School of Earth and Environment

UNIVERSITY OF LEEDS

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Food production and climate: risks and responses

Food and climate

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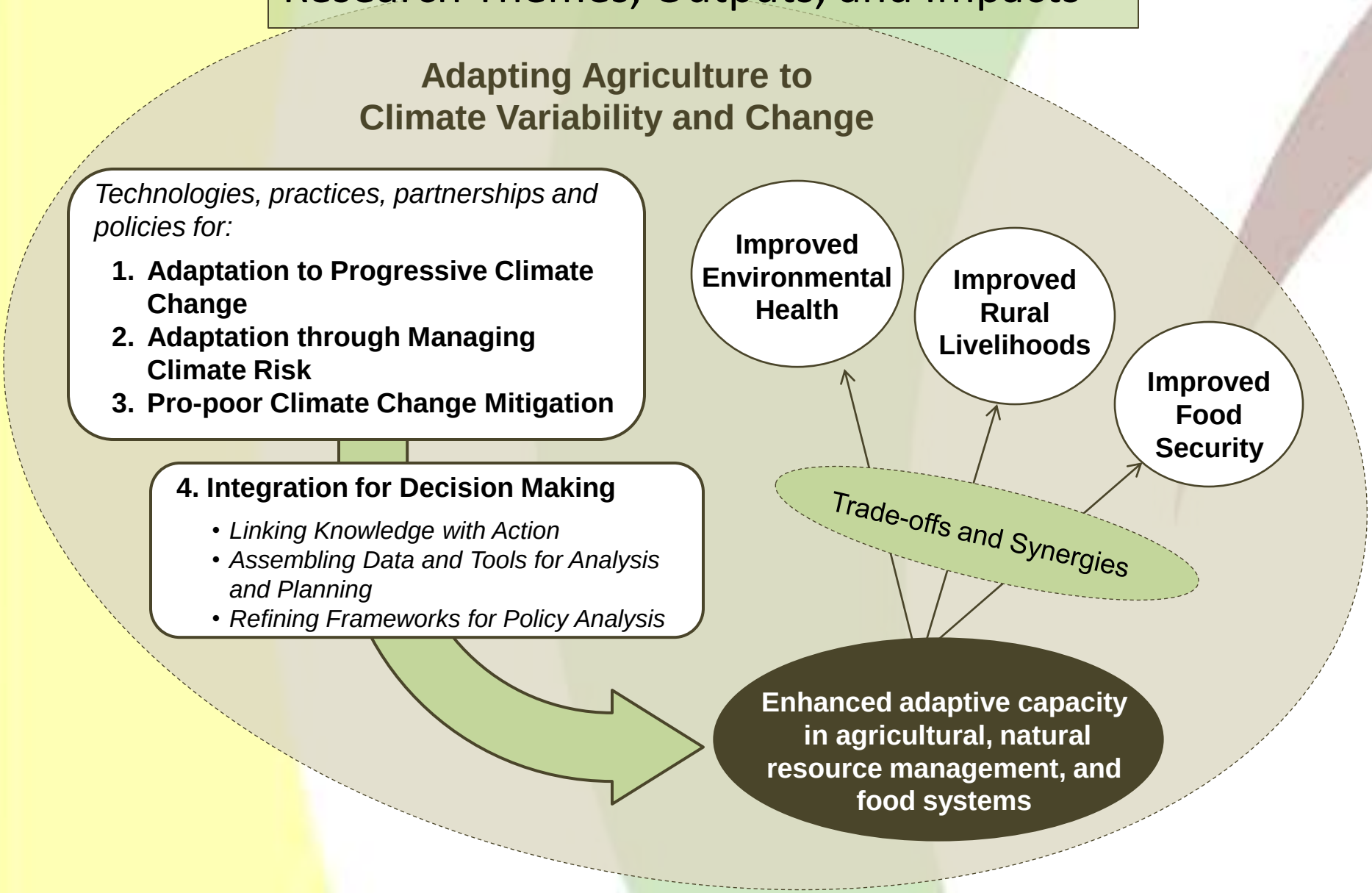
1. Agriculture-centred approach
2. Climate-centred approach
3. Implications for adaptation

The CCAFS Framework:
Research Themes, Outputs, and Impacts



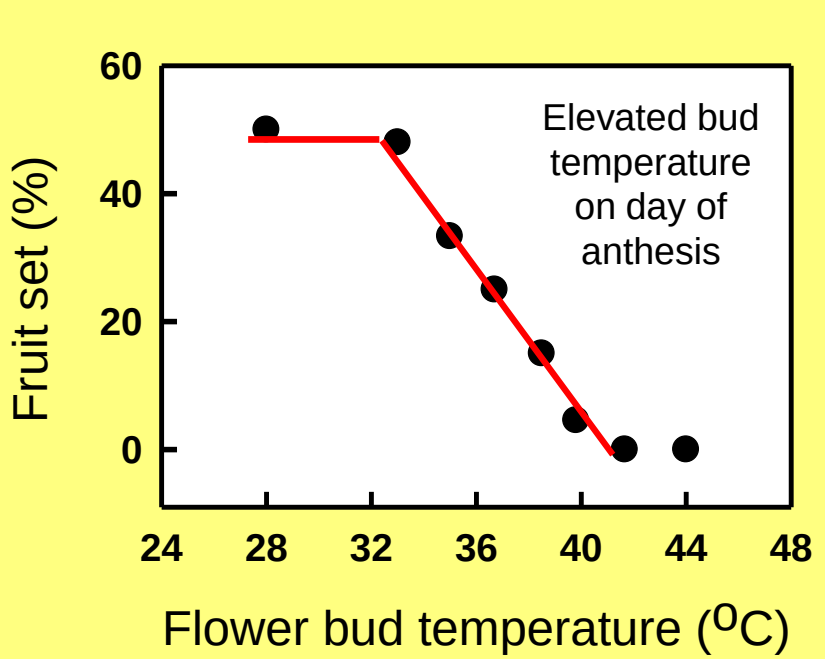
What risks are posed by climate change?

Wealth of knowledge of crop physiology at the field scale, e.g. heat during flowering

Implications for complexity of crop models and the way they are calibrated and used

Model structure, e.g. observable vs non-observable parameters, frames any analysis of uncertainty

Groundnut in controlled environments



Daily T of 32-39 °C , depending on timing

Vara Prasad et al (2001)

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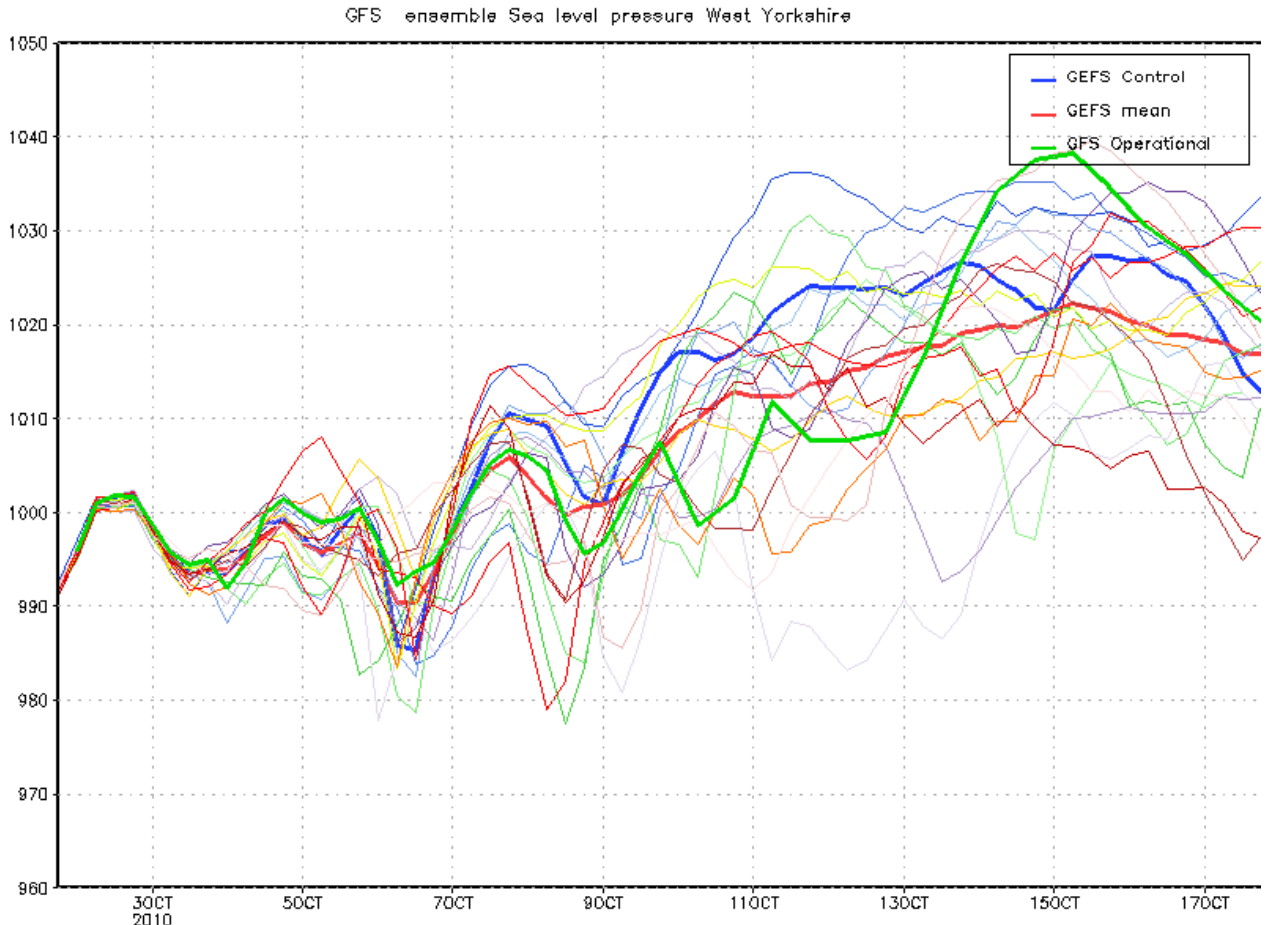
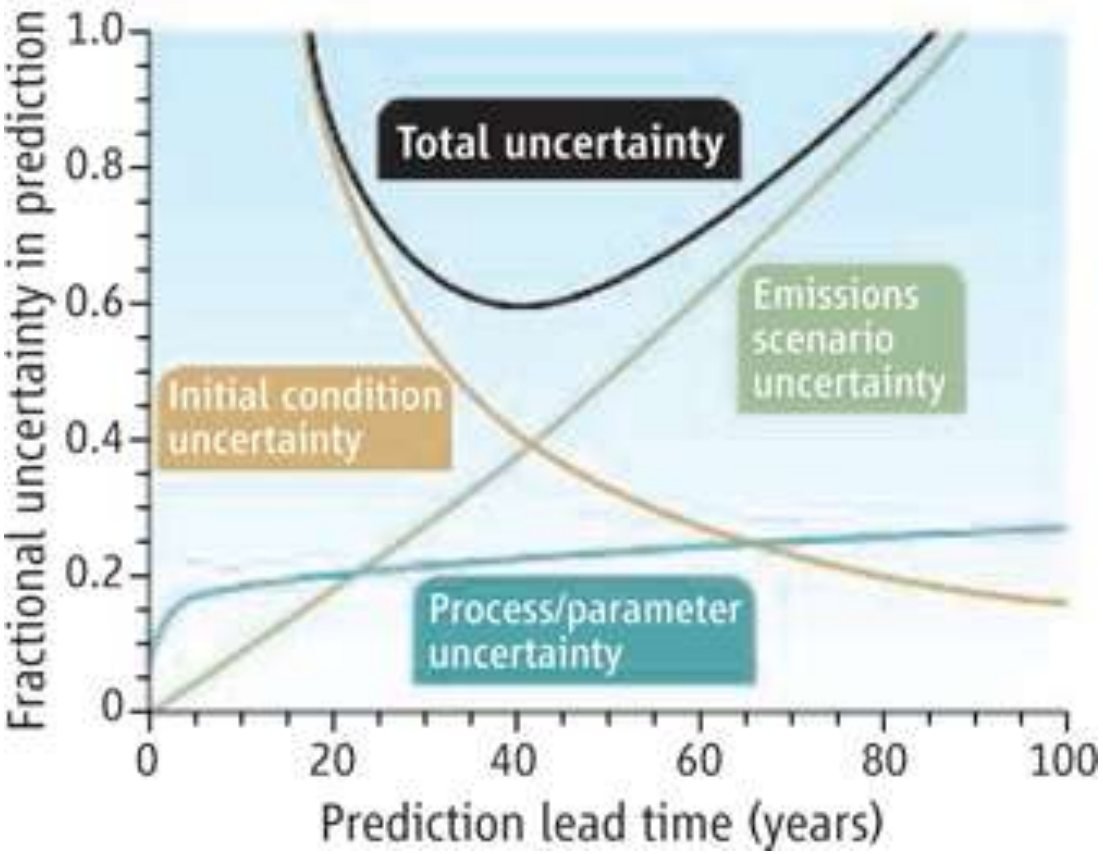
Predictability of weather



NCEP GFS model forecast from http://netweather.tv/

Predictability of climate



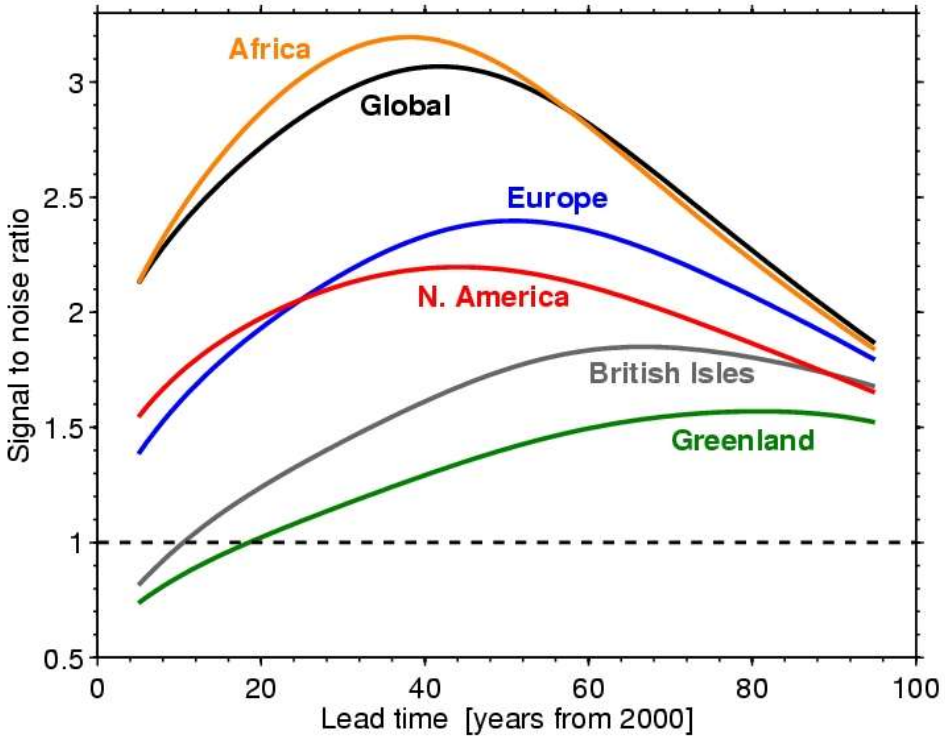
Climate predictions focusing on lead times of ~30 to 50 years have the lowest fractional uncertainty.

This schematic is based on simple modeling.

Cox and Stephenson (2007)
Science 317, 207 - 208

Predictability of climate

Signal to noise ratio for decadal mean surface air temperature predictions

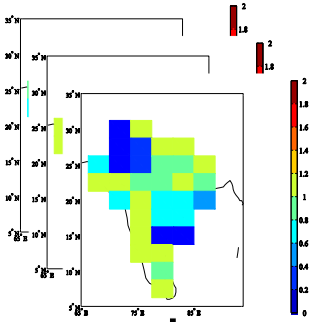


Hawkins and Sutton (2009)

What would these curves look like for impacts?

- Crops
- Health
- …

Climate modelling for impacts studies



Land use: biology, carbon cycle, water cycle ..

Ocean: atmospheric coupling, biology

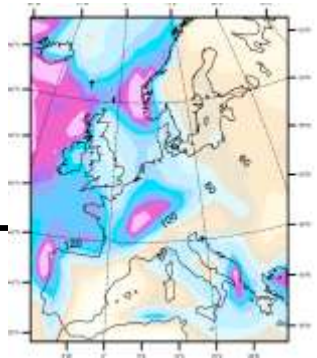
Cryosphere

Atmosphere: physics, chemistry

Ensemble size or simulation length

Complexity

Spatial resolution

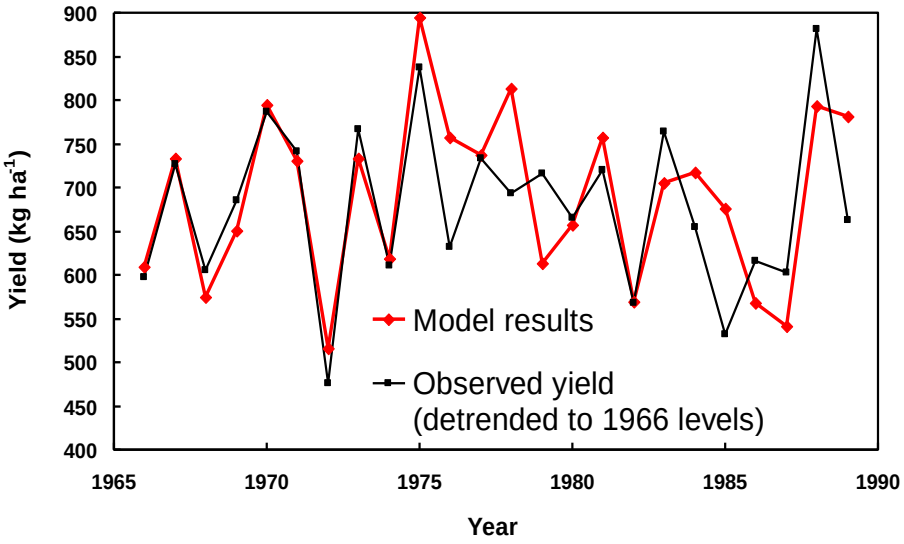


Challinor et al. (2009b)

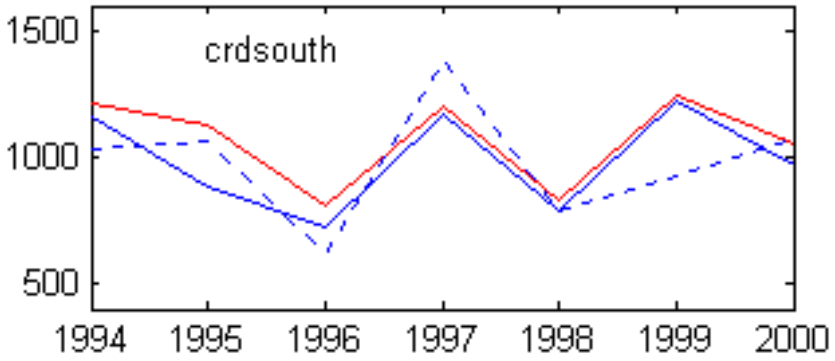
Crop modelling for impacts studies

- Reproduce observed relationships at the spatial scale of interest
- Appropriate complexity, with observable parameters
- Focus on biophysical processes (abiotic stresses)

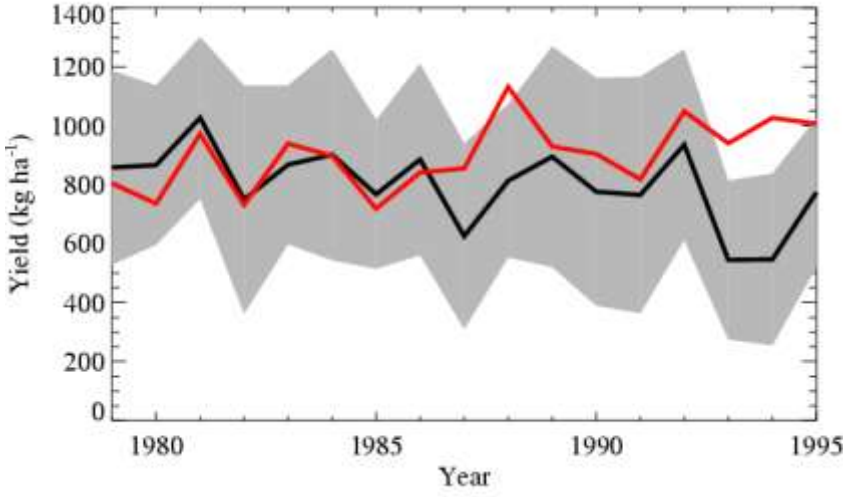
Challinor et al. (2004)



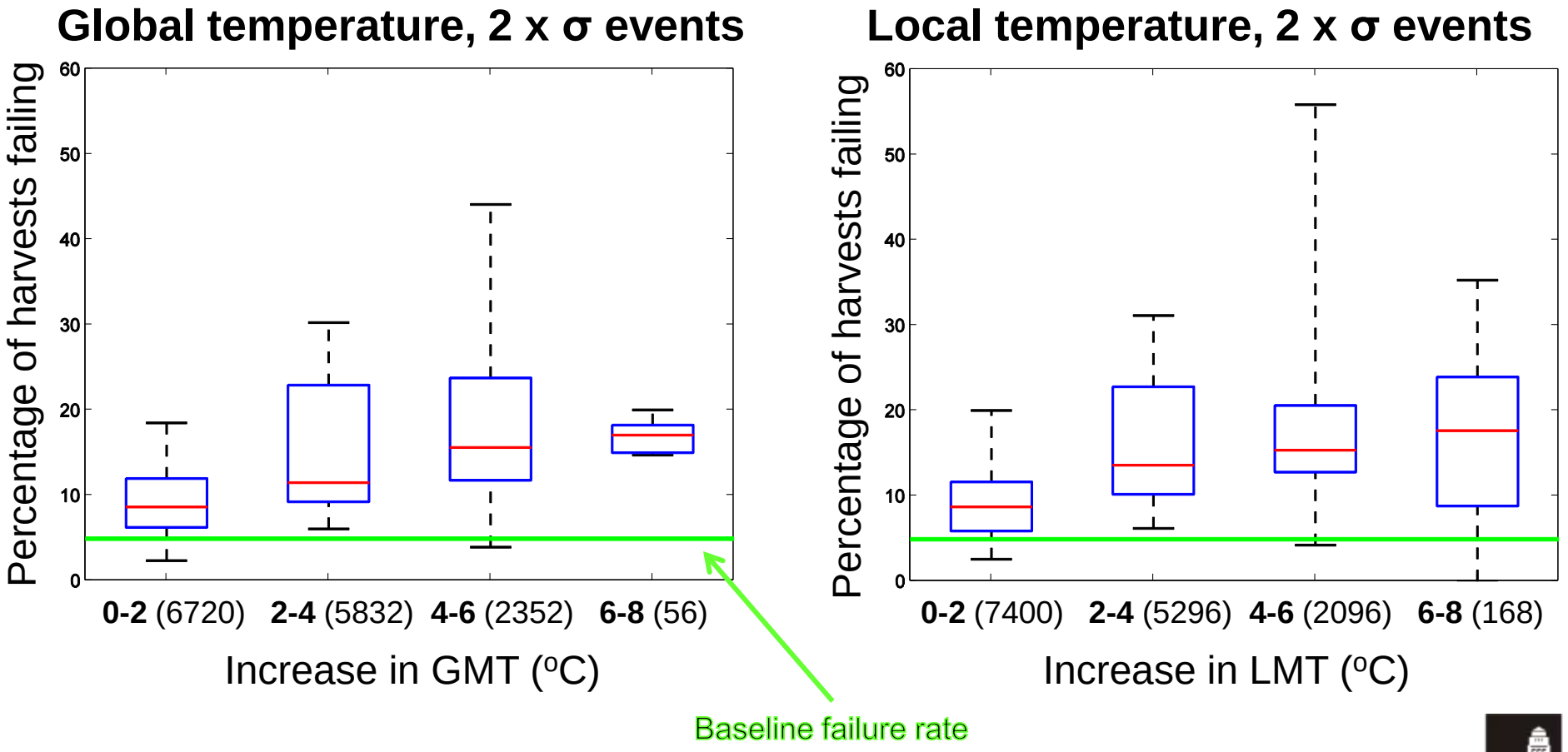
Chee-Kiat (2006)



Osborne (2004)



Impacts as a function of global and local mean temperature change



Challinor et al. (2010; ERL)

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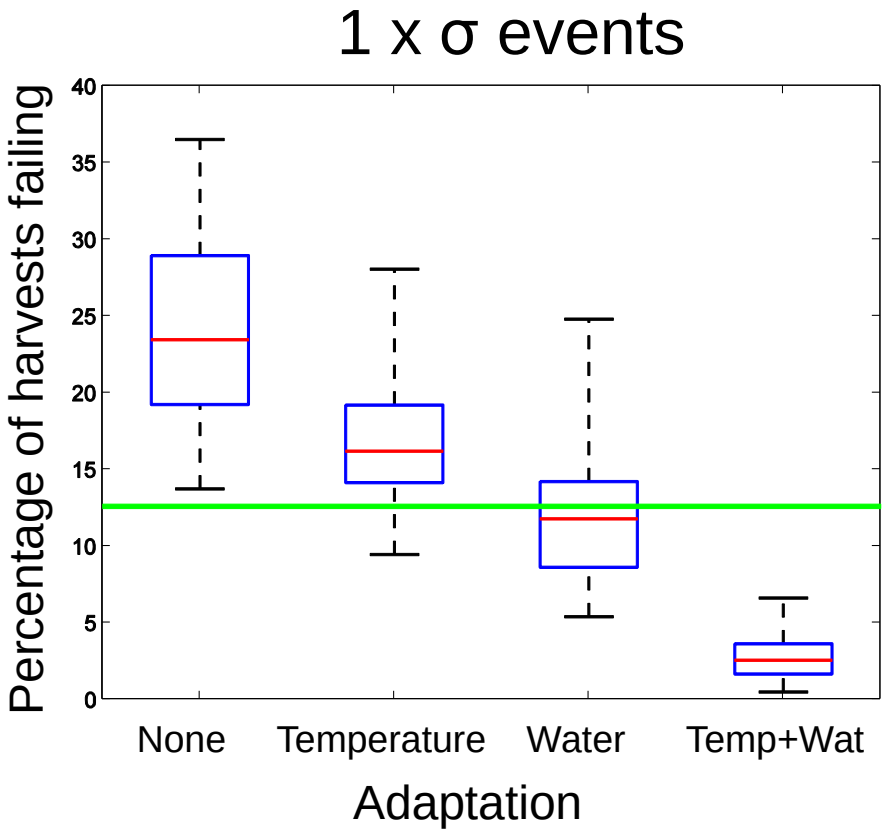
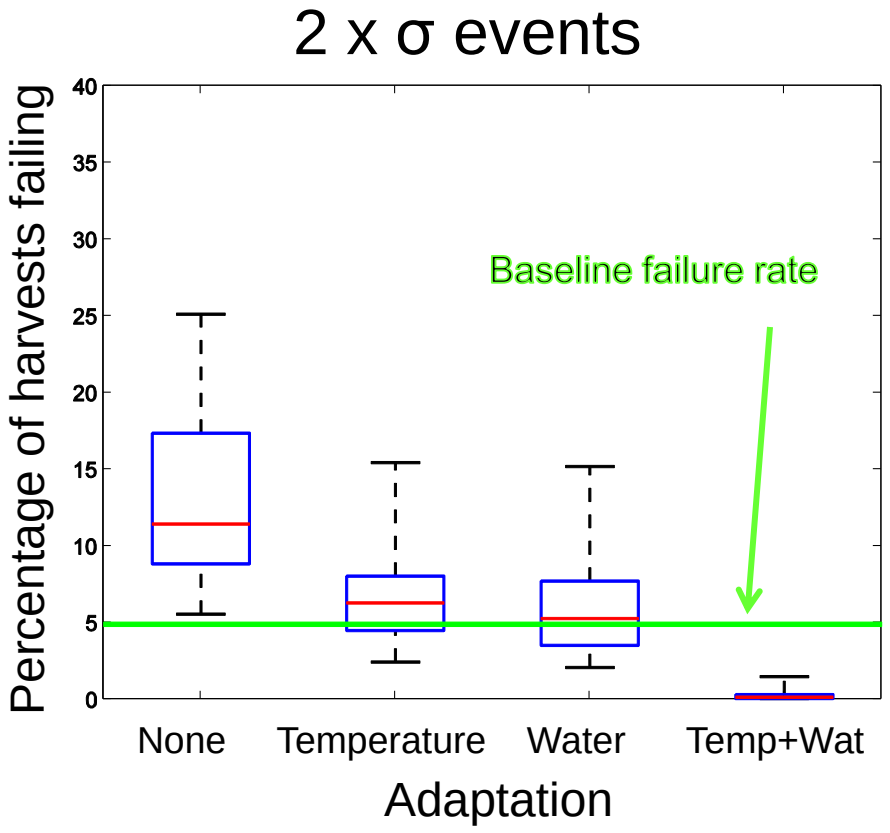
Prioritising adaptation investments – a (virtual) crop-climate perspective

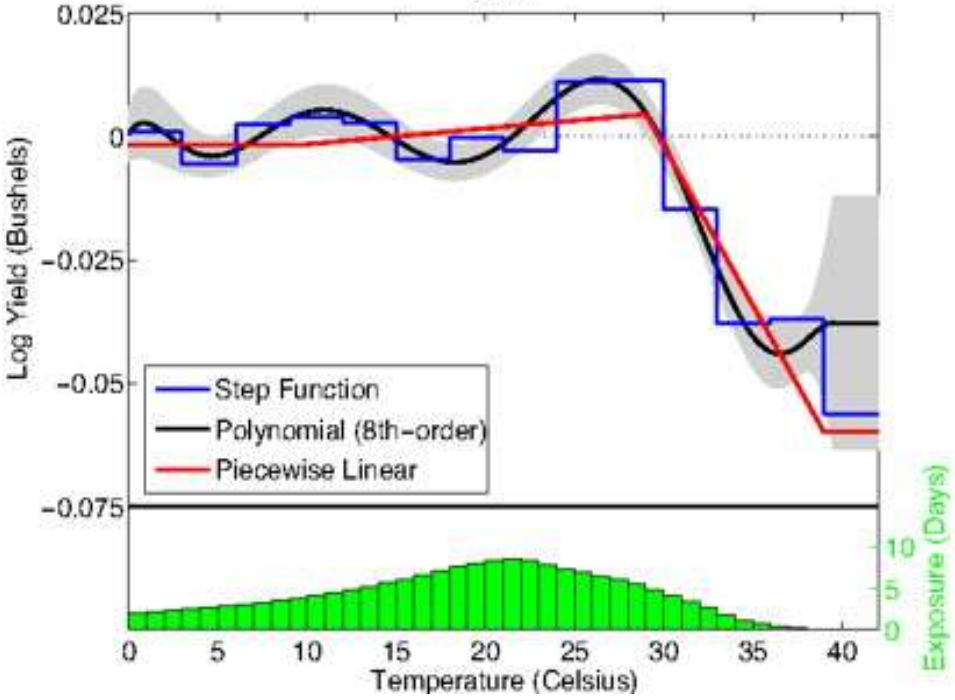




Challinor et al. (2010; ERL)

What are the risks posed by climate change?

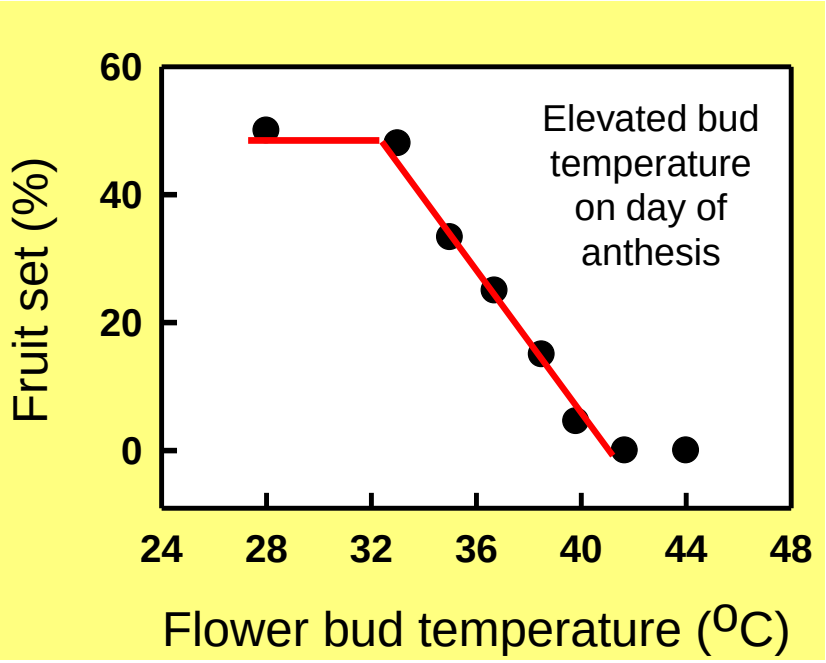
Maize (soybean similar) using county-level yields



Daily T_{max} of 29-30°C

Schlenker & Roberts (2009)

Groundnut in controlled environments



Daily T of 32-39 °C , depending on timing

Vara Prasad et al (2001)

Conclusions

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What are the risks posed by climate change?

- Answer depends on approach taken
- Methods that identify key processes at appropriate spatial and temporal scales are well suited to building resilience
- Need both models and observations in order to do this

Acknowledgements

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Tim Wheeler

Mark Stafford Smith

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EQUIP

www.equip.leeds.ac.uk

CLIMATE CHANGE AGRICULTURE AND FOOD SECURITY

www.ccafs.cgiar.org

Centre for Climate Change Economics and Policy

www.cccep.ac.uk

NATURAL ENVIRONMENT RESEARCH COUNCIL

Living With Environmental Change LWEC

Example of a process study: Interactions between water and CO_2

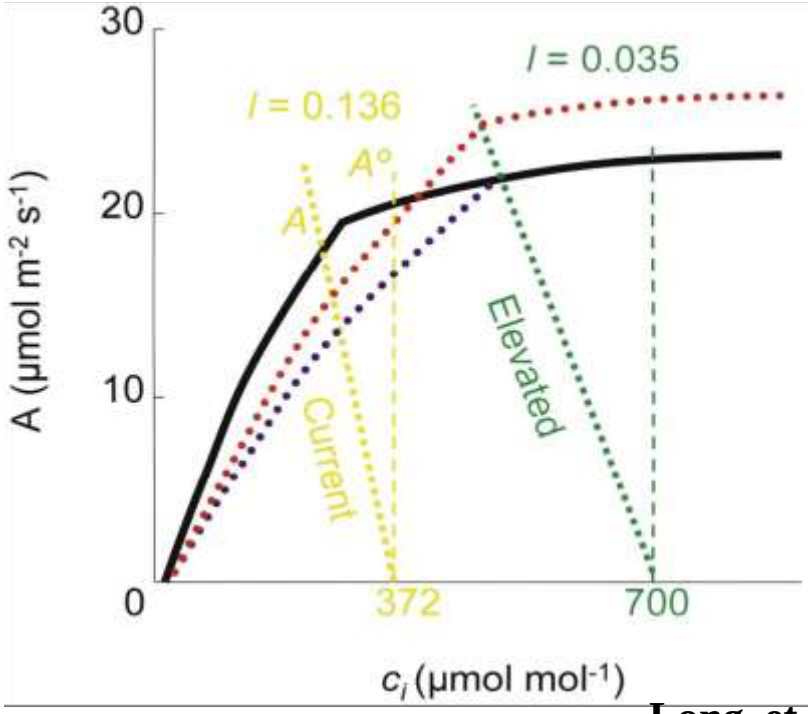
Standard wisdom:

"Droughted plants take better advantage of high CO_2 because they are at a point in the photosynthesis curve that is more CO2-sensitive." (TAR WGII)

What do

- Models
- FACE

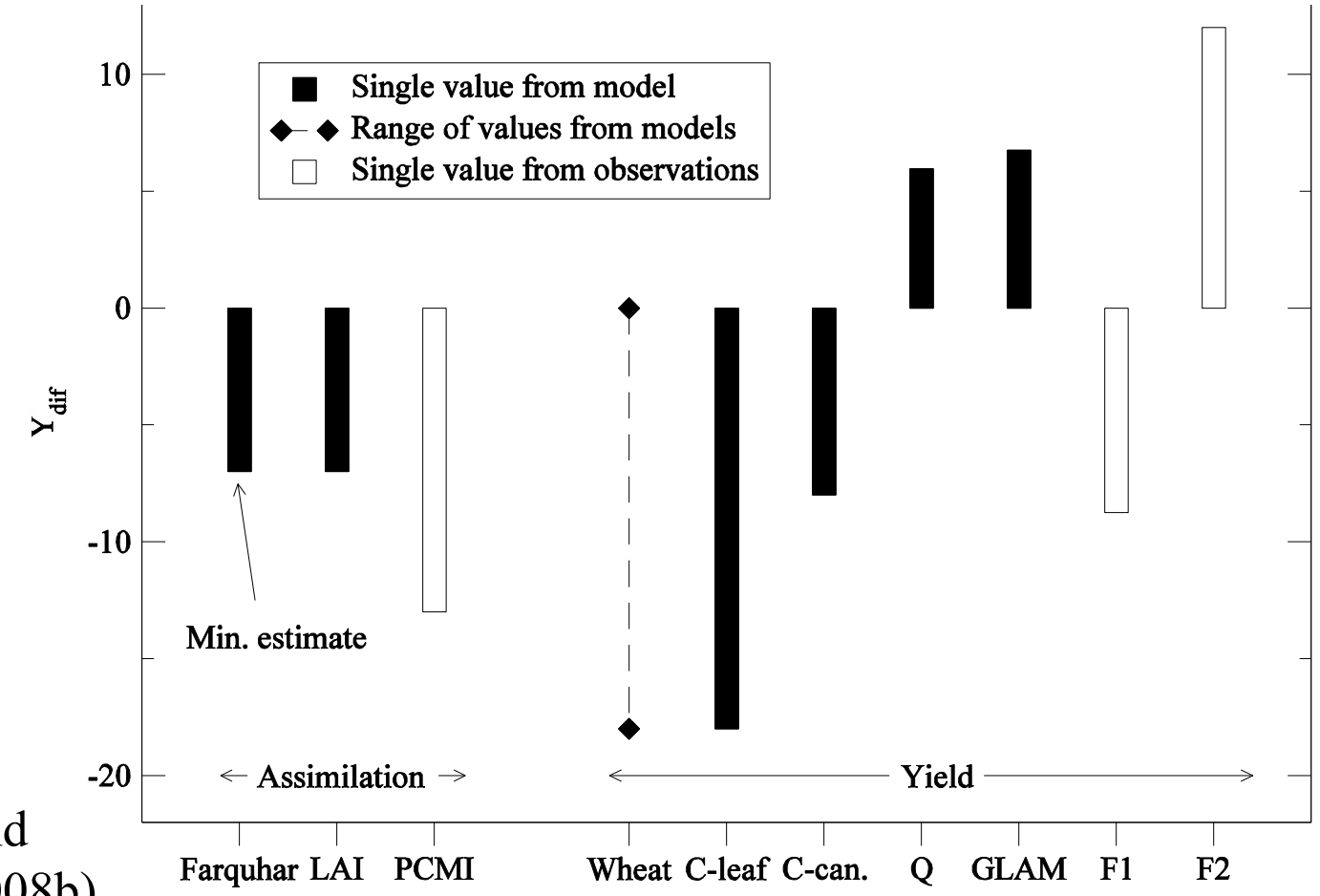
say?



Long, et al., 2004

Interaction between water stress and assimilation

y: yield change for well-watered crop (%) minus yield change for stressed crop (%)
x-axis shows, roughly, increasing level of organisation from left to right



Challinor and Wheeler (2008b)