

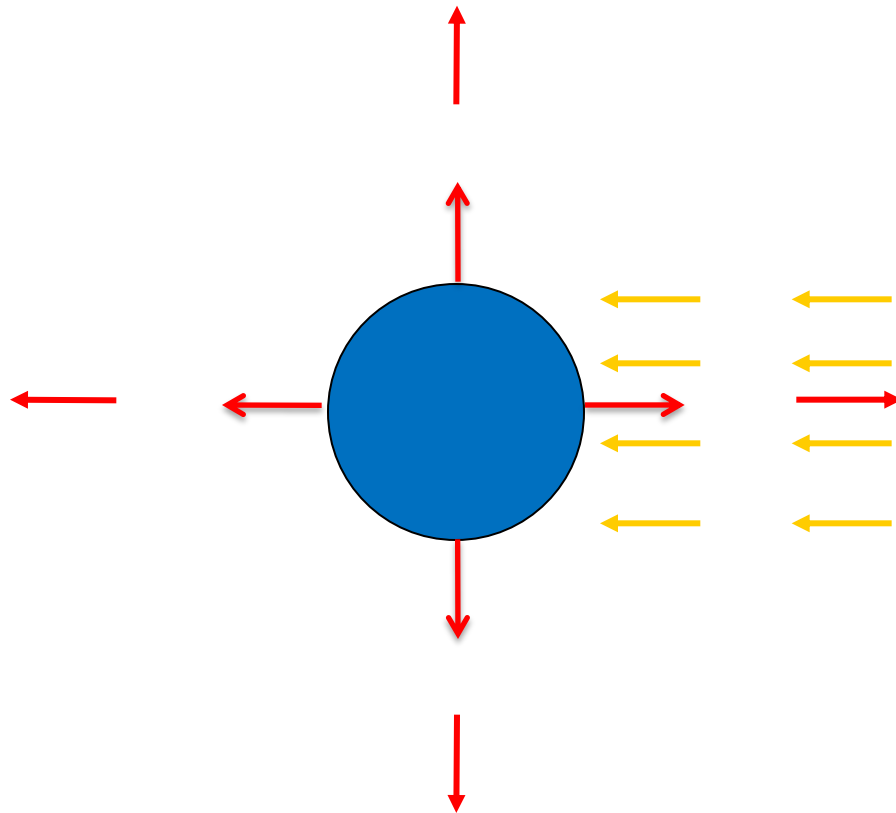
The Scientific Case for Action

Brian Hoskins

Director, Grantham Institute for Climate Change
Imperial College London

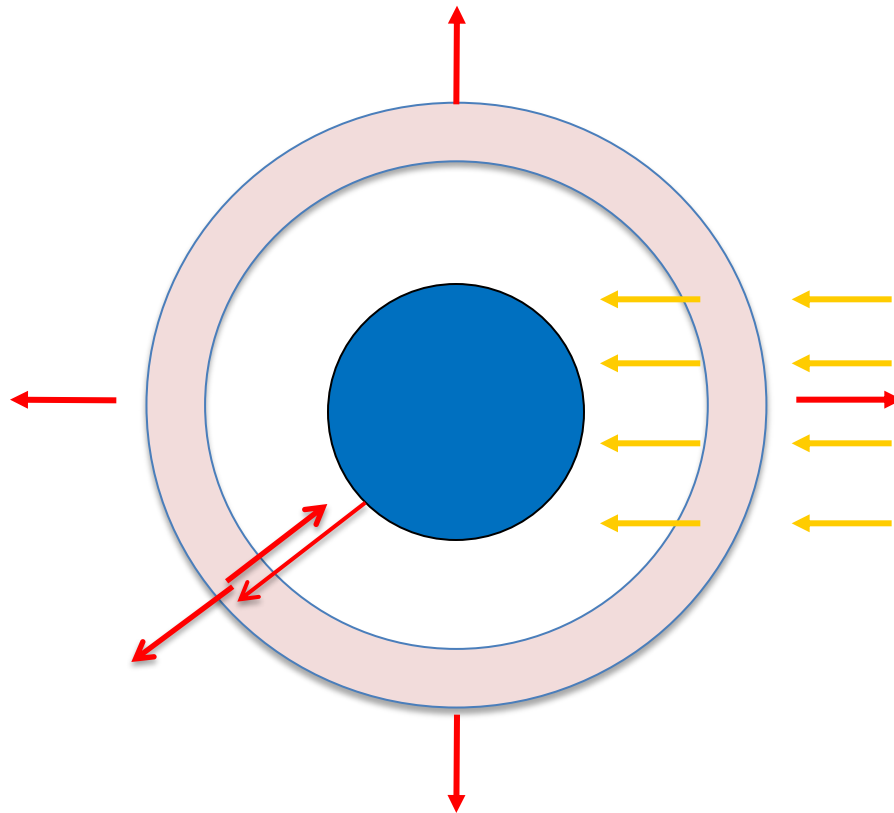
Professor of Meteorology, University of Reading

The Energy Budget of the Earth



The Energy Budget of the Earth

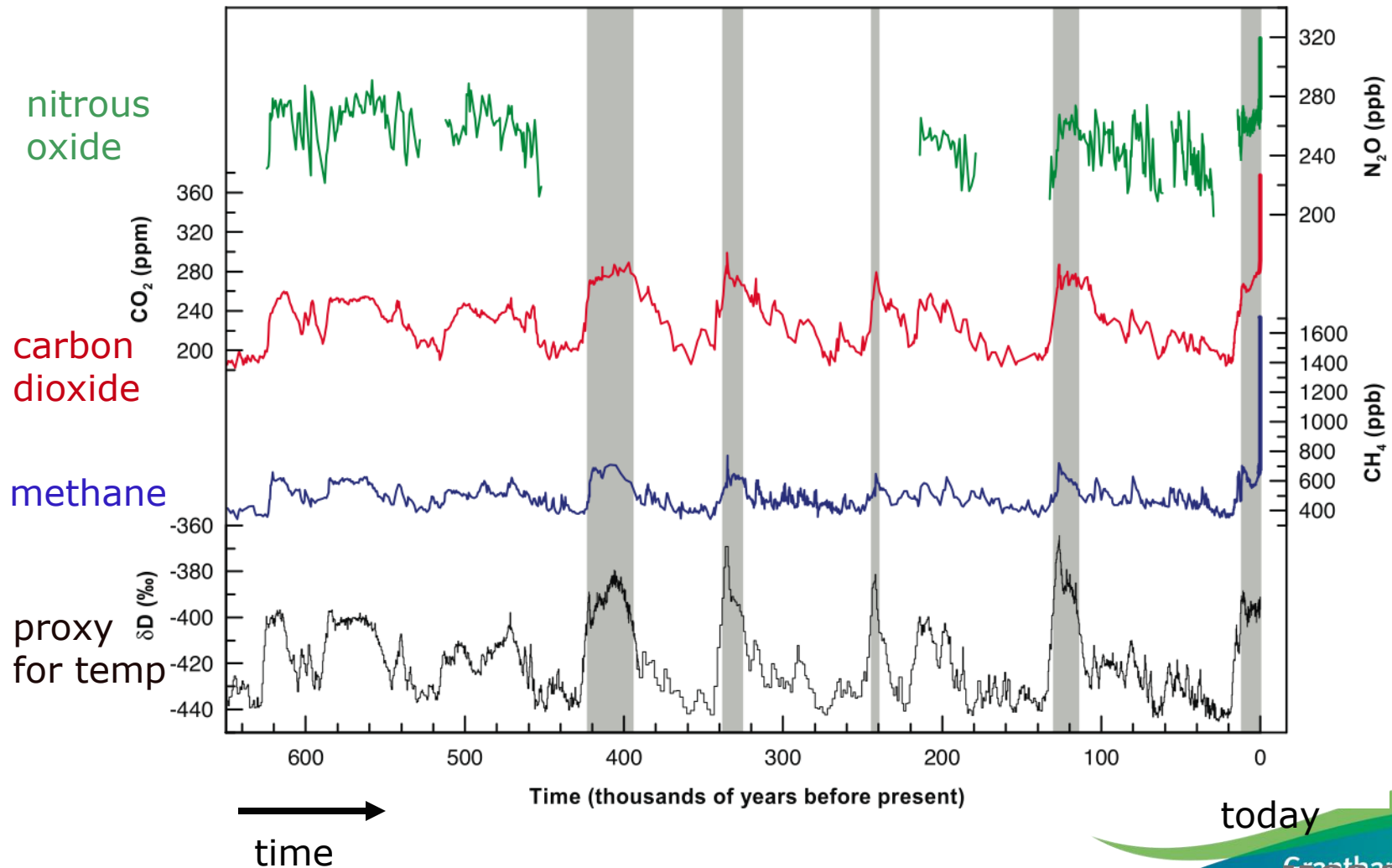
The Greenhouse Effect



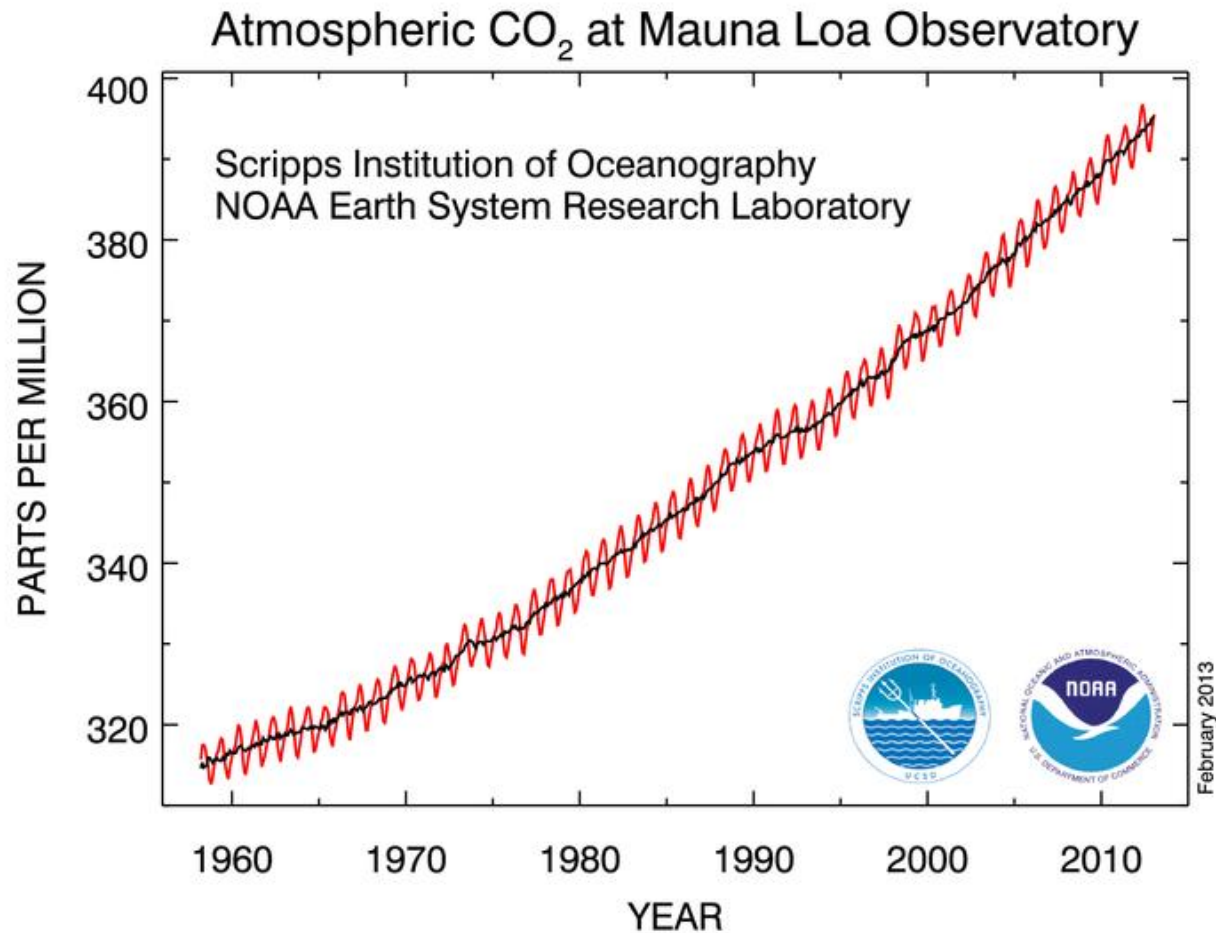
(water vapour) carbon dioxide, methane,...

Fourier (1827), Tyndall (1861)

Temperature and greenhouse gases in past 650,000 y



Carbon Dioxide in the Atmosphere



Carbon Dioxide in the Atmosphere

We can be very confident that this rise in carbon dioxide in the atmosphere is due to the activities of humans

- land use change

- emissions of greenhouse gases,

 - principally by burning coal, oil & gas

If 100t of carbon dioxide is added to the atmosphere

- 40t will be there in 20 years

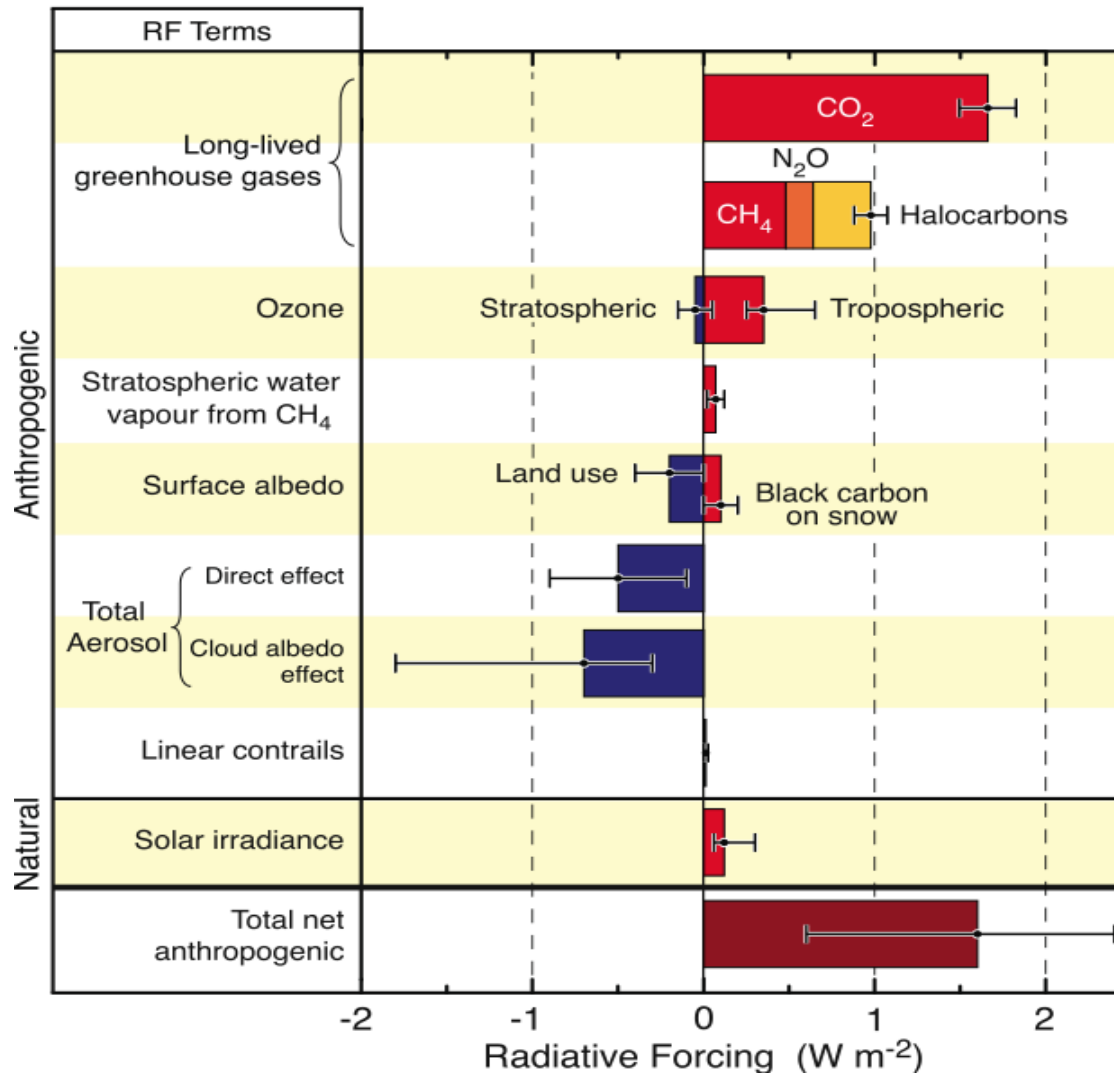
- 35t in 100 years

- 25t in 1000

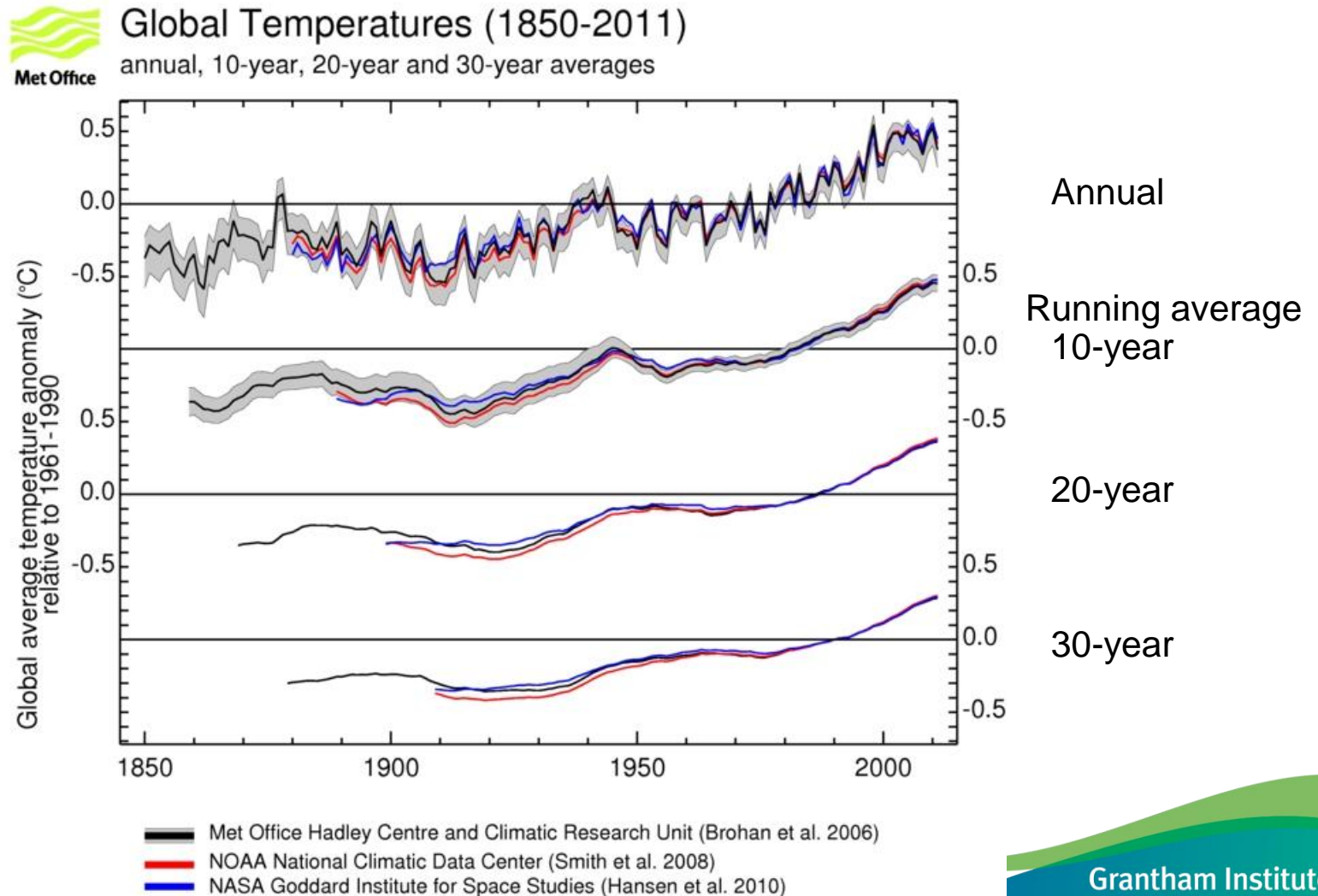
- 20t in 10,000 years

Estimated causes of the current imbalance in the energy budget of Planet Earth

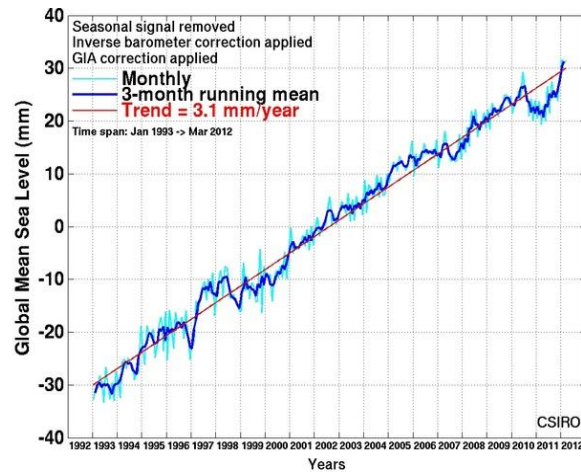
IPCC 2007



Global temperatures and 10, 20 & 30 year running averages

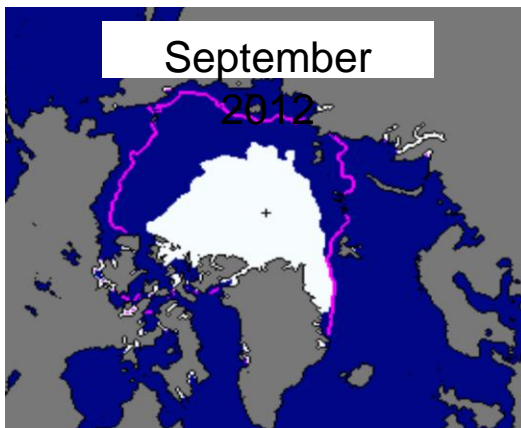


Other evidence of a warming climate



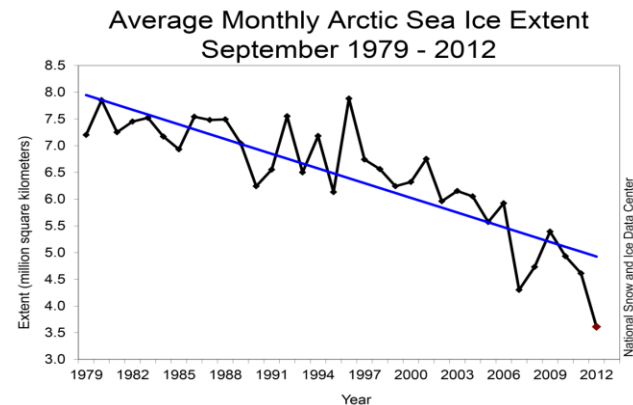
**Global
sea level**

Satellite 1991-



**Arctic
sea ice**

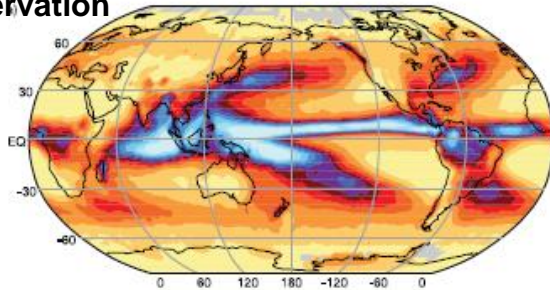
National Snow & Ice Data Center



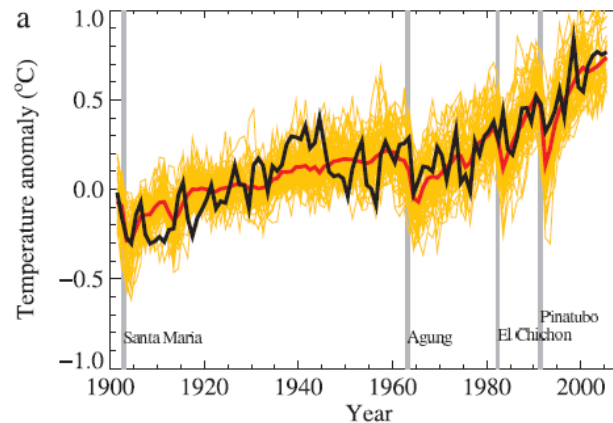
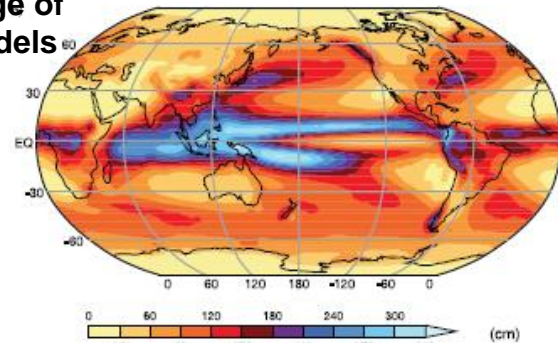
Evaluation of climate models on 20th century climate

Annual precipitation

Observation



Average of
all models

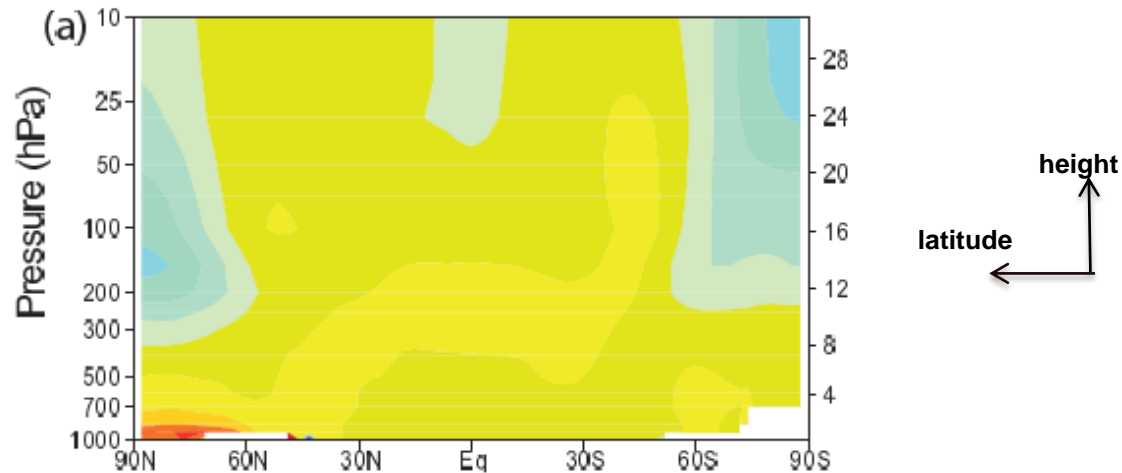


Natural &
anthropogenic forcings
14 models
58 simulations

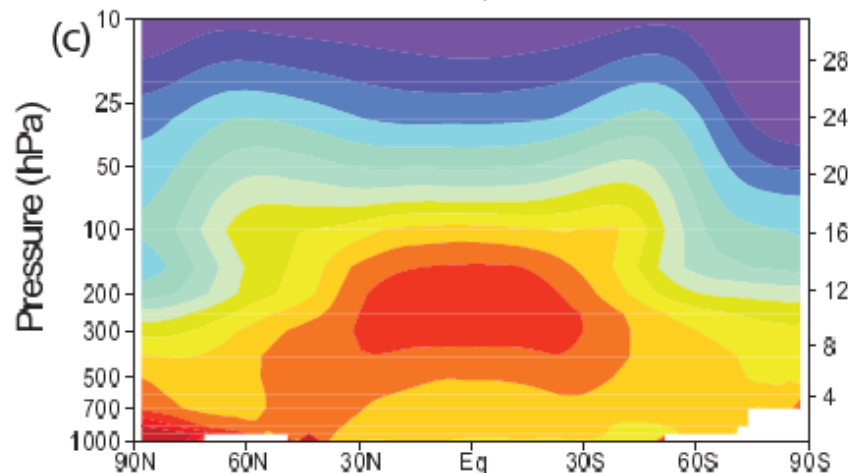
Mean Temperature changes in models for changed conditions

IPCC AR4 WGp1 Ch8

**Increase in
solar flux**

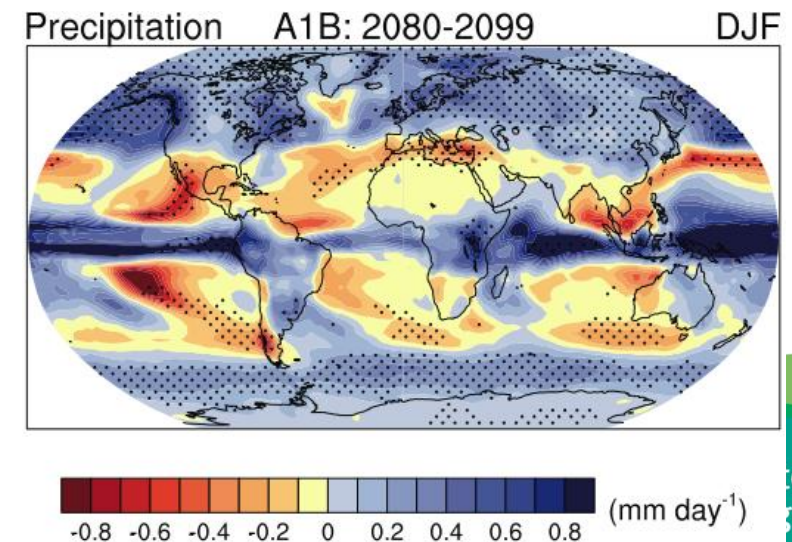
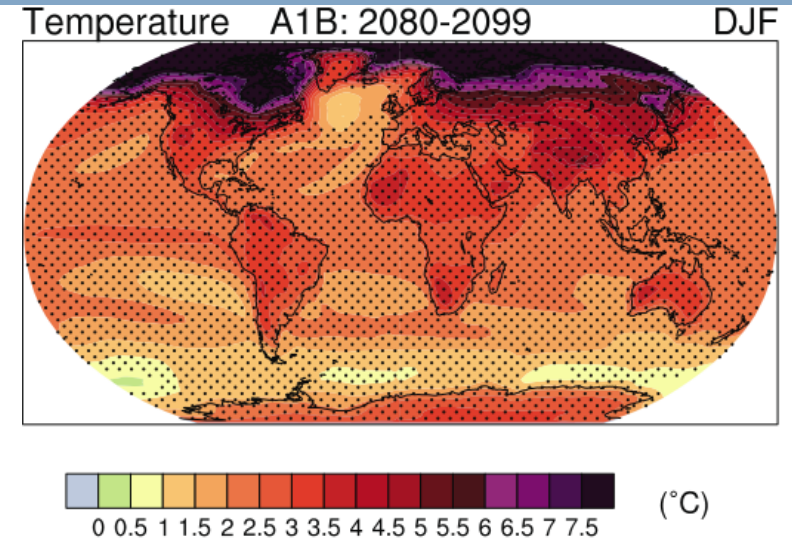
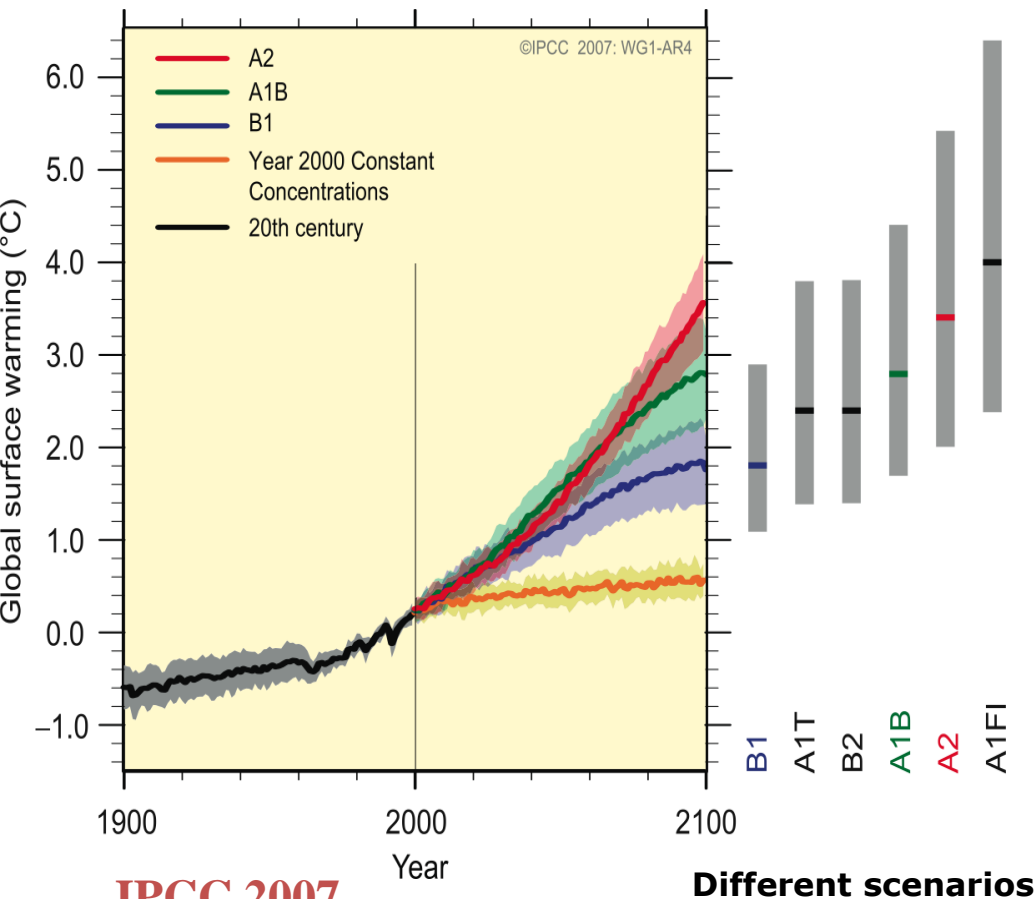


**Increase in
long-lived GHGs**



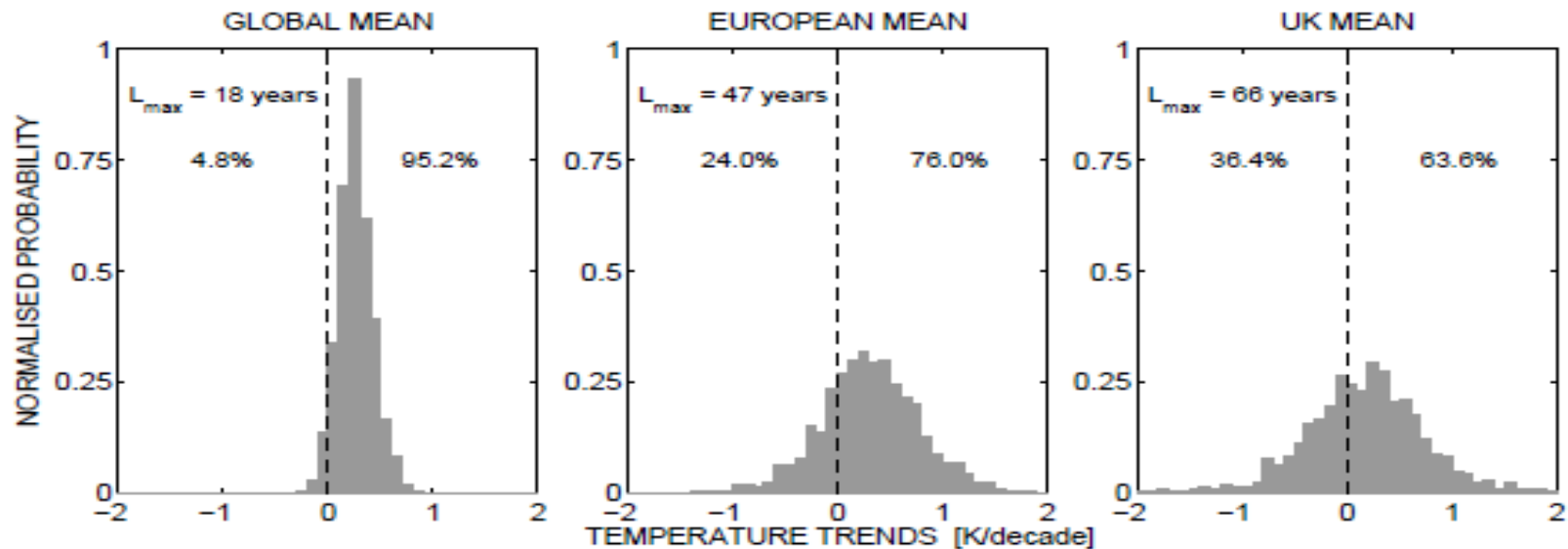
Projections: globally averaged surface warming

Late 21st Century regional changes for 1 emission scenario Dec-Feb



Decadal Temperature trends at end of 21st century (A1B)

Ed Hawkins



Surface T projections for different periods and scenarios

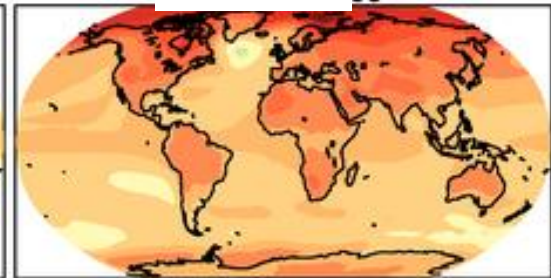
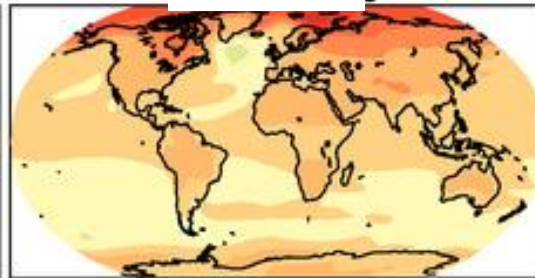
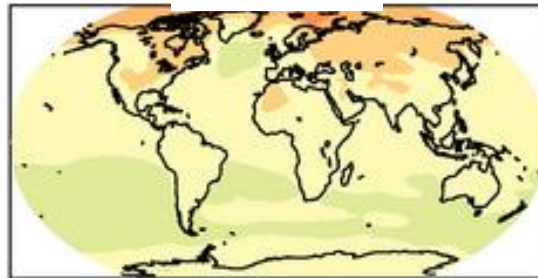
IPCC 2003

2011-30

2046-65

2080-99

B1

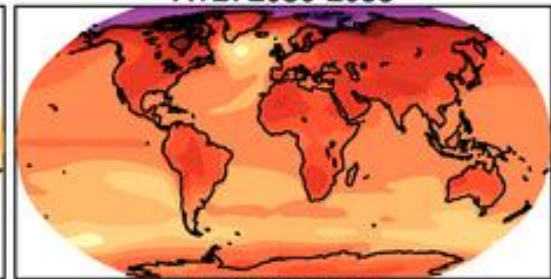
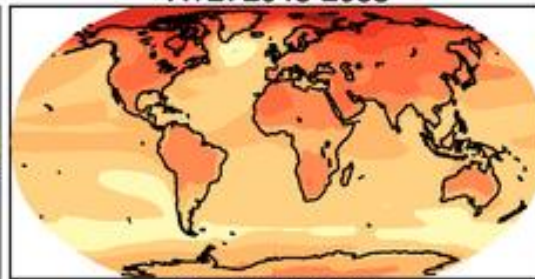
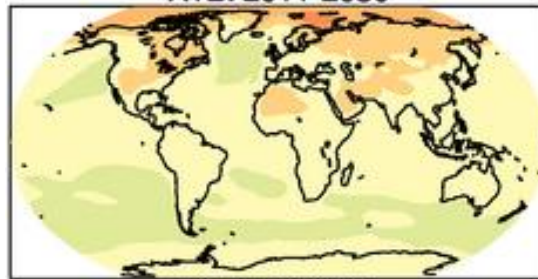


A1B: 2011-2030

A1B: 2046-2065

A1B: 2080-2099

A1B

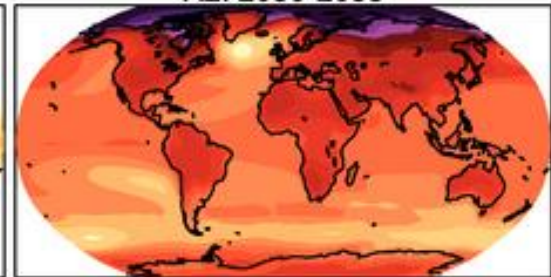
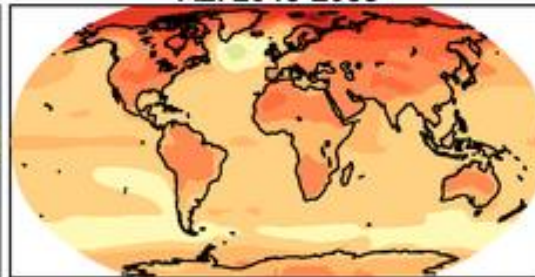
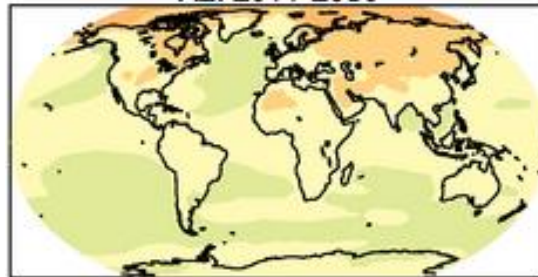


A2: 2011-2030

A2: 2046-2065

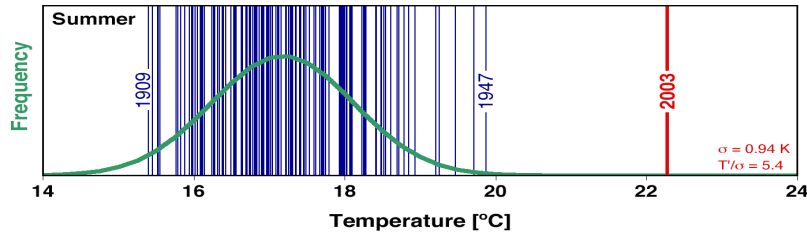
A2: 2080-2099

A2

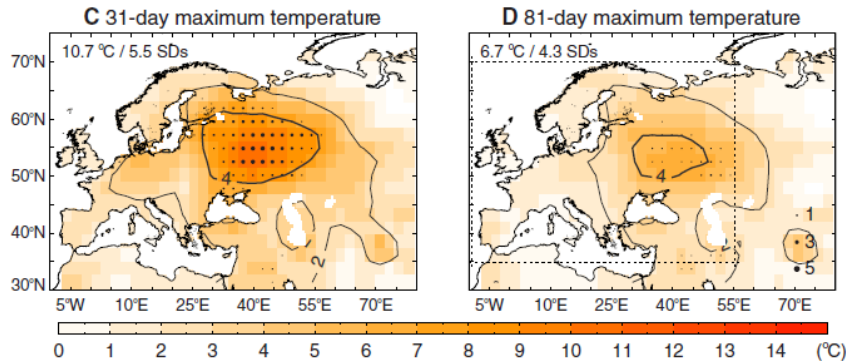


(°C)

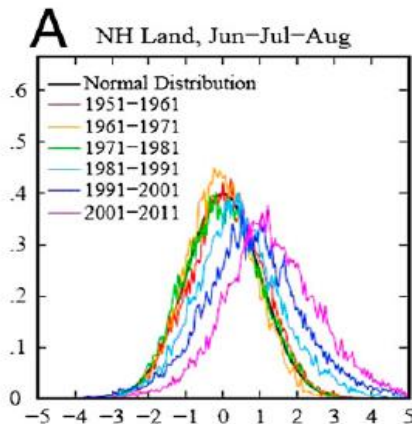
Extreme Summer Heat in the Past Decade



Swiss Temperature Series 1864-2003
(mean of 4 stations) *Schär et al. 2004, Nature, 427, 332-336*

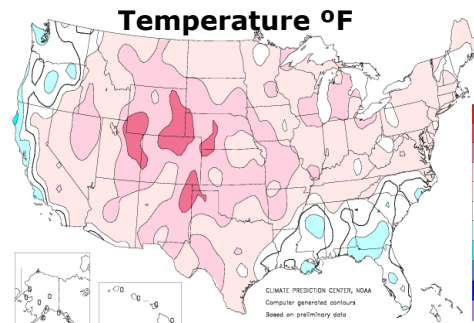


2010 Russian Heat Wave *Barriopedro 2011*

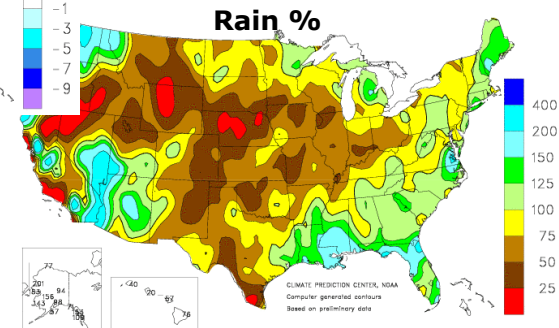


**Frequency of occurrence of
local T anomalies/local standard deviation of T**

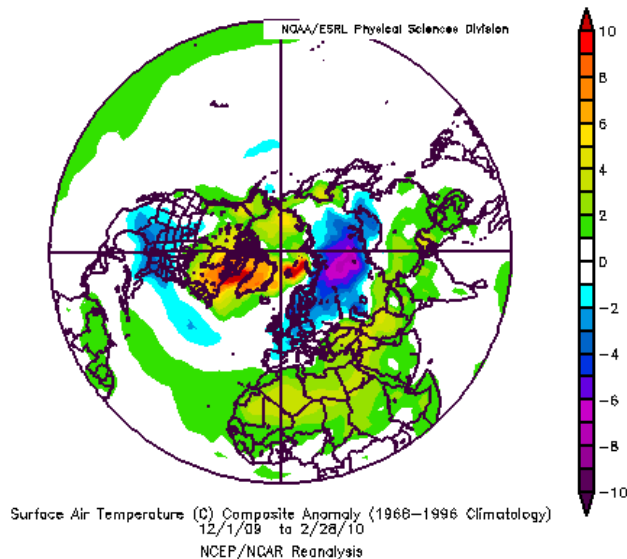
Hansen et al 2012



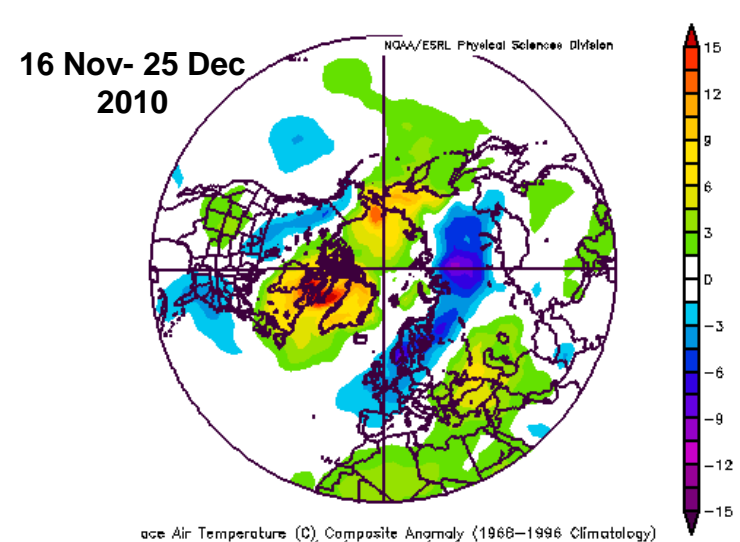
2012 US summer



Cold extremes of the past few years



**Winter 2009/10
Eurasian cold**



**Dec 2010
Record cold in UK**

The anthropogenic climate change problem

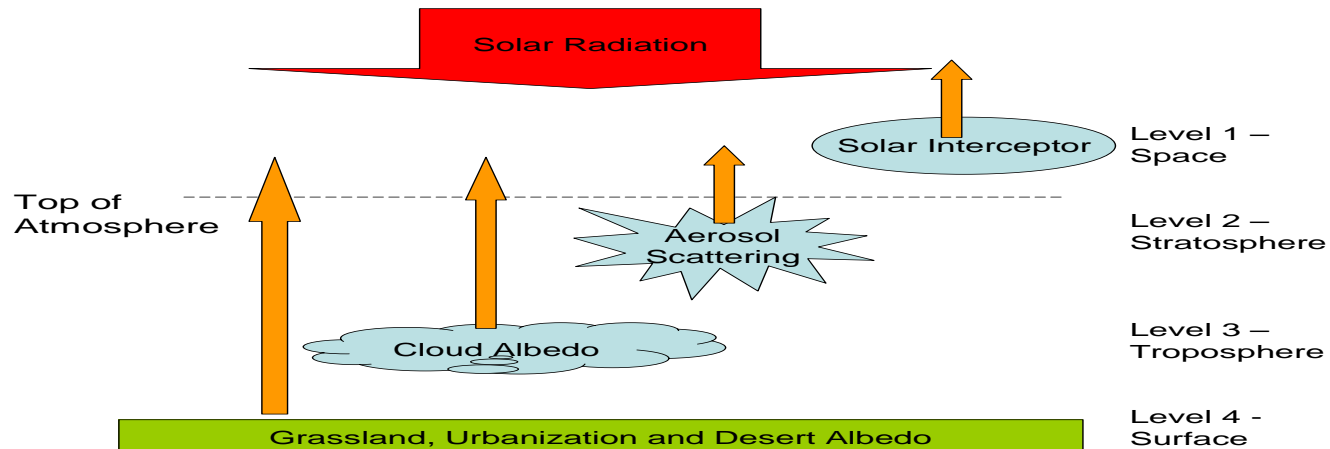
Context: growing world population
need for development
changing diet
increased demand for food, water & energy
other global environmental changes

Impacts: water supply
flooding
ecosystems
agriculture
coastal erosion & flooding
health
.... (ocean acidification)

**The impacts derived from climate models are what are likely to occur if we are lucky -
increasing chance of crossing thresholds in the climate &/or social systems**

Geo-engineering suggestions

1. Carbon Dioxide Removal: remove from the atmosphere
fertilise the ocean
artificial trees, land surface treatment
2. Solar Radiation Management: reduce solar energy at surface



Actual climate impact; other impacts; feasibility?

Mitigation: UK Climate Change Committee

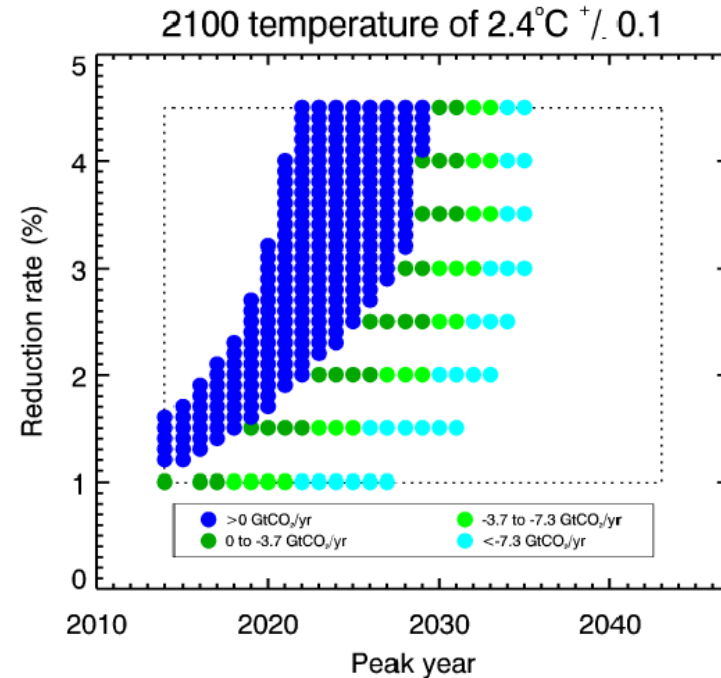
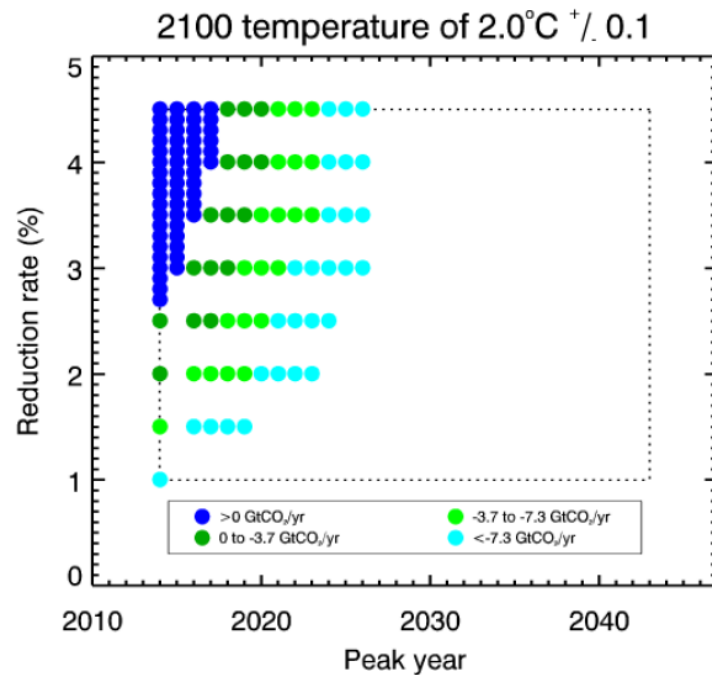
2 Criteria: 50:50 chance of not getting much above 2°C
negligible chance of getting to 4°C

Global 50% reduction in CO_{2e} emissions by 2050: 2.1-2.6 t CO_{2e} per person

In UK: 80% reduction in CO_{2e} emissions by 2050 -enshrined in UK law

The Scientific Case for Action

Achieving targets: sensitivity to parameters



Mitigation

International

UN Framework Convention on Climate Change

Kyoto Protocol,

Conference of the Parties, ...Copenhagen, Cancun, Durban, Doha....

EU 20% emissions reduction from 1990 levels by 2020, 2050 objective 80-95%

UK

Climate Change Bill (Nov 2008)

- Commitment for 2050 reduction in carbon dioxide emissions
- Established system of legally binding 5-year “carbon budgets”
- Established the Climate Change Committee (CCC)