Transformational
Climate Science

The future of climate change research following the IPCC Fifth Assessment Report

www.exeter.ac.uk/climate2014
Working Group I

The challenge of climate change

#climate2014
The challenge of climate change

Professor Thomas Stocker
Co-Chair of Working Group I
The challenges of climate change: The outcomes of IPCC WGI

Thomas Stocker
Co-Chair IPCC Working Group I
University of Bern, Switzerland
Warming of the climate system is unequivocal

IPCC 2013, Fig. SPM.1b

Temperature Difference 1901 to 2012 based on trend (°C)
The concentrations of CO$_2$ have increased to levels unprecedented in at least the last 800,000 years.
IPCC AR5 WGI: Closed energy budget
IPCC AR5 WGI: Closed sea level budget
Understanding

Causes of the observed changes
It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
Human influence on the climate system is clear.
Future

Projections of many future climates
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 CO₂ emissions since 1750
Global mean warming

All CO₂ emissions since 1750
Warming of 0.8 to 2.5°C

Any climate target implies a limited carbon budget

1000 billion tons of carbon
790 Bill. t C
Budget for 2°C target: 790 bill t C

CO₂ emissions until 2013: -535 bill t C

Remaining emissions: 255 bill t C

CO₂ 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.
Challenges for climate research and assessment:

- Maintenance and upgrade of high-quality, high-density observation networks
- Accessibility and manageability of massive amounts of numerical data from 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
- **VXMIP**: MIP on vulnerability and exposure
- **EMIP**: Economic MIP

Maintain a high level of curiosity-driven research
www.climatechange2013.org
Climate Change 2013: The Physical Science Basis
Working Group I contribution to the IPCC Fifth Assessment Report

Full report and further information

www.climatechange2013.org