# Promoting adaptation under uncertainty

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INOVAGRI International Meeting and IV WINOTEC
International Workshop on Innovations
Technology in Irrigation,
Forteleza, Brazil, May 2012

# Promoting adaptation under uncertainty

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1. Background – irrigation in England
2. Deterministic climate change impact modelling
3. Uncertainty
4. Probabilistic modelling
5. How to adapt?
6. On-farm reservoirs.

# Irrigated crops in England

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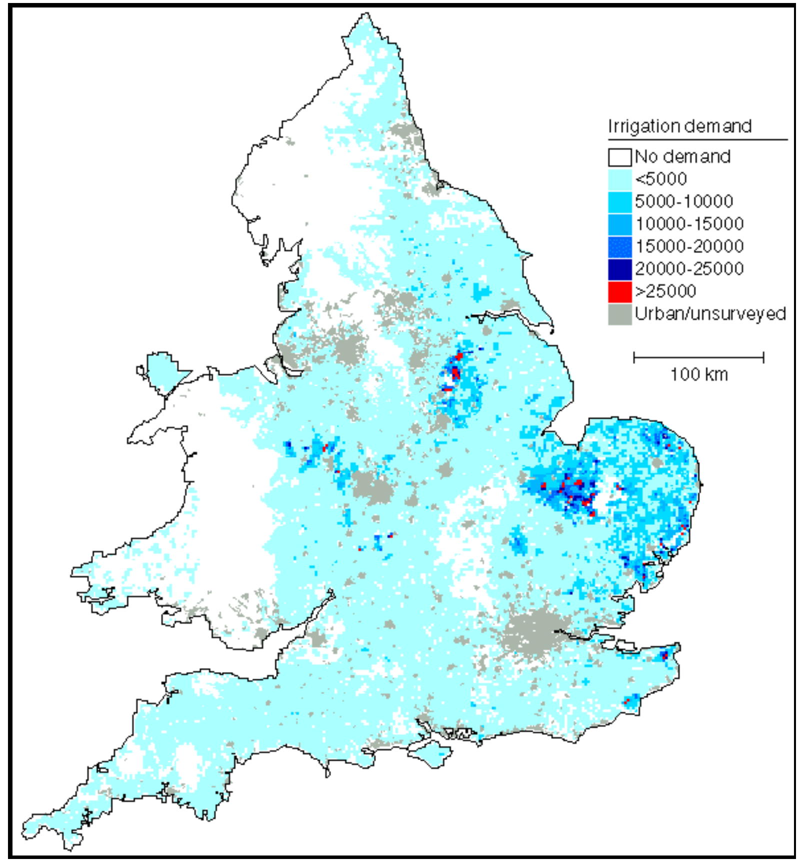
**About 100,000 ha are irrigated**

| | |
|---|---|
| **Potatoes** | **43%** |
| **Vegetables** | **28%** |
| **Cereal crops** | **9%** |
| **Sugar beet** | **7%** |
| **Other** | **6%** |
| **Grass** | **3%** |
| **Small fruit (soft fruit)** | **2%** |
| **Orchard fruit** | **1%** |



# Water availability v irrigated crops

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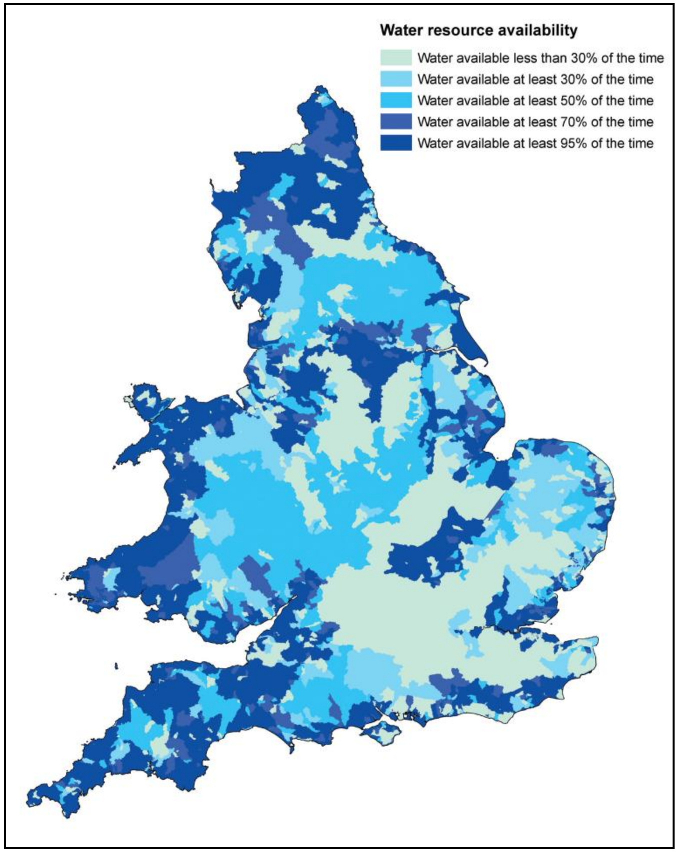
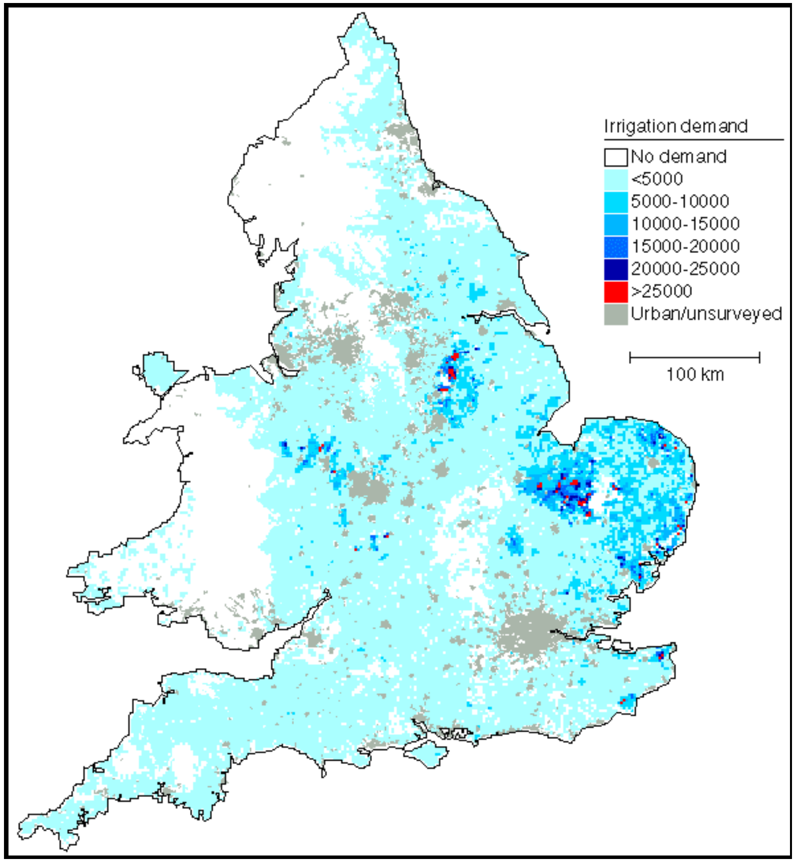



From Environment Agency, The case for change



# Increasing water use efficiency

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Soil moisture probes
In-field weather stations
Telemetry and computer control
Drip irrigation
Computer controlled sprinklers
Irrigation booms

# Increasing water resources

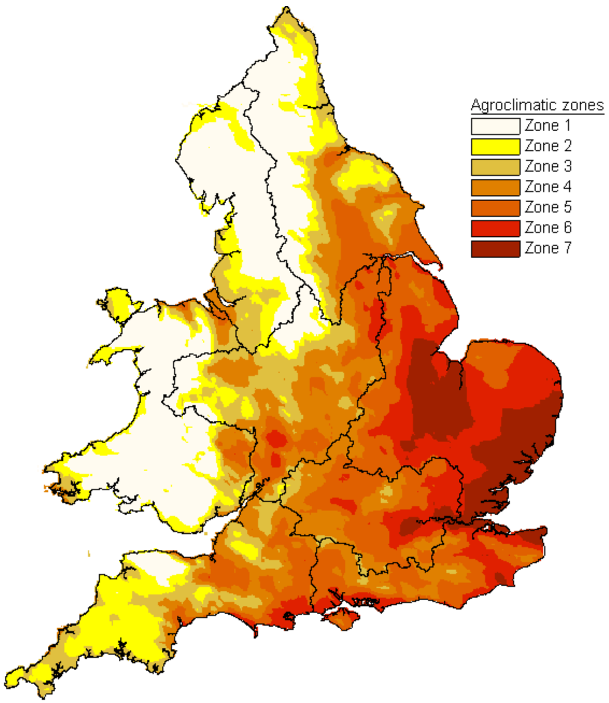
# Planning for the future

- Socio-economic change
- Technological change
- Climate change

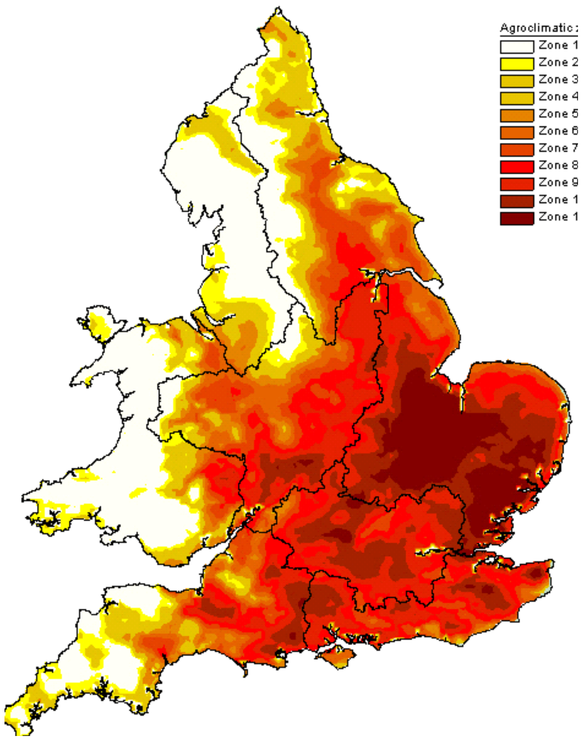
- The future will not be the same as the past

# Climate change - PSMD

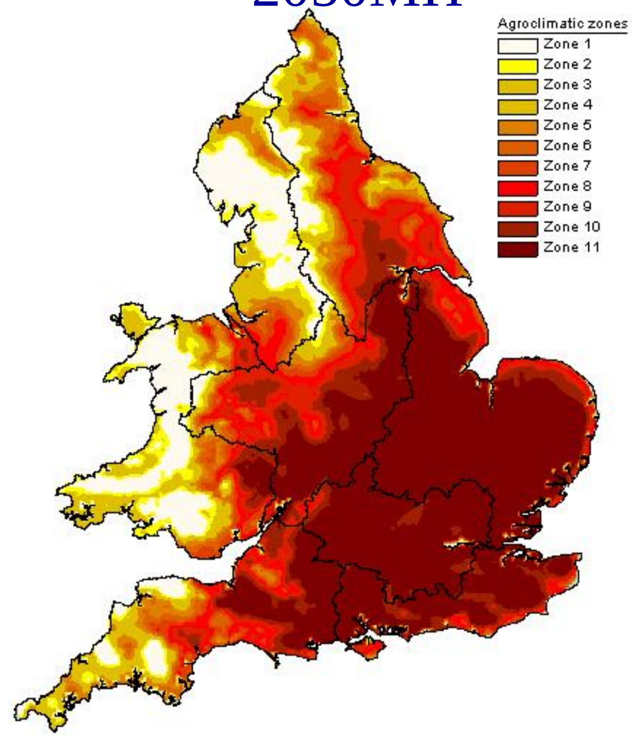
1961-90




2020MH



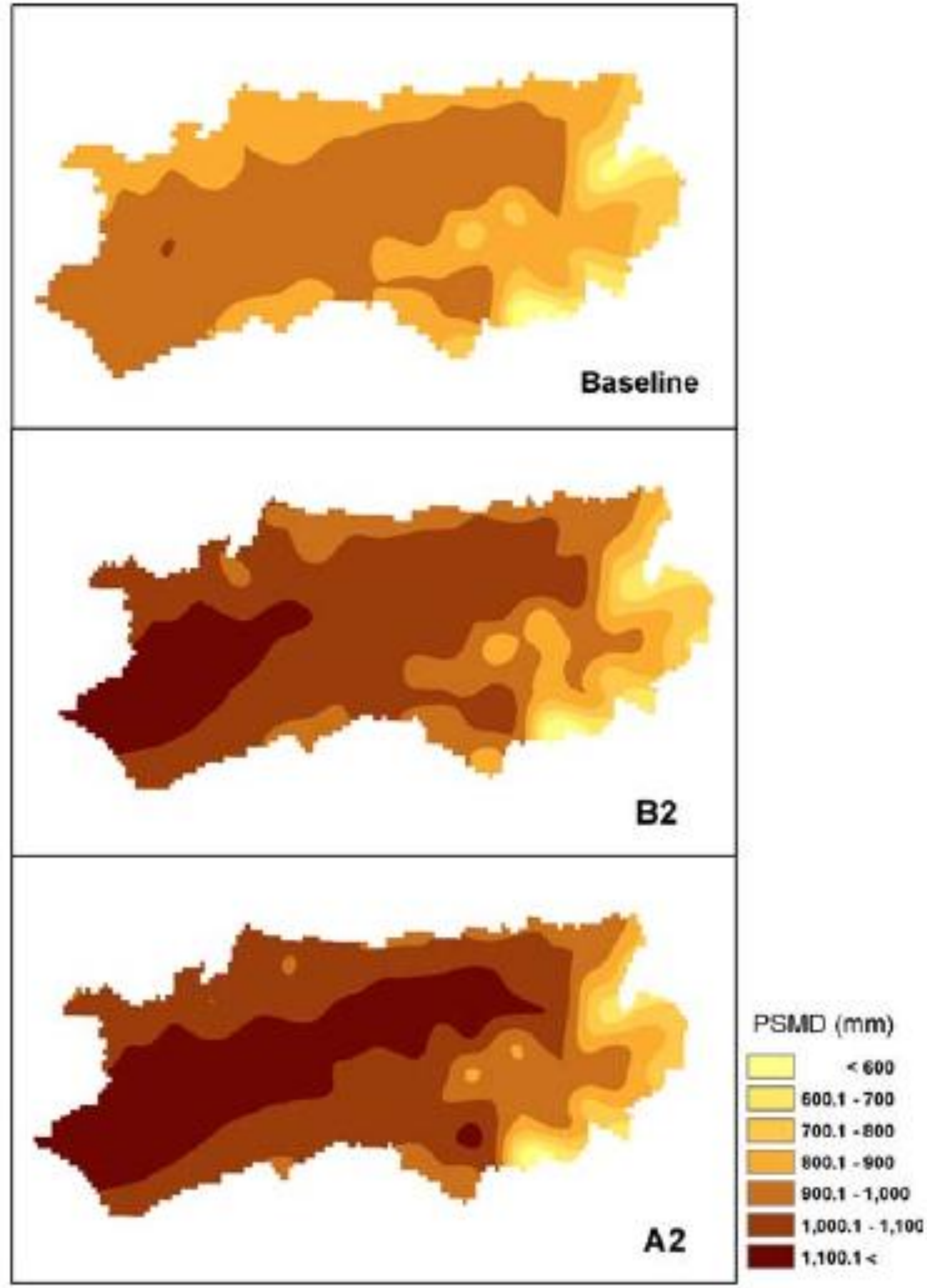

2050MH




Modelled from UKCIP02 data

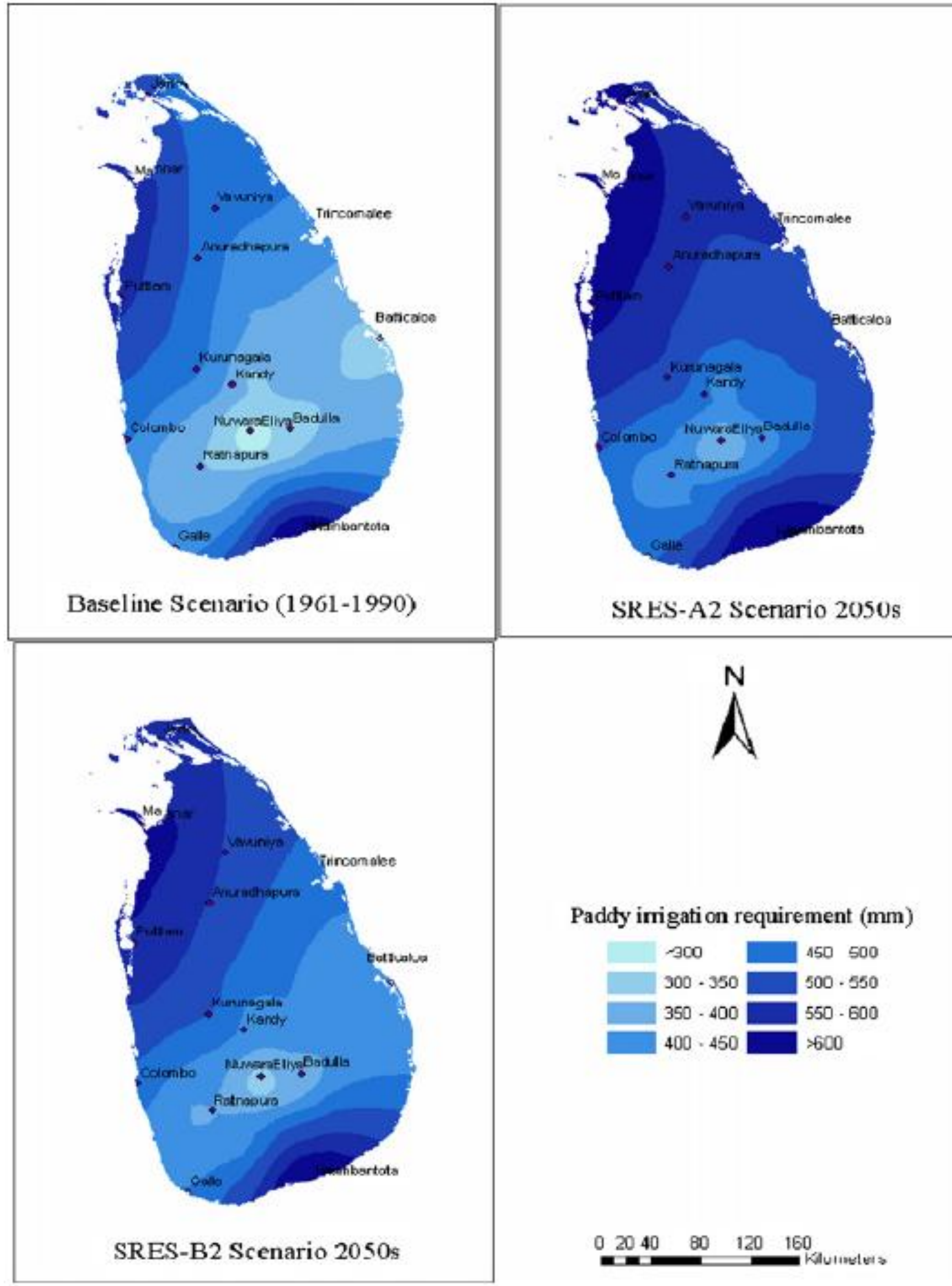
Source: Cranfield University

# Spain: Guadalquivir




HadCM3 GCM
SRES scenarios
IWMI baseline data
Rodriguez Diaz et al, 2007

# Sri Lanka: paddy rice




HadCM3 GCM
SRES scenarios
IWMI baseline data
Cropwat
Oct-Feb paddy rice
De Silva et al, 2007

# The Cascade of Uncertainty

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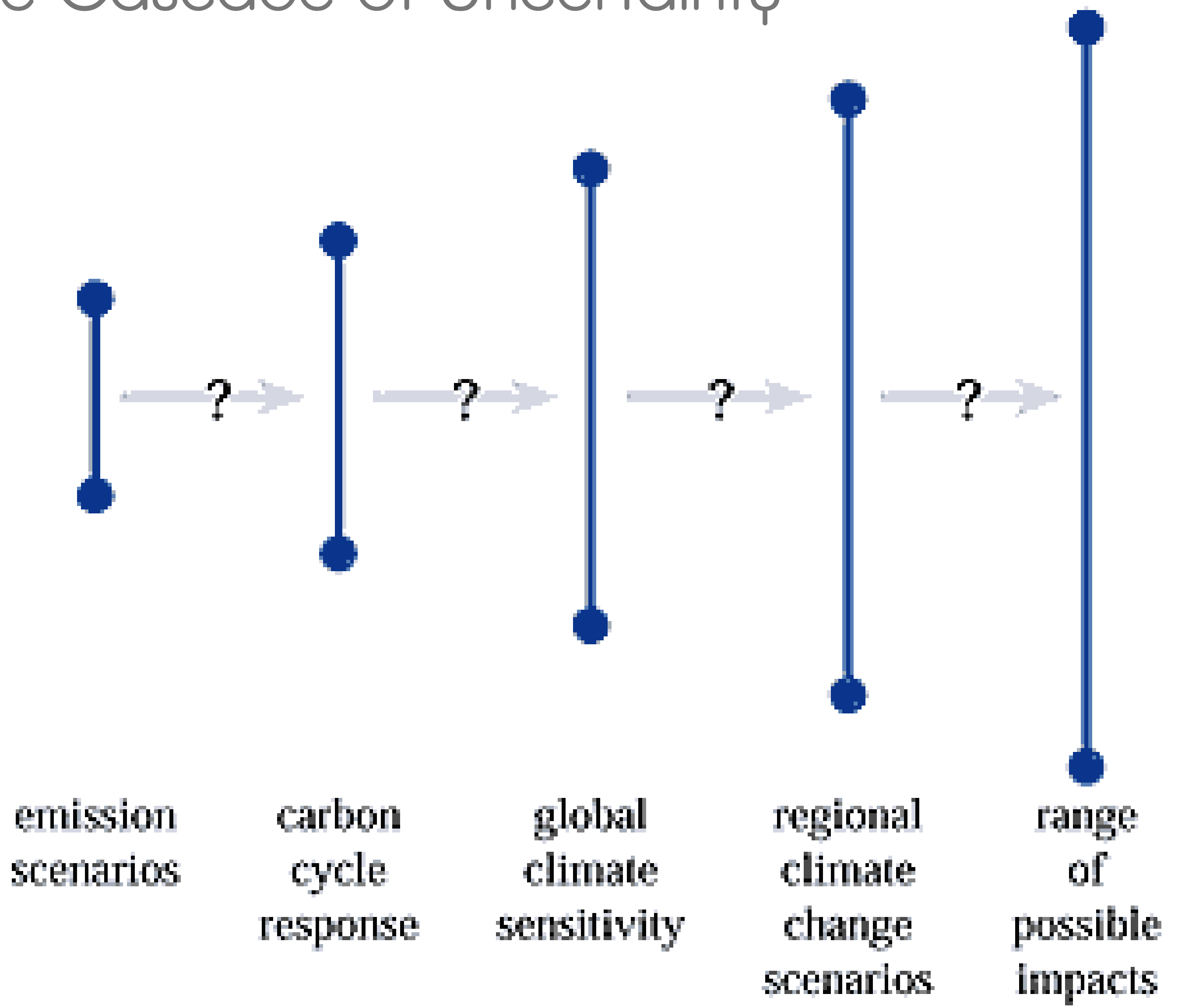



Source: IPCC

# UK Climate Projections 2009 “UKCP09”

Moves from deterministic to probabilistic projections.

300 runs of HADCM3 model, quality weighted,
Probability distribution function corrected for other models.

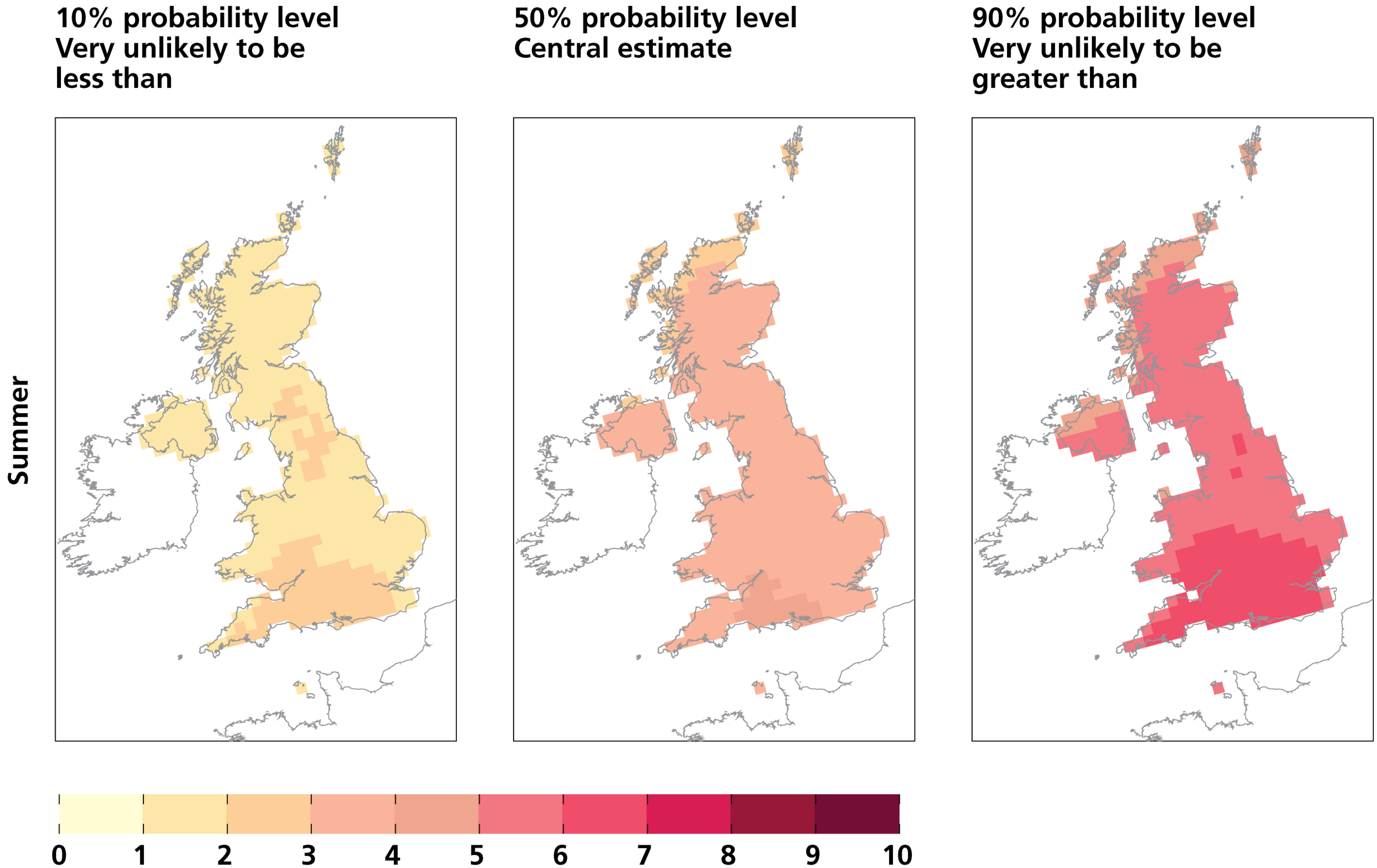
Sampled data:
10,000 equi-probable sample outputs for each variable
3 emissions scenarios
7 overlapping 30 year time periods
monthly data output

Also weather generator producing daily and hourly data.

And 11 spatially coherent regional climate projection

UK CLIMATE PROJECTIONS

# Change in mean summer temperature, 2080s



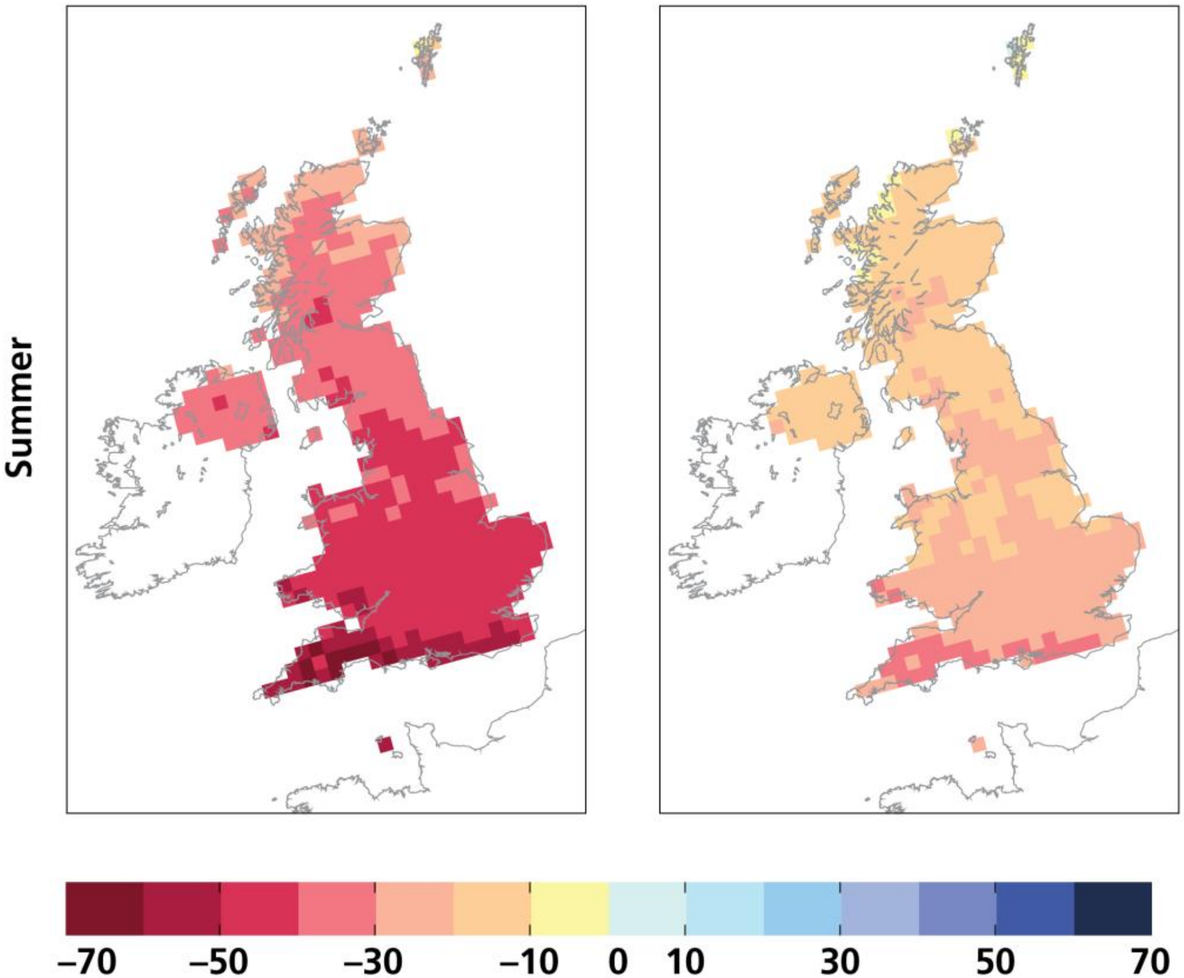

**Change in summer mean temperature (°C) for the 2080s, Medium emissions scenario**

# Change in mean summer rainfall, 2080s

**10% probability level**
**Very unlikely to be less than**

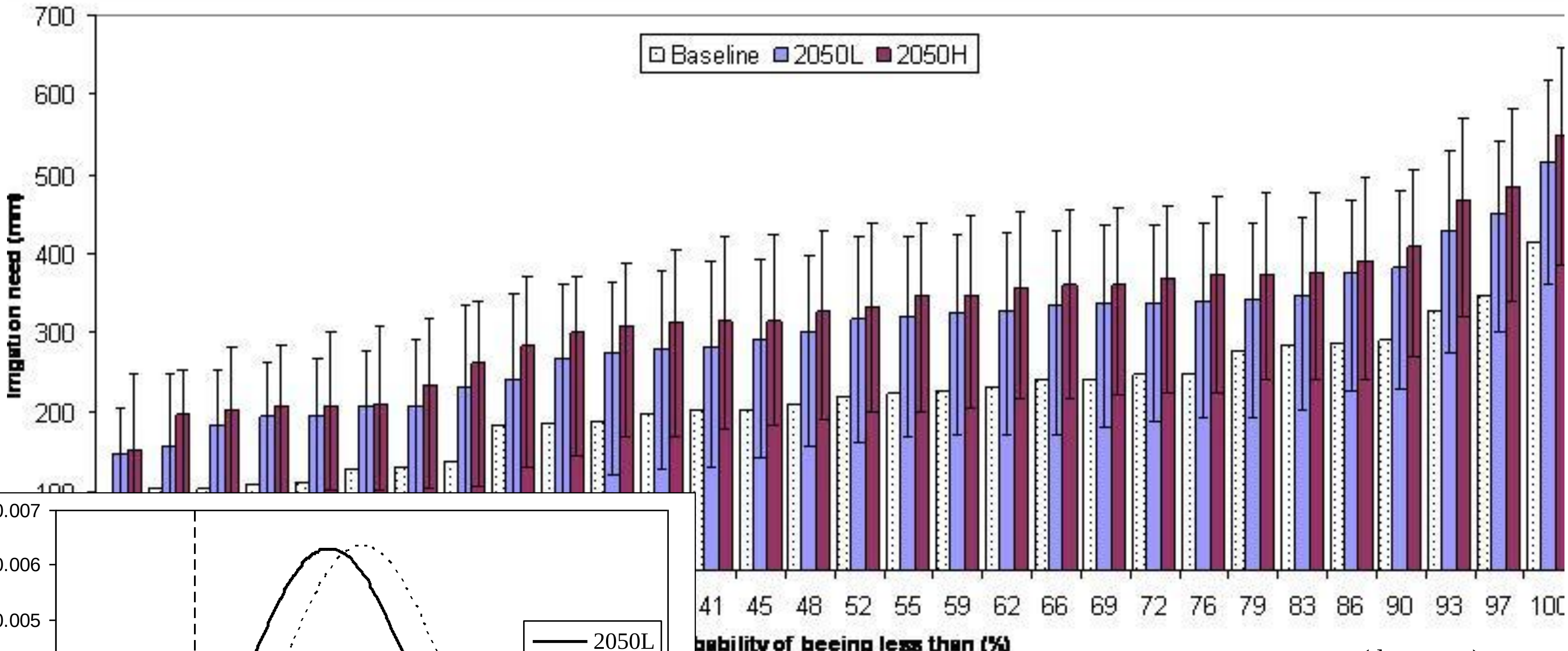
**50% probability level**
**Central estimate**

**90% probability level**
**Very unlikely to be greater than**

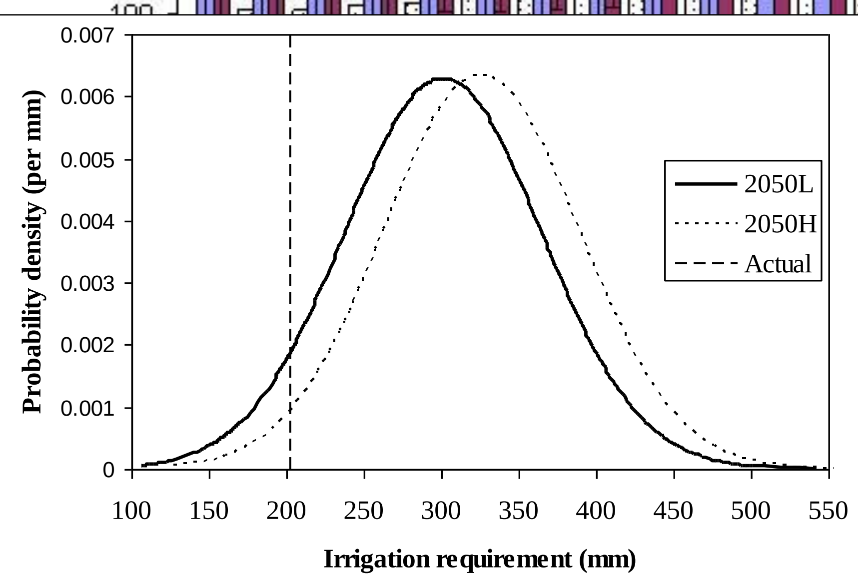



**Change in summer mean precipitation (%) for the 2080s, Medium emissions scenario**

# Impacts of uncertainty on long term need
# Future irrigation need for potatoes near Cambridge




(dry years)




10% and 90% probability error bars

# Impacts on land suitability

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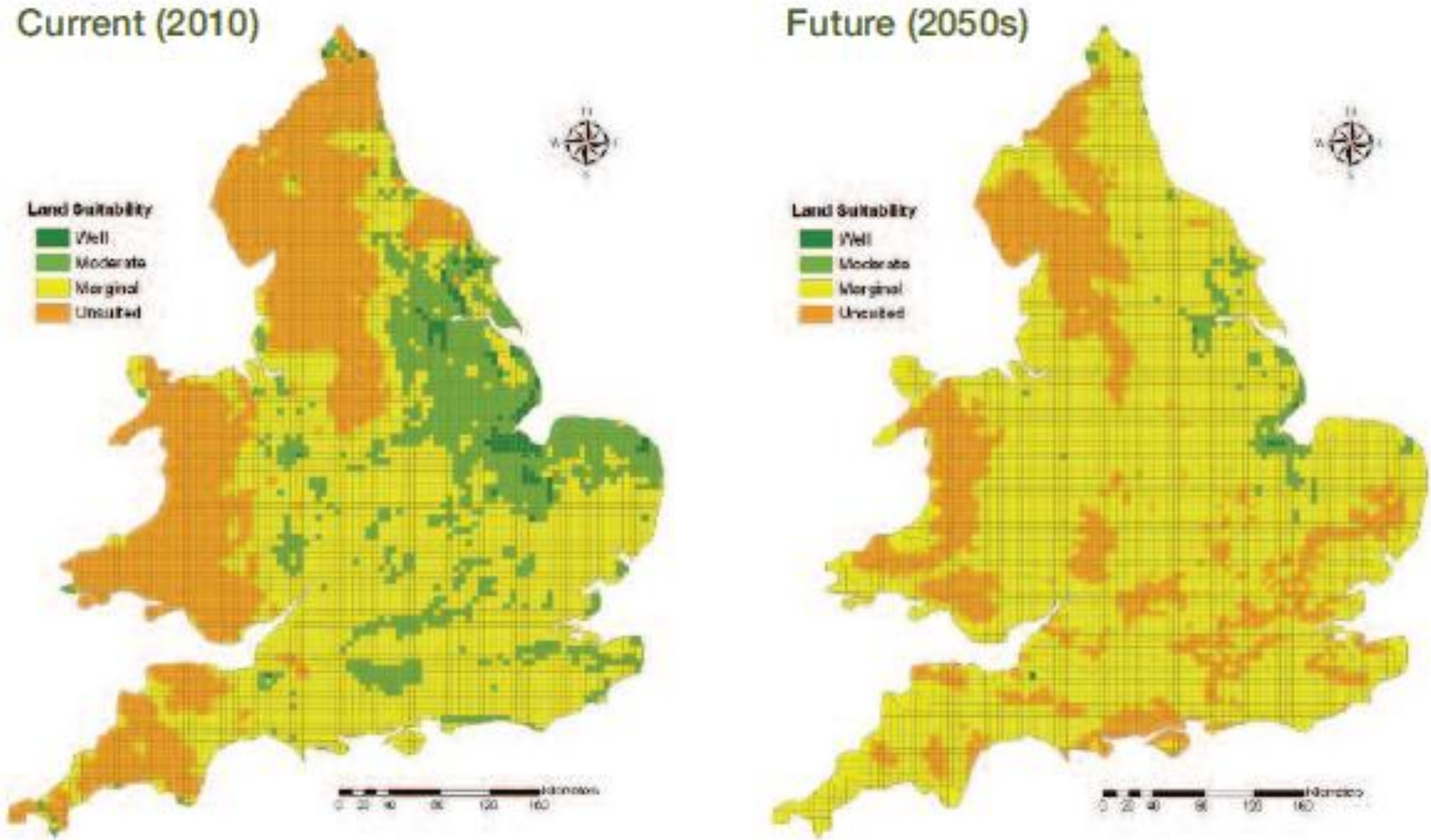


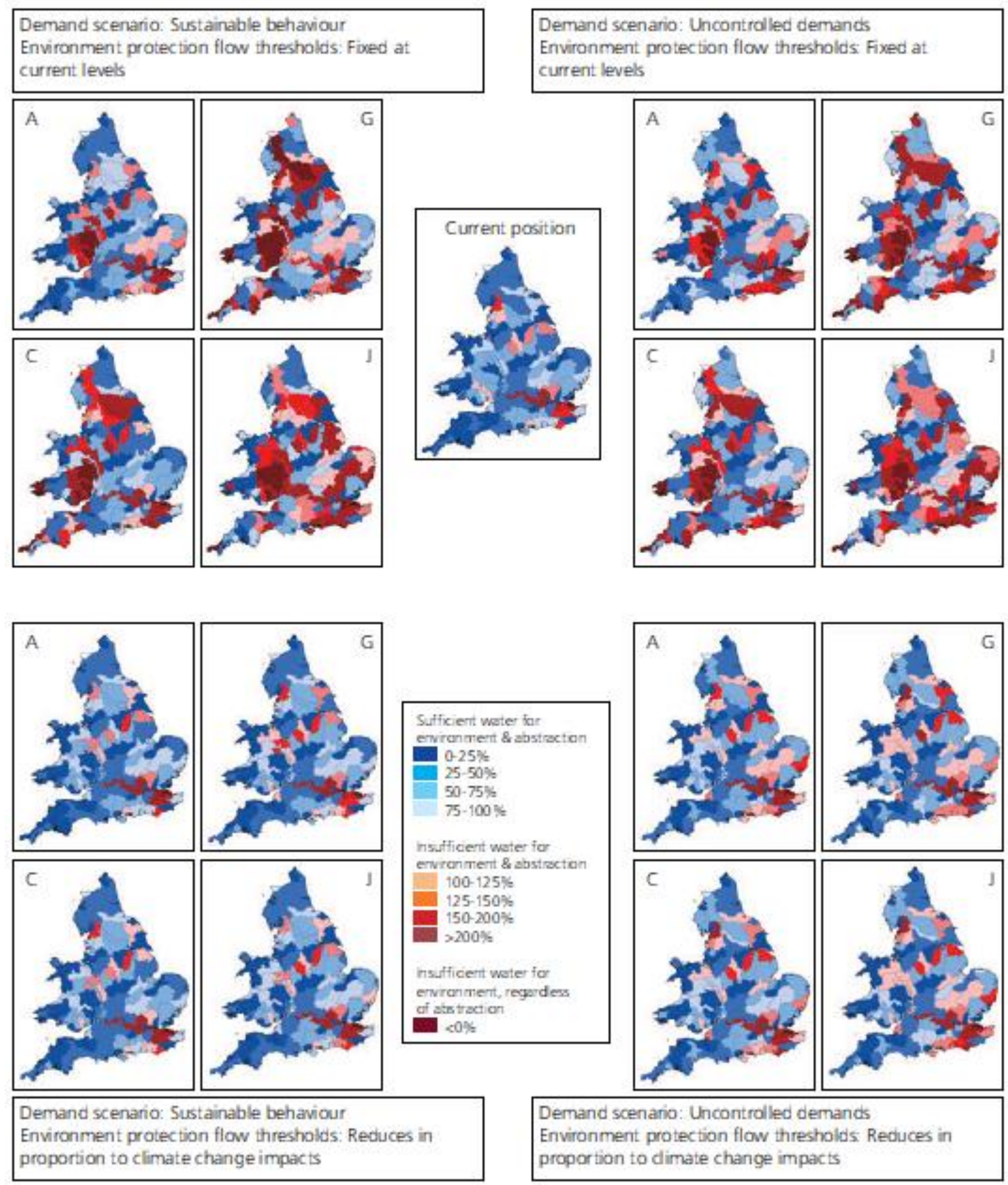

**Figure 5** Projected change in land suitability for rainfed potatoes from the current baseline (2010) to the 2050s.

# Where will the droughts be?

Unmet demand in 2050s

4 socio-economic scenarios

4 climate runs (same model and emissions scenario)




Source: Defra, Water for Life

# How to adapt under uncertainty

?

# Reservoir case study

# Predict?



How much irrigation will be needed?

Which crops will be worth irrigating?

How reliable will the water source be?

We now have lots of "possible futures"

Do we just design on "the most likely"?

or "the worst case"?

# Or use a risk and resilience approach?

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Don't try to predict  a specific answer

Consider ways the system might fail, and the damage caused

Estimate how likely that is to happen

Choose a suitable level of security

Adapt the plans to cope with uncertainty

Try not to overdesign  - keep the system flexible

Avoid locking yourself into “maladaptations”

Look for “no-regret” options

# Changing design to store floodwaters

Bigger pump capacity – fill it  much faster

Bank-side ponds to store flood peaks

Link to sustainable urban drainage

Keith Weatherhead

# Some conclusions

- **There are major uncertainties in all future predictions**
- **These come from many sources – "a cascade of uncertainties"**

- **"Predict and provide" won't work - we can't predict.**
- **A risk and resilience approach may be more successful**

- **Look for no-regrets options in the short term if possible**
- **Adapt gradually and progressively if possible**
- **Look for robust solutions which can cope with most futures**

- **Choosing "Do nothing yet" may sometimes be the best solution**
- **But DONT just ignore climate change, or other change.**

# Combining efficient irrigation and rain water harvesting with reservoir storage

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