

# Climate Change 2013: The Physical Science Basis

Working Group I contribution to the IPCC Fifth Assessment Report

## Highlights of IPCC WG1 Report

Prof Fredolin Tangang  
IPCC WG1 Vice-Chair

259 Authors from 39 Countries

WGI Co-Chairs and TSU Team

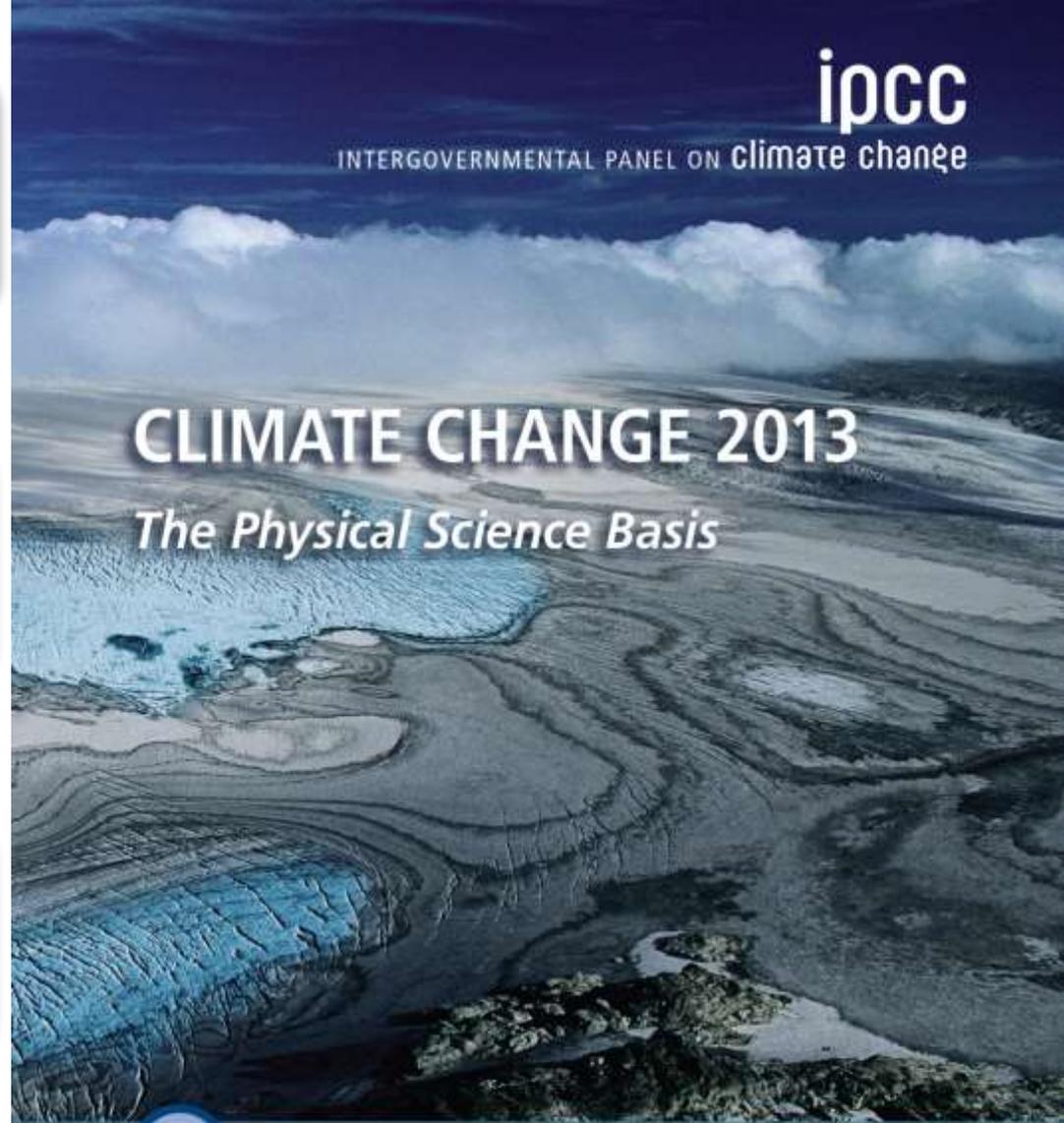
© Yann Arthus-Bertrand / Altitude

Observations

Understanding

Future

[www.climatechange2013.org](http://www.climatechange2013.org)



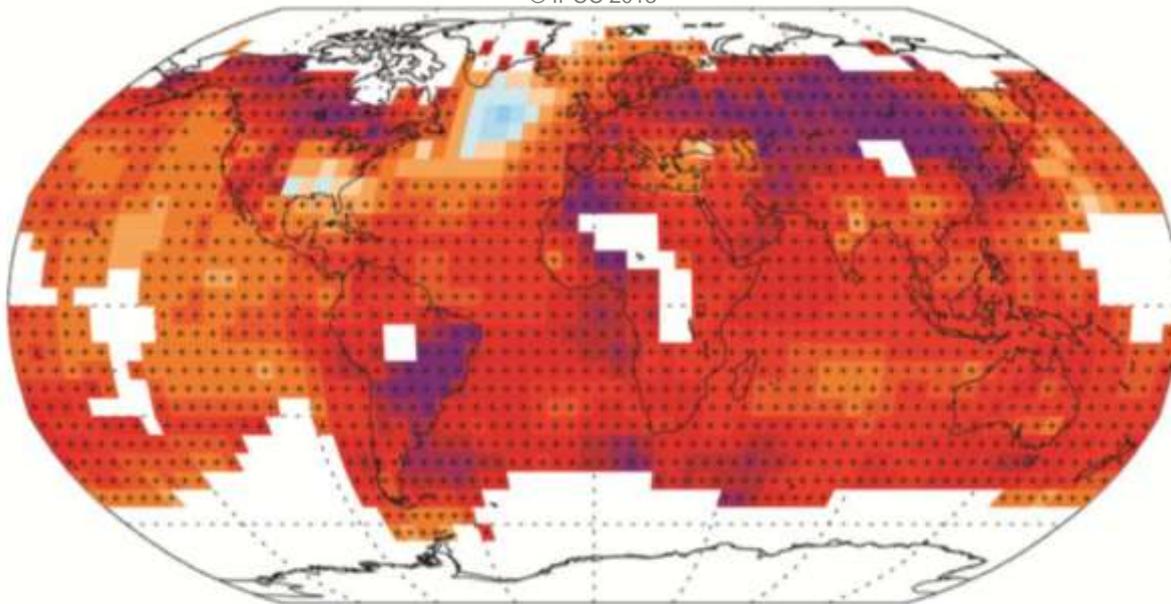
Warming in the climate system  
is unequivocal

Human influence on the  
climate system is clear

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

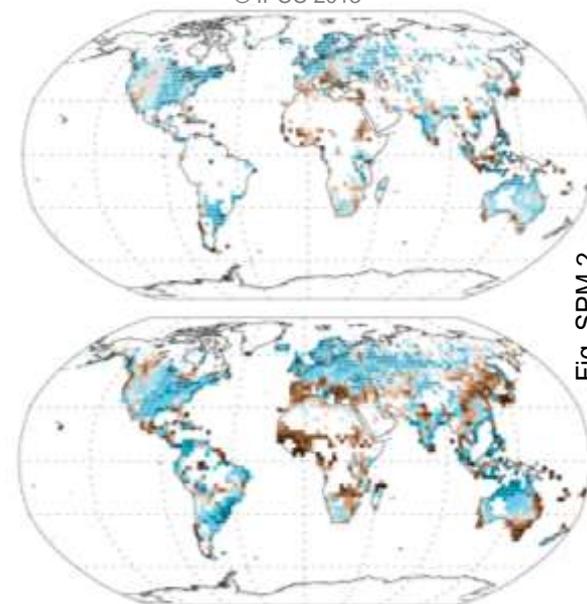
Fig. SPM.1b

© IPCC 2013



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

© IPCC 2013

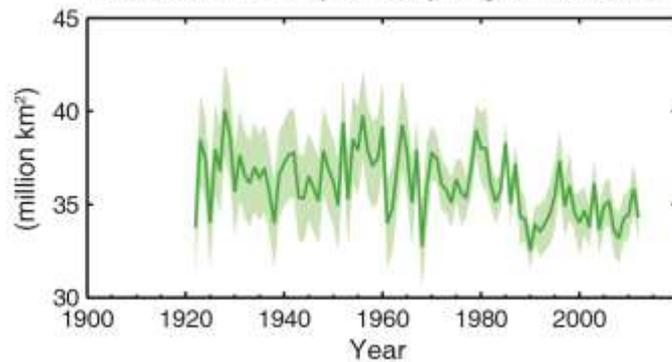


Precipitation Trend (mm/yr per decade)

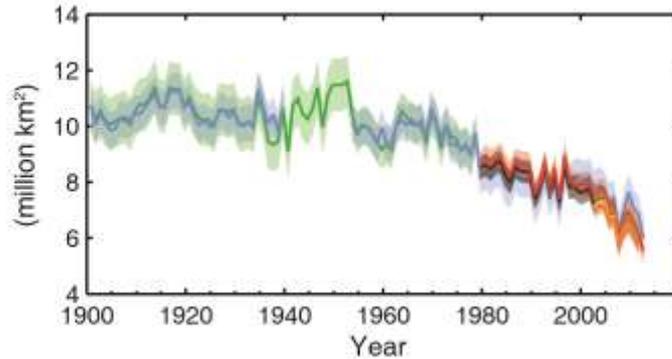
Fig. SPM.2

Warming of the climate system  
is unequivocal

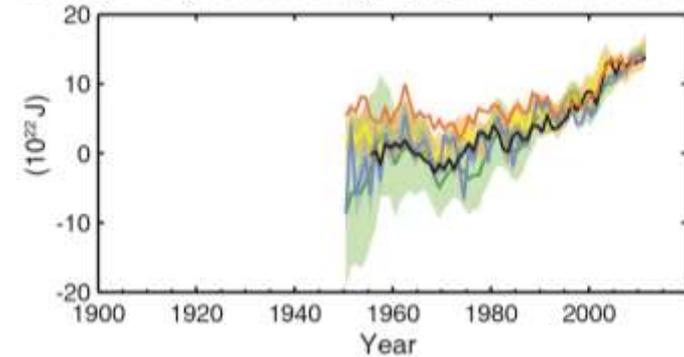
(a) Northern Hemisphere spring snow cover



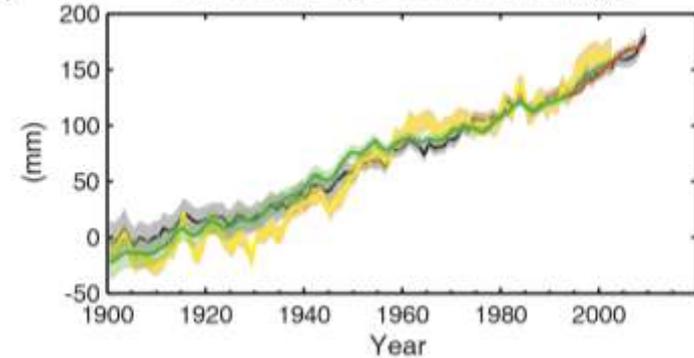
(b) Arctic summer sea ice extent



(c) Change in global average upper ocean heat content

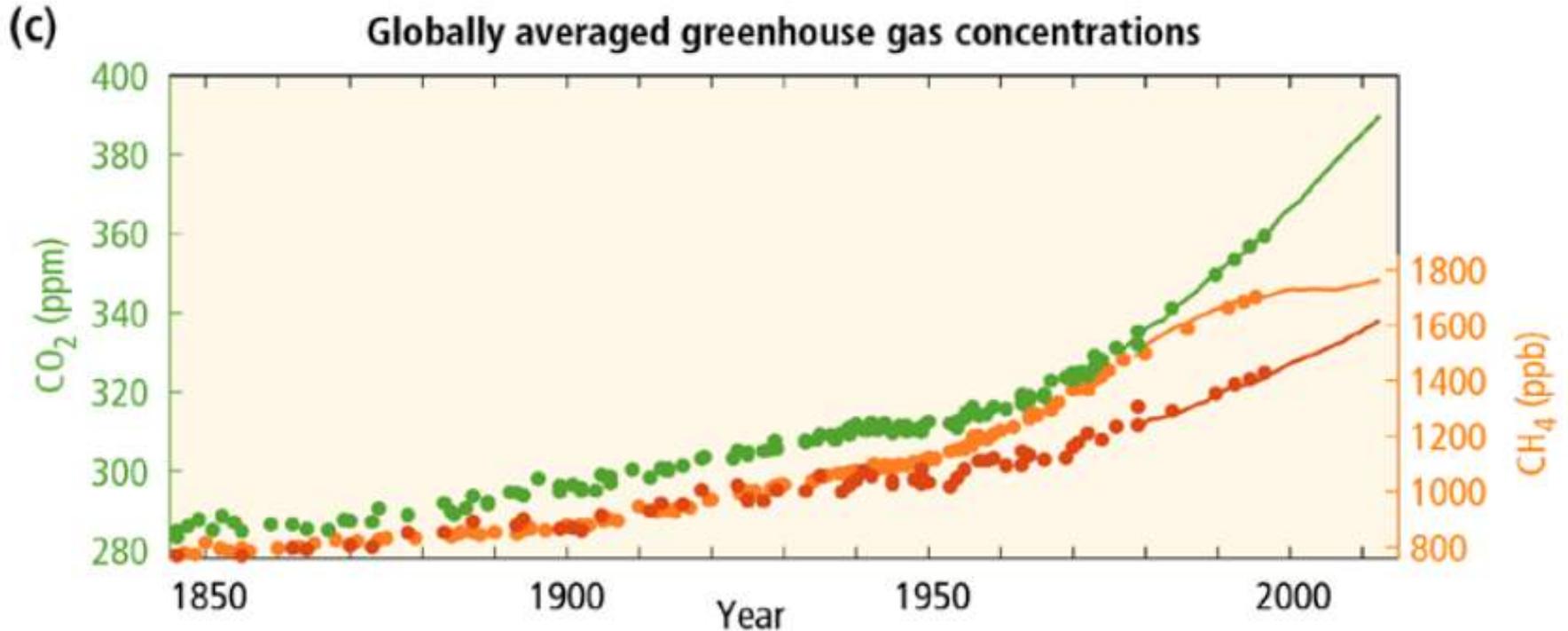


(d) Global average sea level change



Warming of the climate system  
is unequivocal

# Historical GHG Emission

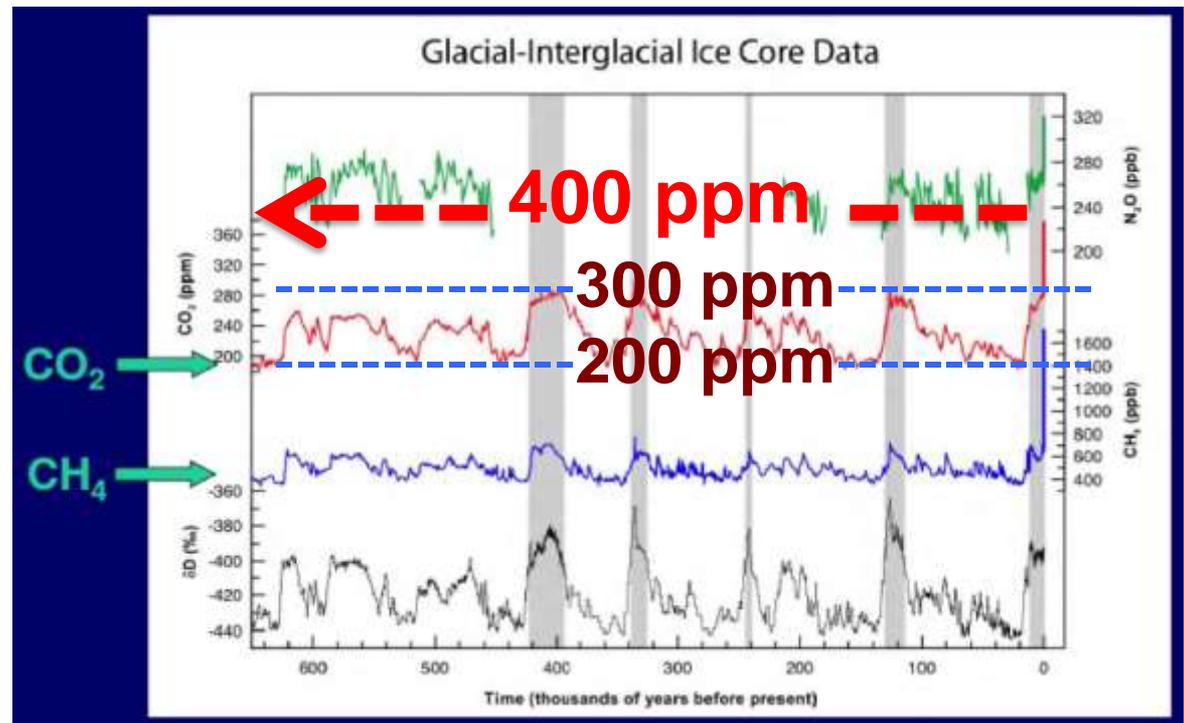


**The atmospheric concentrations of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) have increased to levels unprecedented in at least the last 800,000 years.**

# GHG Historical Record in Ice Cores

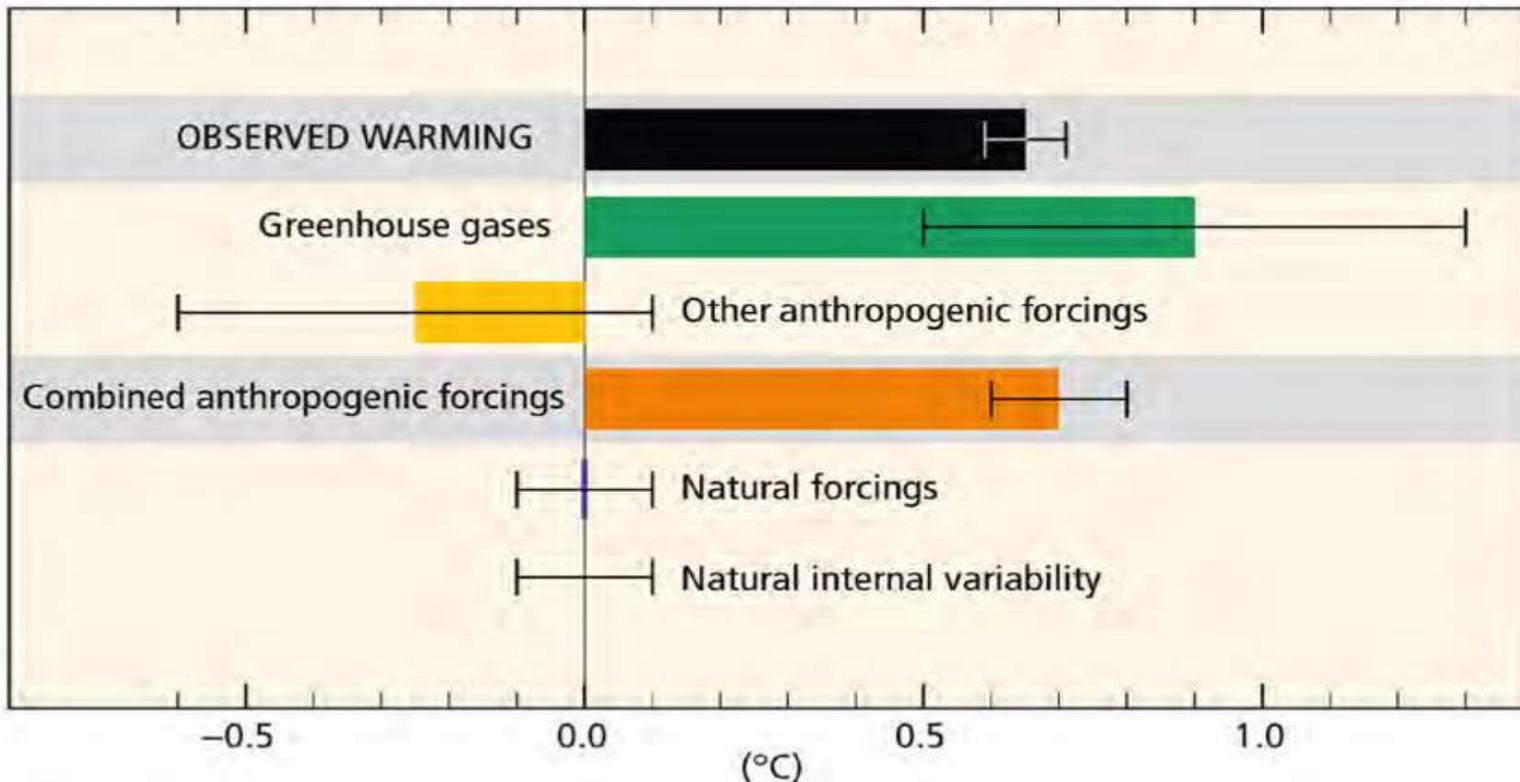


Ice Cores



# Humans are changing the climate

Contributions to observed surface temperature change over the period 1951-2010



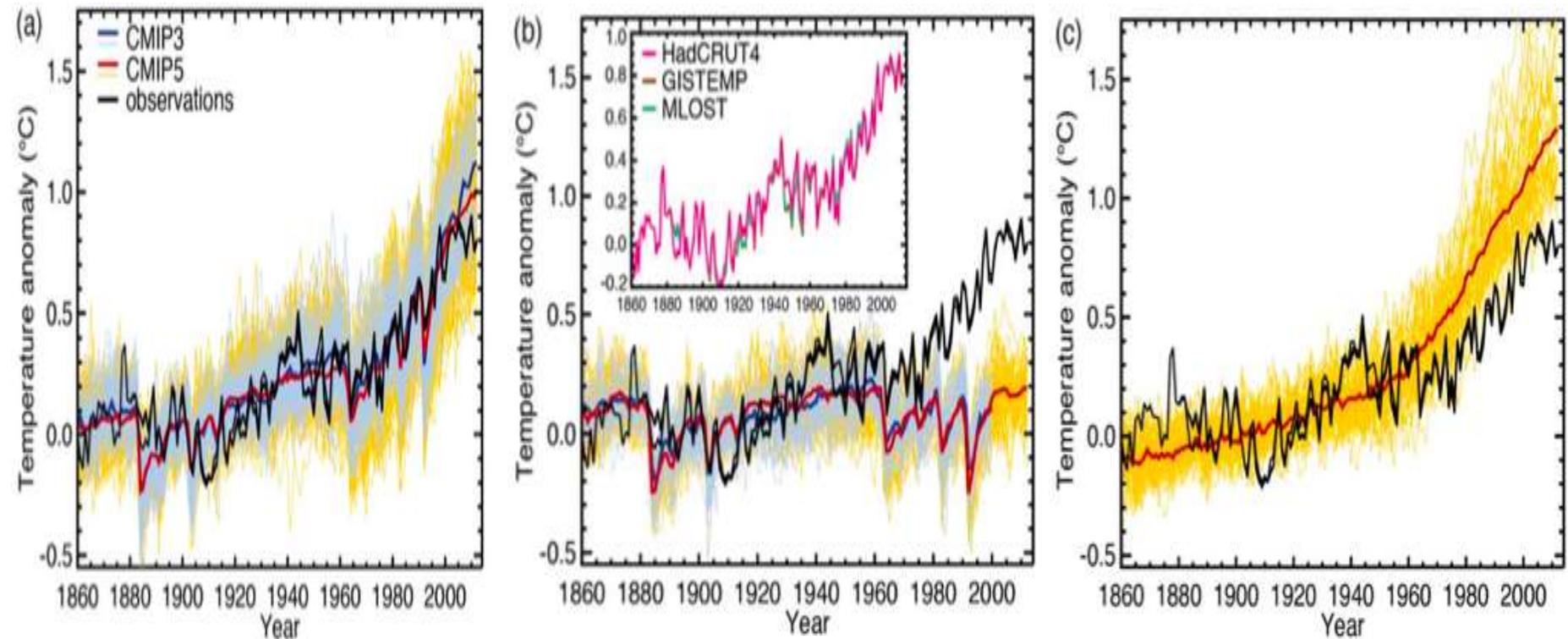
**Human Influence is Clear**

# Climate Models Responses to Various Forcings

Natural + Anthropogenic

Natural

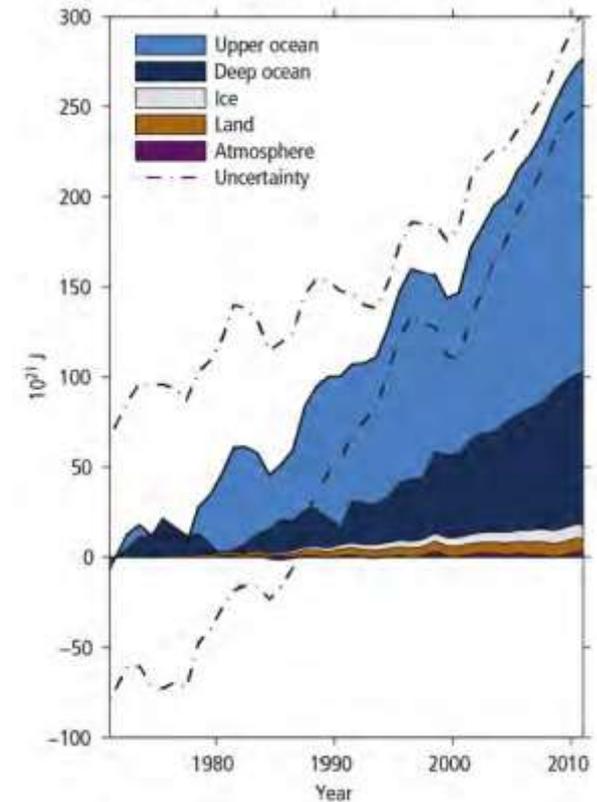
CO2 forcing only



**Human Influence is Clear**

# Earth is in Radiative Imbalance

Earth has been in radiative imbalance, with more energy from the sun entering than exiting the top of the atmosphere, since at least circa 1970. **It is virtually certain that Earth has gained substantial energy from 1971–2010. More than 90% of this extra heat is absorbed by the ocean (high confidence)**

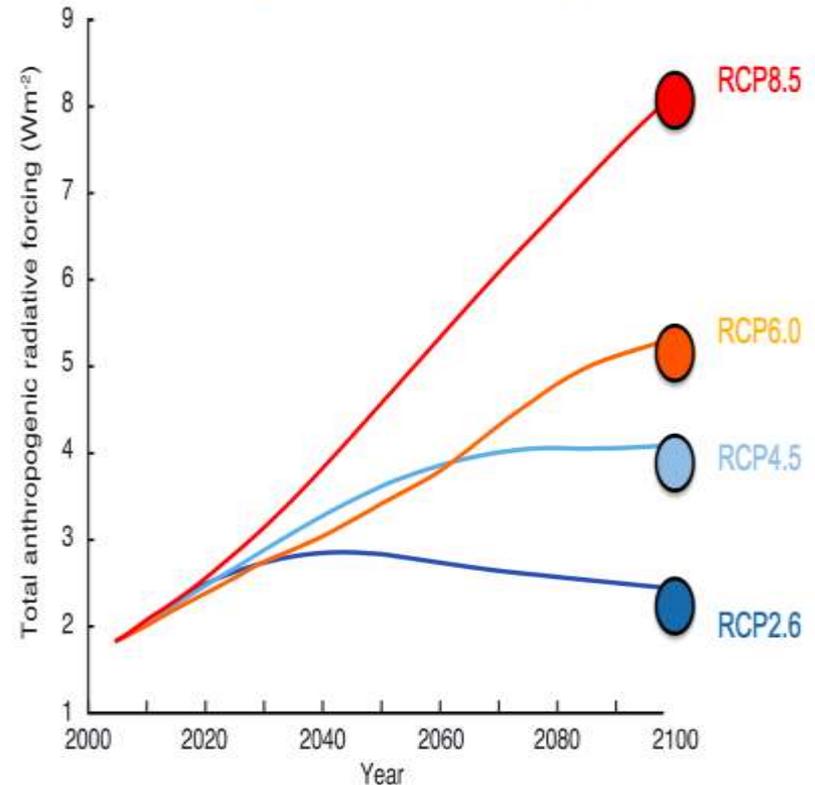




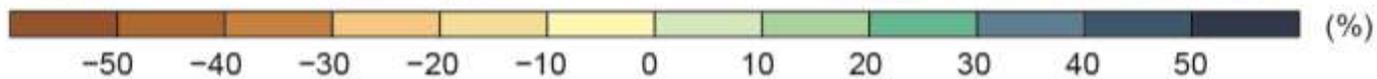
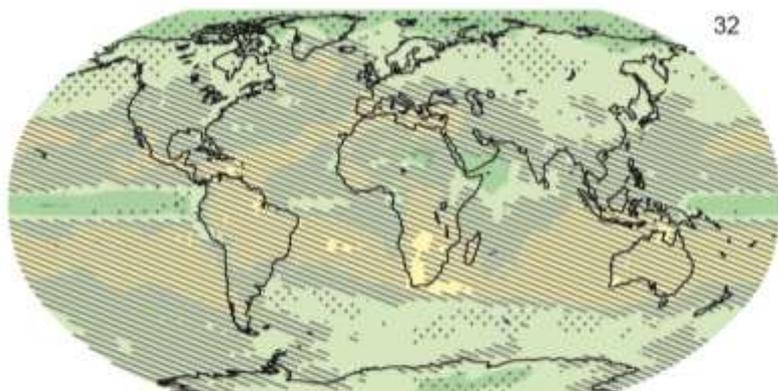
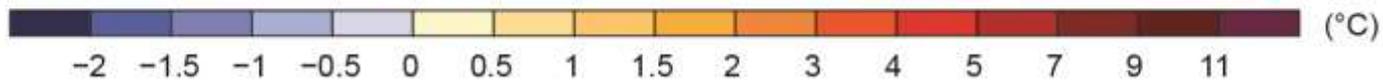
# Projecting Future Climate Requires GHG Concentration Pathway

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

Indicative anthropogenic radiative forcing for the RCPs

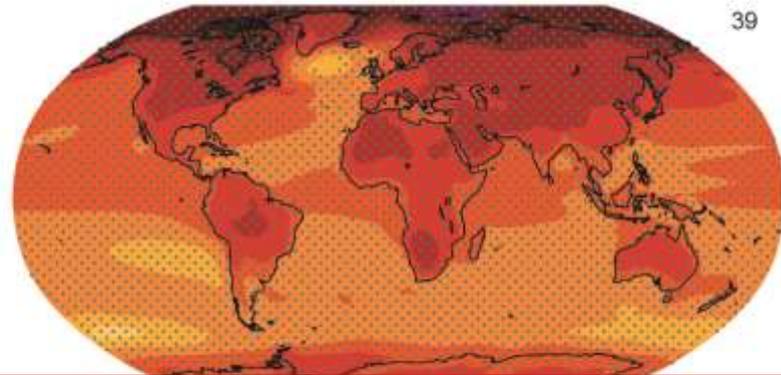


# 2°C world

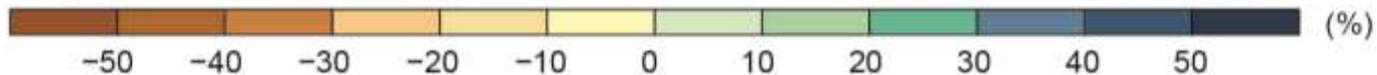
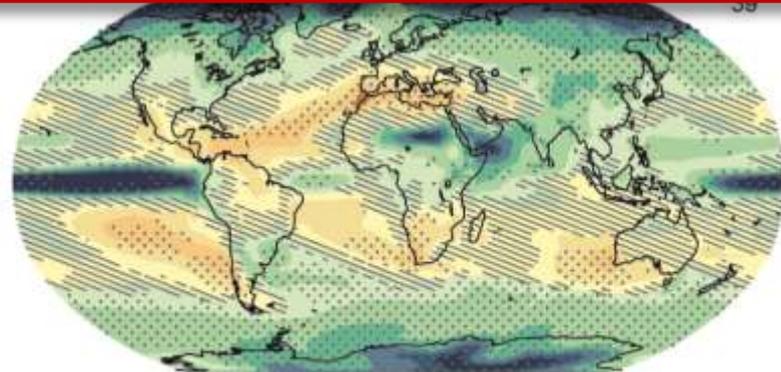
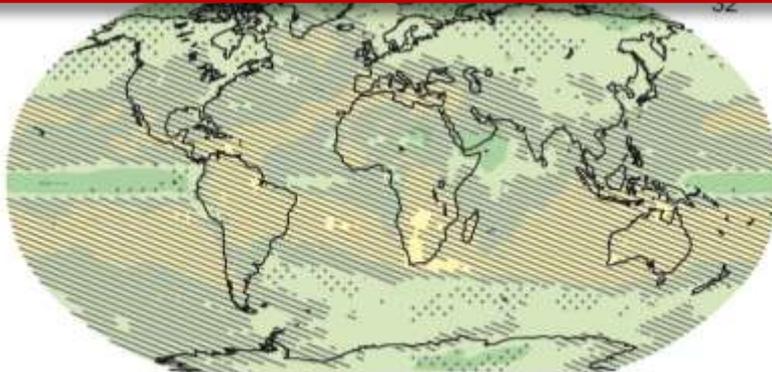


2°C world

4.5°C world



Today we have a choice.



# The window for action is rapidly closing

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

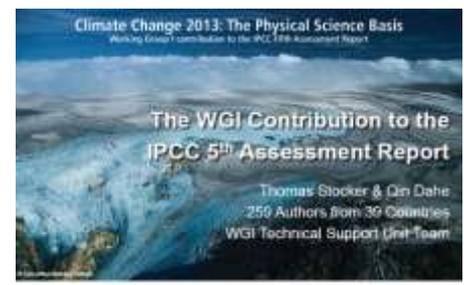
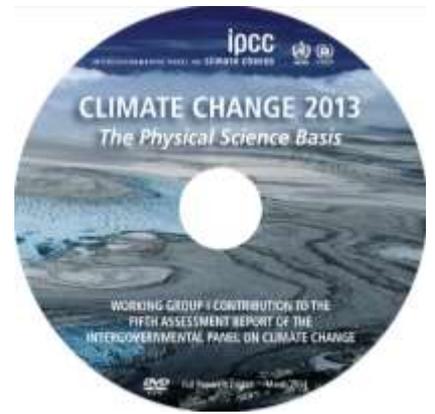
Amount  
Remaining:

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

***CO<sub>2</sub> emissions in 2013:***

***9.9 GtC***

# www.climatechange2013.org



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