Towards IPCC AR5: The Physical Science Basis

Emerging Questions, Structure of Report and Schedule

Thomas Stocker and the Bern Team

IPCC Co-Chair Working Group I

Oeschger Centre for Climate Change Research
Physics Institute, University of Bern, Switzerland
Preliminary remarks:

• IPCC does not perform science but ...

• ... implicitly, the IPCC process stimulates climate science

• curiosity-driven research must remain the top priority

• the highly politicised environment poses a serious risk

• some groups want to discredit climate science and damage IPCC

• IPCC procedures are only as good as their implementation

• need a procedure to address errors effectively and expediently
Preliminary remarks:

- IPCC does not perform science but...
- ... implicitly, the IPCC process stimulates climate science significantly
- curiosity-driven research must remain top priority
- the highly politicised environment poses a serious risk
- some groups want to discredit and damage IPCC, so be vigilant
- IPCC procedures are only as good as their implementation
- need a procedure to address errors effectively and expediently

Rigor
Robustness
Transparency
Comprehensiveness
IPCC (2007):

- Warming in the climate system is unequivocal, as is now evident from observations ....

- Most of the observed increase in global averaged temperature ... is very likely due to ... increase in GHG concentrations.

- Continued GHG emissions ... would induce many changes ... that would very likely be larger than those observed ...

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![Graphs showing global temperature changes](https://example.com/graphs)

![Maps showing temperature changes worldwide](https://example.com/maps)

[...]

2. The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. IPCC reports should be neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies.

3. Review is an essential part of the IPCC process. Since the IPCC is an intergovernmental body, review of IPCC documents should involve both peer review by experts and review by governments.

[...]
Preparations of WGI towards AR5:

Mar 2009  EM on the Science of Alternative Metrics
           ✔ Meeting Report and Recommendations to UNFCCC AWG KP

Sep 2009  EM on Detection and Attribution Relating to ACC
           ✔ Meeting Report and Good Practice Guidance Paper

Jan 2010  EM on Assessing and Combining Multi-Model Climate Projections
           ☐ Meeting Report and Good Practice Guidance Paper

Jun 2010  WS on Sea Level Rise and Ice Sheet Instabilities
           ☐ Meeting Report

Jul 2010  cross-WG Meeting on Consistent Treatment of Uncertainties
           ☐ Update of Guidance Notes
Emerging Questions:

- Trends and rates of observed climate change
  Has climate change accelerated?

- Large ice sheets in polar regions
  Is the Greenland ice sheet stable – what about WAIS and EAIS?

- Irreversibilities and abrupt change in the climate system
  How robust and accurate is our understanding?

- Clouds and aerosols, and their feedbacks
  Can we constrain the uncertainty associated with cloud and aerosol processes?

- Carbon and other biogeochemical cycles
  Which carbon cycle feedbacks become relevant in the coming decades?

- Near-term and long-term climate projections
  How reliable is decadal prediction, what are the uncertainties beyond 2100?

- Climate phenomena across regions
  How do frequencies and amplitudes of monsoon, ENSO, and others change?
Trends and rates of observed climate change

Decadal trends: accelerating in Arctic sea ice, highly variable in temperature

(Kwok et al. 2009)

(Easterling and Wehner, 2009)
Large ice sheets in polar regions
Extensive dynamic thinning along the margins of Greenland and Antarctica
Large ice sheets in polar regions

Accelerating mass loss of both polar ice sheets identified by GRACE

Greenland: $-286 \text{ Gt/yr}_{2007-09}$

Antarctica: $-246 \text{ Gt/yr}_{2006-09}$
Irreversibilities and abrupt climate change

Irreversibility of CO₂ perturbation ... ... and regional consequences

(Plattner et al. 2008)

(Plattner et al., 2008)

(Solomon et al., 2009)
**Irreversibilities and abrupt climate change**

Abrupt climate change ... but no “clathrate gun”

- Steffensen et al. 2008
- Bock et al. 2010

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Temperature Proxy

CH$_4$

δD(CH$_4$)

δ$^{18}$O (‰)

CH$_4$ (ppbv)

age (years before 1950)

34,000 38,000 42,000
Clouds and aerosols, and their feedbacks

Low-level clouds: Positive feedback in the north-east Pacific

(Clement et al. 2009)
**Carbon and other biogeochemical cycles**

Ice core reconstructions of GHGs now back to 800,000 years B.P.
- Carbon and other biogeochemical cycles
  - Regional carbon cycle fingerprints caused by abrupt climate change

![Map of soil moisture and total carbon changes](image-url)
Near-term and long-term climate projections
Multi-model ensemble simulations from CMIP5 (and CMIP3)

Global average surface temperature
- Keenlyside et al. 2008
- Pohllmann et al. 2009
- Smith et al. 2007

Notes:
- Observations (°C)
- Year
- Anomalies from models (°C)

(Trenberth, 2010)
• Near-term and long-term climate projections
  Projections using CMIP5 ensembles and a hierarchy of models

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(Plattner et al., 2008)
Near-term and long-term climate projections

Extreme events: heat waves, tropical cyclones, droughts, etc.

Number of days with $T_{\text{max}} > 35^\circ \text{C}$ and $T_{\text{min}} > 20^\circ \text{C}$
Climate phenomena across the regions
Monsoon systems: processes, observation, projection
Overview of topical groups of chapters in WGI of AR5:

- Introduction
- Observations and Paleoclimate Information
- Process Understanding
- From Forcing to Attribution of Climate Change
- Future Climate Change and Predictability
- Integration

Chapter 1
Chapters 2, 3, 4, 5
Chapters 6, 7
Chapters 8, 9, 10
Chapters 11, 12
Chapters 13, 14

The full Outline of WGI is available on www.ipcc.unibe.ch
Structure of AR5 in perspective

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**papers in press:** 15. March 2013

**papers submitted:** 31. July 2012
Challenges:

- Amount of material (literature, simulations) and the burden to the scientific community
- Significantly broader model diversity and likely increase in uncertainty
- Communication of uncertainties: what is known, what is emerging
- More cross-WG cooperation retaining full coherency
- Maintain the highest standards under increased pressure and expectations in a highly politicized environment
- Rigor, Robustness, Transparency, Comprehensiveness
The AR5 is you – your input is key!
as authors, contributors, reviewers
New features in WGI AR5

Chapter 7: Clouds and Aerosols
Executive Summary
- Observations of clouds and their representation in models
- Coupling of clouds, water vapour, precipitation and the large-scale circulation
- Cloud and water vapour feedbacks and their effects on climate sensitivity
- Observations of aerosols and their representation in models
- Aerosol types including black carbon: chemistry, sources, sinks and distribution
- Direct and indirect aerosol forcing and effects, including contrails and cosmic rays
- Aerosol-cloud-precipitation interactions
- Geoengineering involving clouds and aerosols
Frequently Asked Questions

The full Outline of WGI is available on www.ipcc.unibe.ch
New features in WGI AR5

Chapter 11: Near-term Climate Change: Projections and Predictability
Executive Summary
  • Predictability of interannual to decadal climate variations and change
  • Projections for the next few decades
  • Regional climate change, variability and extremes
  • Atmospheric composition and air quality
  • Possible effects of geoengineering
  • Quantification of the range of climate change projections
Frequently Asked Questions

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New features in WGI AR5

Chapter 12: Long-term Climate Change: Projections, Commitments and Irreversibility

Executive Summary
- Scenario description
- Projections for the 21st century
- Projections beyond the 21st century
- Regional climate change, variability and extremes
- Forcing, response and climate sensitivity
- Climate change commitment and inertia
- Potential for abrupt change and irreversibility in the climate system
- Quantification of the range of climate change projections

Frequently Asked Questions

The full Outline of WGI is available on www.ipcc.unibe.ch
New features in WGI AR5

Chapter 13: Sea Level Change

Executive Summary
- Synthesis of past sea level change and its components
- Models for sea level change
- Projections of globally averaged sea level rise
- Projections of the regional distribution of sea level change
- Extreme sea level events
- Potential ice sheet instability and its implications
- Multi-century projections

Frequently Asked Questions

The full Outline of WGI is available on www.ipcc.unibe.ch
New features in WGI AR5

Chapter 14: Climate Phenomena and their Relevance for Future Regional Climate Change

Executive Summary
- Patterns of variability: observations, understanding and projections
- Monsoon systems: observations, understanding and projections
- Extremes: observations, understanding and projections
- Interconnections among phenomena
Frequently Asked Questions

Annex I: Atlas of Global and Regional Climate Projections:

Editorial Team, Review Editor Team, Advisory Board

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