Informing climate targets: Recent results from the Met Office Hadley Centre and the AVOID programme

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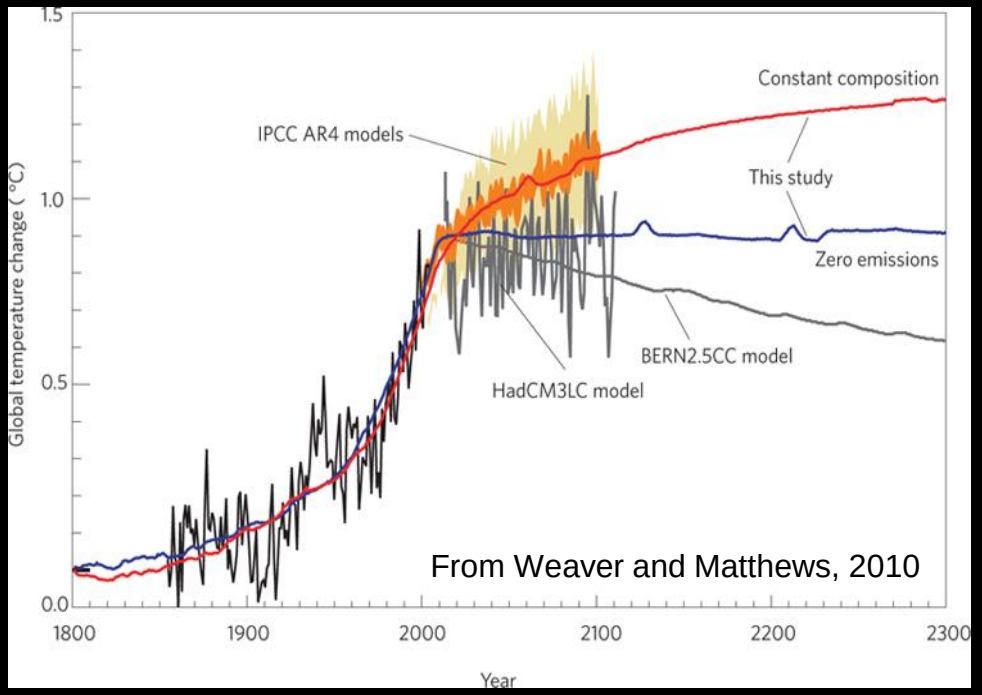
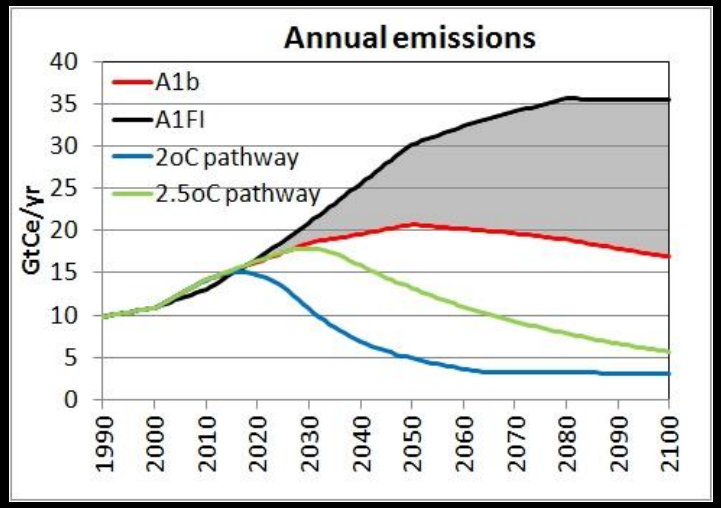
Part 1 – The feasibility of limiting warming

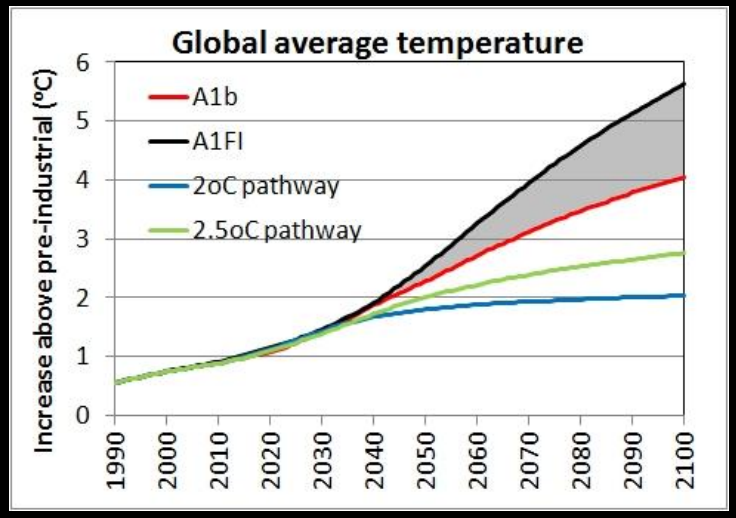
Feasibility of limiting warming

- Climate constraints: Given an emissions pathway, what happens to temperature?
- Economic and technological constraints: on achieving an emission pathway
- Political and market constraints: Creating the situation to drive emission reductions.



Climate modelling results from the AVOID programme





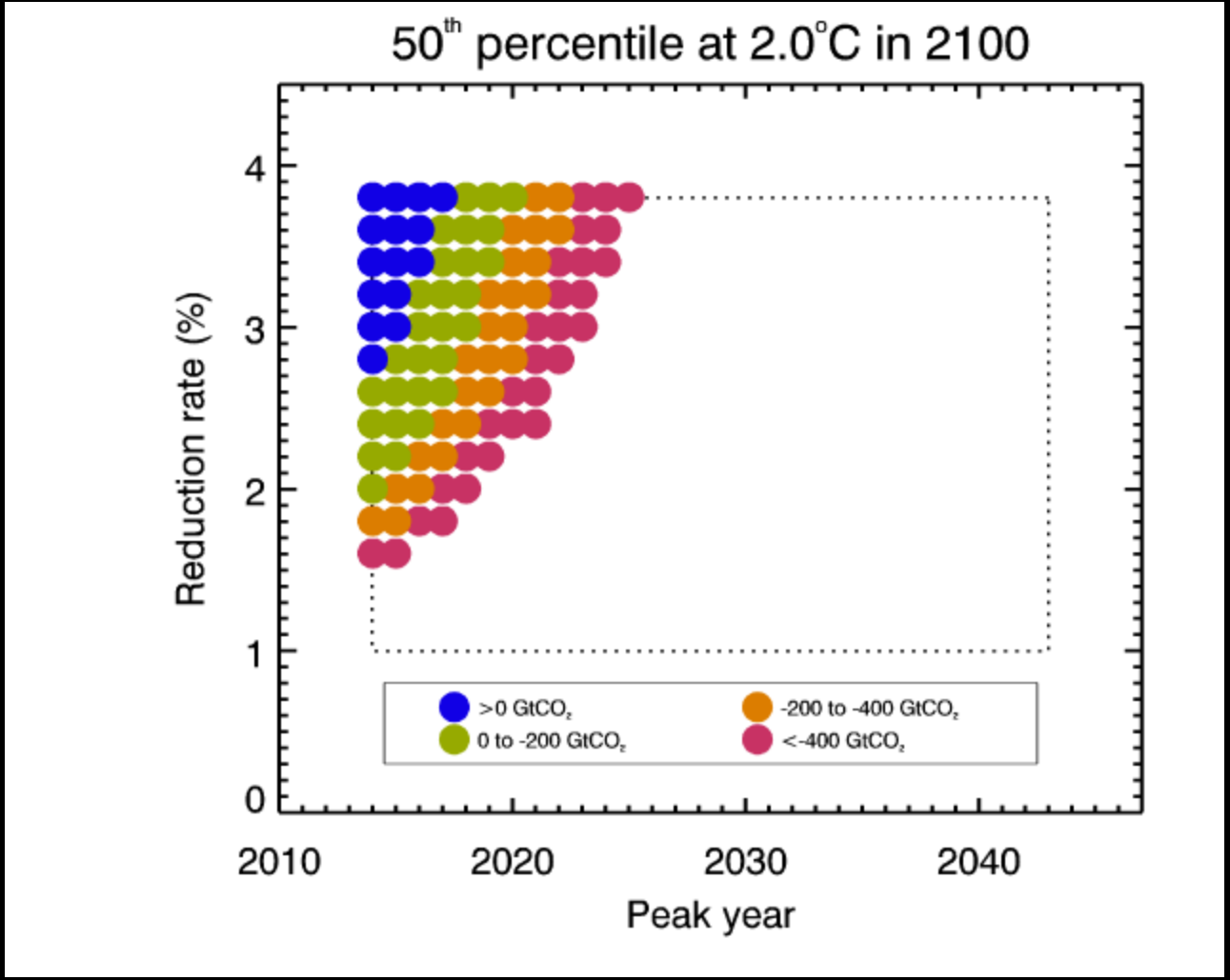
Policy simulations – 150,000 different pathways

Negative emissions allowed

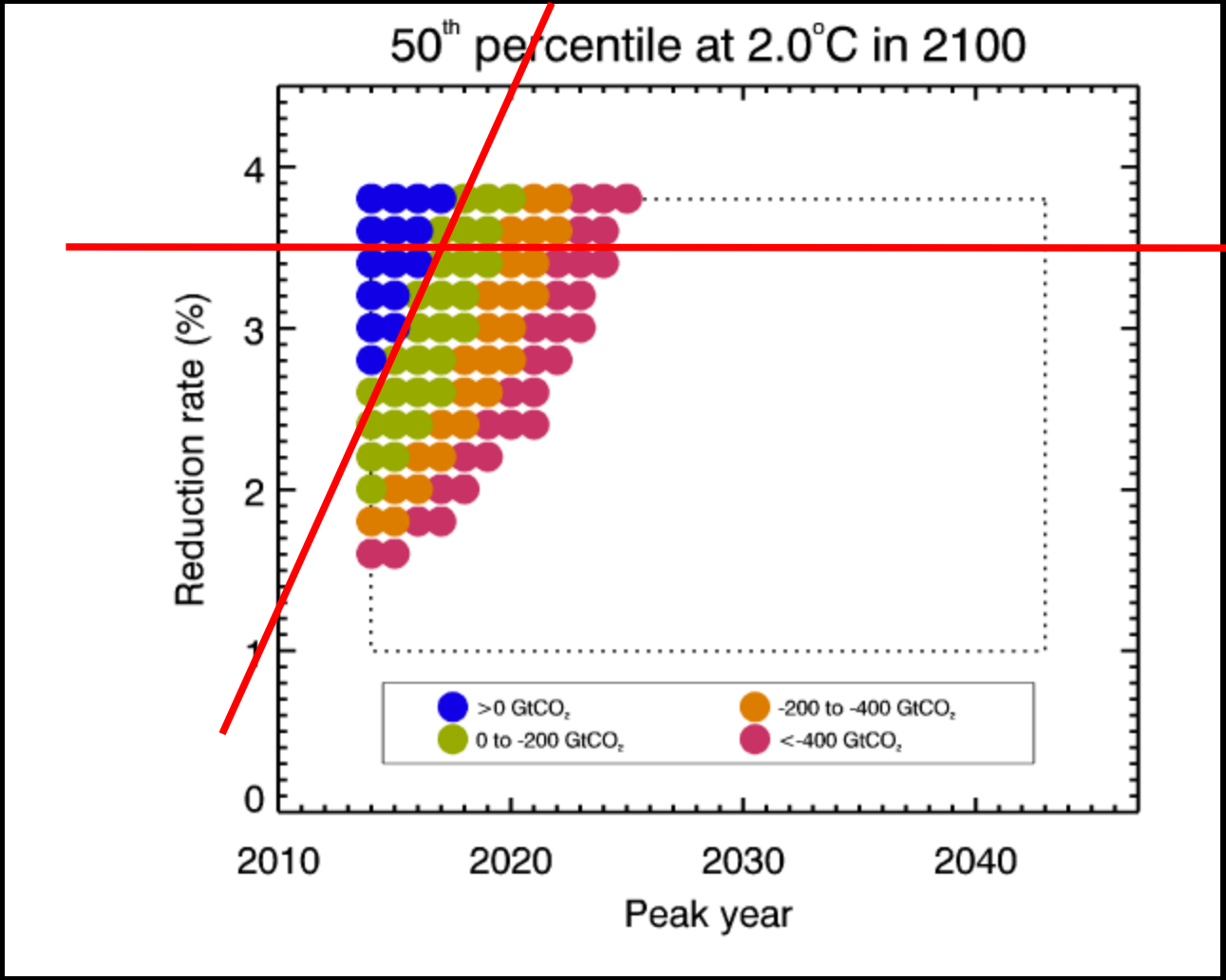
Simulations runs with a simple climate set up to:

- Represent more complex climate models
- Sample uncertainty

Pathways compatible with 2°C



Pathways compatible with 2°C



Other temperature target levels

1.5°C warming limit


Climatic Change (2012) 111:973–981
DOI 10.1007/s10584-012-0414-8

LETTER

Is it possible to limit global warming to no more than 1.5°C?

A letter

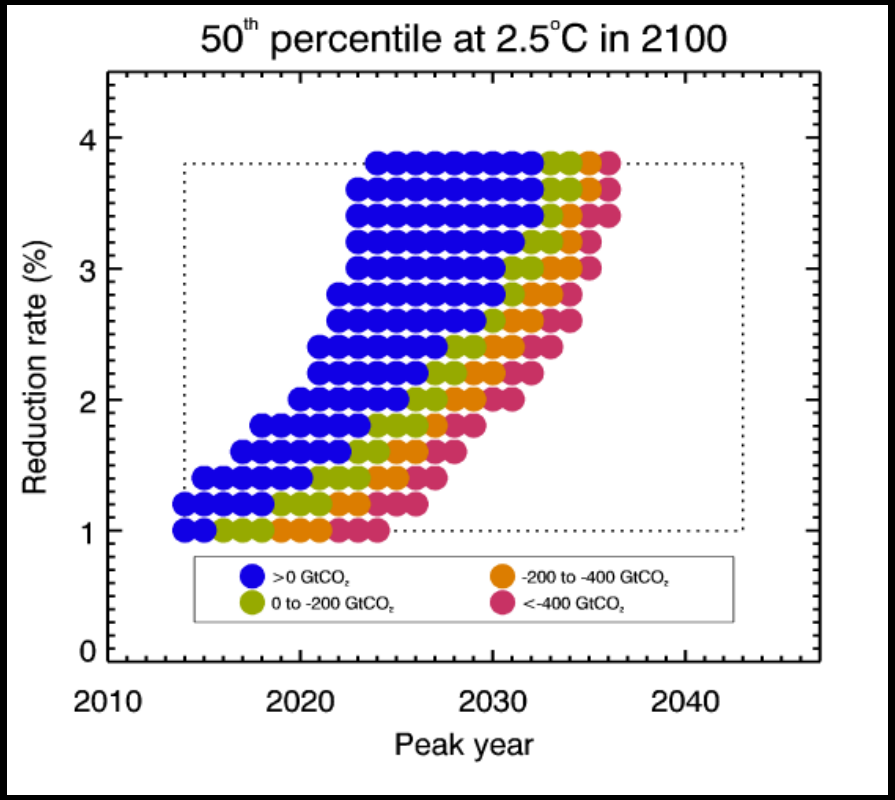
N. Ranger · L. K. Gohar · J. A. Lowe · S. C. B. Raper · A. Bowen · R. E. Ward

1.5ºC possible with lower probability

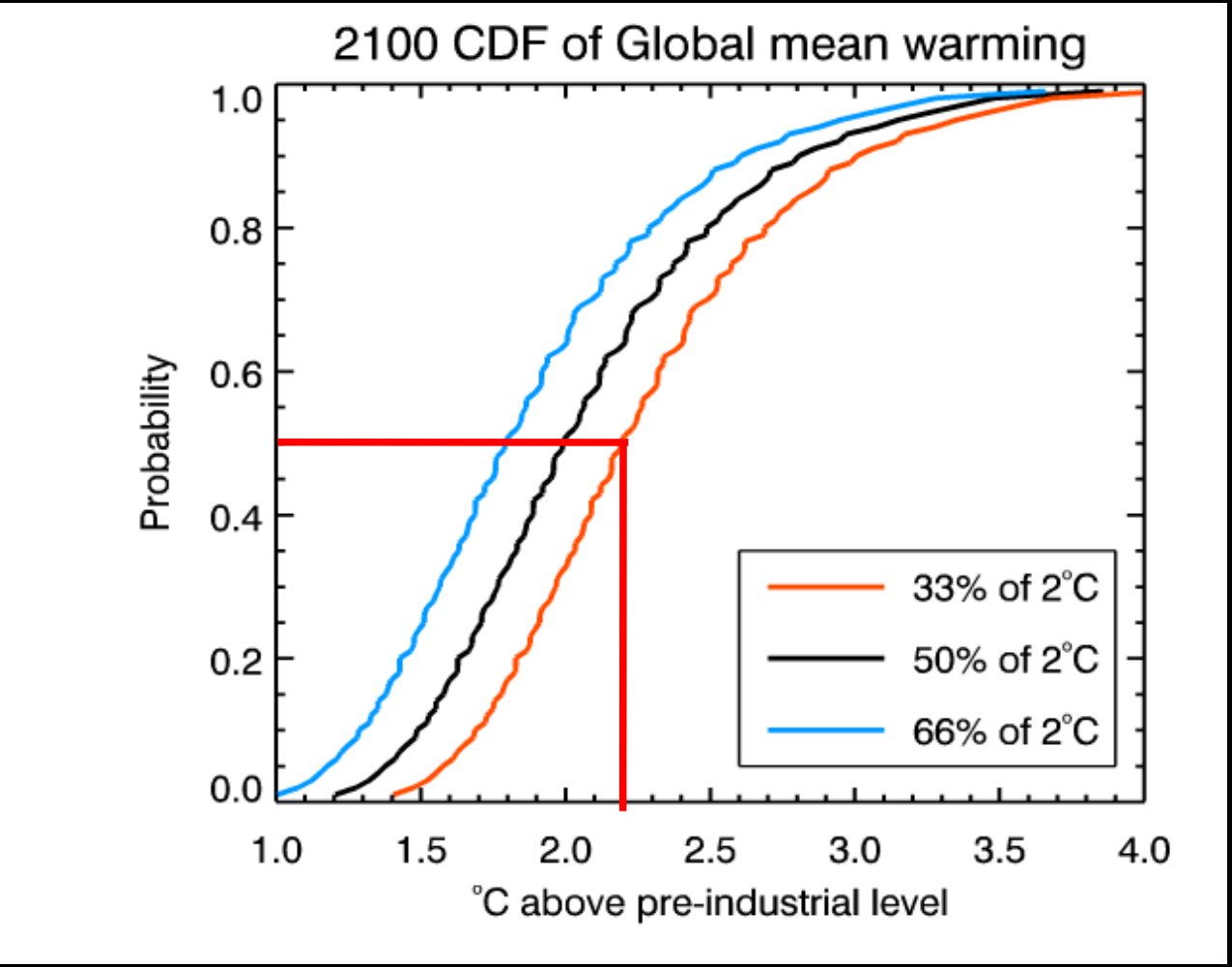
OR

With a temperature overshoot of at least several decades

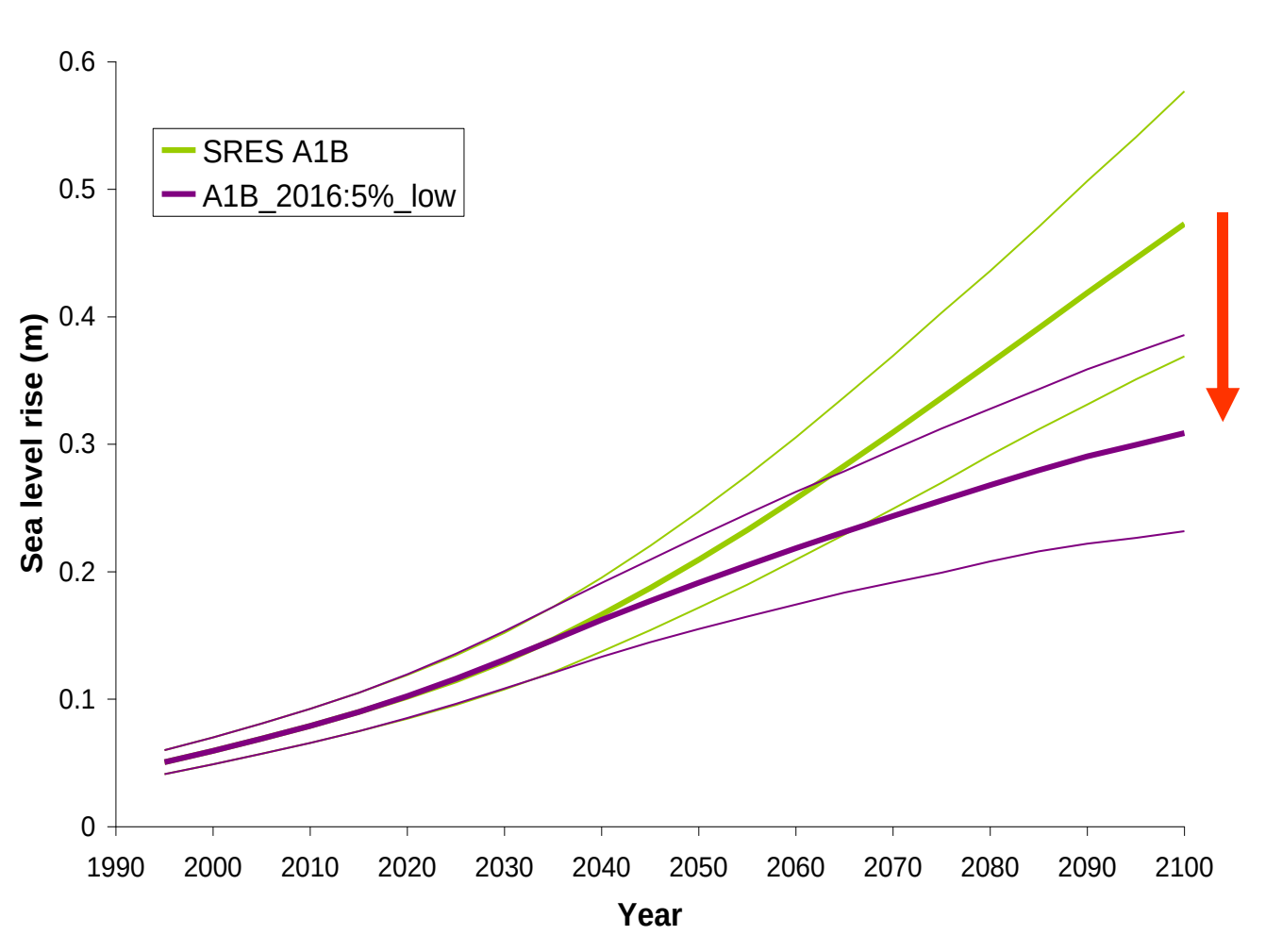
2.5°C warming limit



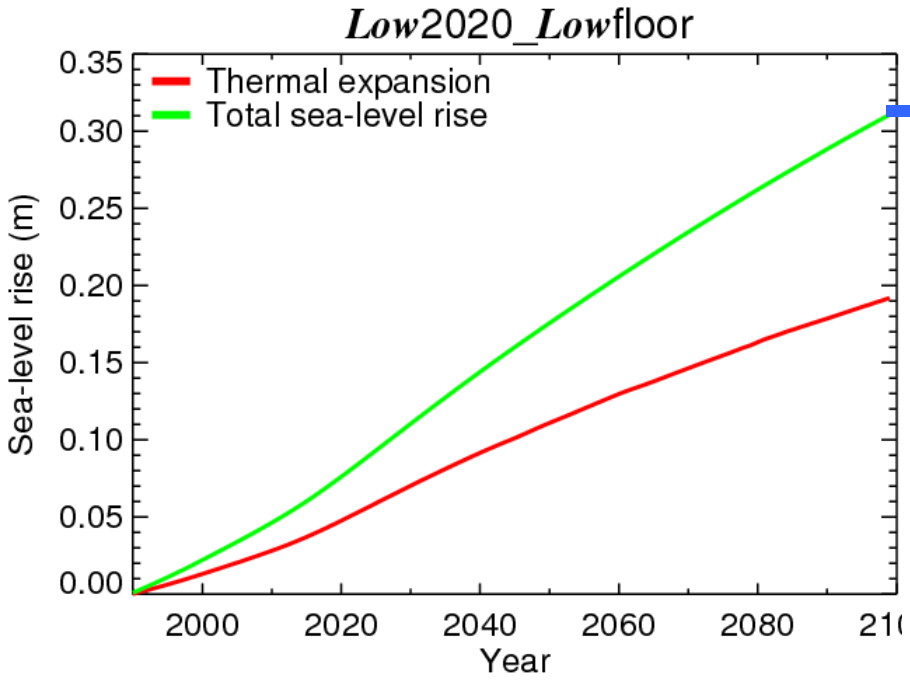
What about other probability levels?

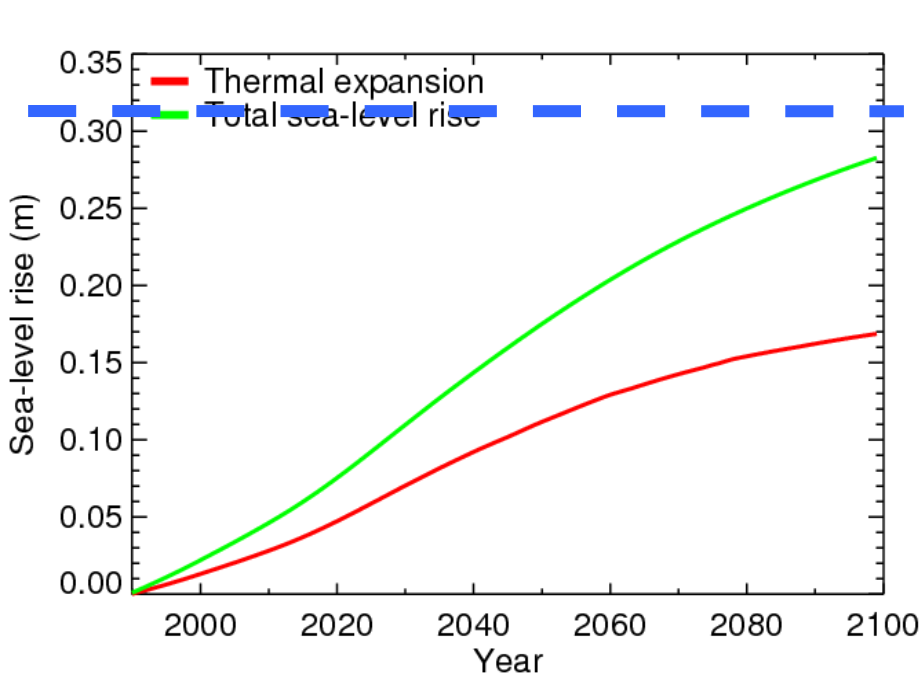


Mitigation can avoid some future sea-level rise



Moving to a 1.5°C target may only provide a small additional sea level benefit this century





By 2100 a further 3 to 4cm of sea-level rise is avoided if a temperature target of around 1.5°C is used instead of 2°C. However, benefits grow after 2100.

Part 2 – Evidence to inform a temperature target level

Impacts of climate change on people, infrastructure and natural systems

Water availability

Exposure to river floods

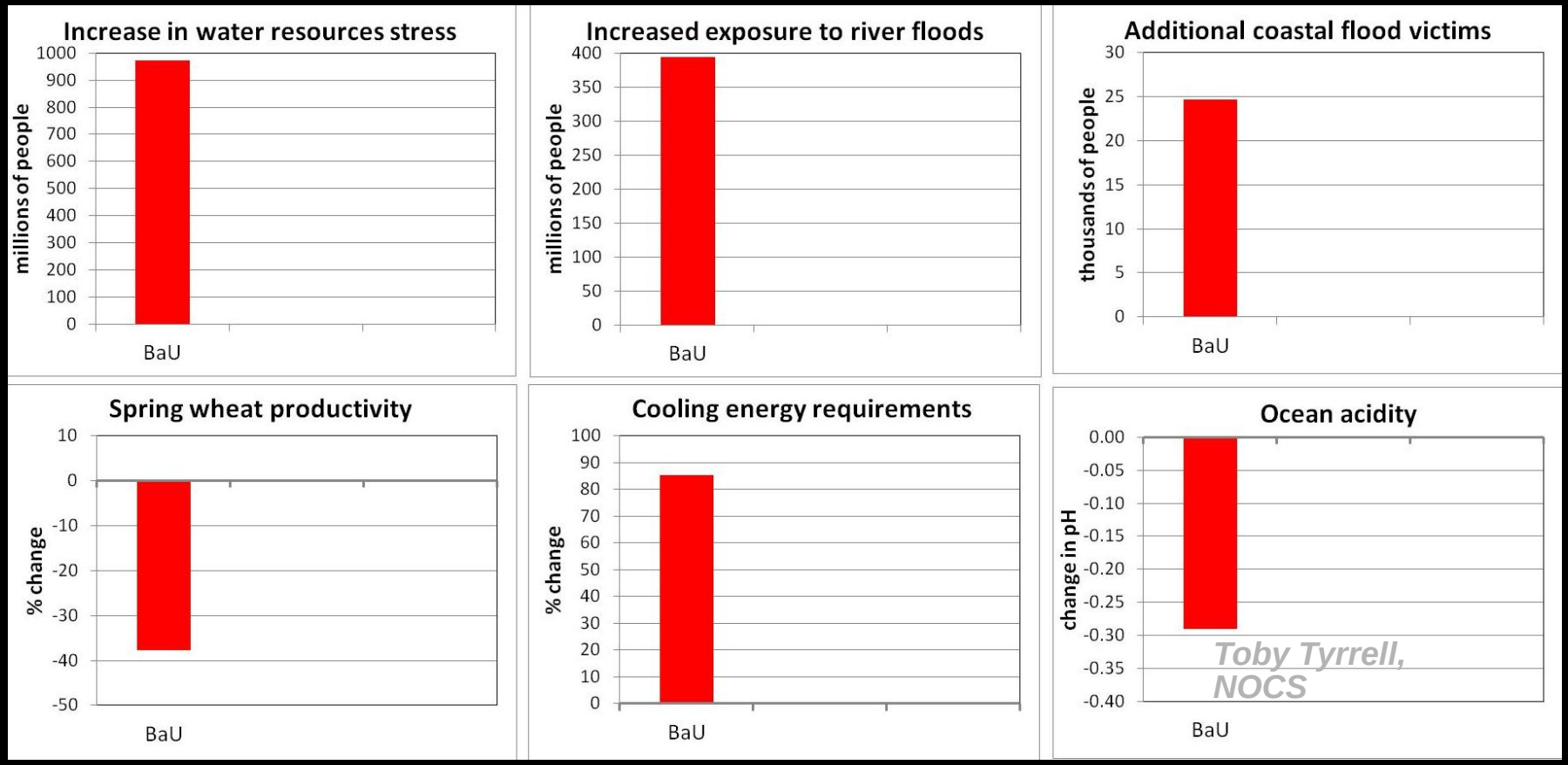
Coastal flooding

Crop yields

Cooling demand

Ocean acidification

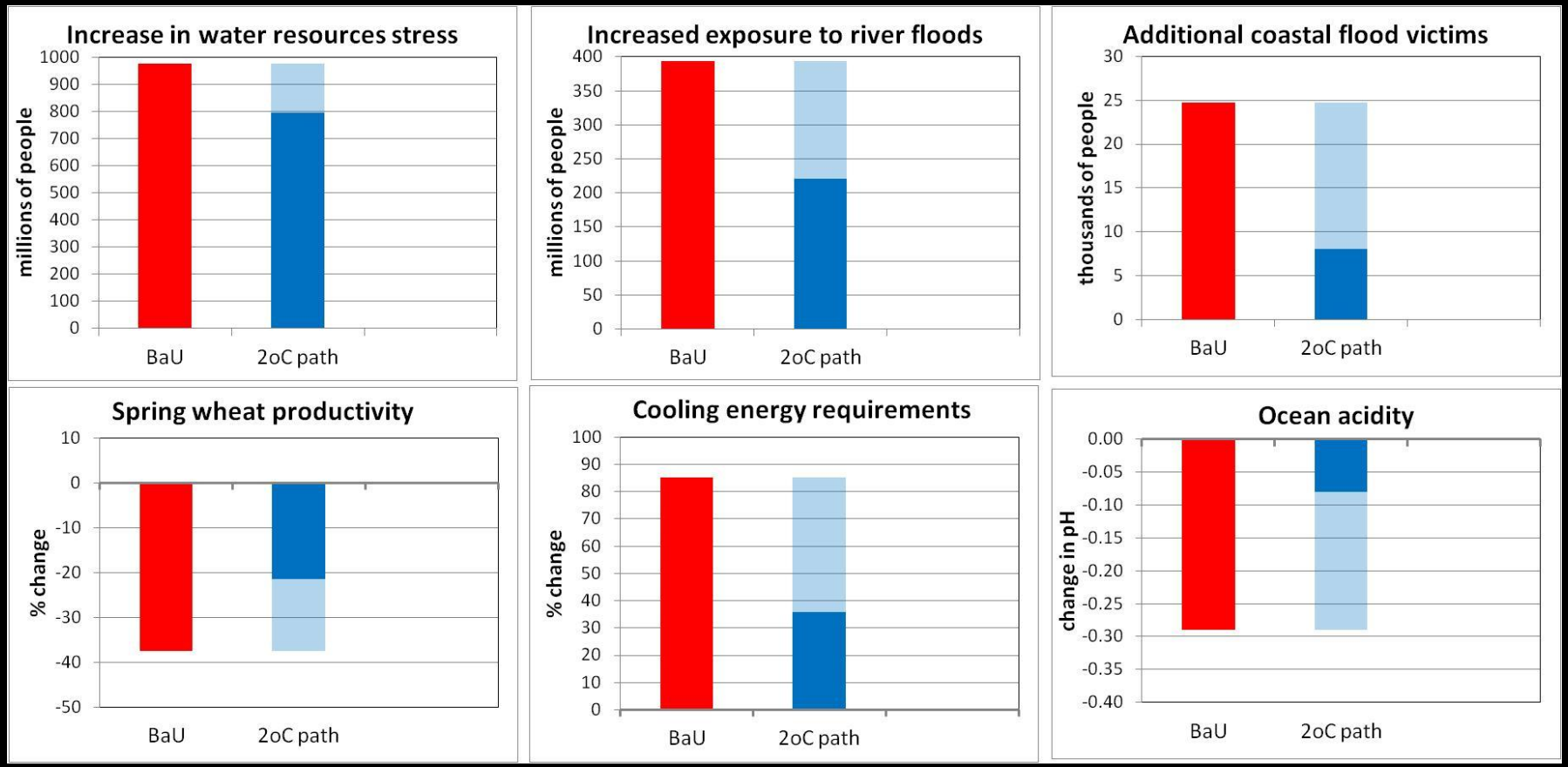
A plausible estimate of impacts at 2100 for a business-as-usual scenario



***2100** HadCM3 A1B BAU*

Adapted from Arnell et al 2013

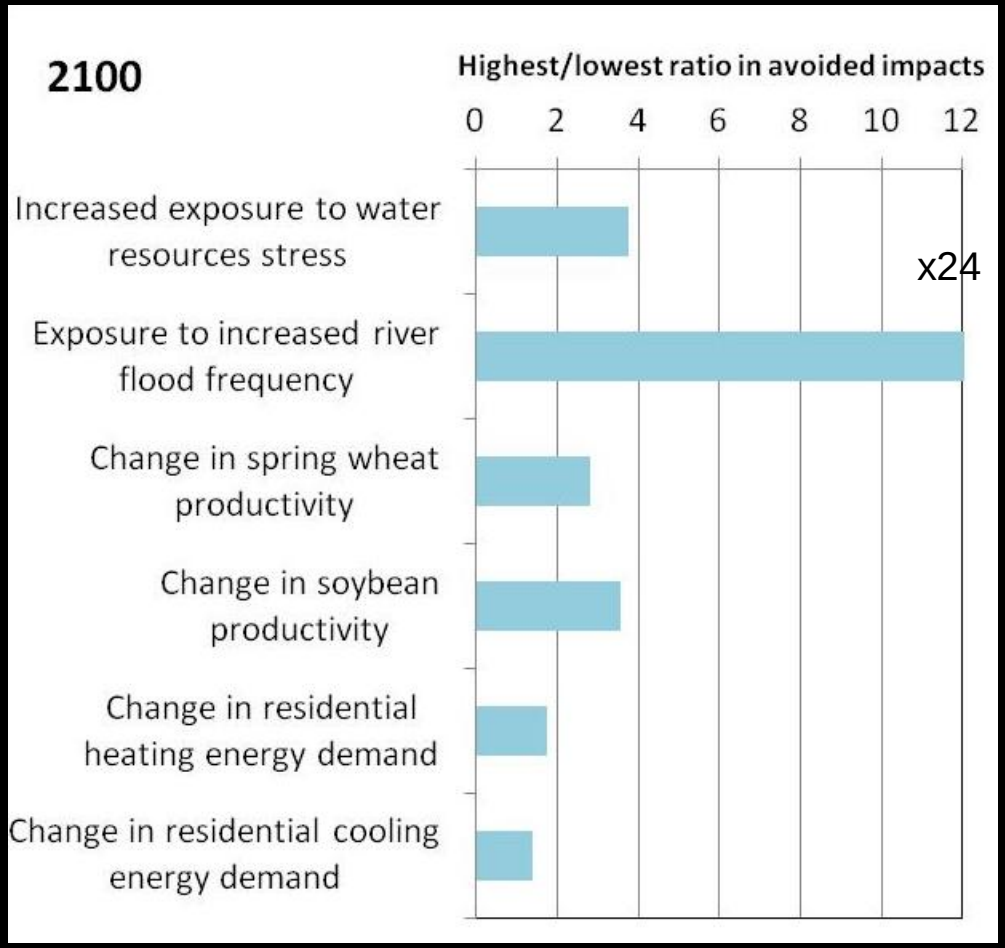
Impacts AVOIDed by a 2°C target...



***2100** HadCM3 A1B BAU*

Adapted from Arnell et al 2013

The estimated *absolute* avoided impacts are uncertain



2ºC target, compared with A1B BaU

Bars represents ratio of absolute avoided impacts across seven climate model patterns

from Arnell et al 2013

Large-scale climate system thresholds

- Collapse of Atlantic overturning circulation
- Loss of Arctic sea ice
- Loss of Greenland or West Antarctic ice sheet
- Shift in large-scale atmospheric circulation?

- Die-back of tropical forest
- Release of carbon/methane from permafrost
- Release of carbon/methane from Clathrates

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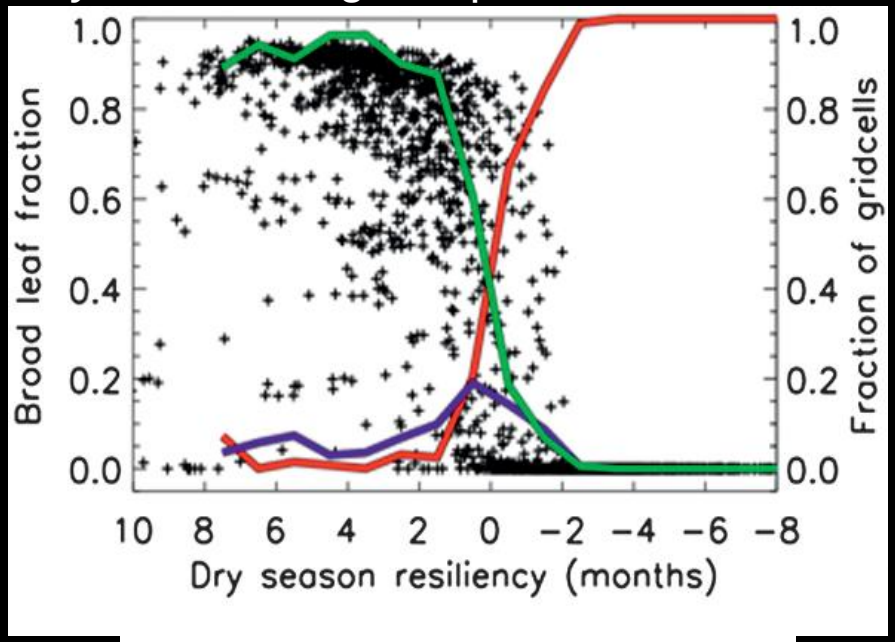
Interactions between thresholds may significantly affect the overall risk of abrupt climate change

Some systems may be affected by more than temperature

Tropical forests: CO2 concentration and dry season length important



$$\mathrm{DSR} = (\text{dry season length}) + 0.46T - 0.0043\mathrm{CO}_2 - 18.7.$$

Good P, C Jones, J Lowe, R Betts, B Booth and C Huntingford, 2011. J. Climate, 24, 1337–1349

Atmospheric aerosol found to have an impact on**:**

Atlantic ocean overturning

Booth et al., 2012

Aerosols implicated as a prime driver of twentieth-century North Atlantic climate

NATURE Volume: 484 Issue: 7393

DOI: 10.1038/nature10946

AND

Hurricane activity

Dunstone et al. Nature Geo Sci In Press

Conclusions - 1

- In practice, specifying a temperature target requires a baseline and probability level.
- It is possible to apply multiple temperature targets: e.g. a 50% probability of limiting warming to less than, say, 2ºC, and 90% probability of limiting warming to less than say, 4ºC.
- Without negative emissions a 50% probability of limiting warming to 2ºC above pre-industrial still appears feasible – but the window of opportunity is narrow.
- A temperature limit of 1.5ºC may require some **temperature overshoot**. Science on temporary resilience is limited.
- Should temperature targets requiring **concentration overshooting** or **temperature overshooting** be treated in the same way as the no overshoot cases?

Conclusions - 2

- Undesirable impacts on people and their environment increase with temperature but the range of projected impacts is very wide.
- Some benefits of climate change are also likely to occur in some parts of the world.
- Understanding of large-scale physical thresholds in the climate system is increasing and the likelihood of passing key thresholds appears to increase with temperature.
- BUT not all local impacts or large-scale system changes depend solely on global average temperature rise. Other drivers of local changes might be very important.
- The IPCC fifth assessment report will provide a valuable snapshot of recent scientific progress
- Climate change is already detectable. A Warming limit of 1°C, 1.5°C, 2°C or higher will not avoid all of the impacts.

Questions and answers