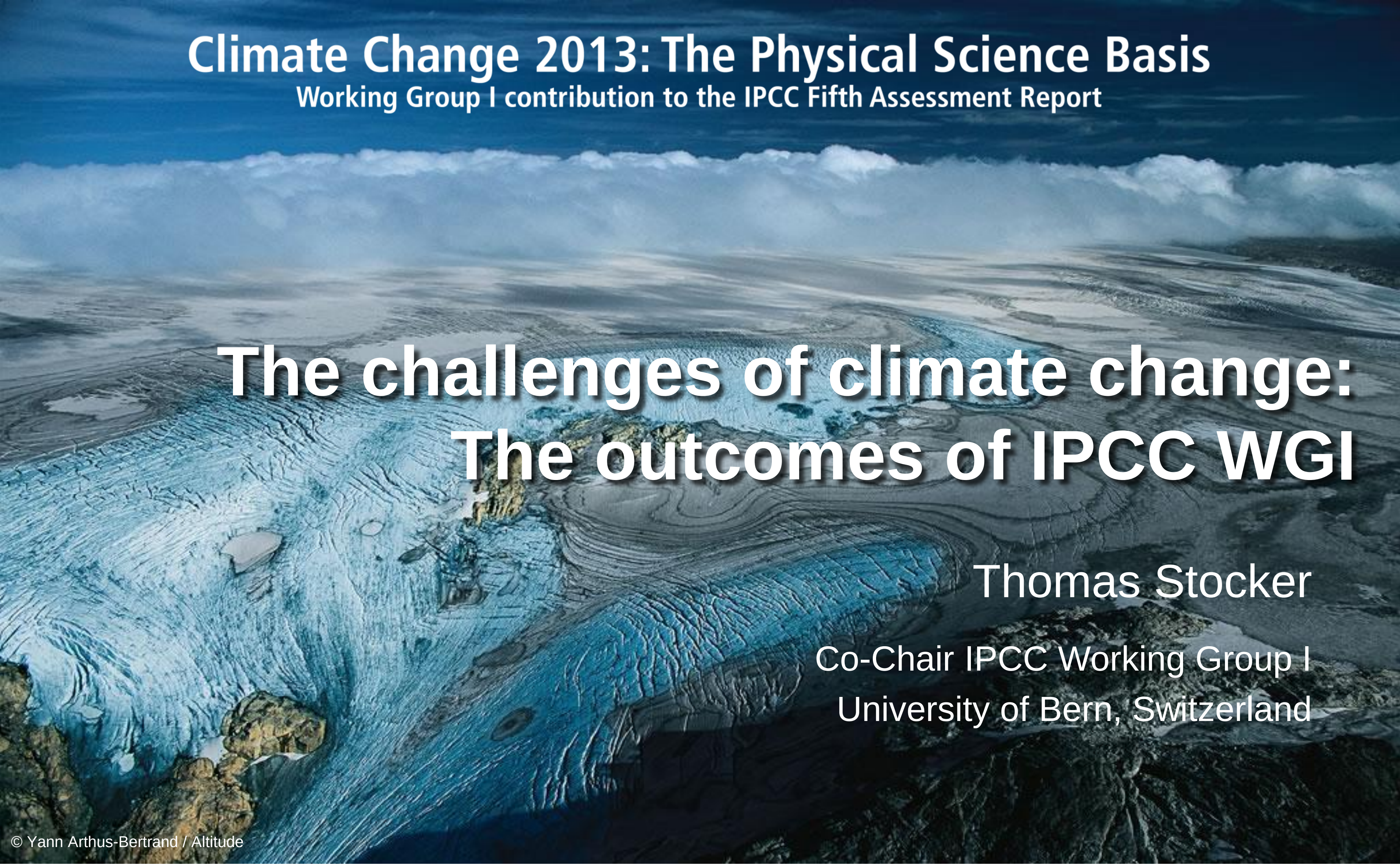


Climate Change 2013: The Physical Science Basis

Working Group I contribution to the IPCC Fifth Assessment Report

The challenges of climate change: The outcomes of IPCC WGI

Thomas Stocker

Co-Chair IPCC Working Group I

University of Bern, Switzerland

ipcc INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Key SPM Messages

19 Headlines

on less than 2 Pages

Summary for Policymakers

14,000 Words

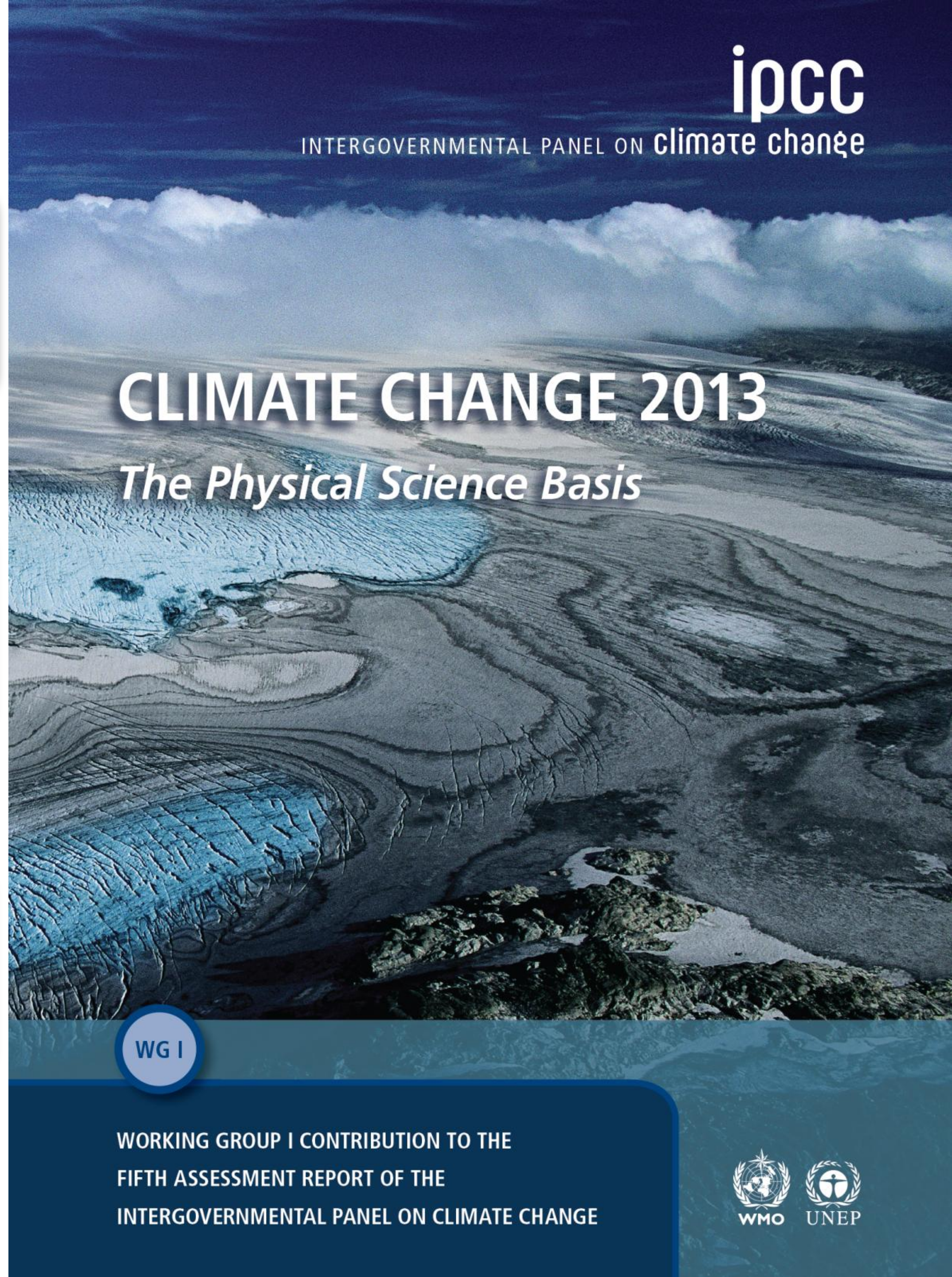
14 Chapters & Atlas

1,100,000 Words

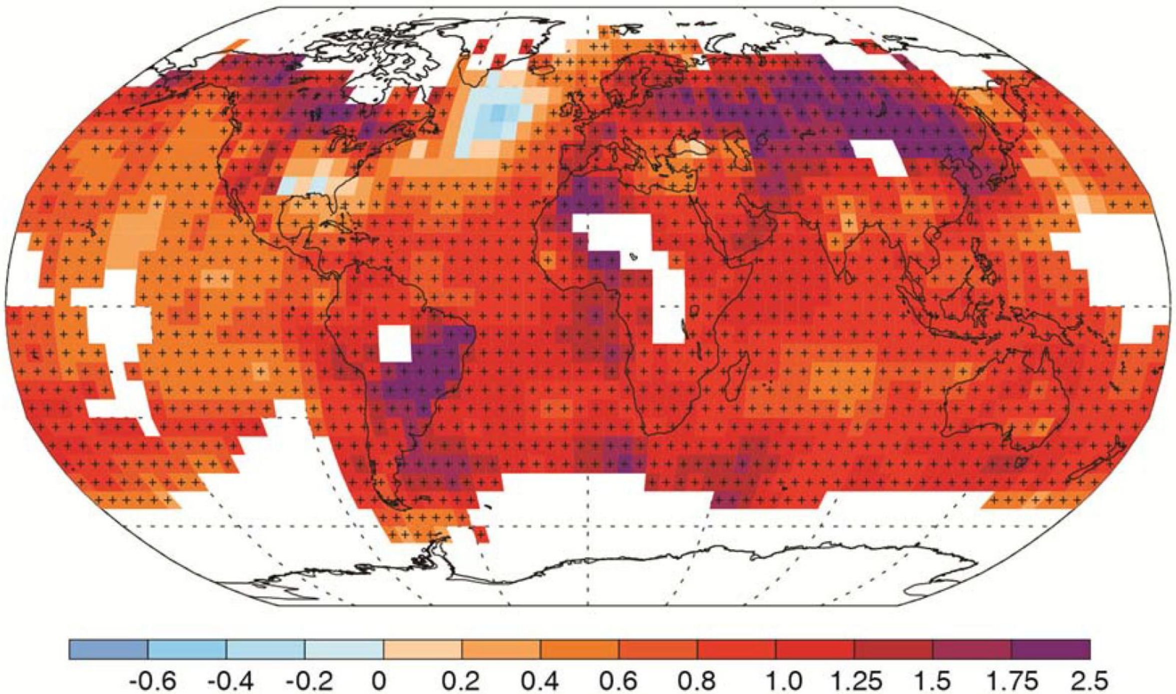
Observations

Understanding

Future

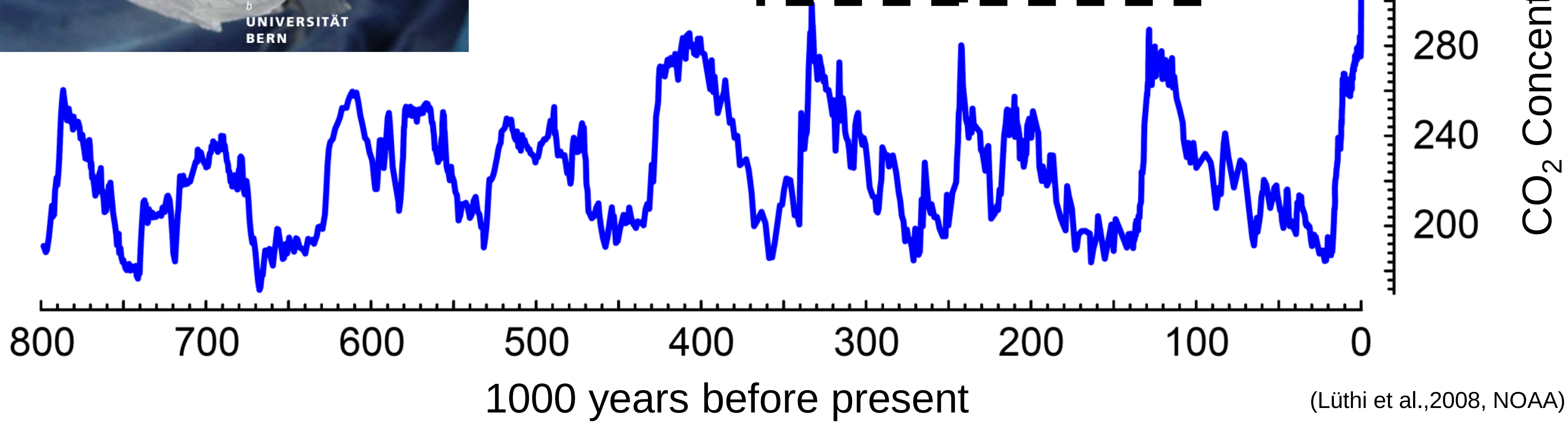


IPCC 2013, Fig. SPM.1b

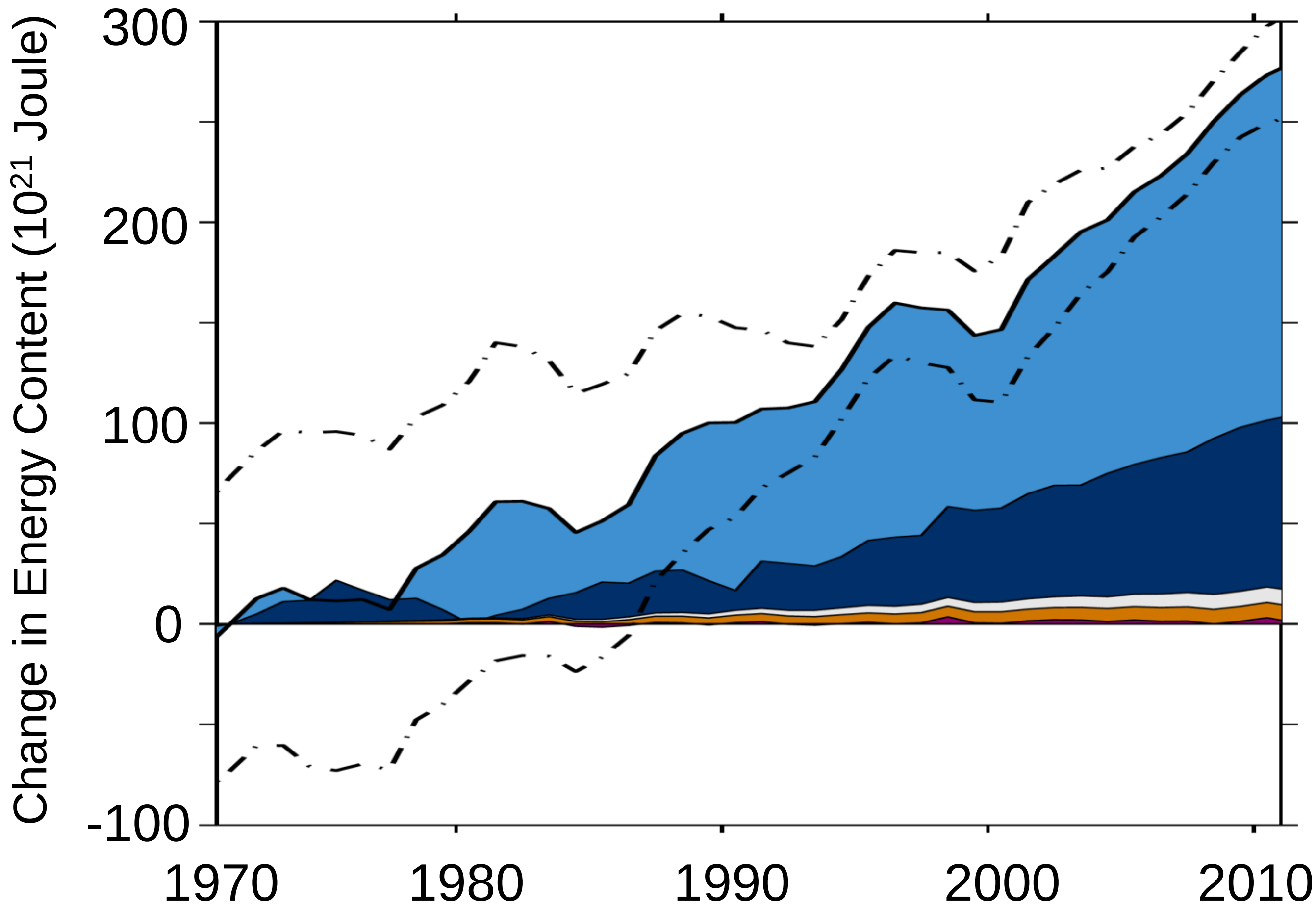


Temperature Difference 1901 to 2012 based on trend (°C)

Warming of the climate system is unequivocal

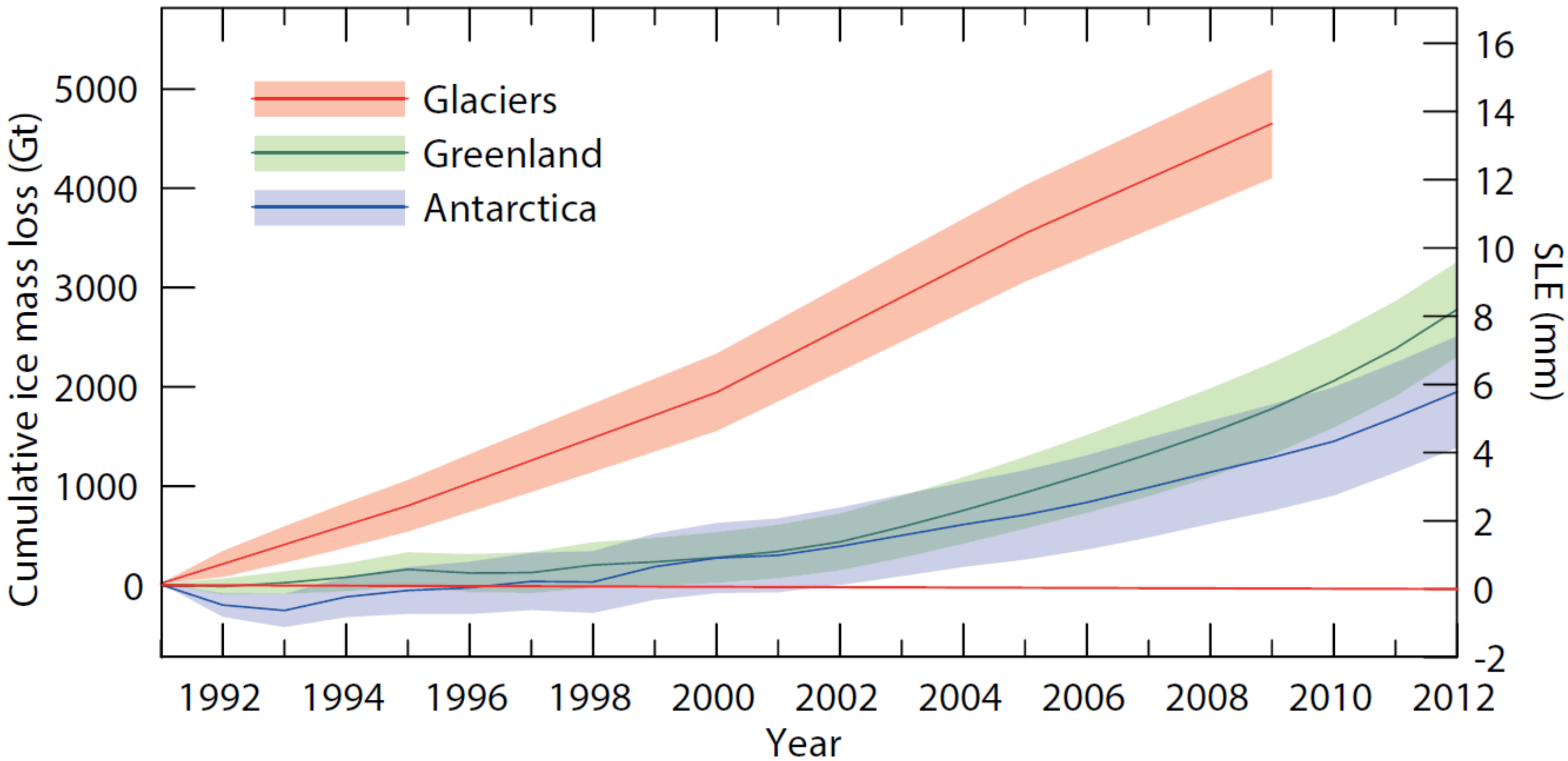


The concentrations of CO_2 have increased to levels unprecedented in at least the last 800,000 years.



IPCC 2013, Box 3.1, Fig. 1, modified

IPCC AR5 WGI: Closed energy budget



IPCC 2013, Fig. TS.3

IPCC AR5 WGI: Closed sea level budget

Understanding

Causes of the observed changes

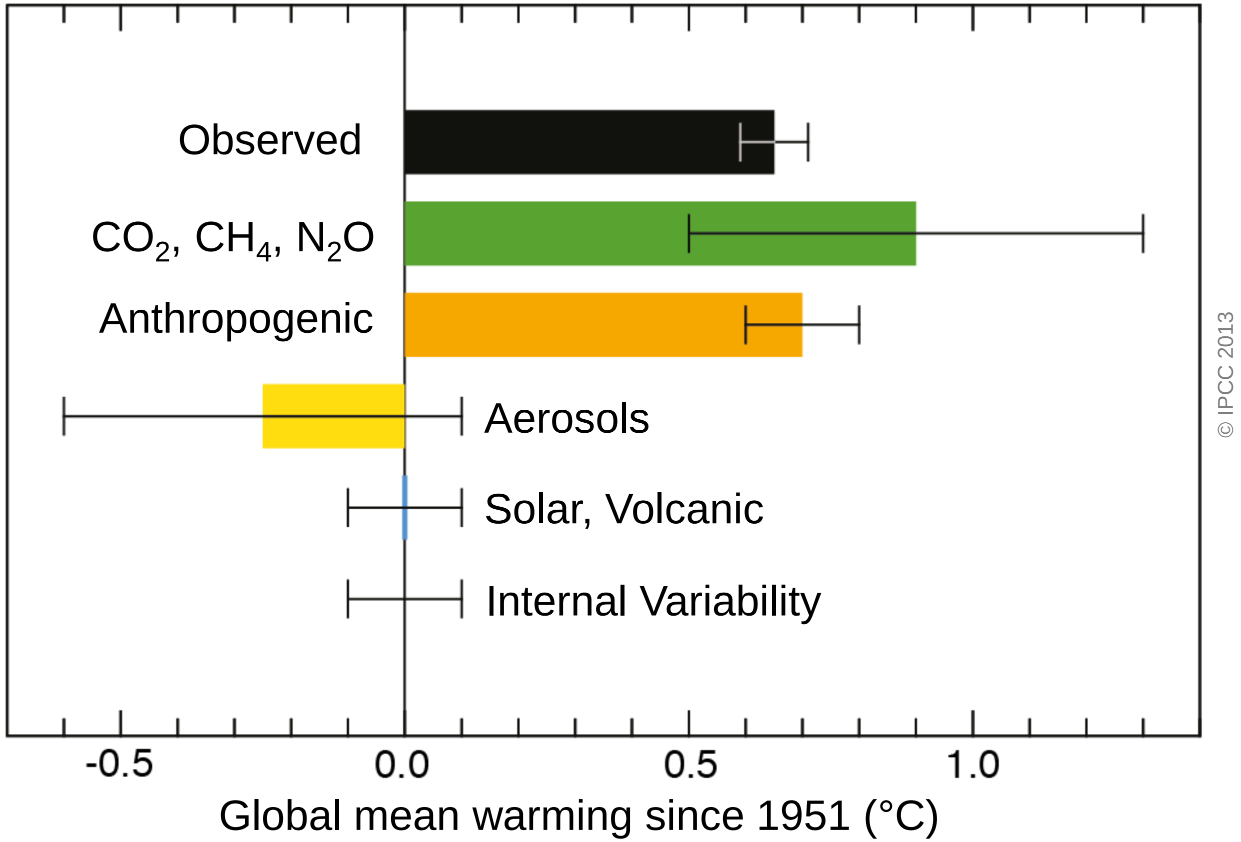
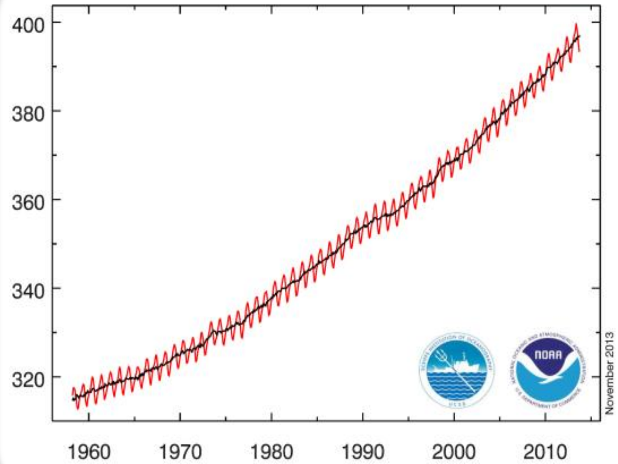


Fig. TS.10

It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century.

Worldwide Effects

Cause



atmosphere, land, ocean

extreme events

water cycle

sea ice, glaciers, ice sheets

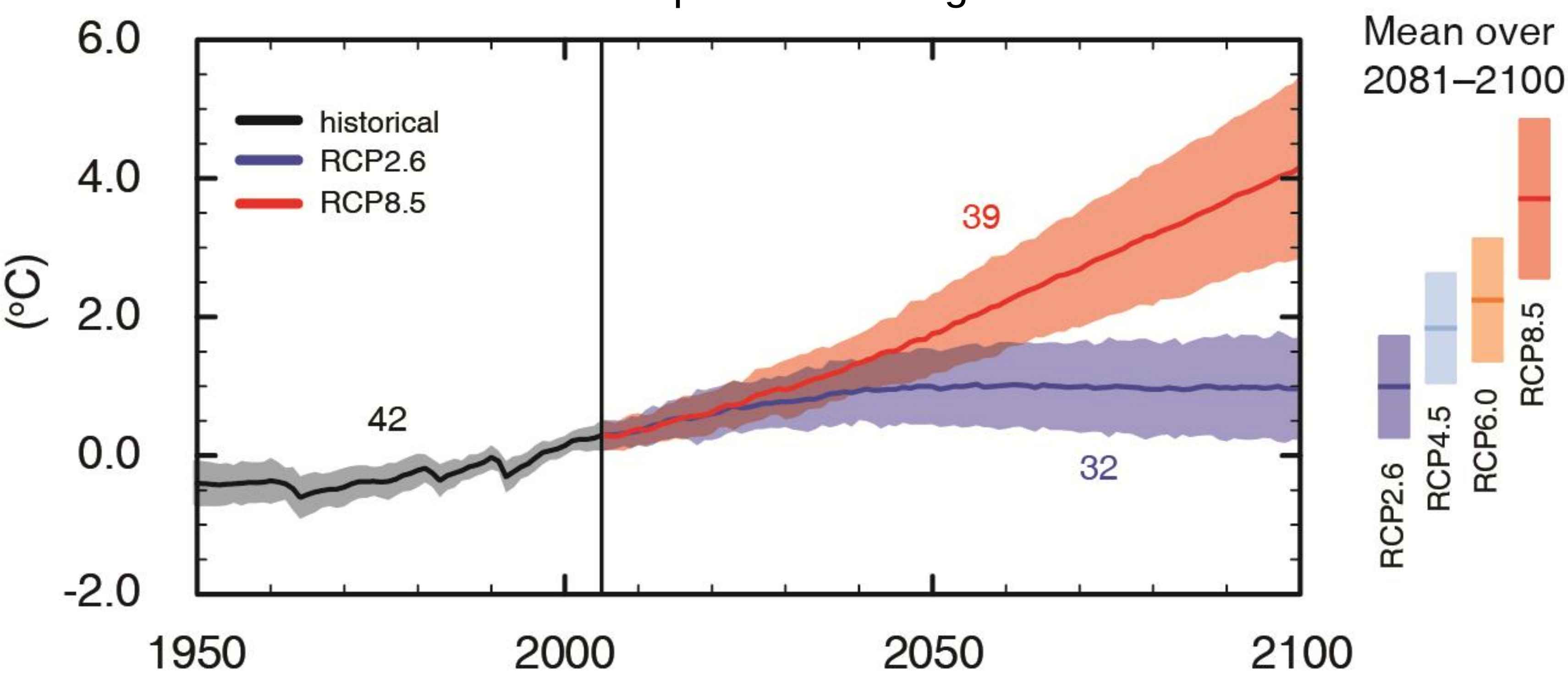
global mean sea level

Human influence on the climate system is clear.

Future

Projections of many future climates

Global mean surface temperature change from 1986-2005



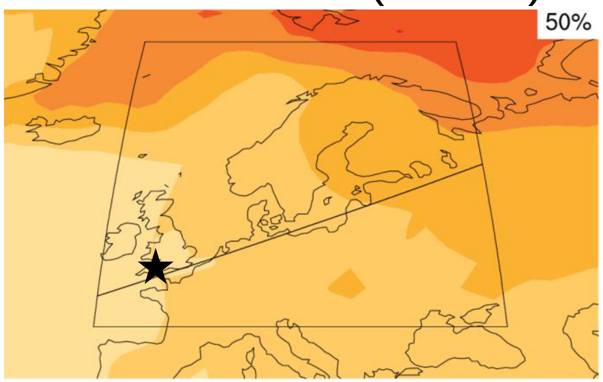
IPCC 2013, Fig. SPM.7a

Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850−1900 for all scenarios except RCP2.6.

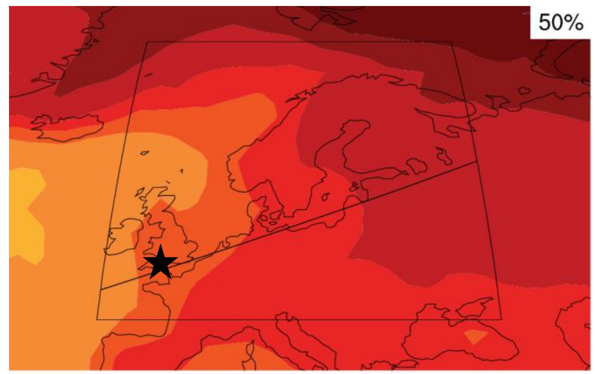
IPCC 2013: Atlas of Global and Regional Climate Projections

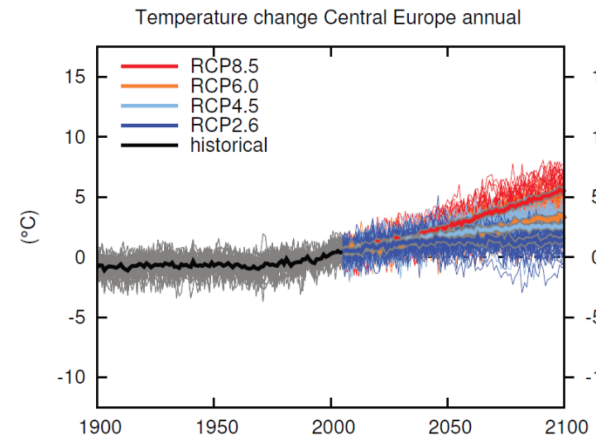
Regional Changes in Europe (2081-2100)

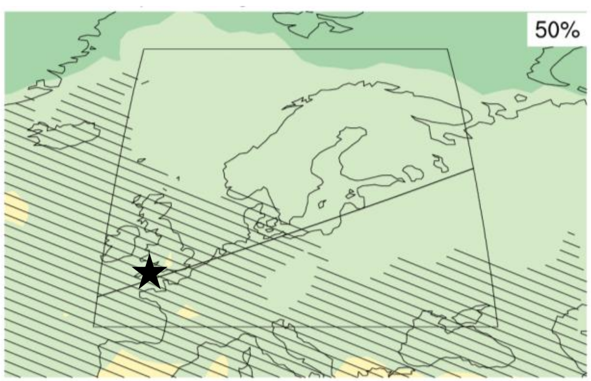
RCP 2.6 (annual)

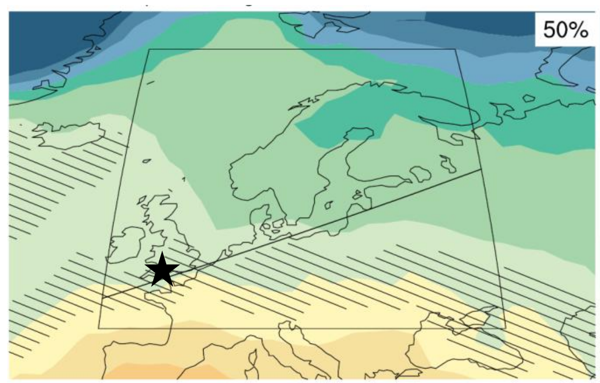


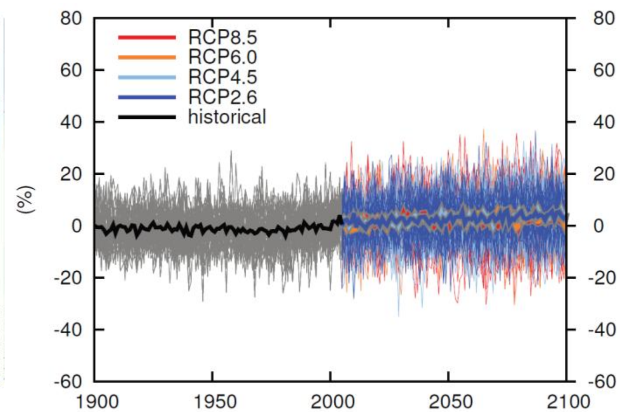
RCP 8.5 (annual)



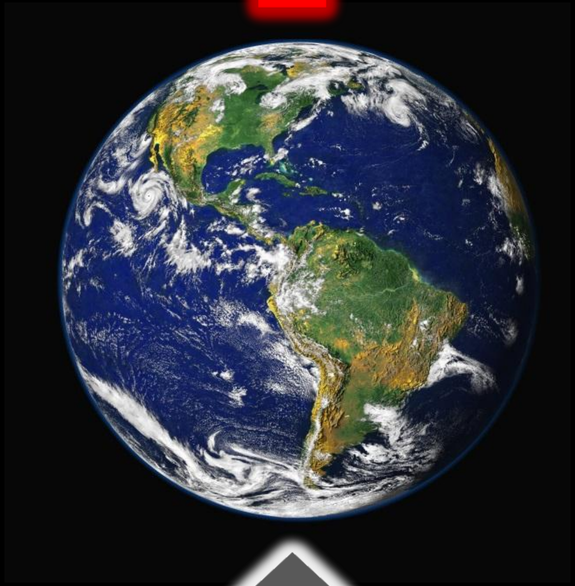








Global mean warming

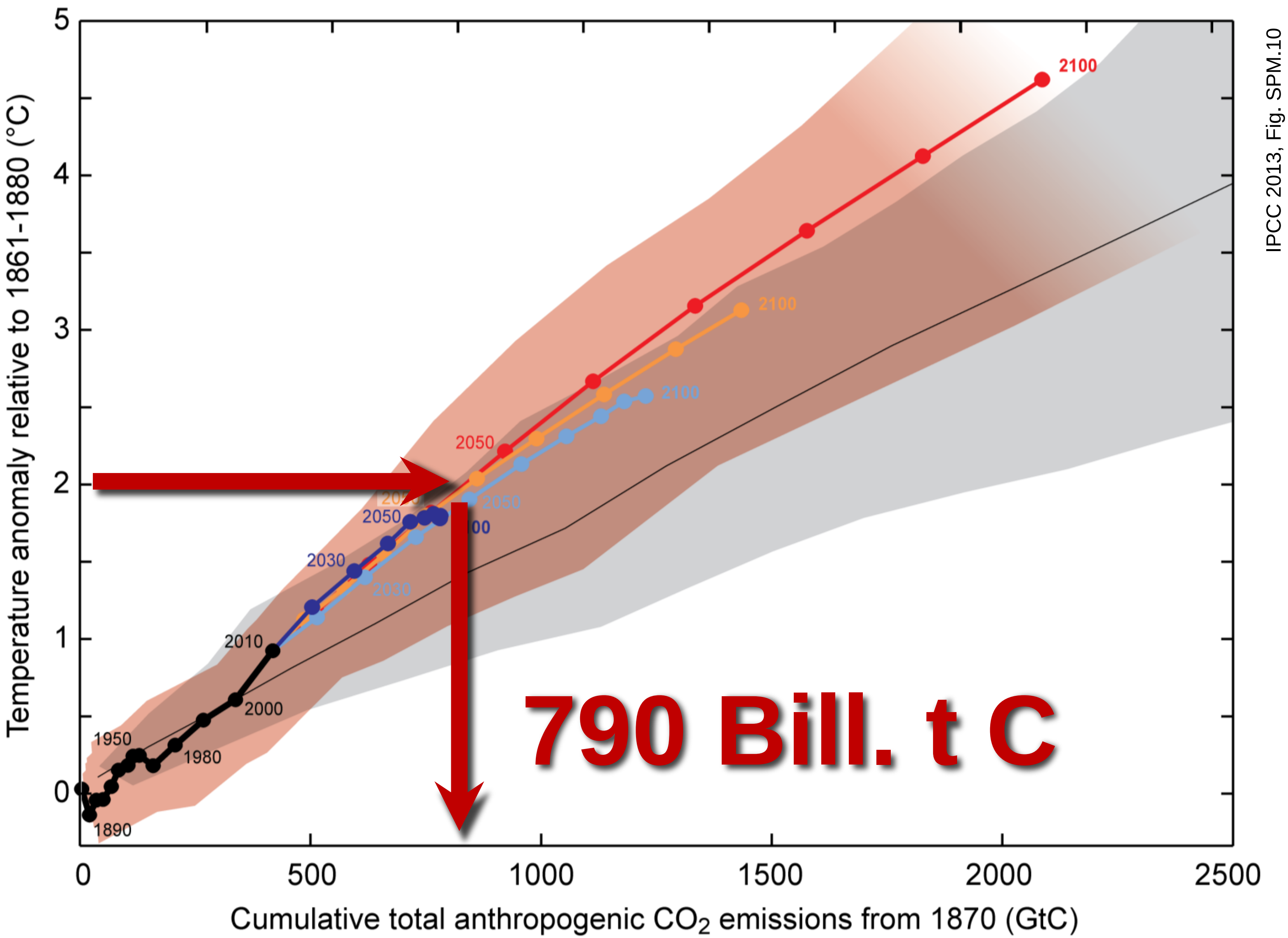


All CO_2 emissions since 1750

Warming of 0.8 to 2.5°C

Any **climate target** implies a limited **carbon budget**

1000 billion tons of carbon

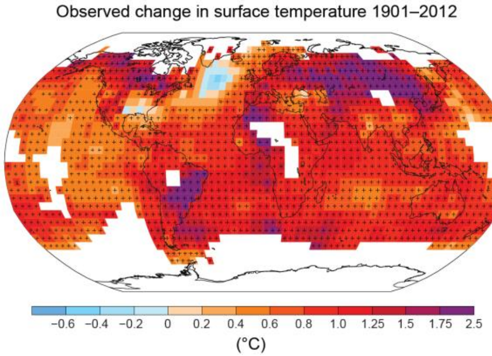


5
4
3
2
1
0
Temperature anomaly relative to 1861-1880 (°C)
0
500
1000
1500
2000
2500
Cumulative total anthropogenic CO_2 emissions from 1870 (GtC)
2100
2100
2100
2050
2050
2050
2030
2030
2010
2000
1980
1950
1890
790 Bill. t C
IPCC 2013, Fig. SPM.10

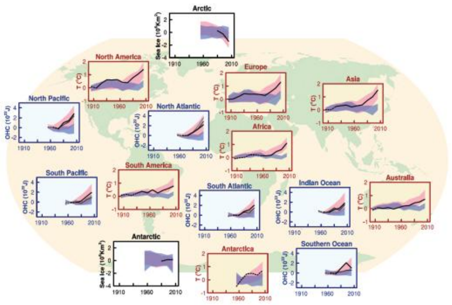
Budget for 2°C target:	790 bill t C
CO_2 emissions until 2013:	−535 bill t C
Remaining emissions:	**255 bill t C**

CO_2 emissions in 2013: ***9.9 bill t C***

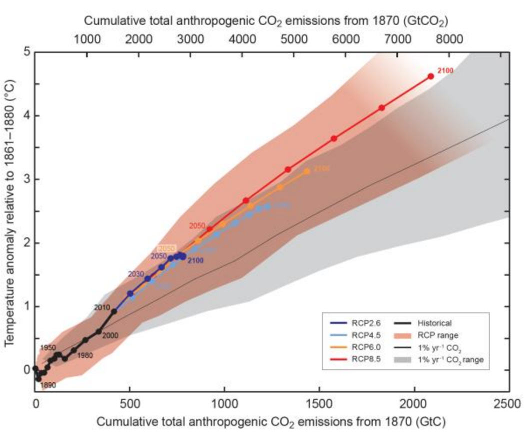
Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.



Warming of 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.

Future Challenges

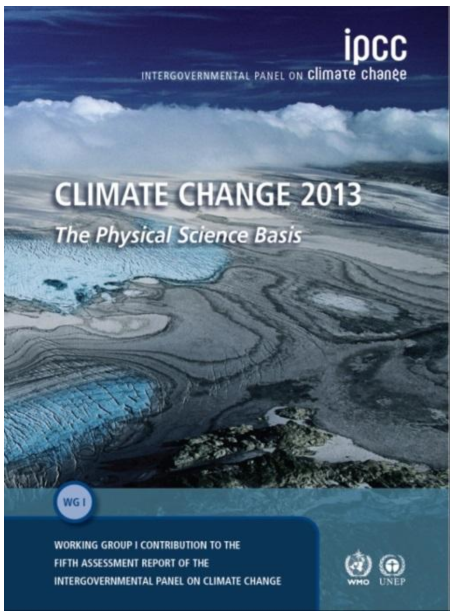
Climate research and assessment

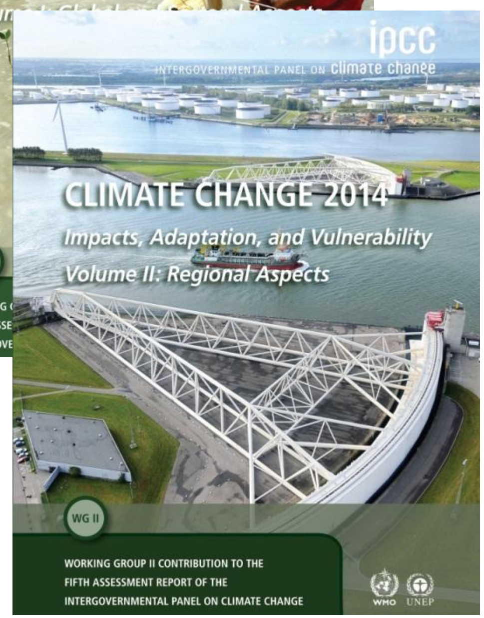
Challenges for climate research and assessment:

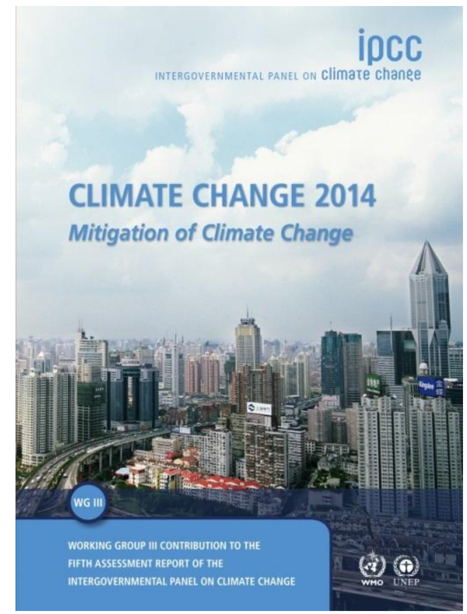
Logistic challenges:

- Maintenance and upgrade of high-quality, high-density **observation networks**
- Accessibility and manageability of massive amounts of numerical data from of **climate model simulations**
- Role of climate science in the new **Future Earth** programme
- Climate research in the regions: capacity still limited inspite of many years of **capacity building**

Increase institutional support of scientific assessment work







Challenges for climate research and assessment:

Scientific challenges (1/2):

- **Regional modelling** with a focus on the water cycle
- **Statistics** of extreme events, quantification of the tails
- **Detection and Attribution of regional changes**
- Spatial quantification of **vulnerability and exposure** for a well chosen set or variables
- Coupling of **economic models** using approaches compatible with the physical sciences

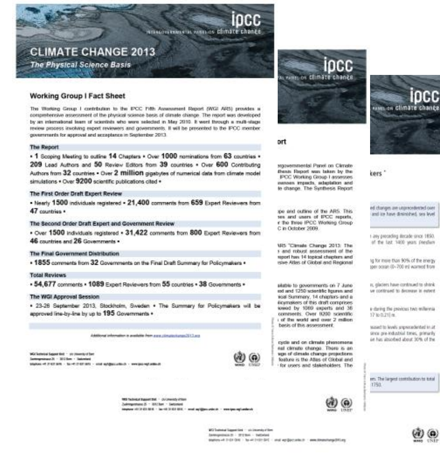
Challenges for climate research and assessment:

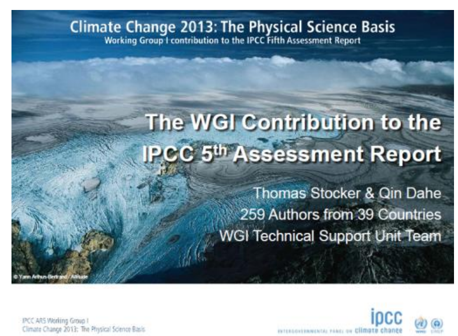
Scientific challenges (2/2):

- Coordinated **model intercomparison projects (MIP)** across the topics of the three IPCC WGs
- **RMIP**: Regional MIP — **WGI, WGII**
- **VXMIP**: MIP on vulnerability and exposure — **WGII**
- **EMIP**: Economic MIP — **WGI, WGIII**

Maintain a high level of curiosity-driven research

www.climatechange2013.org





IPCC AR5 Working Group I
Climate Change 2013: The Physical Science Basis

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Full report and further information

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