Reducing scientific uncertainty about climate change

Tony Payne
University of Bristol

My role

- Lead author on Chapter 13 Sea Level

- Responsible for assessing the impact of ice-sheet dynamics of sea level

- Contributed to the Summary for Policymakers and attended governmental approval in Stockholm

Outline

- The IPCC process
- Some highlights from the 5th Assessment Report
- Sea level change

What is the IPCC?

Three Working Groups

- Working Group I assesses the **physical scientific aspects** of the climate system and climate change (September 2013).

- Working Group II assesses **the vulnerability of socio-economic and natural systems** to climate change and options for adapting to it (March 2014).

- Working Group III assesses options for **mitigating** climate change through limiting or **preventing** greenhouse gas emissions (April 2014).

Small technical group in Zurich that coordinates production etc.

What is the IPCC?

This is the 5th Assessment Report (AR5) following AR4 in 2007.

Reports scientific progress between 2007 and March 2013.

Report itself contains

- **14** chapters (~3000 pages) on various aspects of climate observation, understanding and projection.
- **209** lead authors (~ 15 per chapter).
- Authors nominated by governments and do not work for the IPCC.
- Further **600**+ contributing authors.

Summary for Policy Makers (SPM) drawn from the report and approved by 195 Governments.

What is an Assessment Report?

An assessment of the relevant scientific literature

- Over 9,200 scientific papers are cited
- No **grey** literature, i.e., each paper would have been fully reviewed prior to publication

It is NOT a simple review

- Synthesize different lines of evidence
- Need to assess the quality of the evidence
- Need to justify scientific logic behind the assessment

It is NOT original science

- Can only base evidence on cited literature
- Cannot introduce ideas or calculations that have are not part of the reviewed literature

Extensive drafting and reviewing process

Zero-order draft (March 2011)

- Agree remit of each chapter and areas of overlap

First-order draft (December 2011) and Expert review

- Review open to anyone (self nominate)
- Qualification to have published in the scientific literature
- 21,400 comments by 659 reviewers

Second-order draft (October 2012) and Expert review

- 31,422 comments by 800 reviewers (total ~20 per page)

Third-order draft and *Summary for Policy Makers* (SPM)

Governmental review

- 1855 comments from 32 Governments

Primer on IPCC-speak

Very few things are certain ... the IPCC uses a method of capturing this qualitatively in the language that it uses.

An example from the projections section

"The global mean surface temperature change for the period 2016–2035 relative to 1986–2005 will *likely* be in the range of 0.3°C to 0.7°C (medium confidence)."

- "*Likely*" refers to likelihood that the actual value falls within the range
- "medium confidence" refers to how certain we are of this statement

Primer on IPCC-speak

Identify statement you want to make

Assess evidence for the statement
- How much evidence is there?
- Different types?
- How much agreement is there?

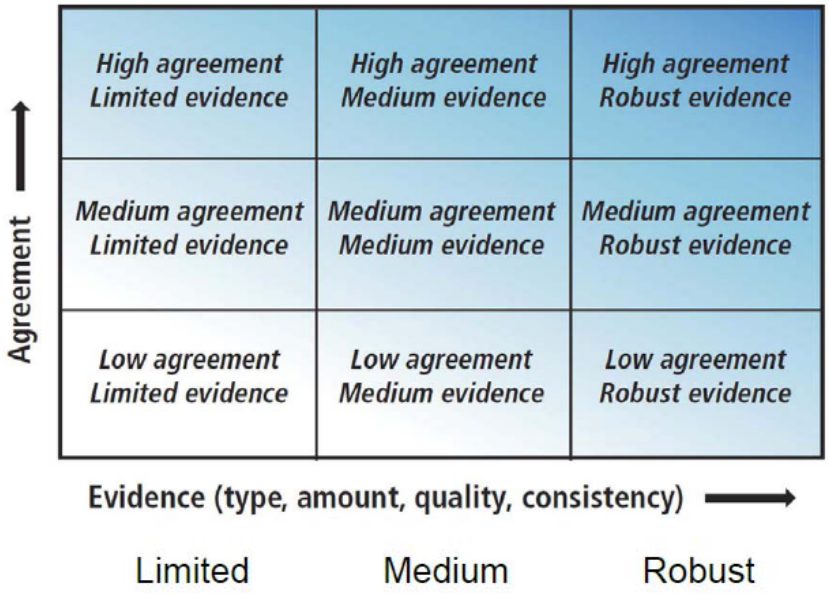
Assess confidence that can be associated
- Very high
- High
- Medium
- Low
- Very low

If have sufficient confidence, make likelihood statement

High

Medium

Low



Primer on IPCC-speak

Have established how much confidence can be claimed.

Express likelihood in *calibrated uncertainty language*.

Assessment not precise quantitative calculations but indicative.

Virtually certain	≥ 99%	Unlikely	0 to 33%
Very likely	90 to 100%	Very unlikely	0 to 10%
Likely	66 to 100%	Exceptionally unlikely	≤ 1%

Example

A *likely* temperature range means that there is **better than a two-in-three chance** that the actual temperature lies in the range.

What is the Summary for Policy Makers?

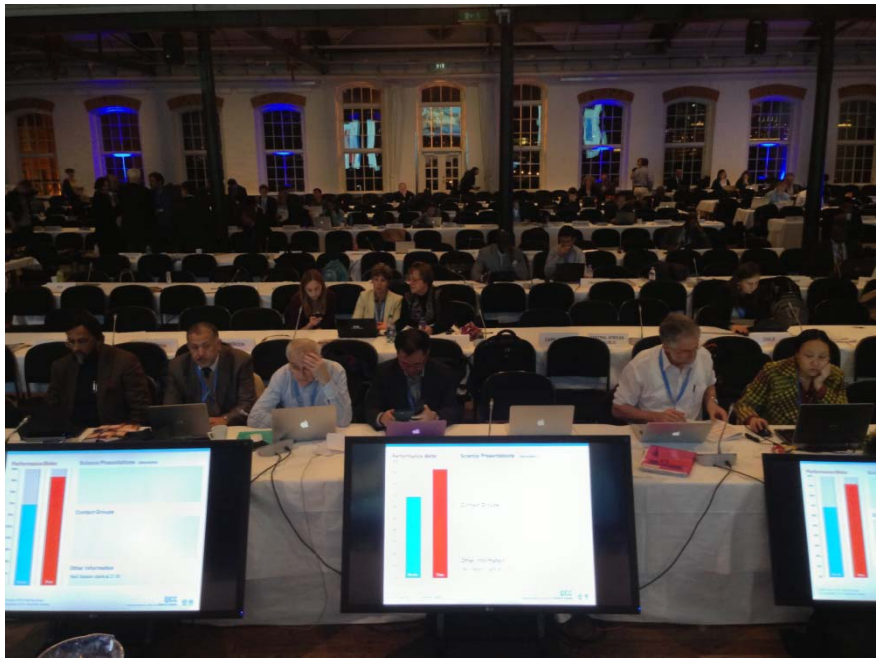
Chapter teams agree key policy-relevant statements based on their scientific assessments distilled into ~30 pages.

Reviewed by governments with suggestions for revision.

Scientific discussion on how (and if) governments' suggestions can be incorporated.

Line-by-line approval by governments in Stockholm, September 2013.


[INSERT FOOTNOTE X: No best estimate for equilibrium climate sensitivity can now be given because of a lack of agreement on values across assessed lines of evidence and studies.]

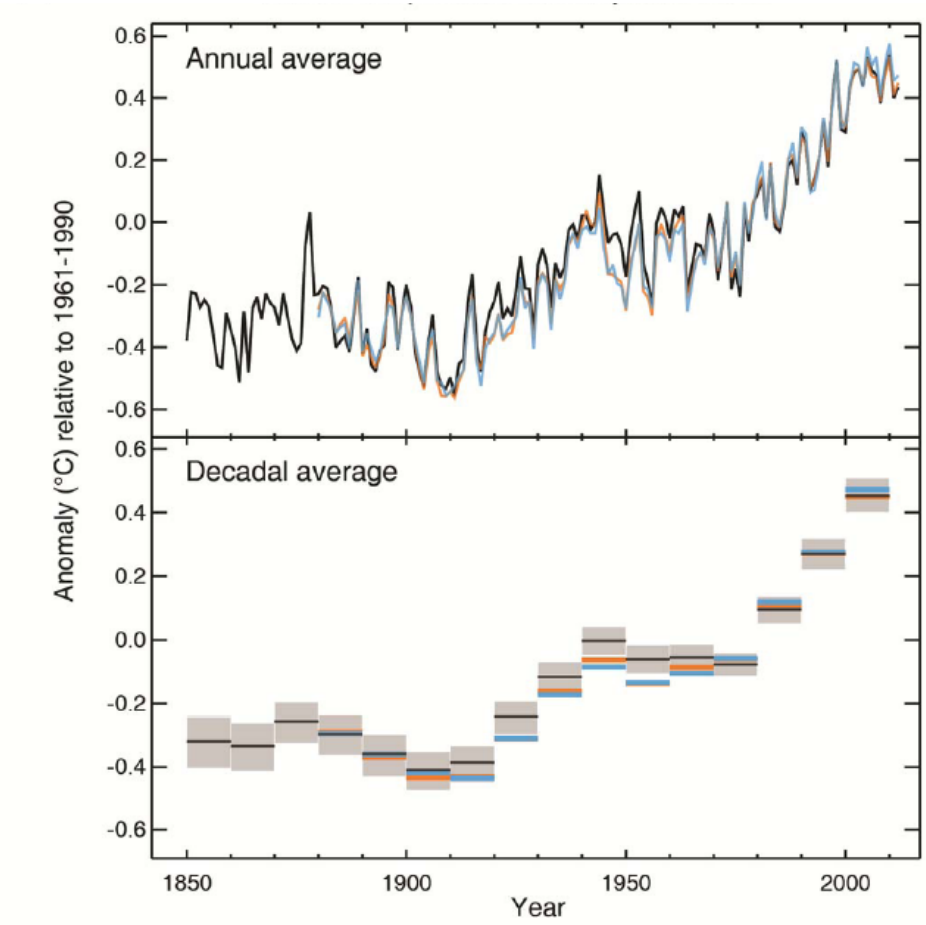


Some highlights from the Assessment Report

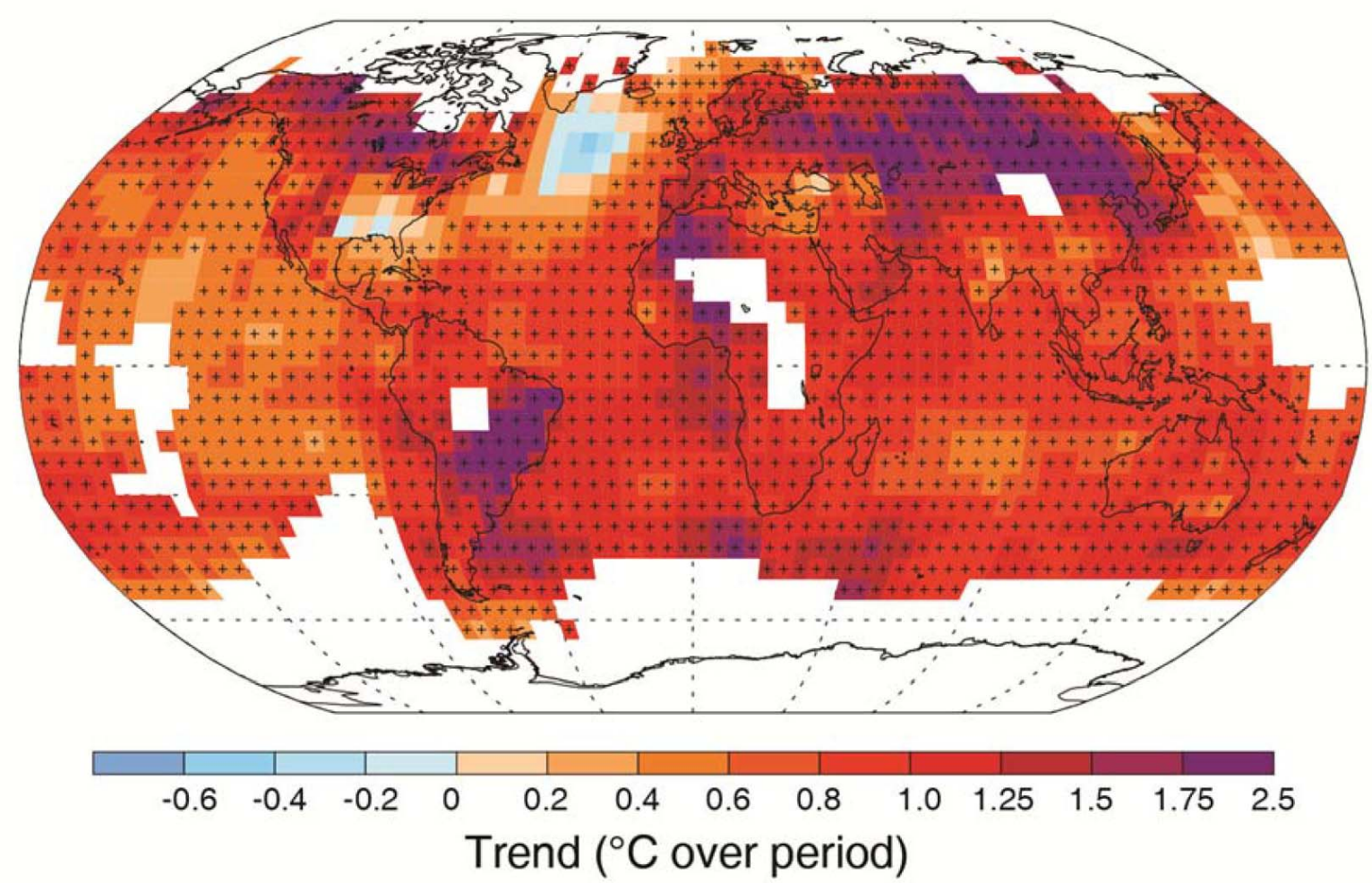
- Observations
- Understanding
- Projection

Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

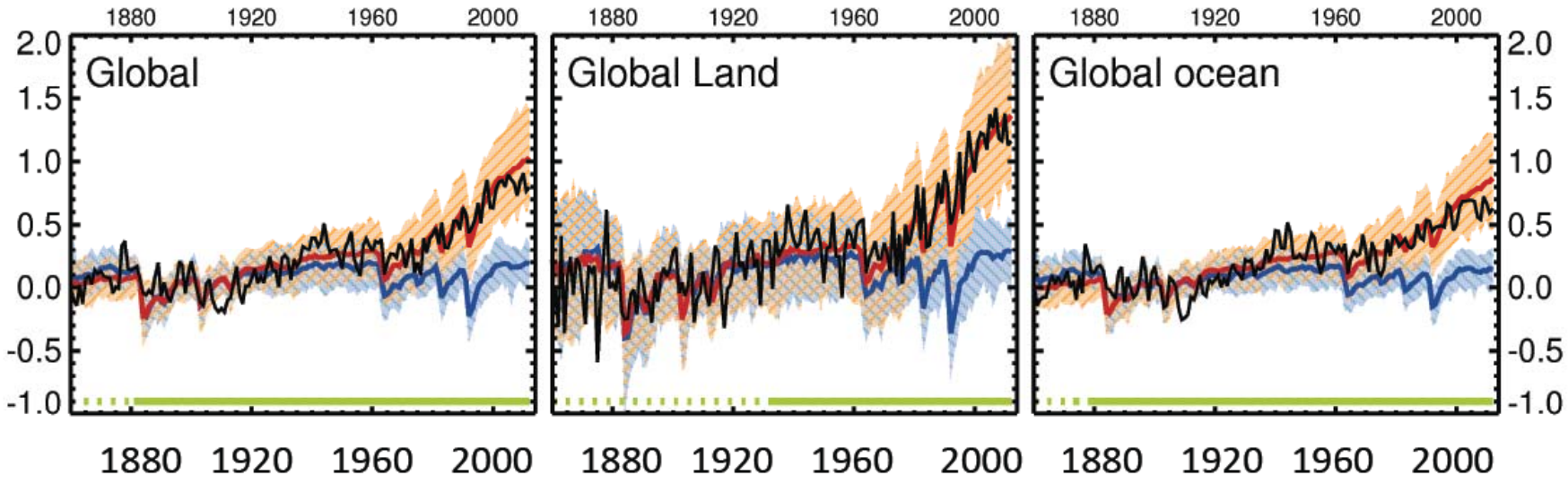
In the Northern Hemisphere, 1983–2012 was *likely* the warmest 30-year period of the last 1400 years (*medium confidence*).



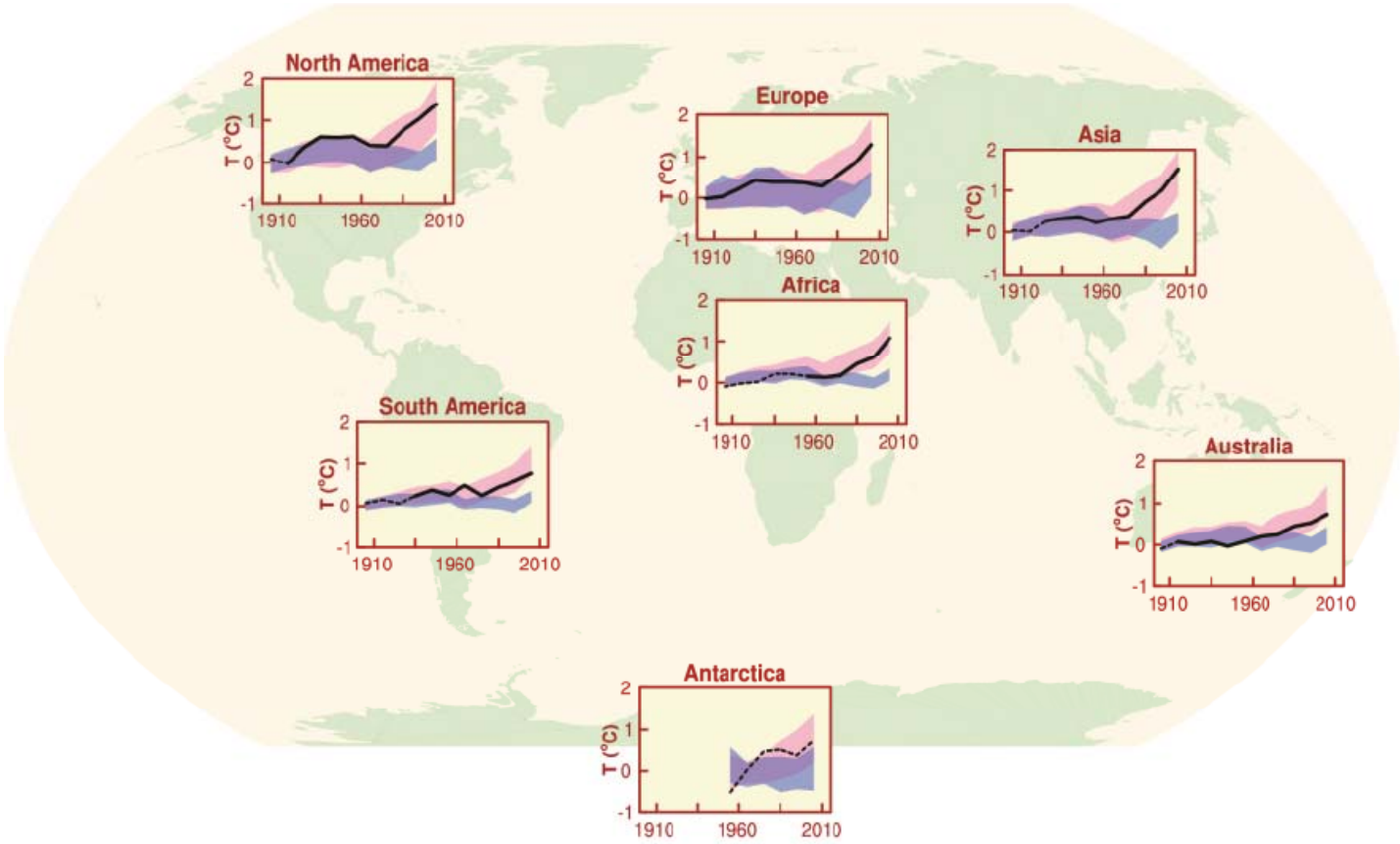
Warming in the climate system is unequivocal



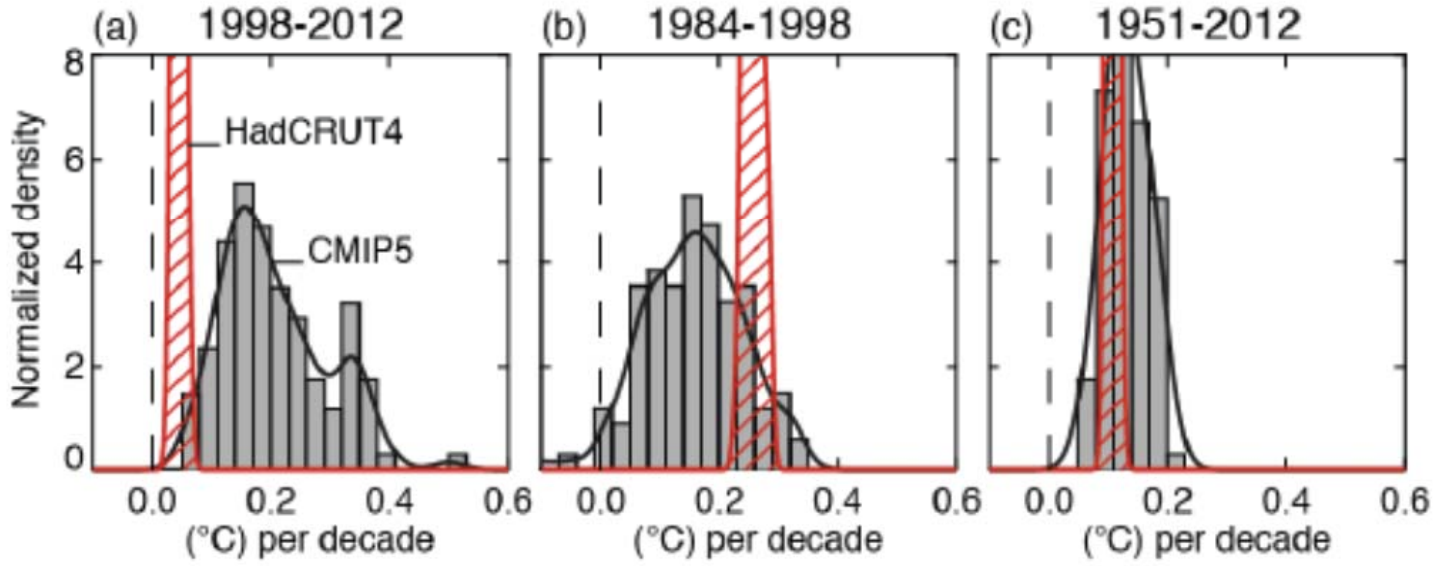
Observed warming consistent with that expected from anthropogenic factors and inconsistent with that expected from natural factors



Human influence on the climate system is clear

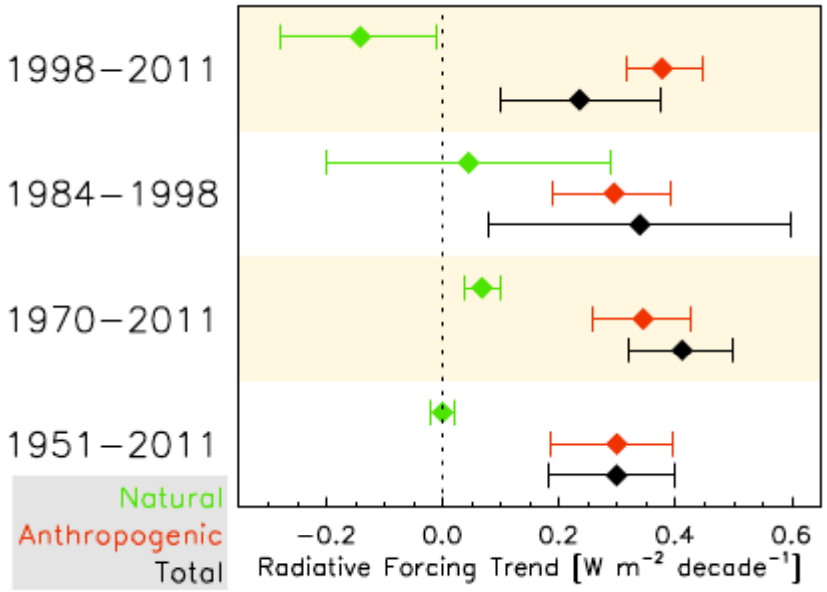


Reduced warming trend is due in roughly equal measure to a reduced trend in radiative forcing and a cooling contribution from internal variability (*medium confidence)*

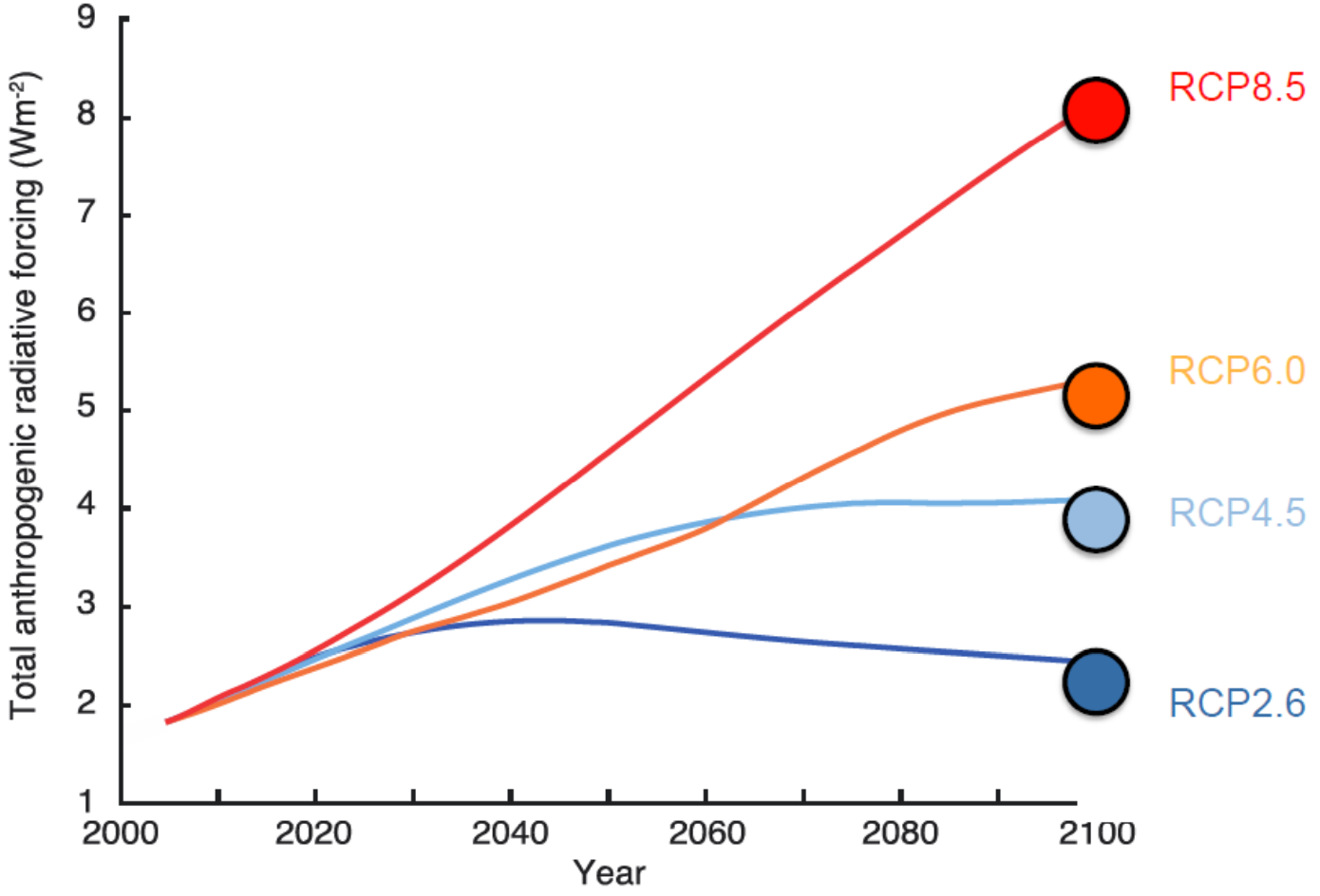


Evidence for a reduced forcing trend from 1998 compared to from 1951.

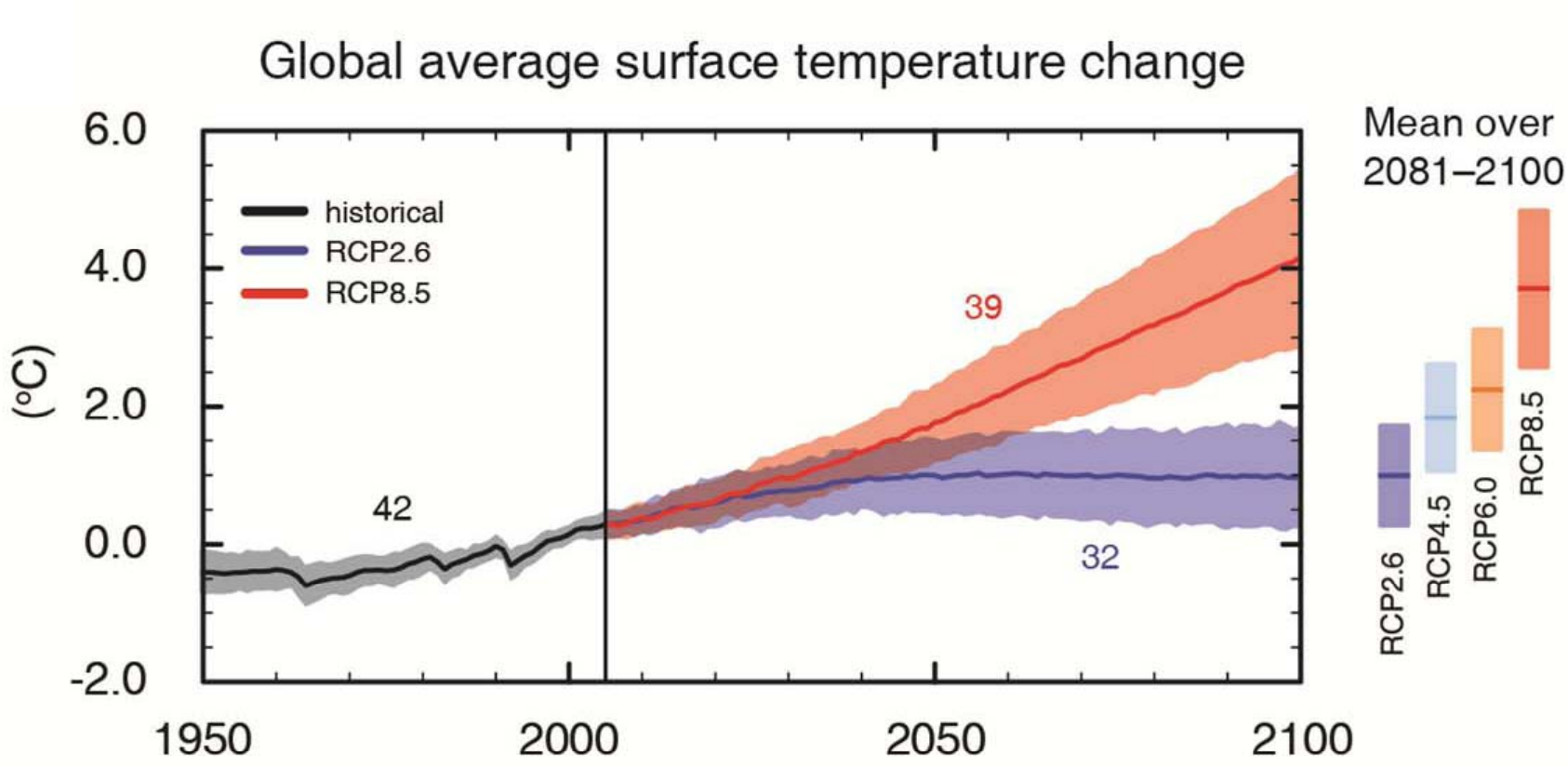
Primarily due to volcanic
eruptions and the downward phase of the solar cycle.



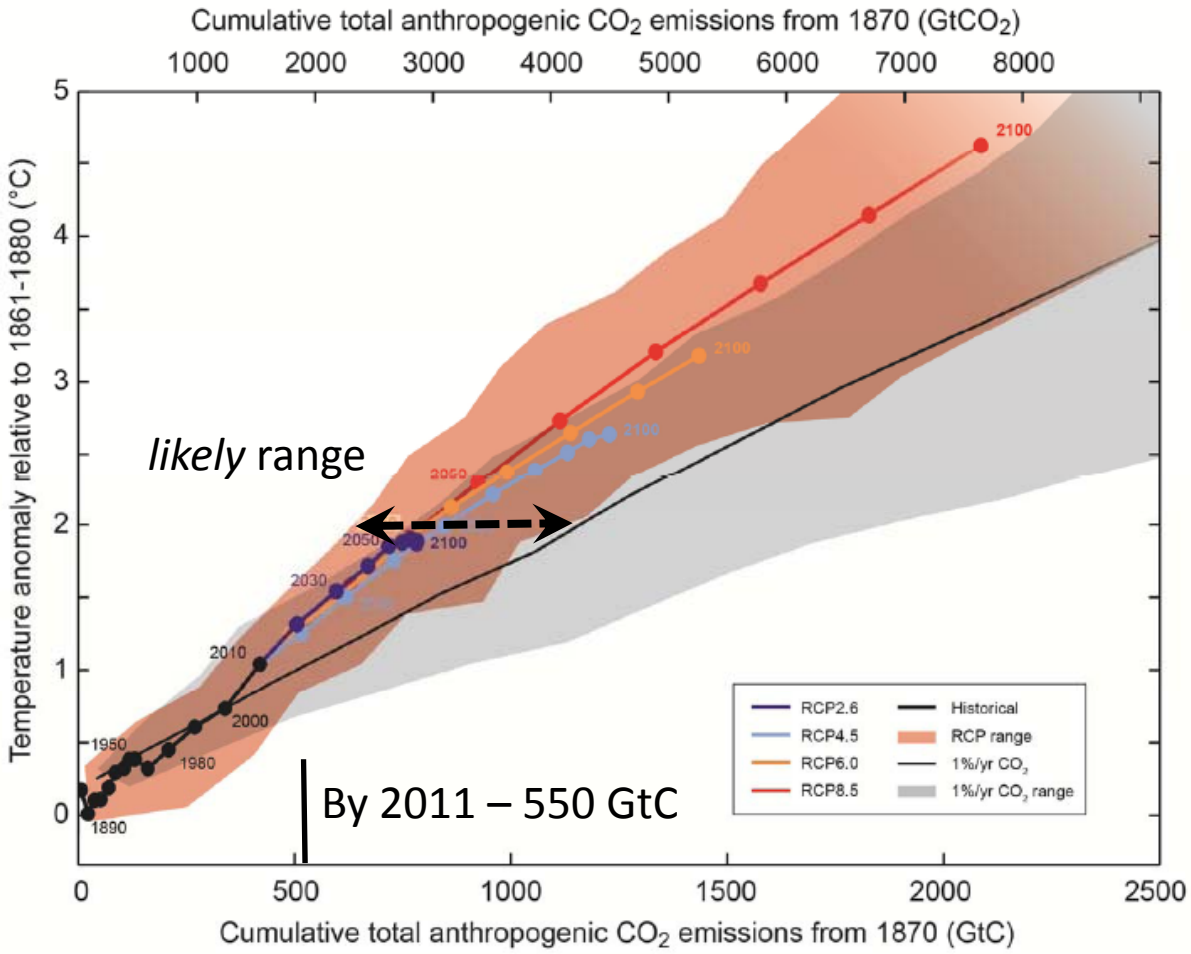
Revised scenarios – Representative Concentration Pathways (RCPs)



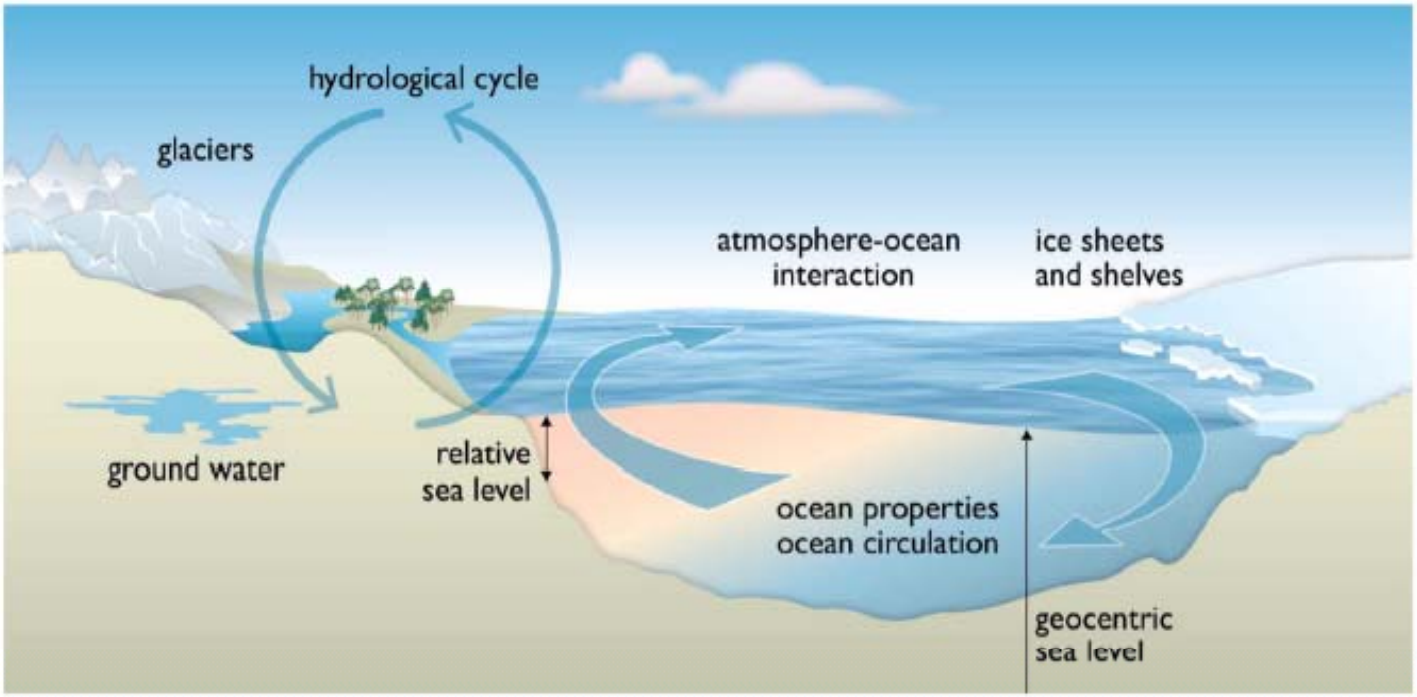
Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850 for all scenarios



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



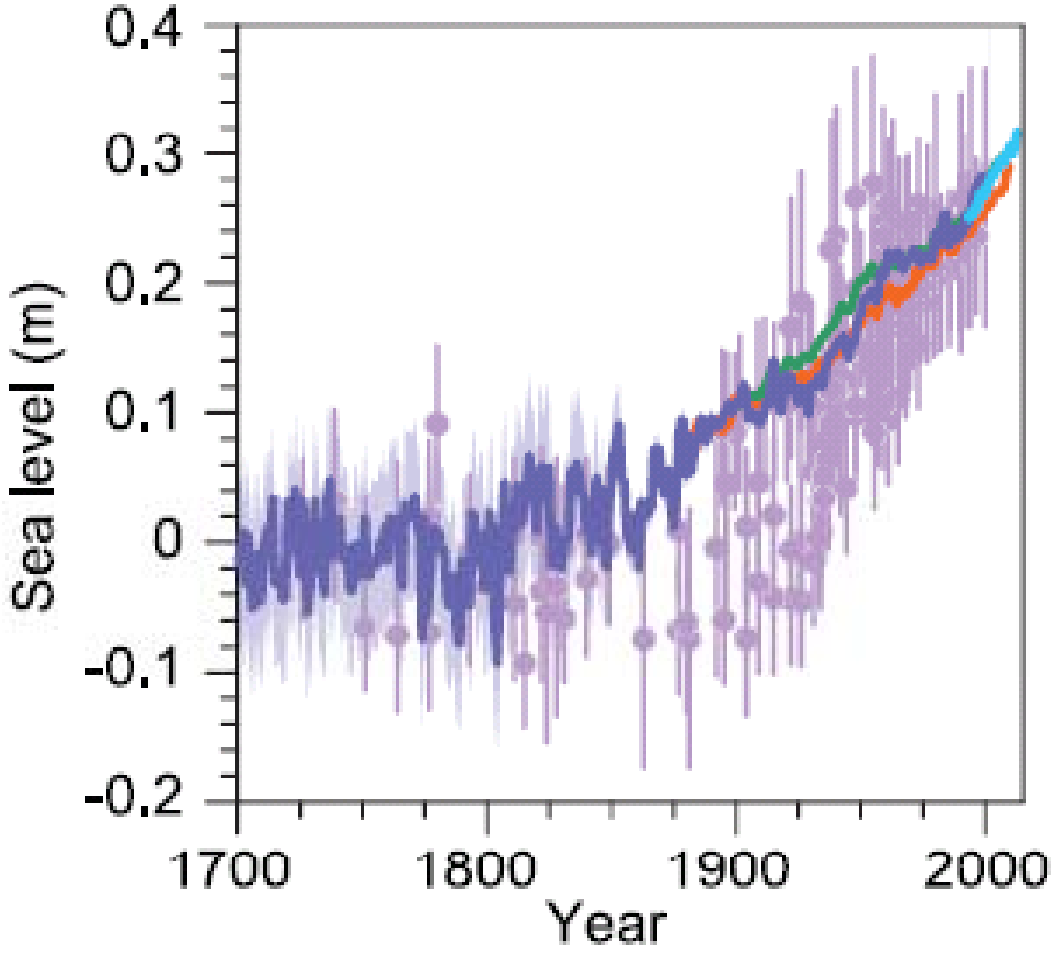
- Warming the ocean (thermal expansion)
- Loss of ice by glaciers and ice sheets
- Reduction of liquid water storage on land



Relative sea level is also affected by land movement, ocean density and circulation, and distribution of mass on the Earth

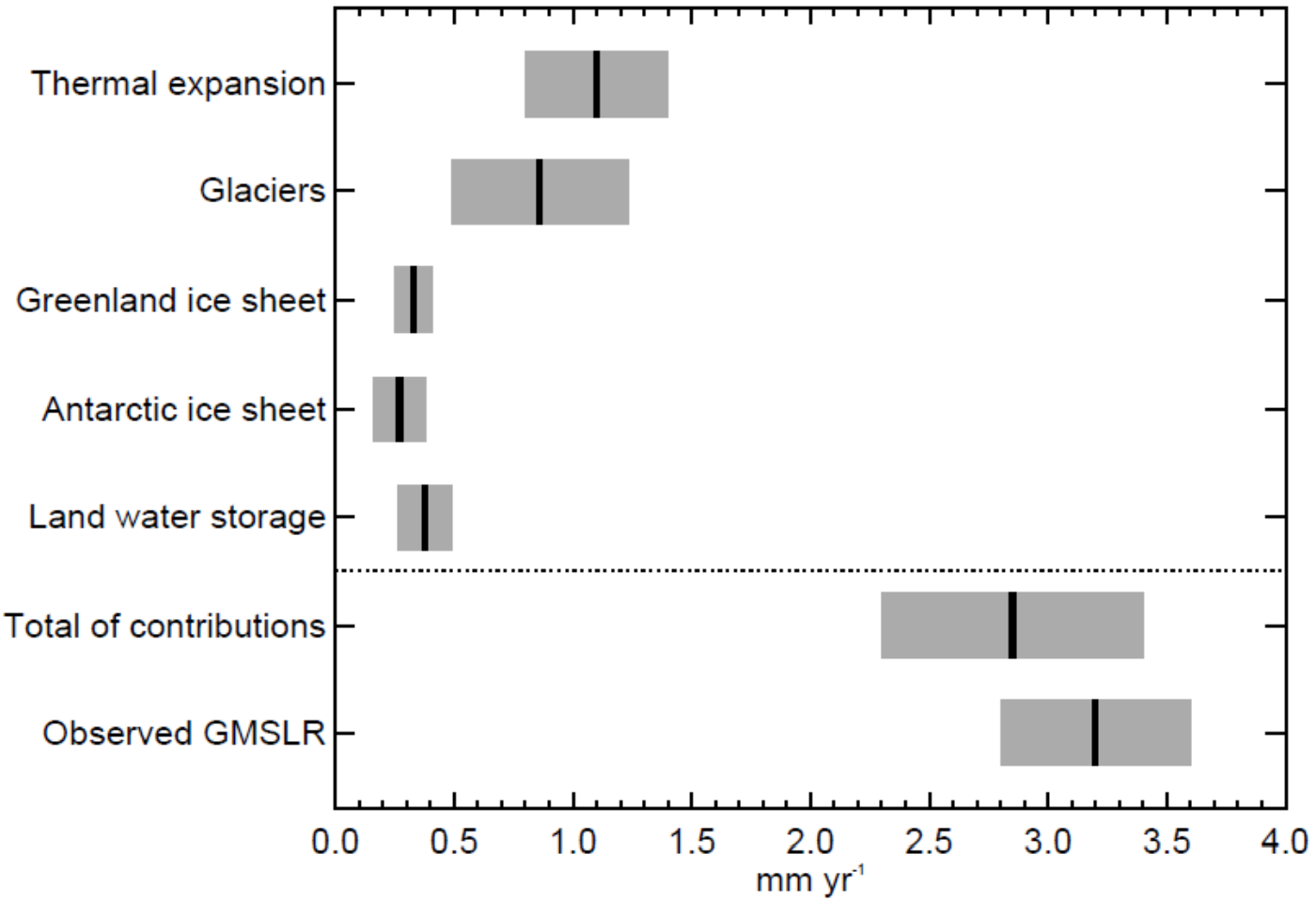
Rate of GMSLR has been greater since the mid-19th century

Rate during the last two millennia was of order a few tenths of mm yr^{-1}.



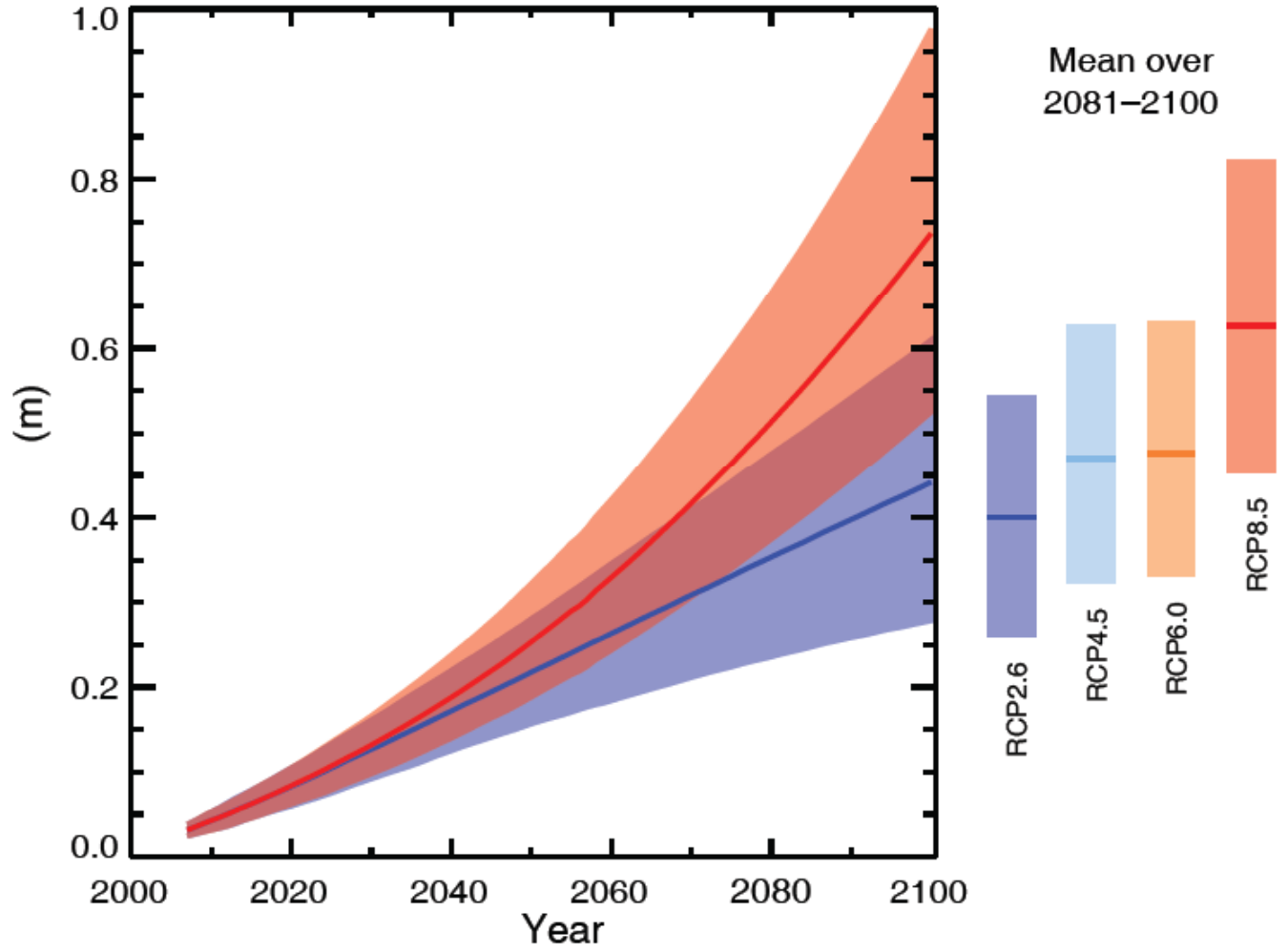
- Rate during 1901-1990 was 1.5 [1.3 to 1.7] mm yr^{-1}.
- Rate during 1993-2010 was 3.2 [2.8 to 3.6] mm yr^{-1}.

Observed contributions explain observed GMSLR 1993-2010

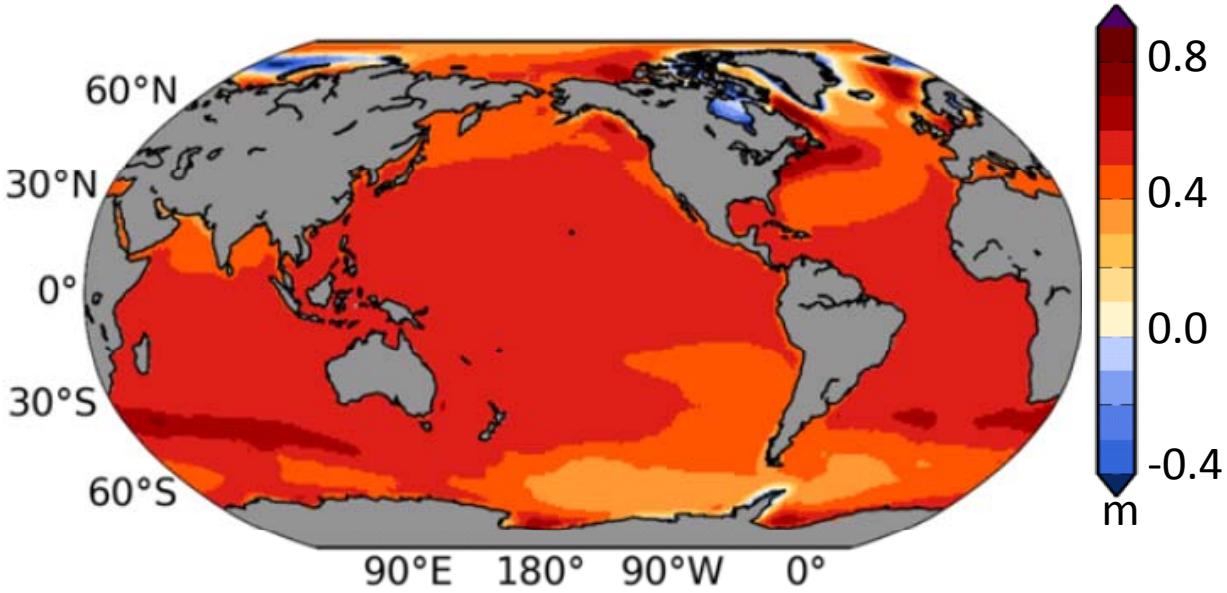


Projections of 21st-century GMSLR under RCPs

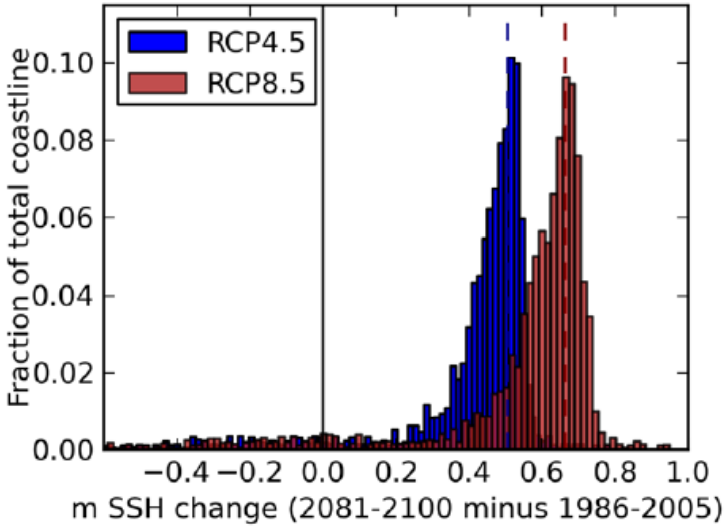
Medium confidence in *likely* ranges. *Very likely* that the 21st-century mean rate of GMSLR will exceed that of 1971-2010 under all RCPs.



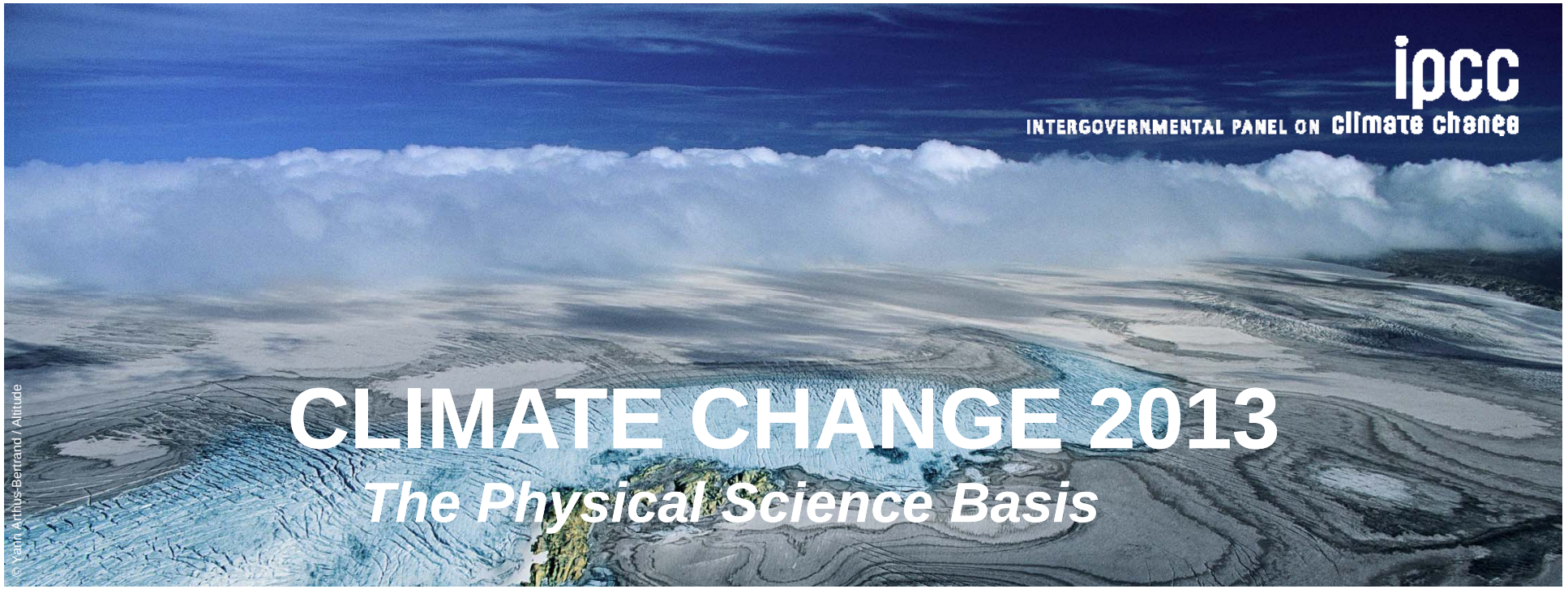
Regional sea level rise by the end of the 21st century



It is *very likely* that sea level will rise in more than about 95% of the ocean area.



About 70% of worldwide experience sea level change within 20% of the global mean sea level change.



Further Information

www.climatechange2013.org

Working Group I contribution to
the IPCC Fifth Assessment Report

WMO UNEP