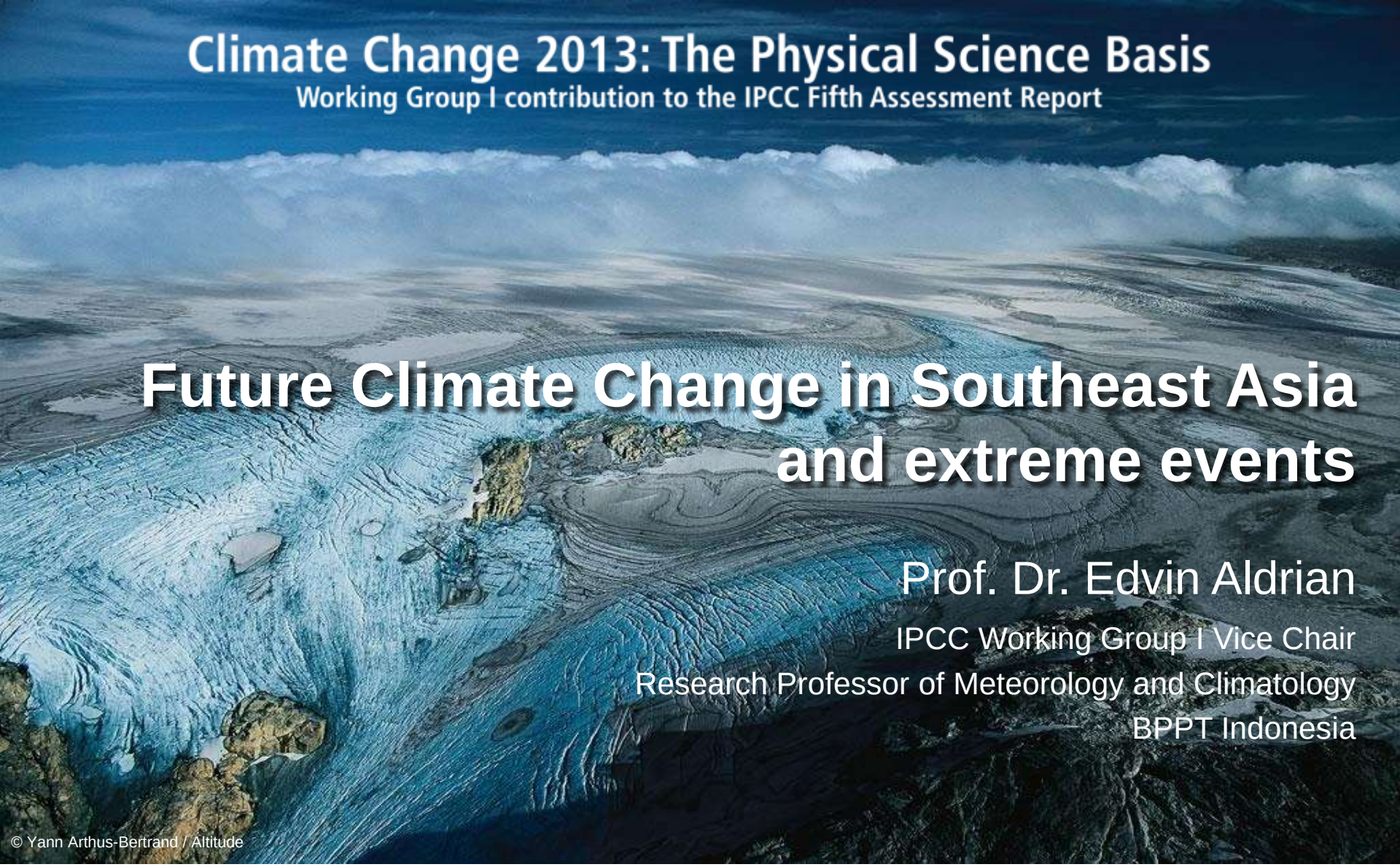


Future Climate Change in Southeast Asia and extreme events

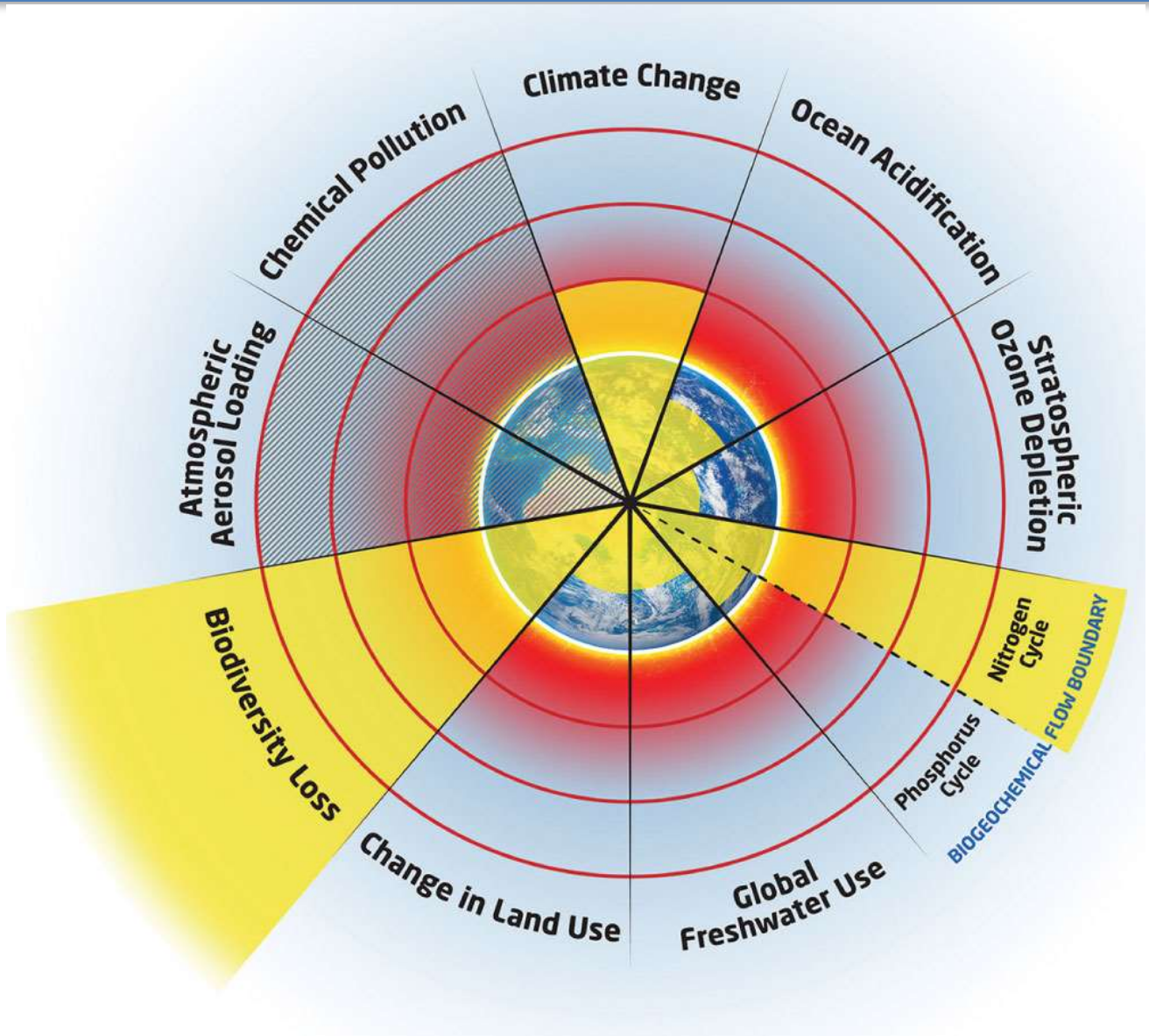
Prof. Dr. Edvin Aldrian
IPCC Working Group I Vice Chair
Research Professor of Meteorology and Climatology
BPPT Indonesia

Presented at Role, Activities And Findings of the IPCC - Outreach Event, Riyadh, 19 - 20 September 2017

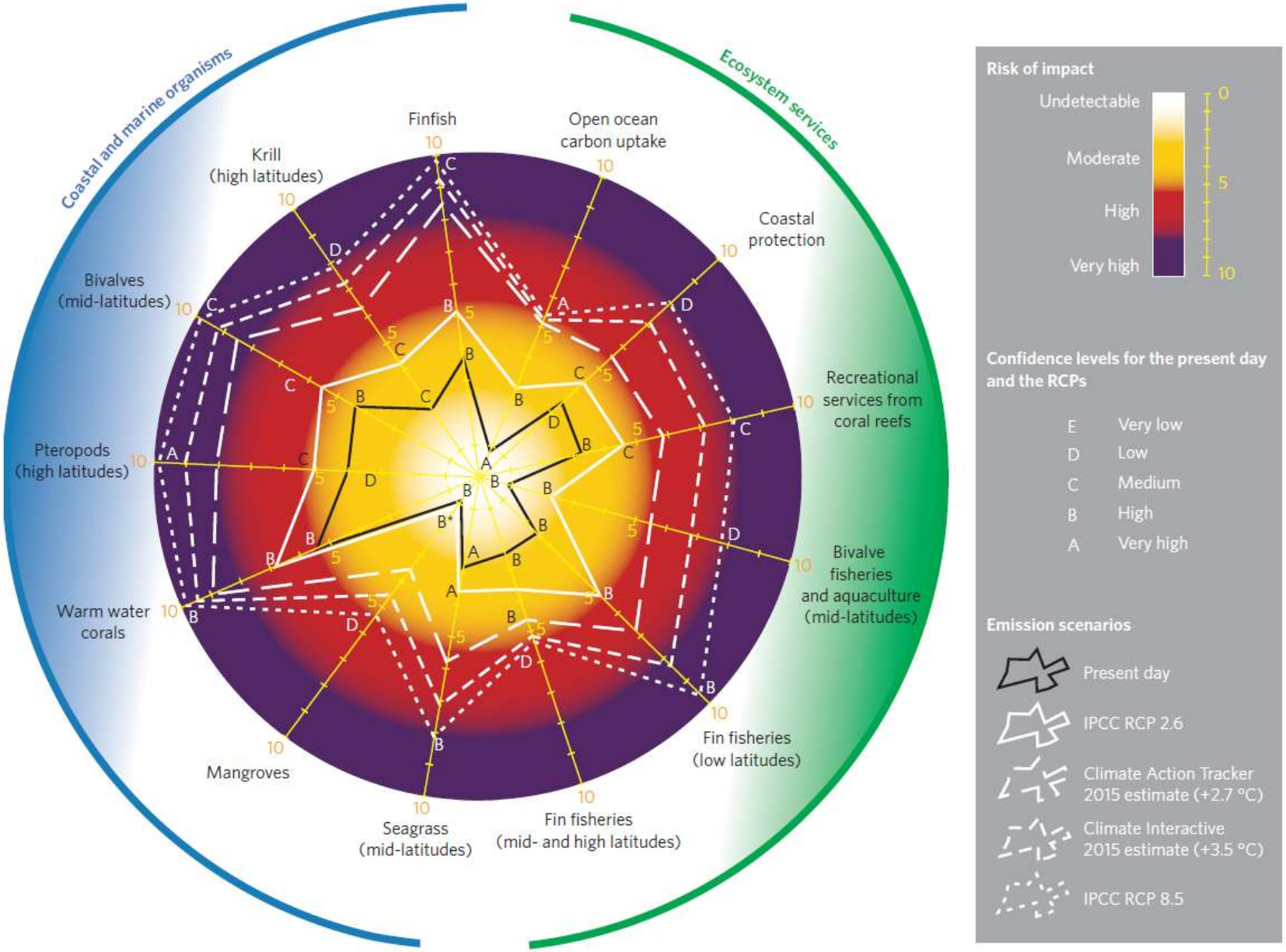
ipcc INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Outline

- Global changes challanges
- Human influences on climate
- Attribution of climate change
- Global Climate parameter changes
- Regional changes of West Asia

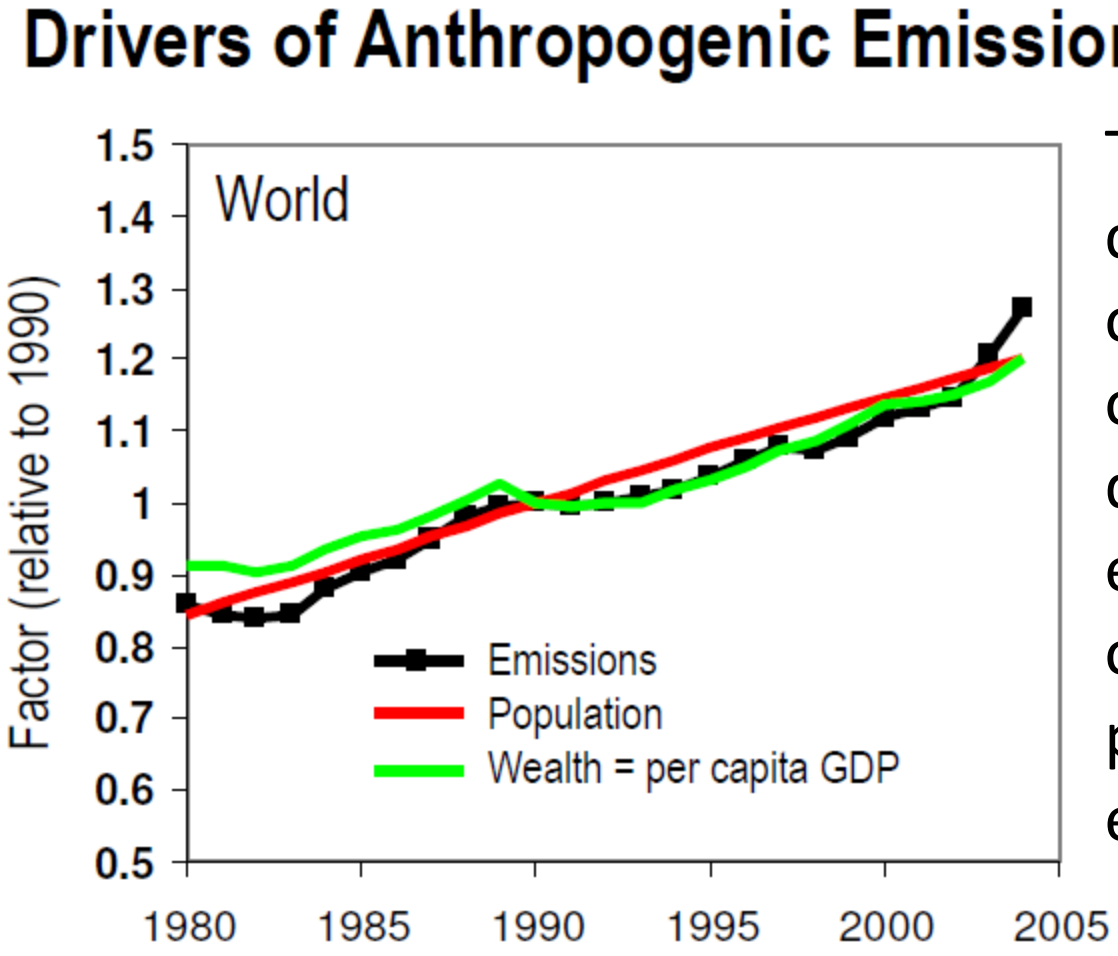


Rockström, et al. 2009. Planetary boundaries:exploring the safe operating 3 space for humanity. *Ecology and Society* **14**(2): 32



Magnan *et al.*, Nature Climate Change, 2016

Population, wealth and emission



Raupach et al. (2007, PNAS)

The future of the climate system (and our survival) depends on our ability to decouple future emissions from the other two factors: population and economic growth

Key SPM Messages

19 Headlines

on less than 2 Pages

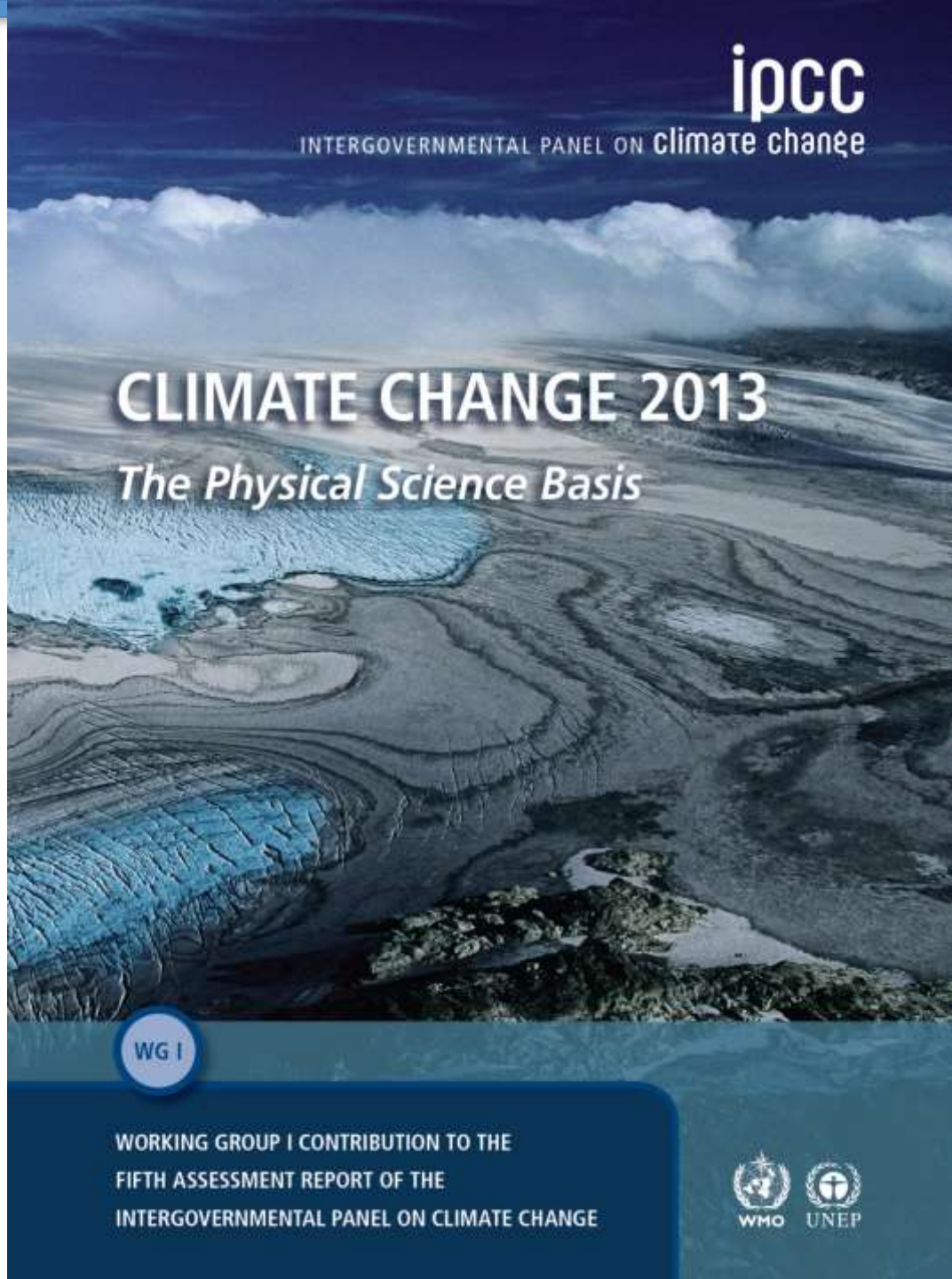
Summary for Policymakers
~14,000 Words

14 Chapters
Atlas of Regional Projections

54,677 Review Comments
by 1089 Experts

2010: 259 Authors Selected

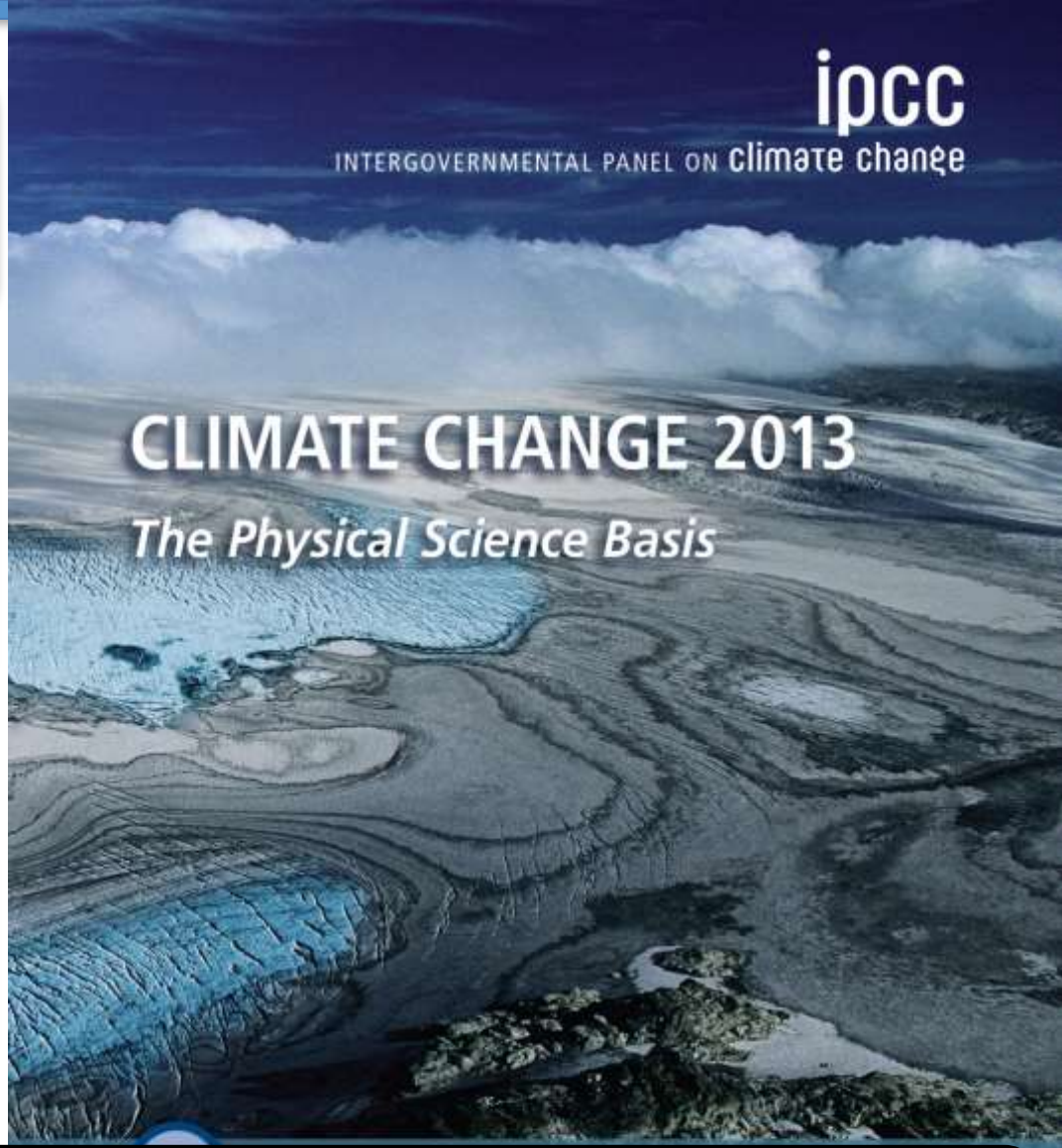
2009: WGI Outline Approved



Observations

Understanding

Future



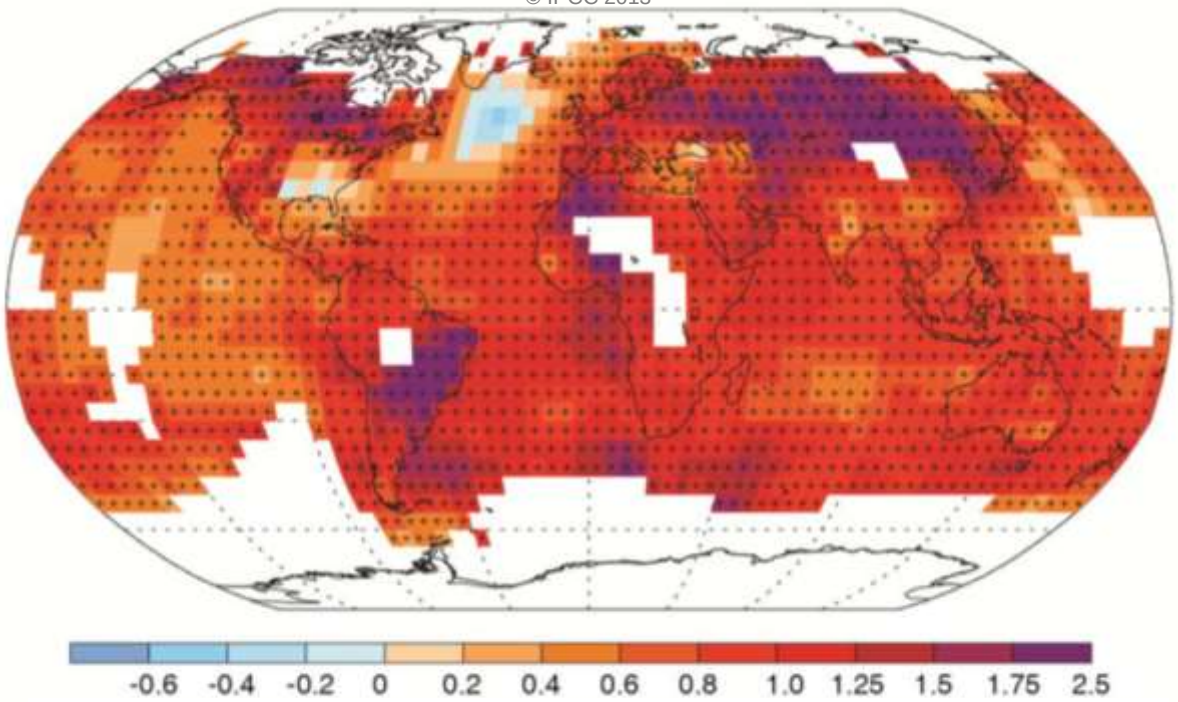
www.climatechange2013.org

Warming in the climate system is unequivocal

Human influence on the climate system is clear

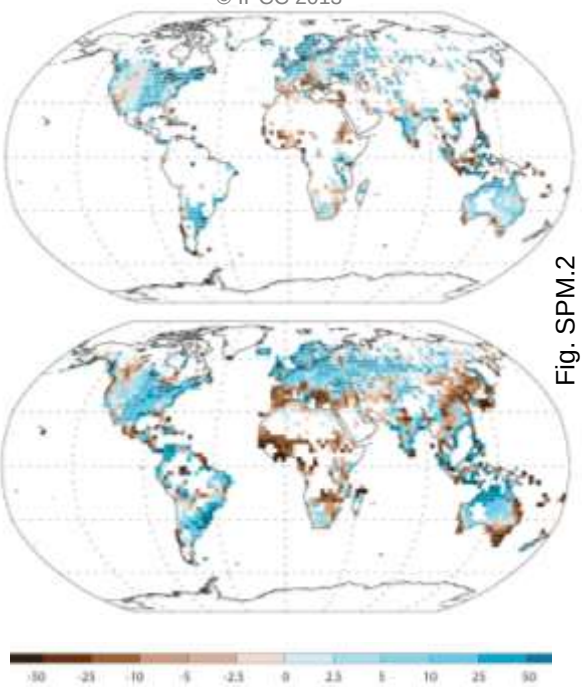
Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions

Fig. SPM.1b



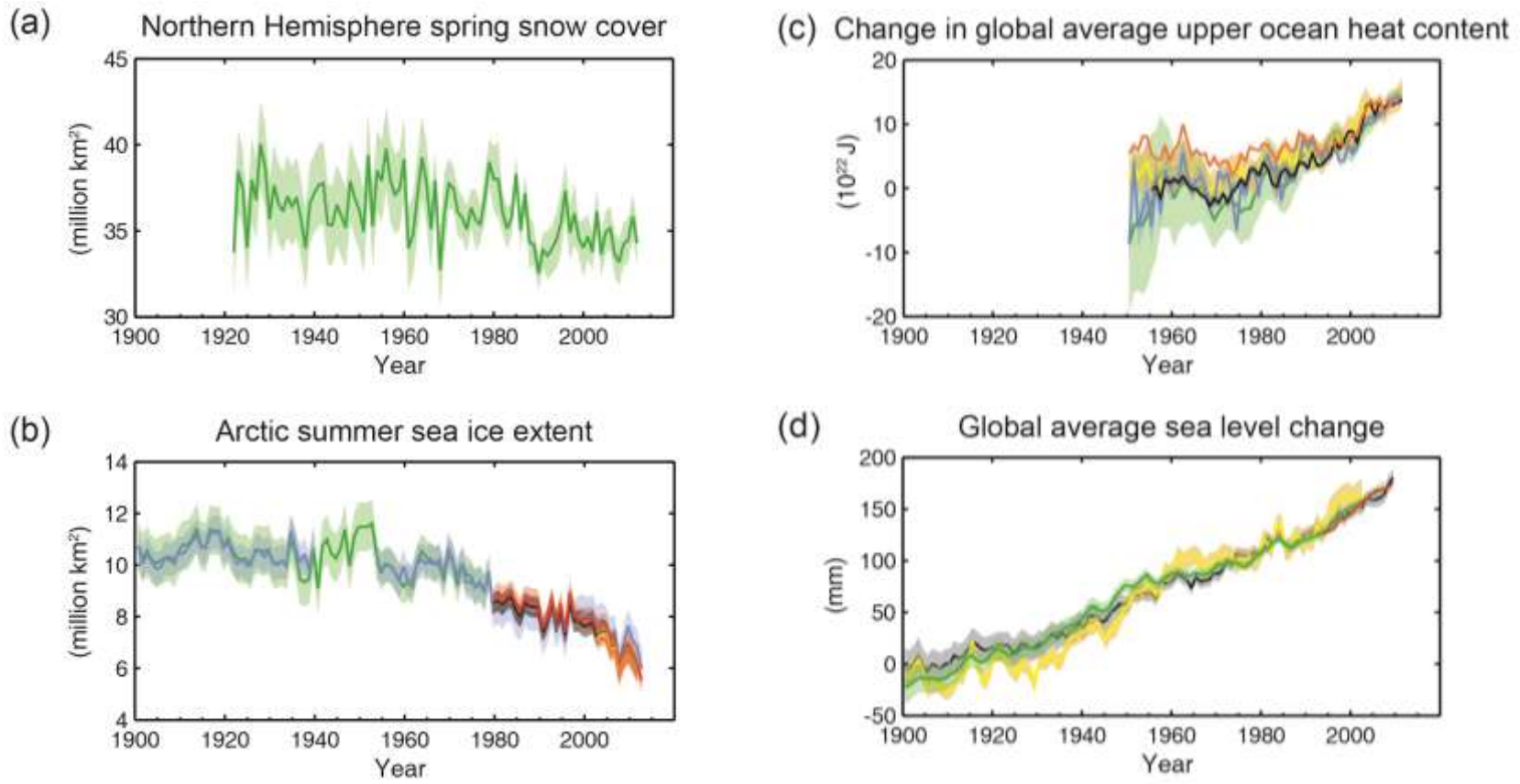
Temperature Difference 1901 to 2012 based on trend (°C)

Fig. SPM.2

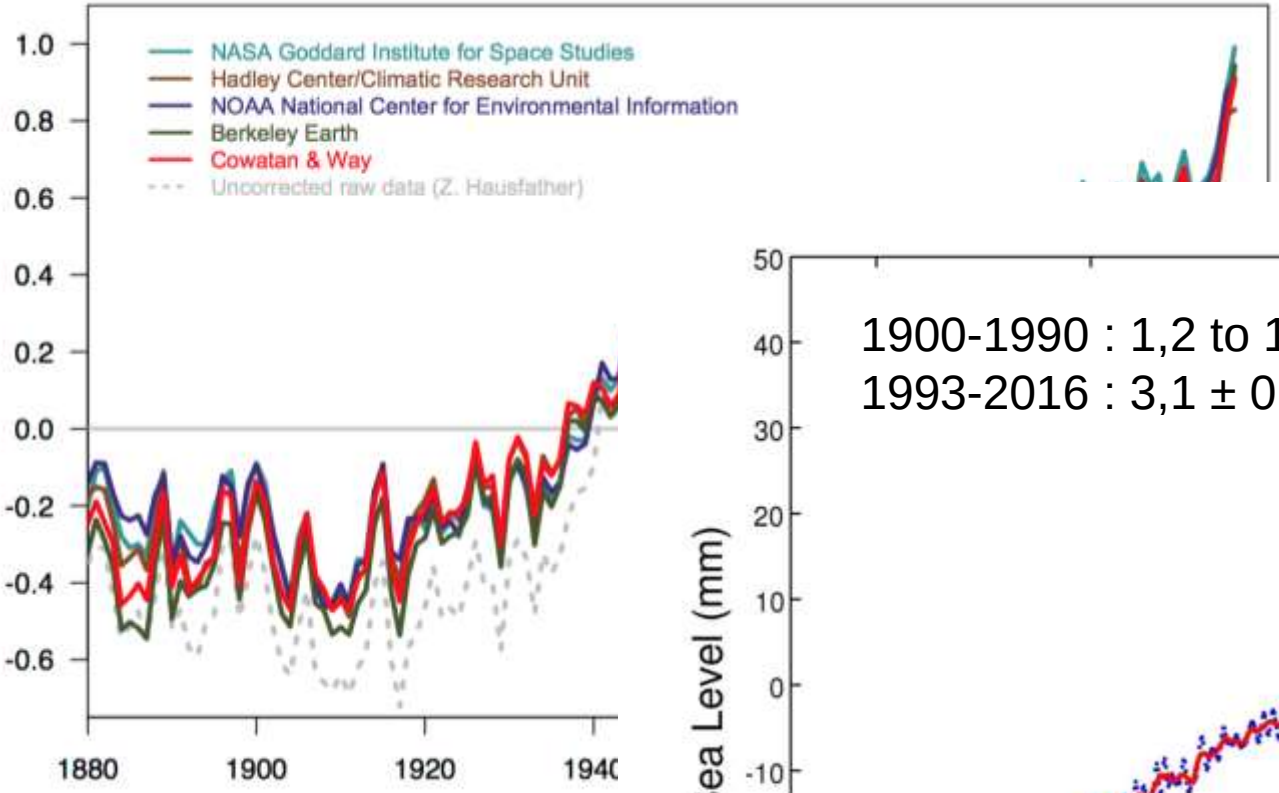


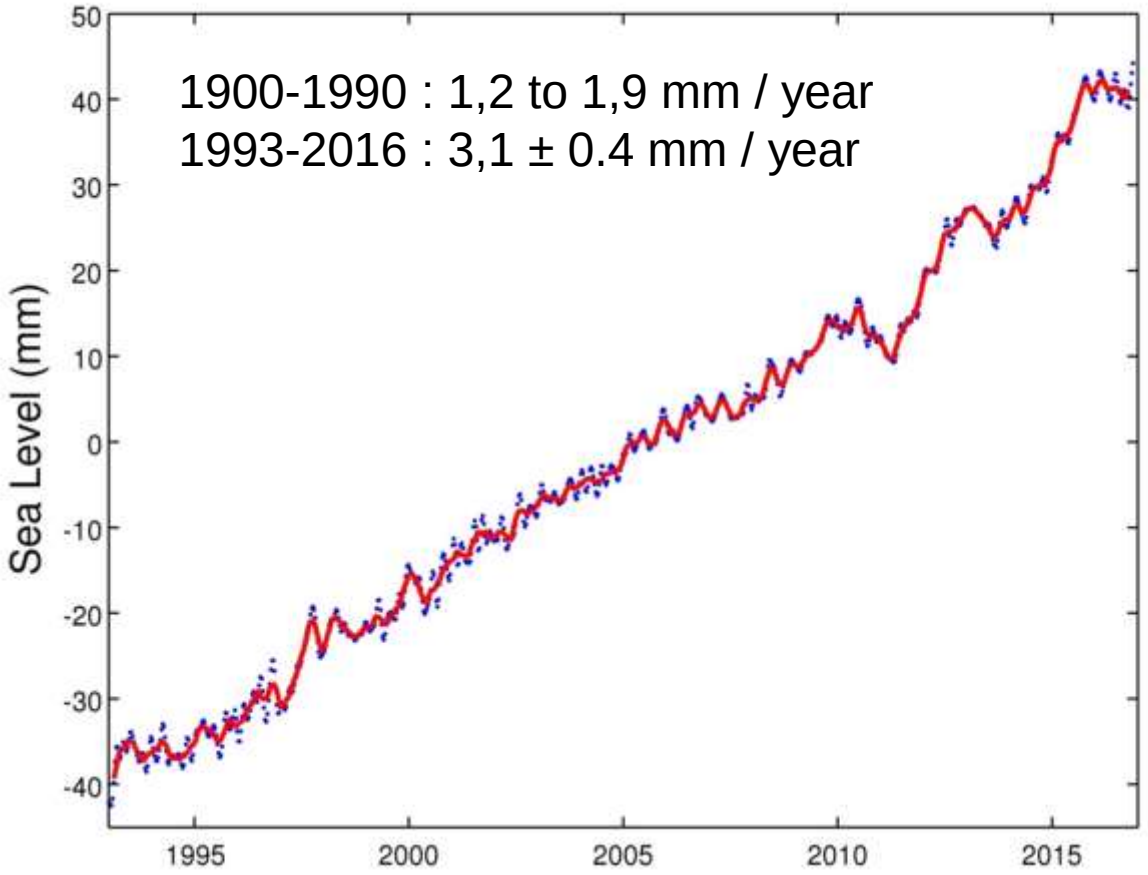
Precipitation Trend (mm/yr per decade)

Warming of the climate system is unequivocal



Warming of the climate system is unequivocal





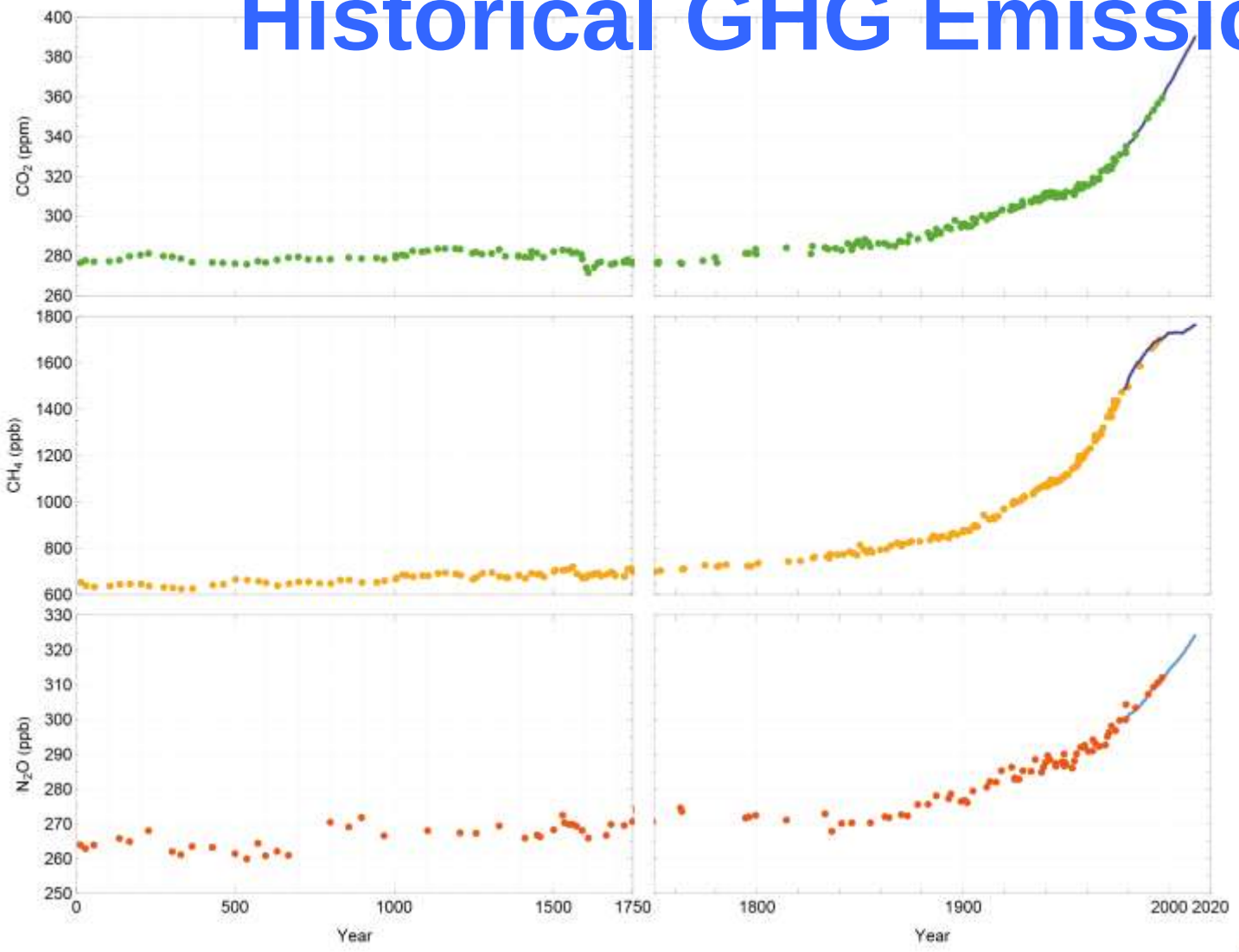
Trend: + 0.18 ° C per decade

2015 and 2016:> 1 ° C above the pre industrial level

NASA GISS; Hawkins et al, BAMS, 2017

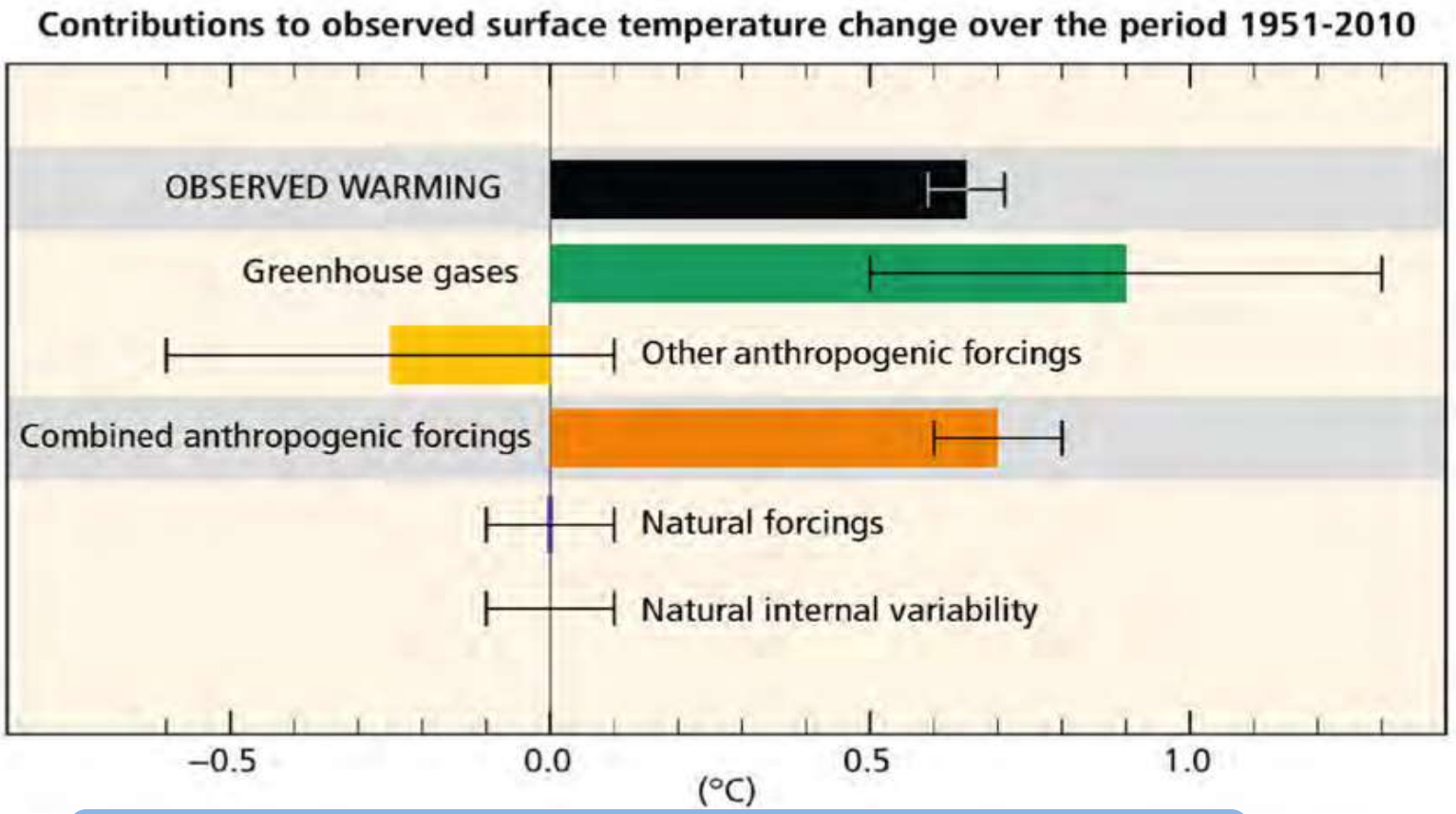
The total radiative forcing is positive and has led to a net absorption of energy by the climate system. The greatest contribution to this radiative forcing is due to the increase in the atmospheric CO_2 content since 1750

Historical GHG Emission



Human Influence on Atmospheric Composition

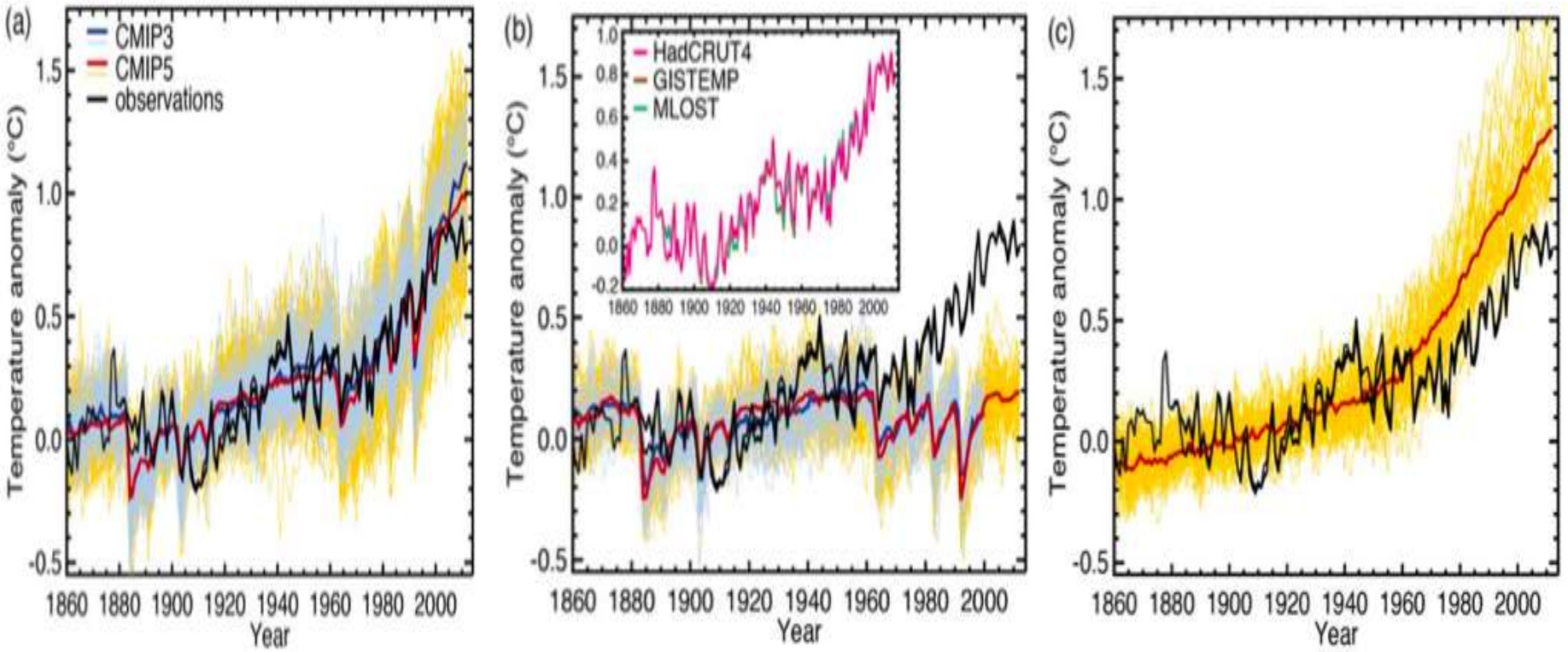
Humans are changing the climate



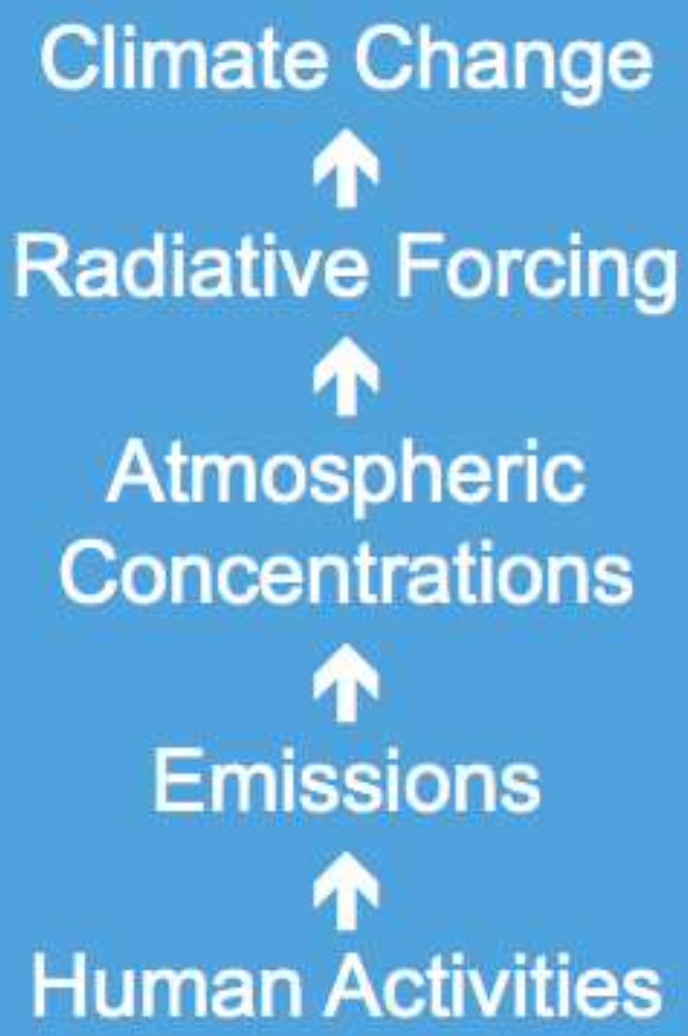
Human Influence is Clear

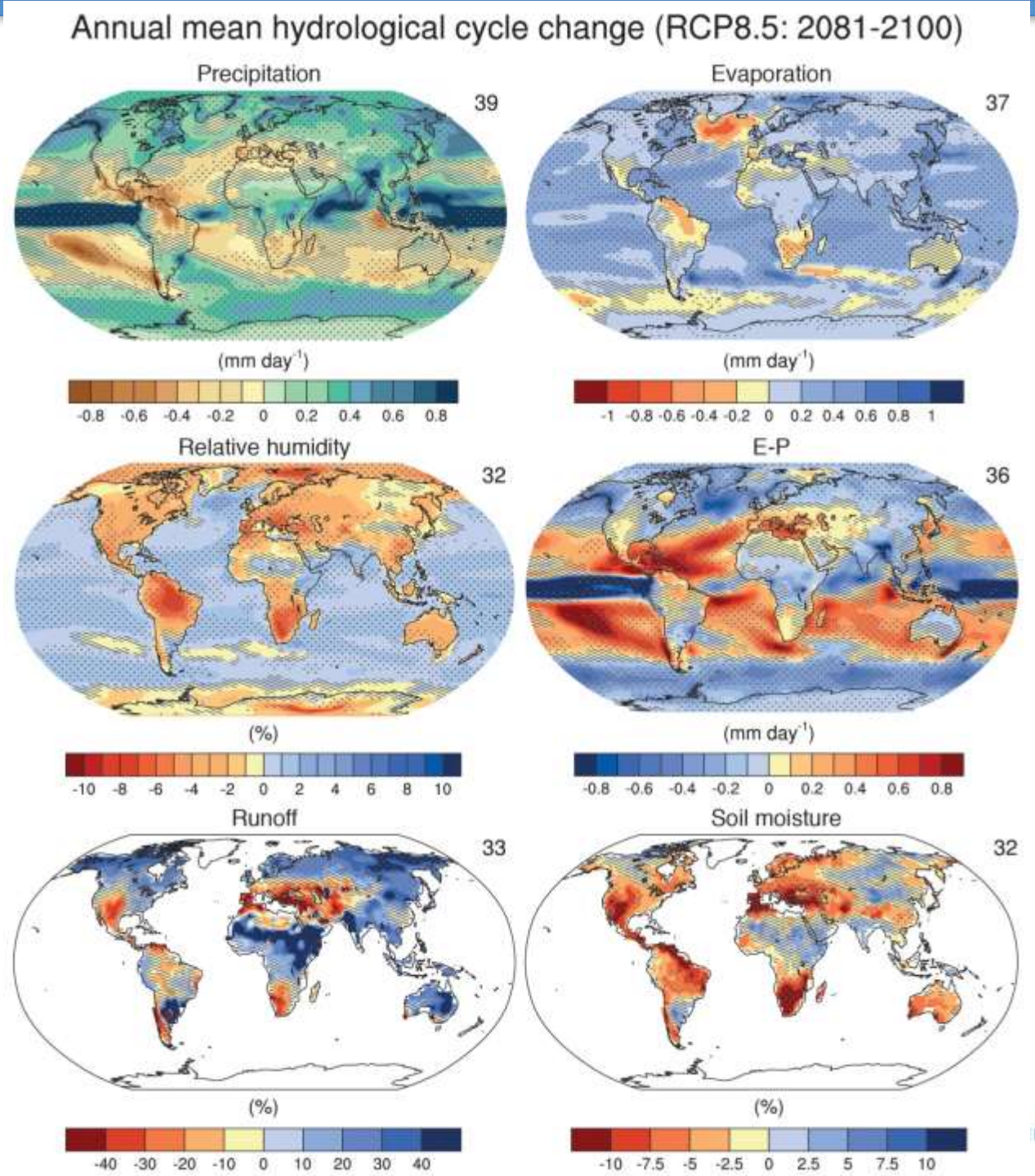
Climate Models Responses to Various Forcings

Natural + Anthropogenic | **Natural** | **CO2 forcing only**



Human Influence is Clear


Climate Change
Radiative Forcing
Atmospheric Concentrations
Emissions
Human Activities



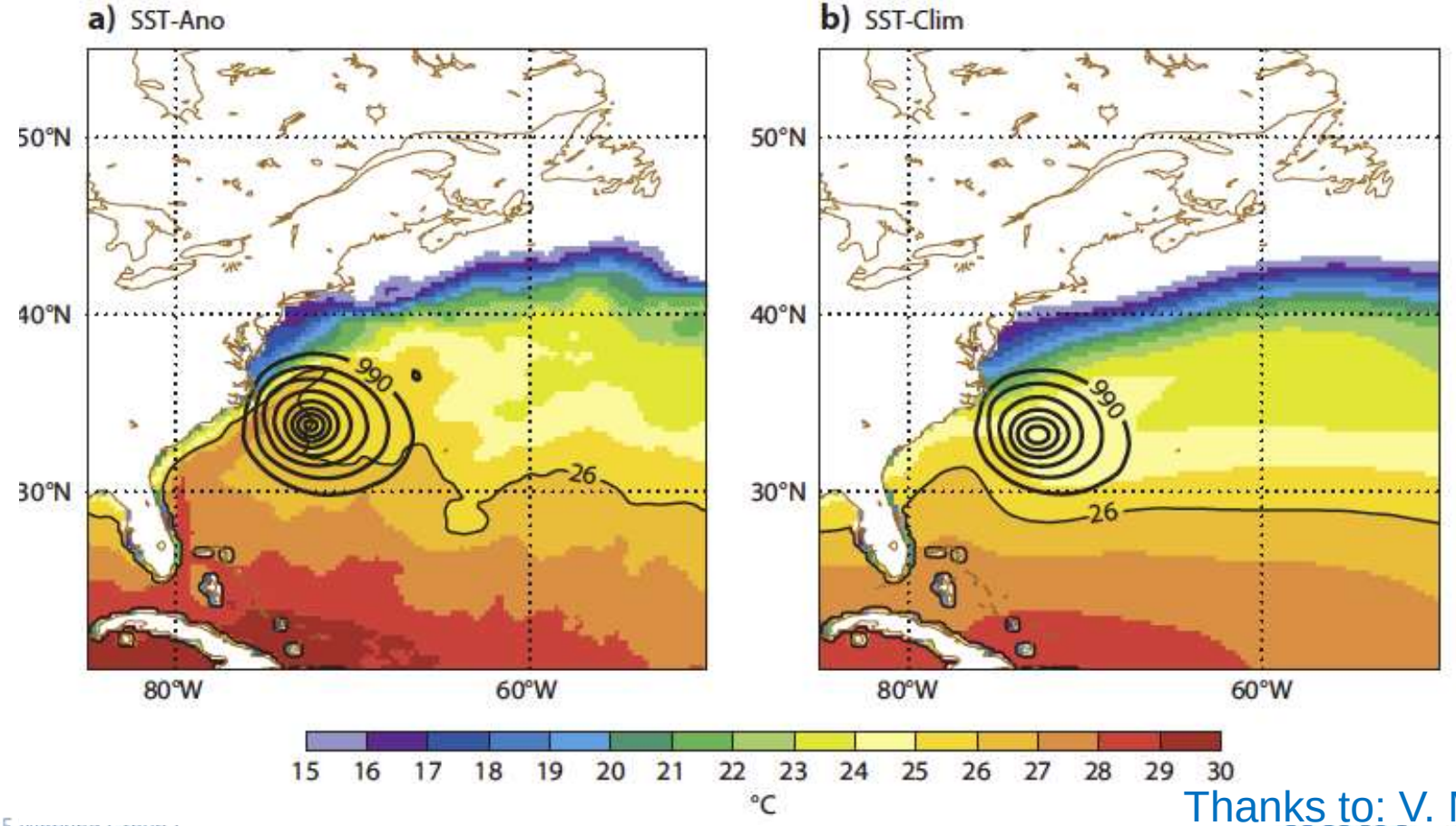
New greenhouse gas emissions will imply continued warming and changes affecting all components of the climate system. Reducing climate change will require significant and sustainable reductions in greenhouse gas emissions.

Hurrican Sandy (30 oct. 2012)

$ 70 billion damage around New York: winds, rains and submersion

Forecast (with actual sea temperature)

Forecast ("normal" sea temperature)

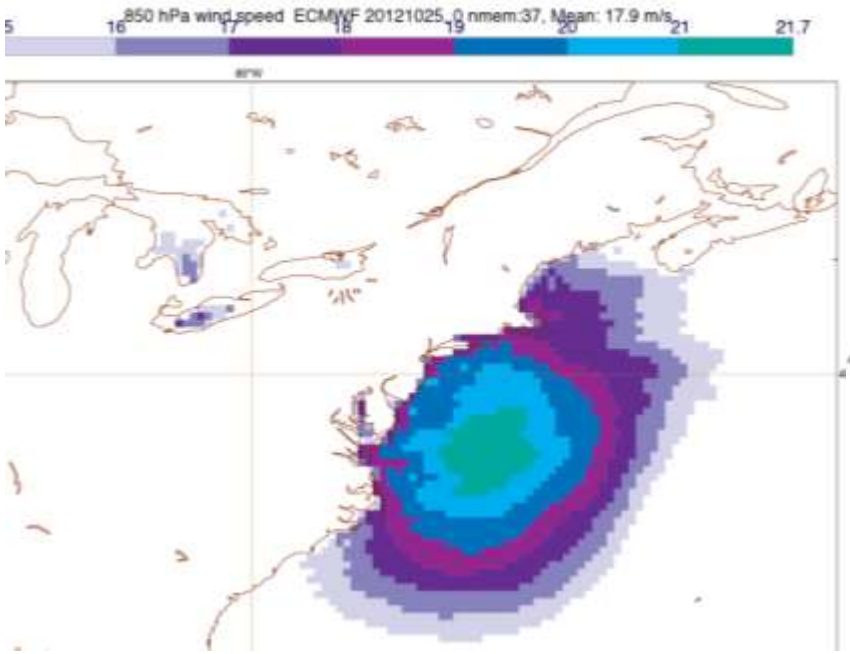


Thanks to: V. Masson

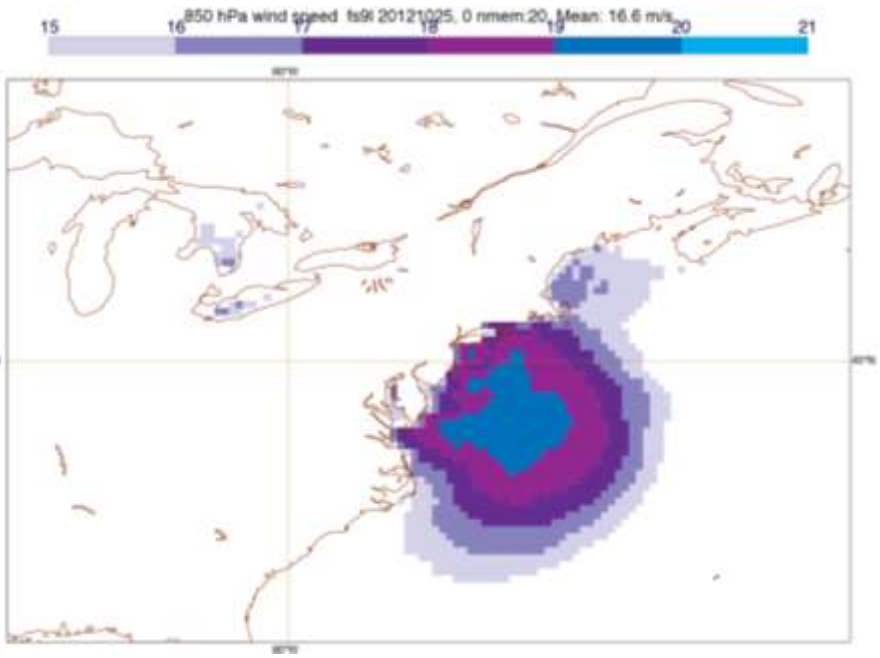
Magnusson et al 2013 WMR

Present: attribution studies

Wind (with actual sea temperature)



Wind ("normal" sea temperature)



Higher sea temperature: winds +3.6 m / s, rainfall + 35%
Sea level +19 cm

Thanks to: V. Masson

Magnusson et al 2013 WMR

Implications of 1.5 and 2 ° global warming

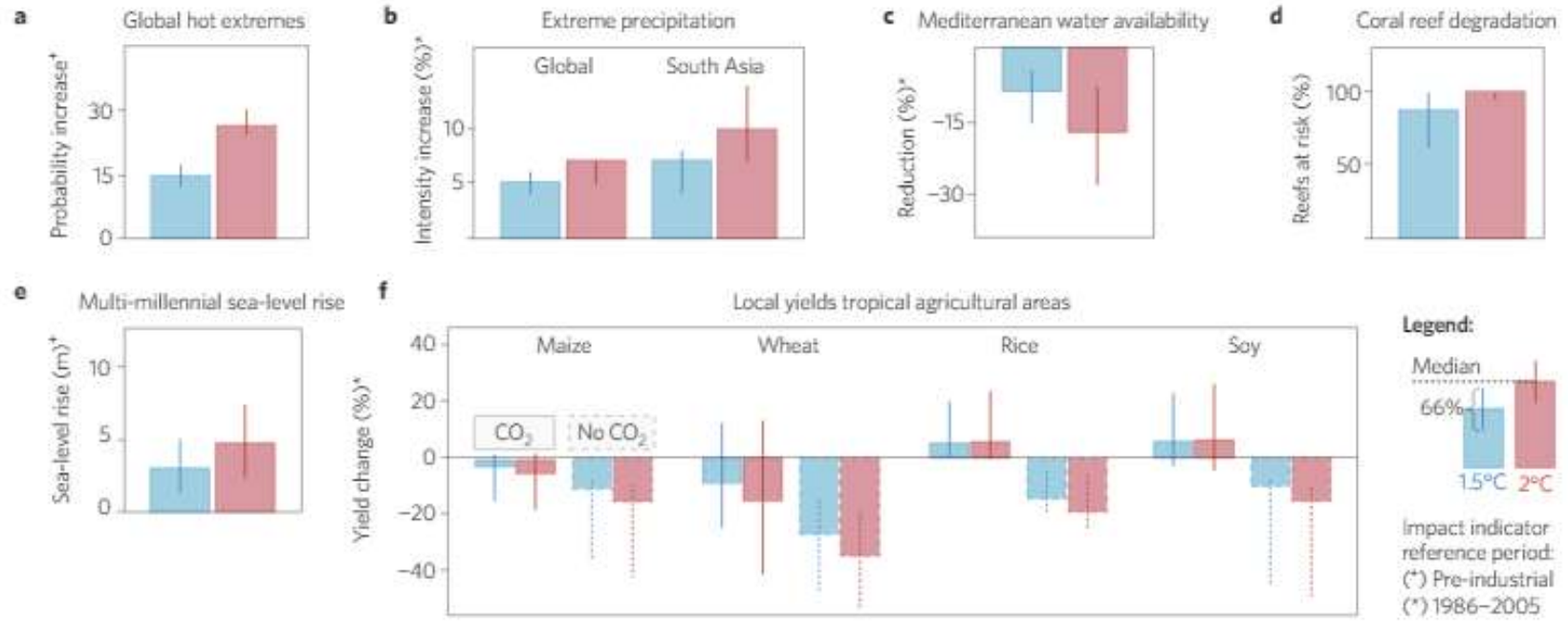


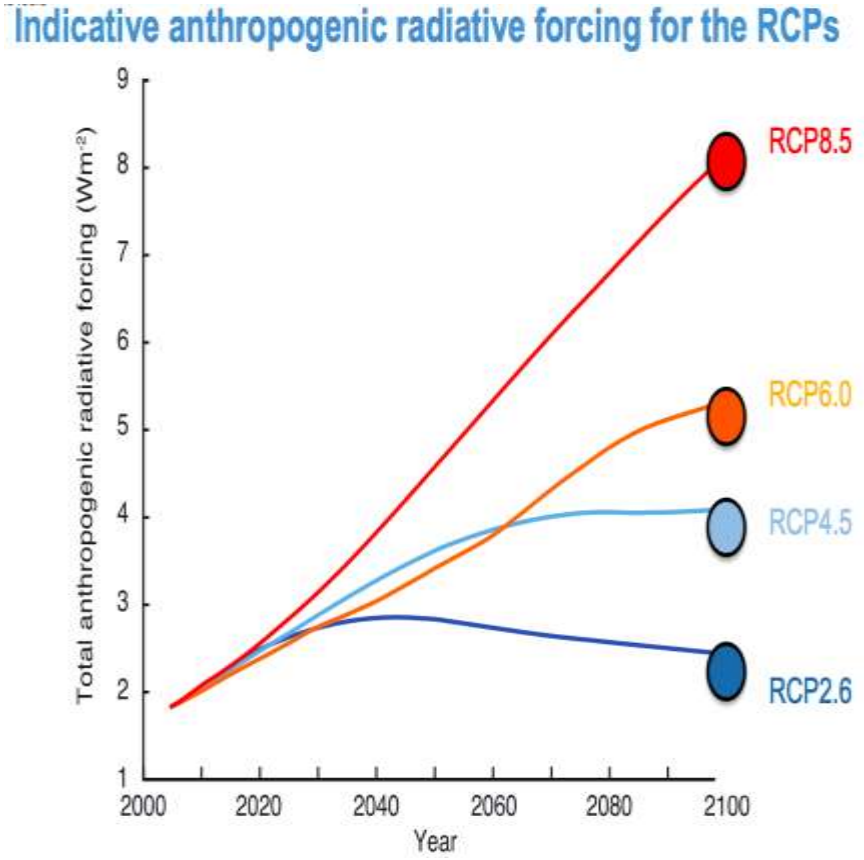
Figure 1 | Projected impacts at 1.5 °C and 2 °C GMT increase above pre-industrial levels for a selection of indicators and regions. a, Increase in global occurrence probability of pre-industrial 1-in-a-1000 day extreme temperature events[7]. **b**, Increase in extreme precipitation intensity (RX5Day) for the global land area below 66° N/S and South Asia[21]. **c**, Red risk of long-term degradation[37]. **e**, Global sea-level rise c yields for present-day tropical agricultural areas[21] (belov increase in CO_2 fertilization (No CO_2). Panels **b**, **c** and **f**

Regional reduction in median water availability for the Mediterranean is found to nearly double from 9% to 17% between 1.5◦C and 2◦C.

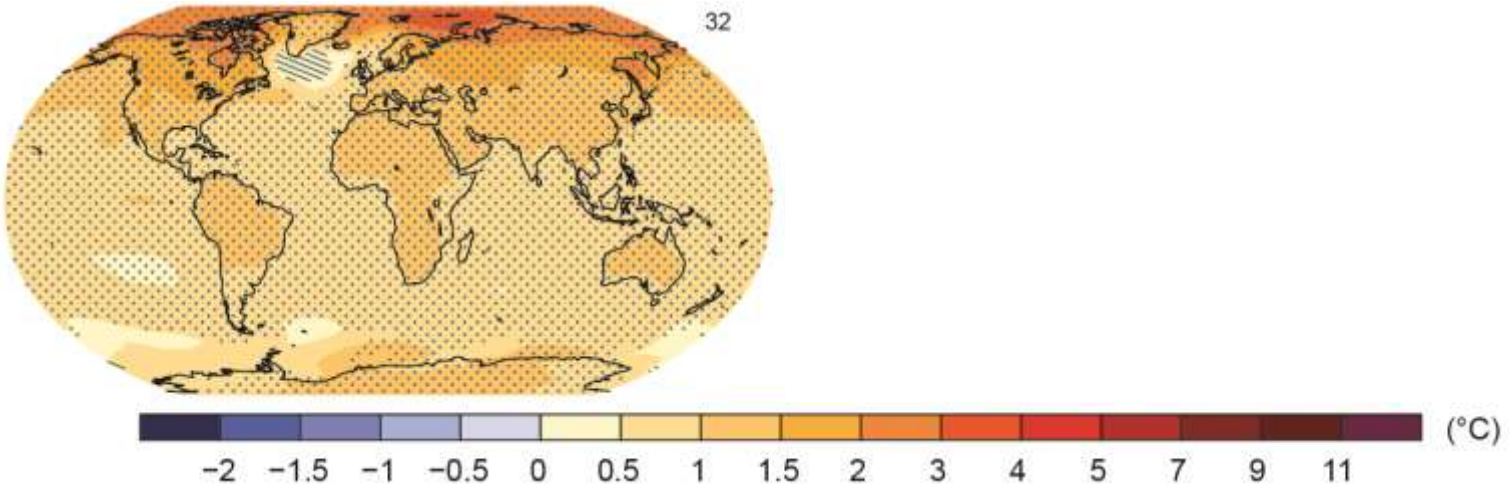
Projected lengthening of regional dry spells increases from 7 to 11%.

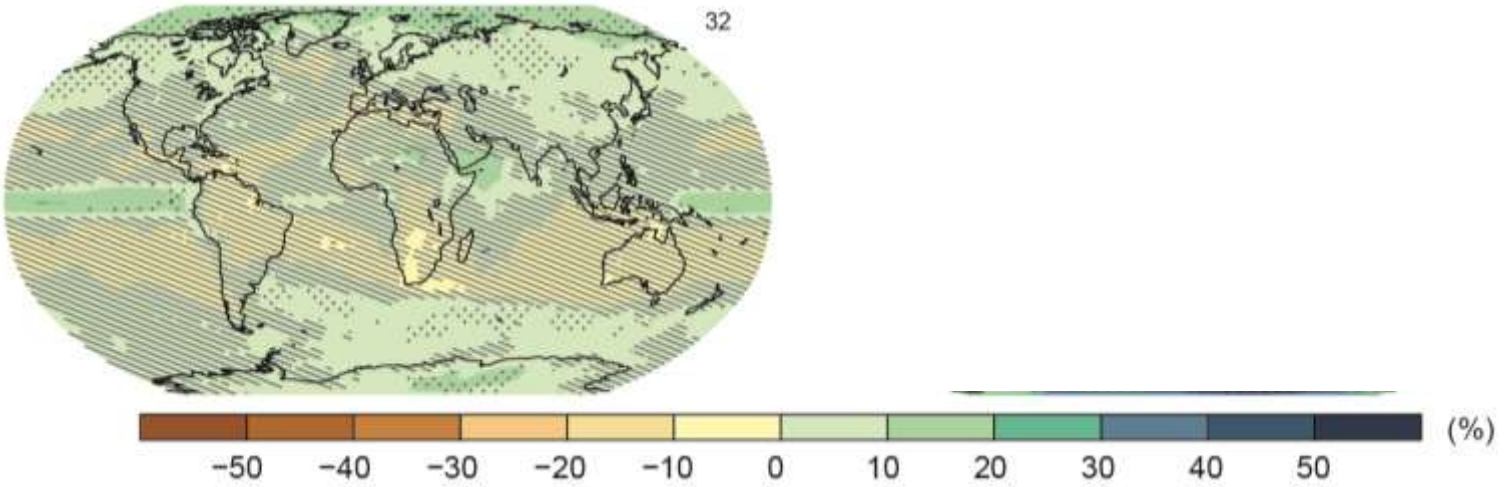
Projecting Future Climate Requires GHG Concentration Pathway

For future climate projections, climate models require Emission Scenarios. Models in AR5 use Representative Concentration Pathway (RCP)



2°C world





IPCC 2013, Fig. SPM.8

2°C world

4.5°C world

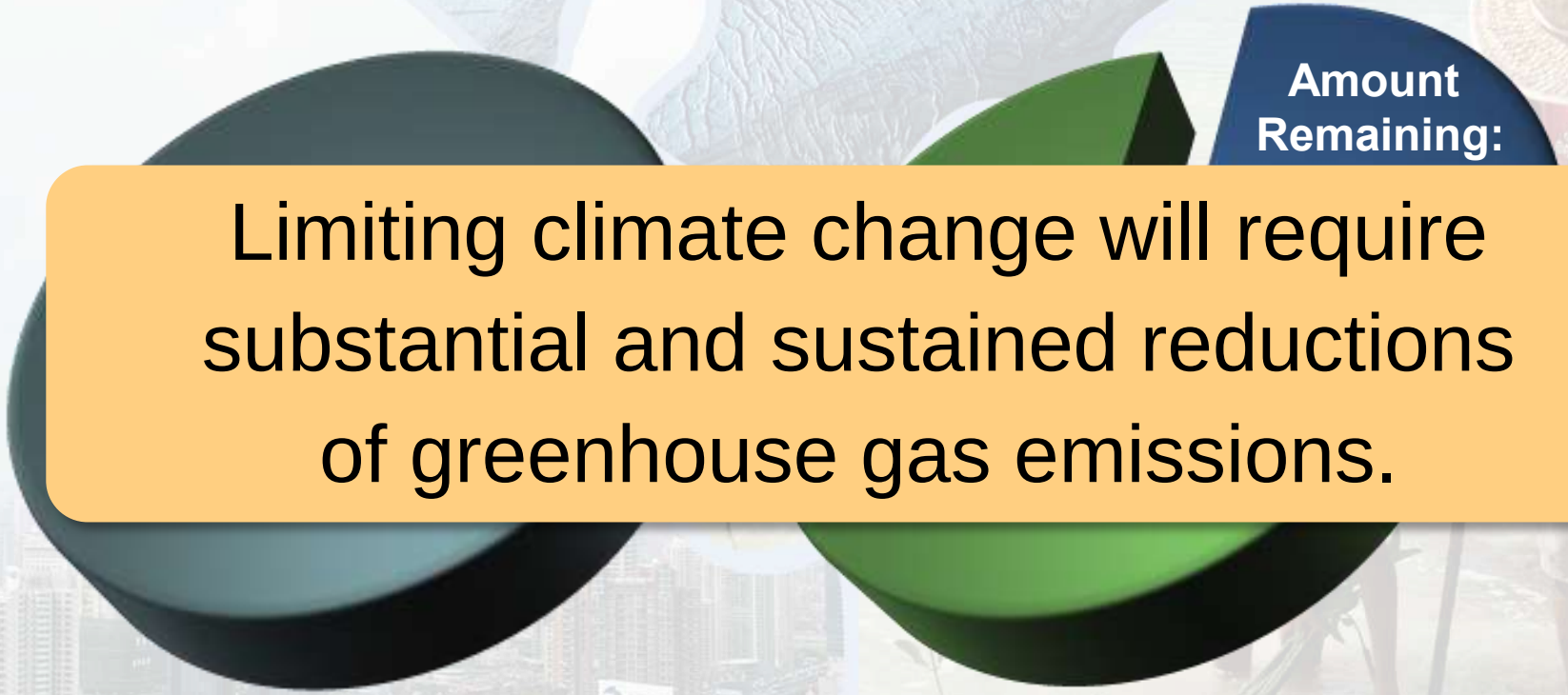
Today we have a choice.

IPCC 2013, Fig. SPM.8

IPCC AR5
Climate C

The window for action is rapidly closing

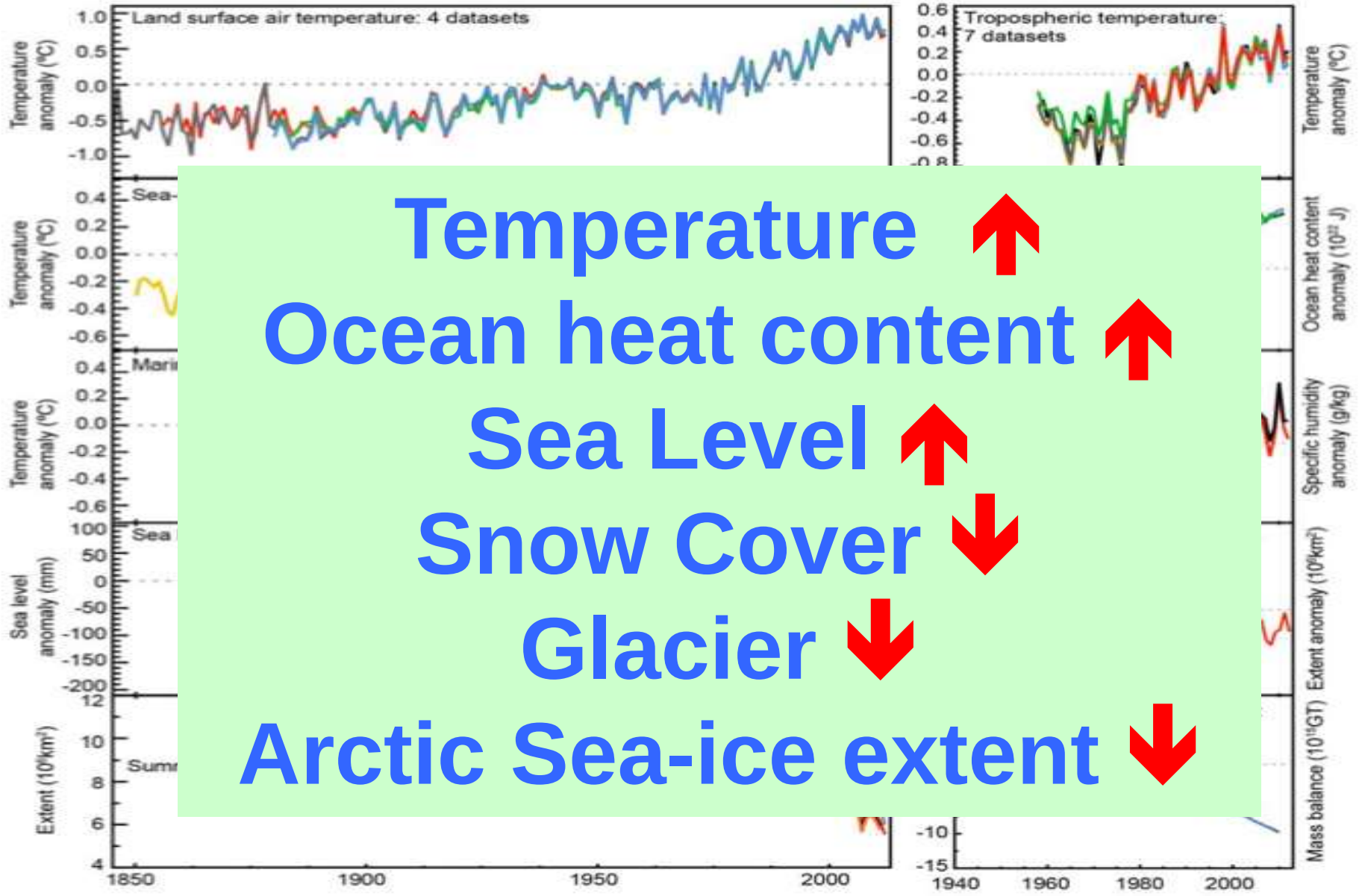
65% of our carbon budget compatible with a 2°C goal already used



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

CO_2 emissions in 2013: ***9.9 GtC***

ipcc
INTERGOVERNMENTAL PANEL ON climate change



Temperature ↑

Ocean heat content ↑

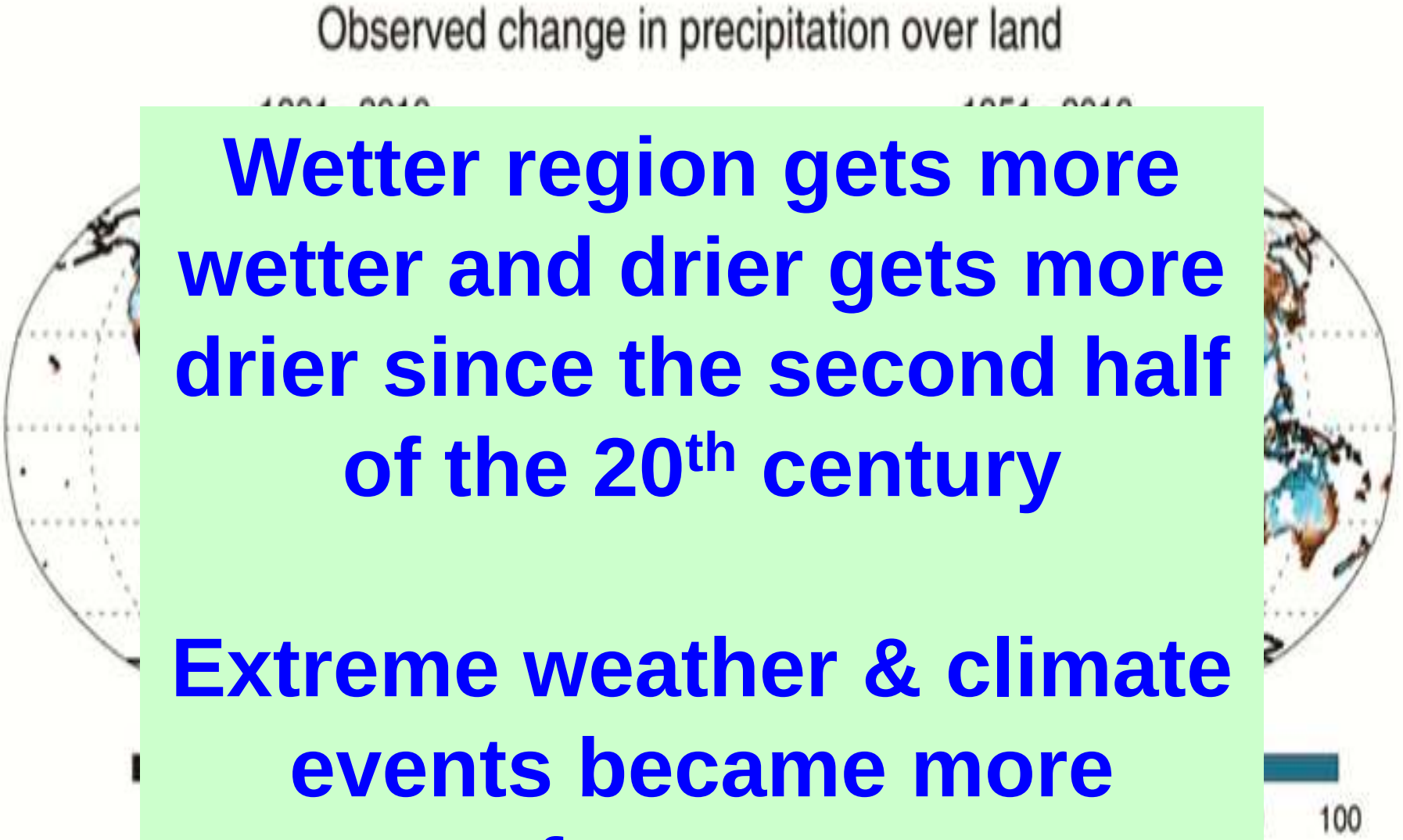
Sea Level ↑

Snow Cover ↓

Glacier ↓

Arctic Sea-ice extent ↓

(IPCC 2013. Fig TS.1)



Wetter region gets more wetter and drier gets more drier since the second half of the 20th century

Extreme weather & climate events became more frequent

(IPCC 2013. Fig SPM.2)

Tropical phenomena: Convergence Zones

Rainfall Change
(*medium confidence*)

"wet-get-wetter" over CZ regions

"warmer-get-wetter" over oceans

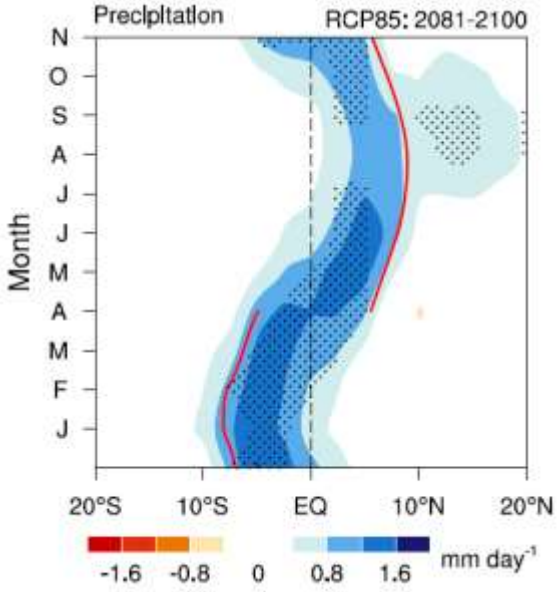


Figure 14.9: Seasonal cycle of zonal-mean tropical precipitation change (2081–2100 in RCP8.5 minus 1986–2005) in CMIP5 multimodel ensemble mean. Eighteen CMIP5 models were used. Stippling indicates that more than 90% models agree on the sign of MME change. The red curve represents the meridional maximum of the climatological rainfall. Adapted from Huang et al. (2013).

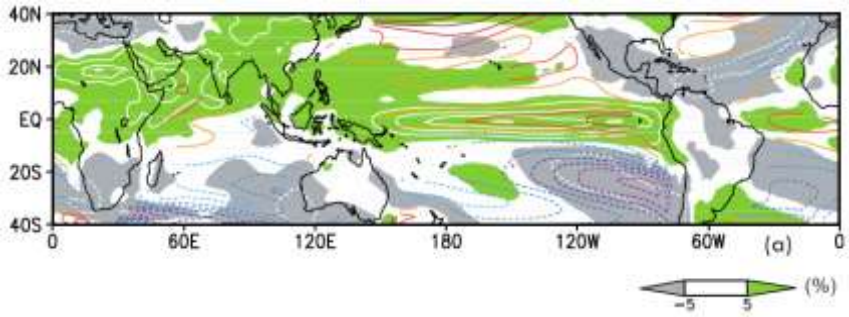
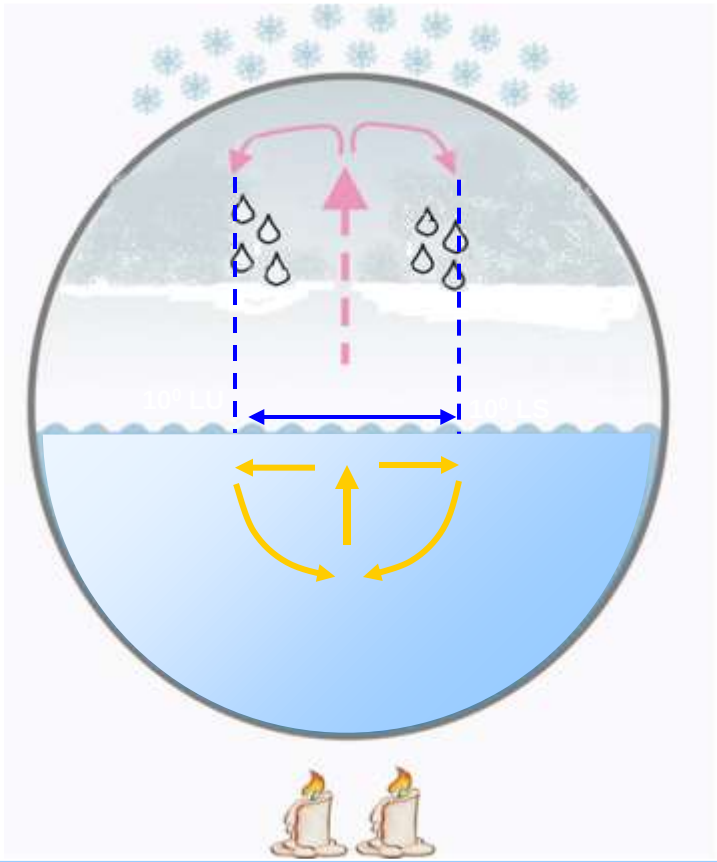


Figure 14.8: Upper panel: Annual-mean precipitation percentage change (ΔP/P in green/gray shade and white contours at 20% intervals), and relative SST change (colour contours at intervals of 0.2°C; negative shaded) to the tropical (20S–20N) mean warming in RCP8.5 projections, shown as 23 CMIP5 model ensemble mean.

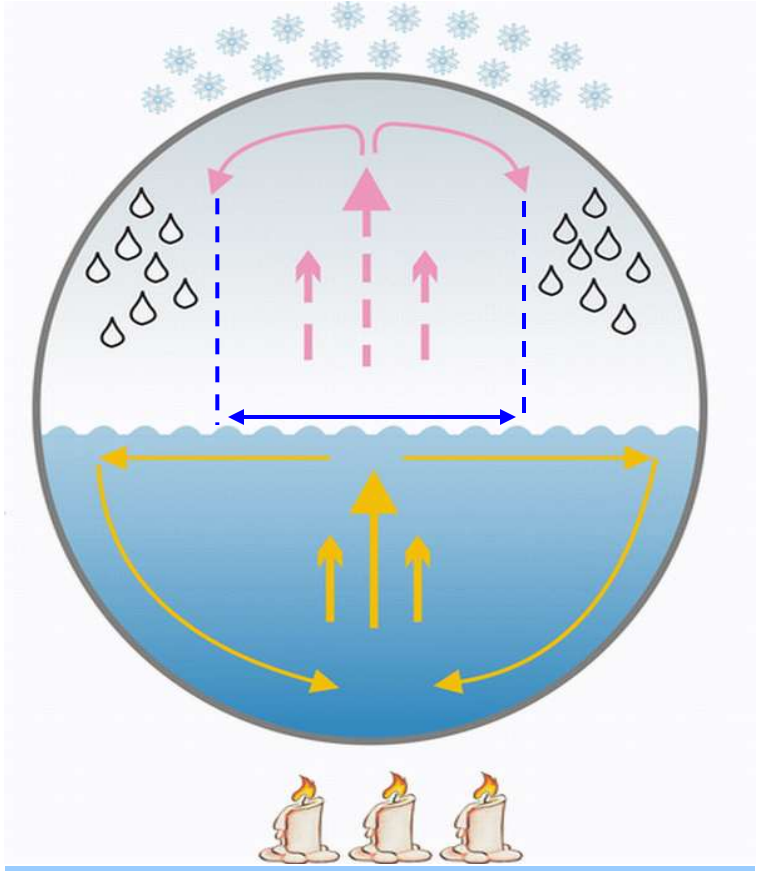
The seasonal-mean rainfall is projected to increase on the ITCZ equatorward flank

More warming and rainfall at north of the equator. Less zonal SST gradient across the equatorial Pacific that contribute to the weakened Walker cells.

EXPANSION OF TROPICS DUE TO CLIMATE CHANGE?



PRISTINE CLIMATE



WARMING CLIMATE

- **tropical** climate will be **wetter (2015** and extreme year without dry season **2016)**
- **Sub tropical** climate will be **tropical climate like**
- **Faster** water cycle circulation
- Extreme weather will be usual and more **dry PERIOD**(2003; 2005; 2007; 2008)

Annex I: Atlas of Global and Regional Climate Projections

- **35 regions**
- **42 global climate models**
- **2 variables**

  Temperature, Precipitation

- **4 scenarios**

  RCPs 2.6, 4.5, 6.0, 8.5

- **2 seasons**

  temp: DJF, JJA (for temp)
  precip: AMJJAS, ONDJFM

- **Maps for 3 time horizons**

  2016-35, 2046-65, 2081-2100
  reference period 1986-2005

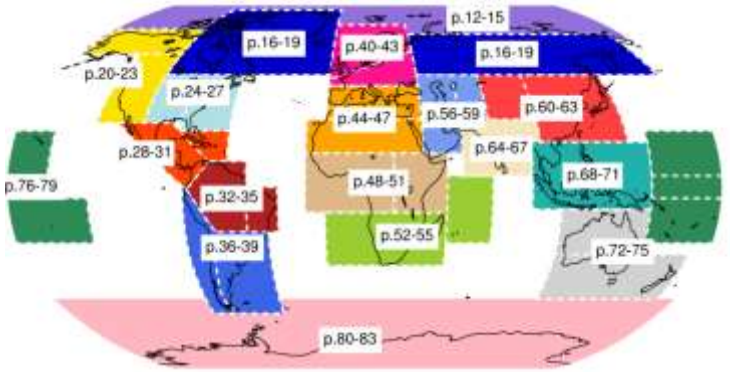
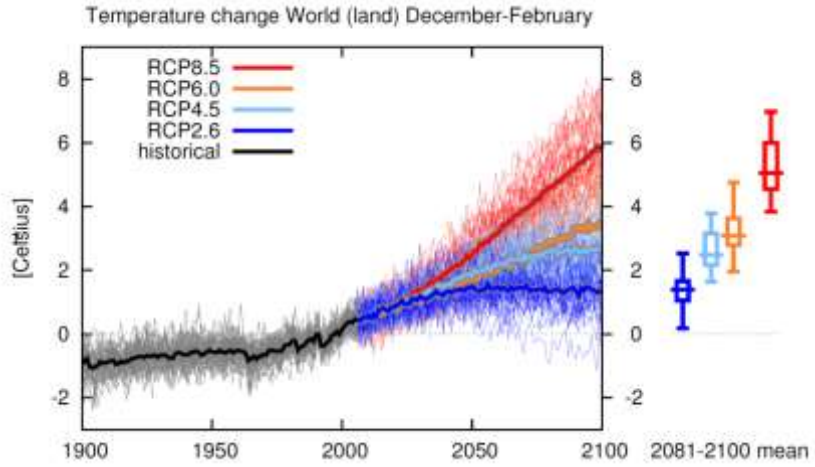


Fig. AI.3



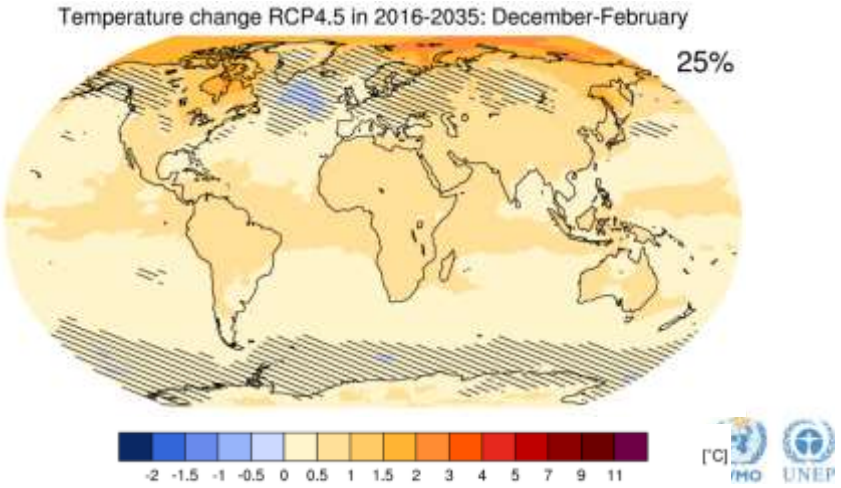
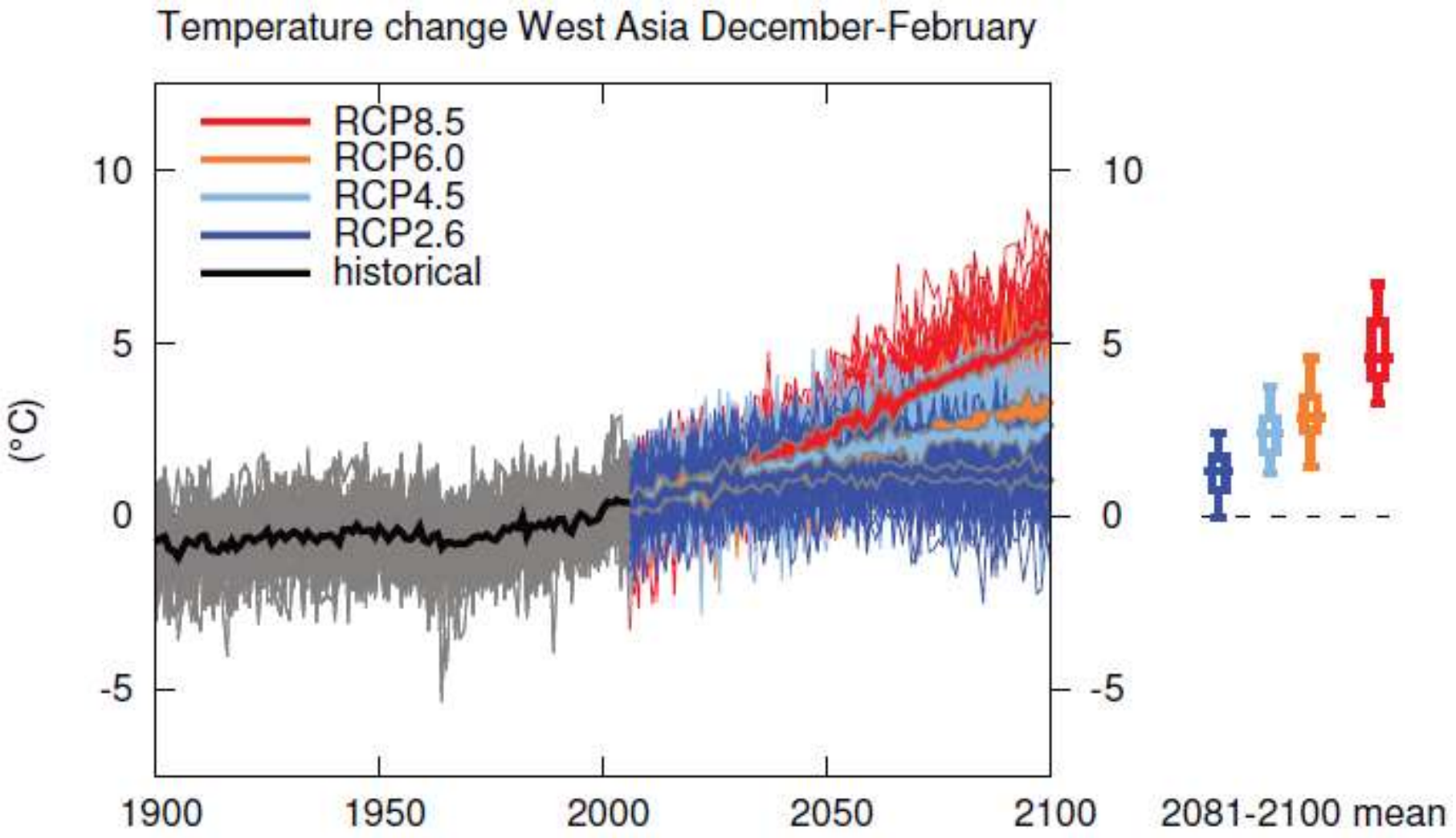
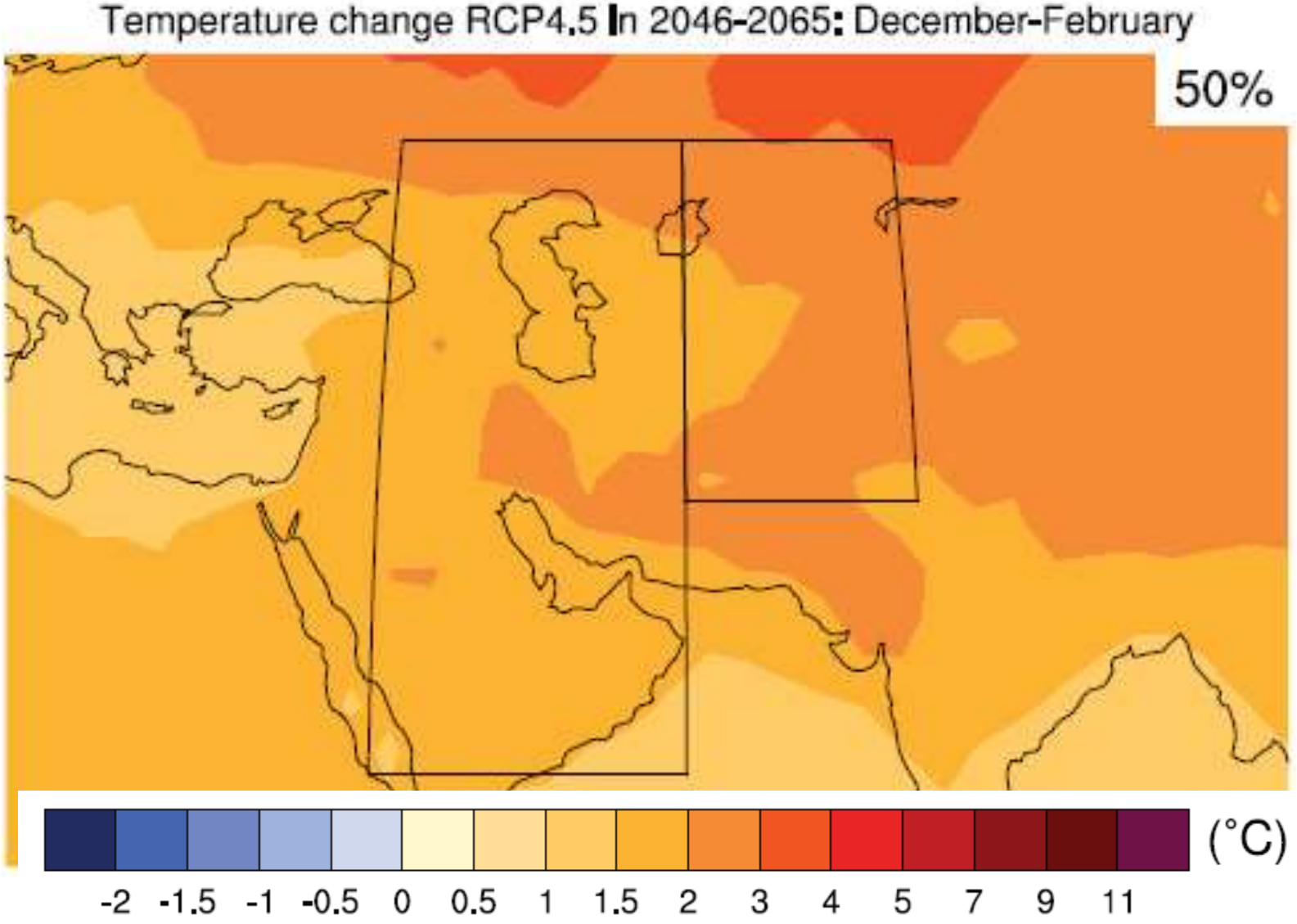


Fig. AI.4

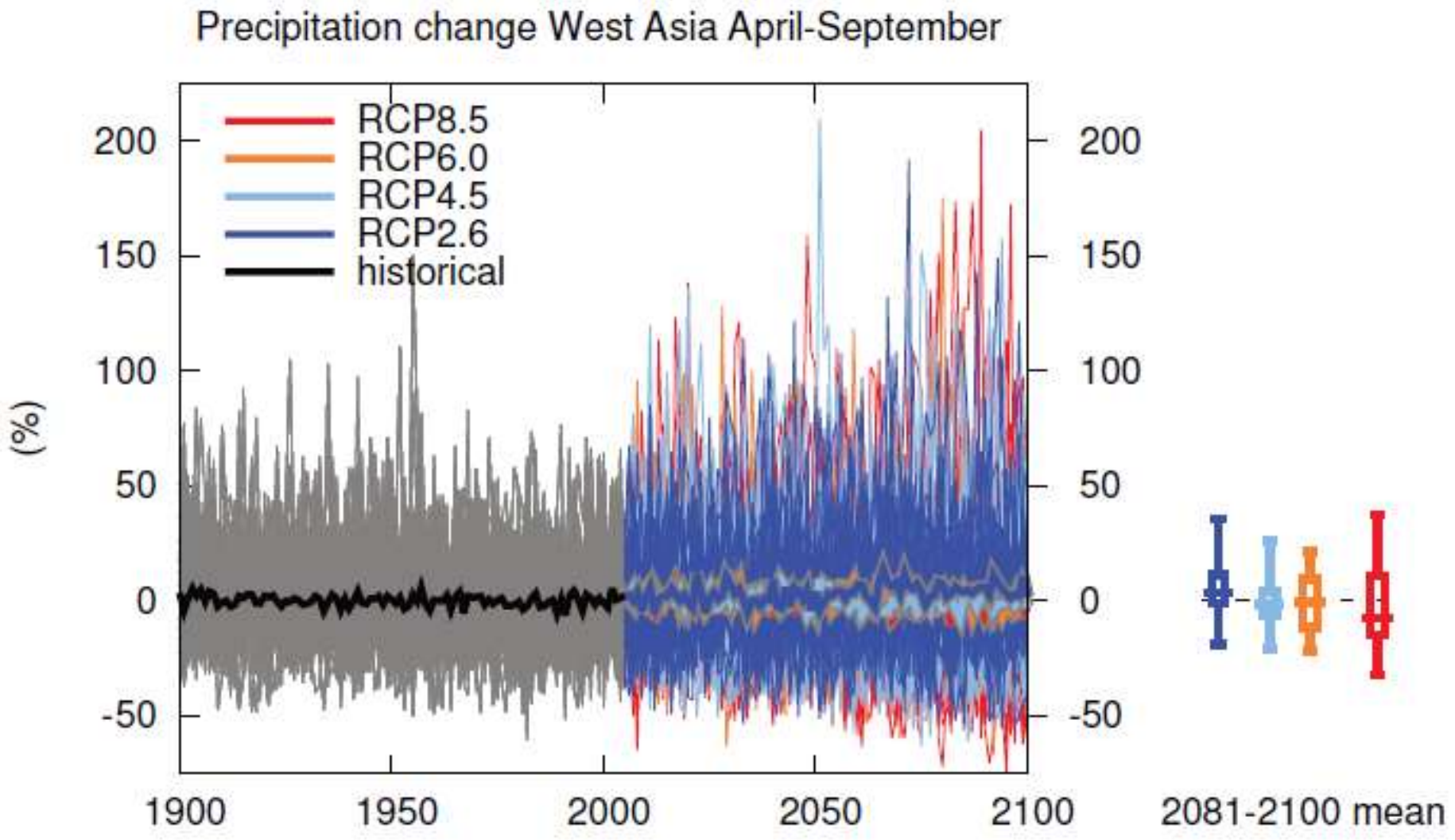
Temperature Change Graph – West Asia



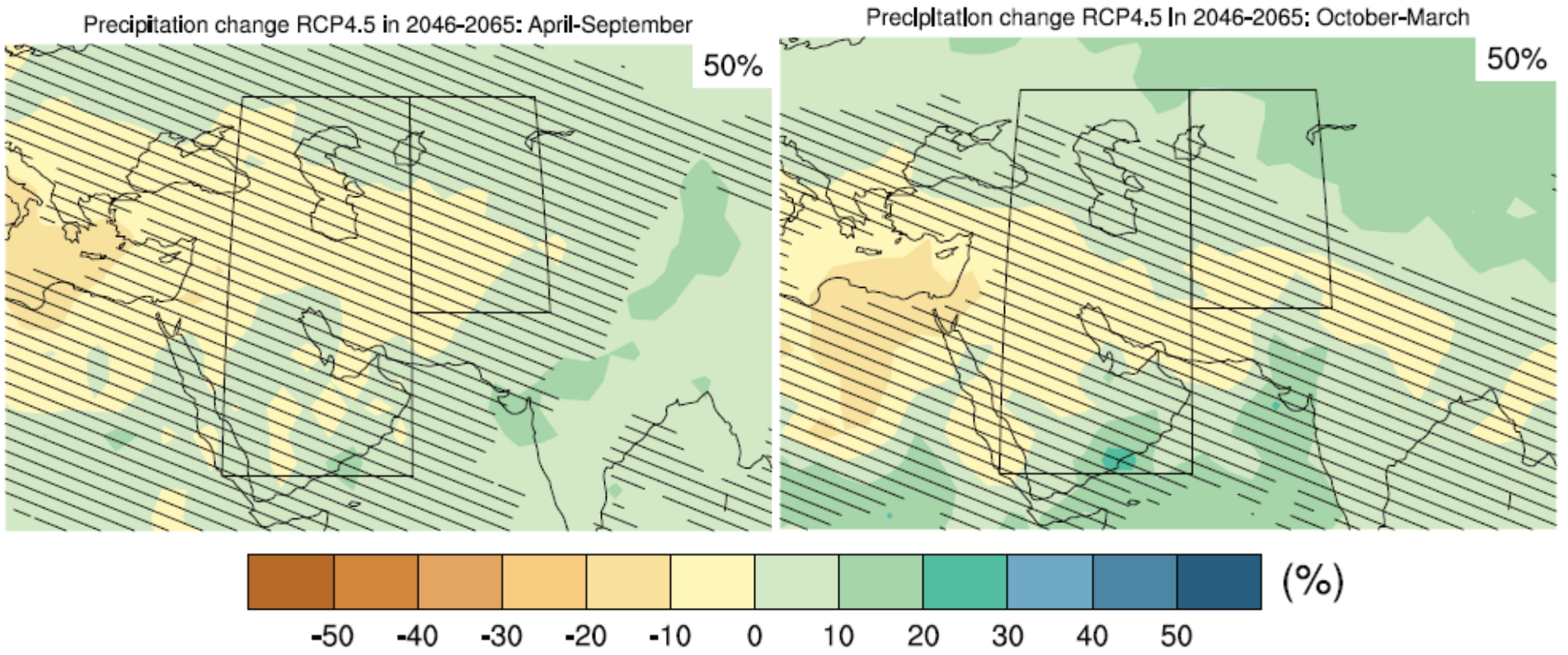
Temperature Change Map West Asia – RCP4.5



Rainfall Change Graph – West Asia



Rainfall Change Maps West Asia - RCP4.5



WGI Outline

Summary for Policy Makers

Technical Summary

Chapter 1: Framing, context, methods

Chapter 2: Changing state of the climate system

Chapter 3: Human influence on the climate system

Chapter 4: Future global climate: scenario-based projections and near-term information

Chapter 5: Global carbon and other biogeochemical cycles and feedbacks

Chapter 6: Short-lived climate forcers

Chapter 7: The Earth's energy budget, climate feedbacks, and climate sensitivity

Chapter 8: Water cycle changes

Chapter 9: Ocean, cryosphere, and sea level change

Chapter 10: Linking global to regional climate change

Chapter 11: Weather and climate extreme events in a changing climate

Chapter 12: Climate change information for regional impact and for risk assessment

Annexes incl. options for a Regional Atlas and Technical Annexes

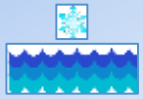
Glossary, Index

Sept 2018

Global warming of 1.5 °C

Fall 2019

Oceans and cryosphere



April 2021

The Physical Science Basis

October 2021

Climate Change Impacts, Adaptation and Vulnerability

April 2022

The Synthesis Report

Dialogue facilitateur UNFCCC

Land Use

Fall 2019

Mitigation of Climate Change

July 2021

Inventaire global 2023 UNFCCC

THANK YOU FOR YOUR ATTENTION!

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IPCC Secretariat: ipcc-sec@wmo.int
IPCC Press Office: ipcc-media@wmo.int

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https://vimeo.com/ipcc

INTERGOVERNMENTAL PANEL ON Climate Change