

# The change to probabilistic projections: farm reservoir design in the UK

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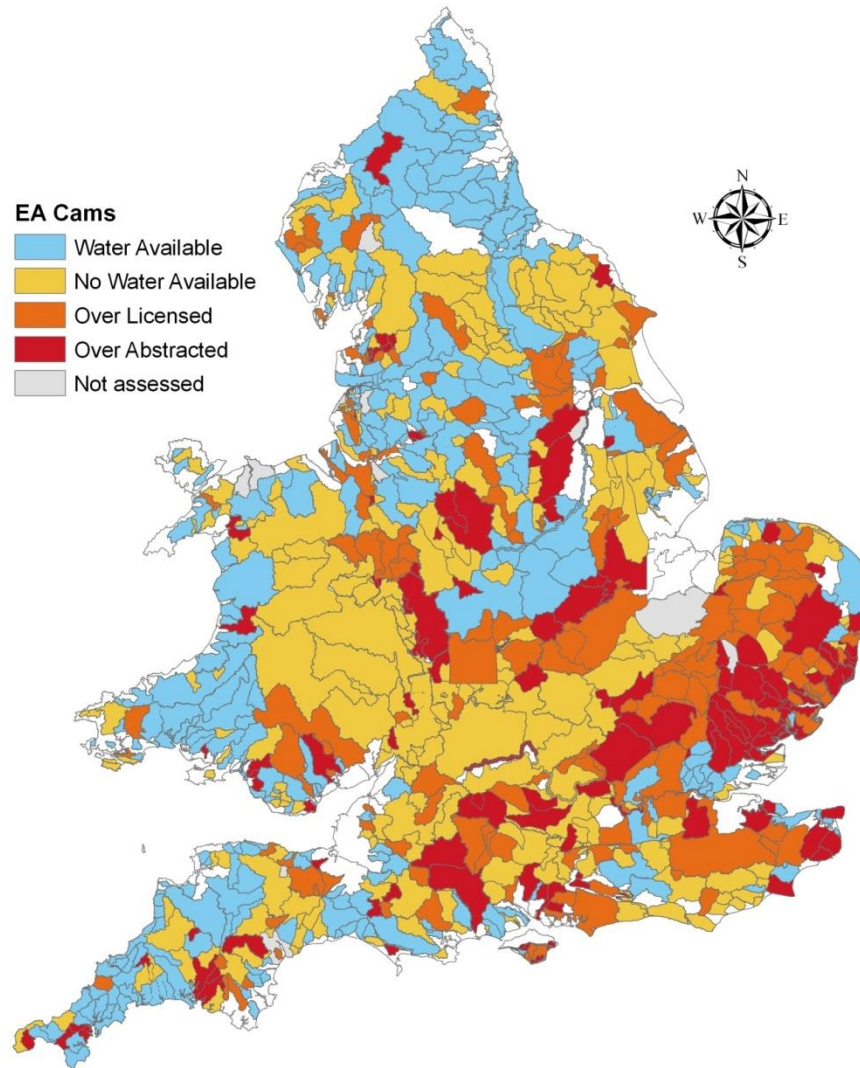
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With thanks to EPSRC and Defra

# Current water resource stress - summer availability

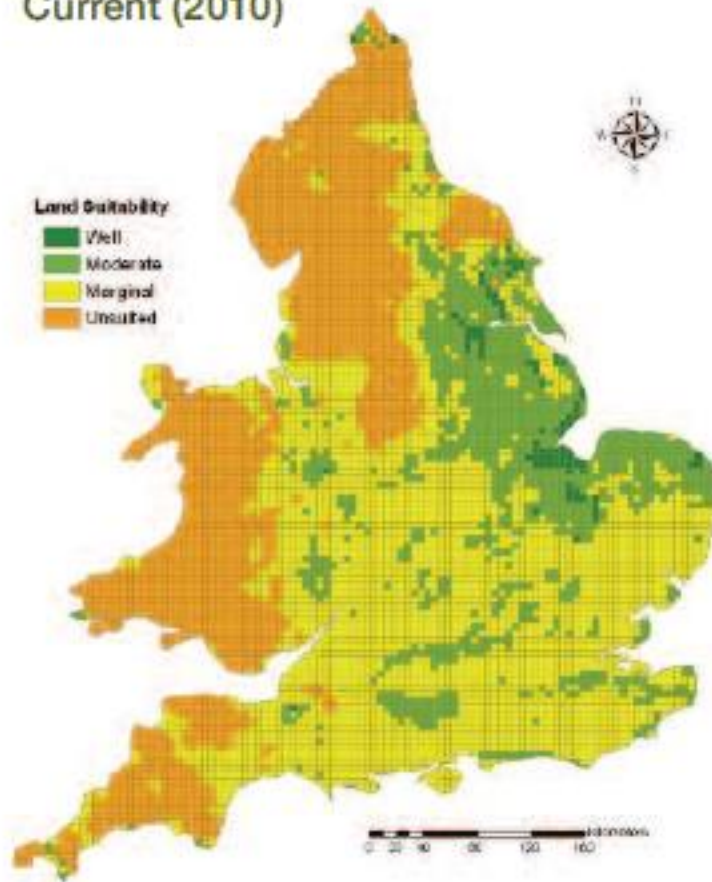


(Source: EA, 2008)

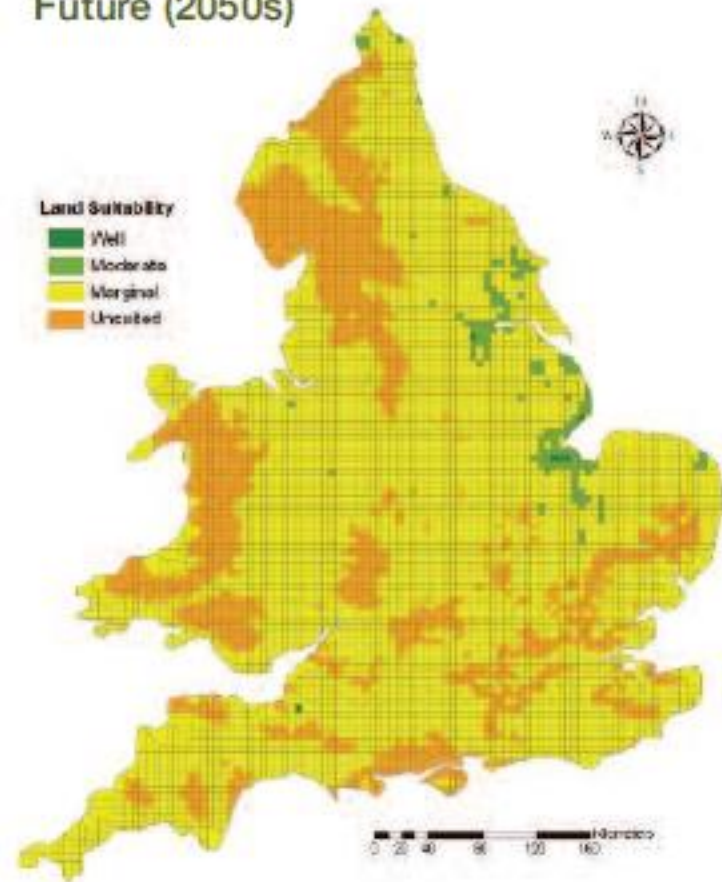
(Source: PCL, 2009)

# Land suitability for rainfed potatoes

Current (2010)



Future (2050s)



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

# Farm reservoirs in England

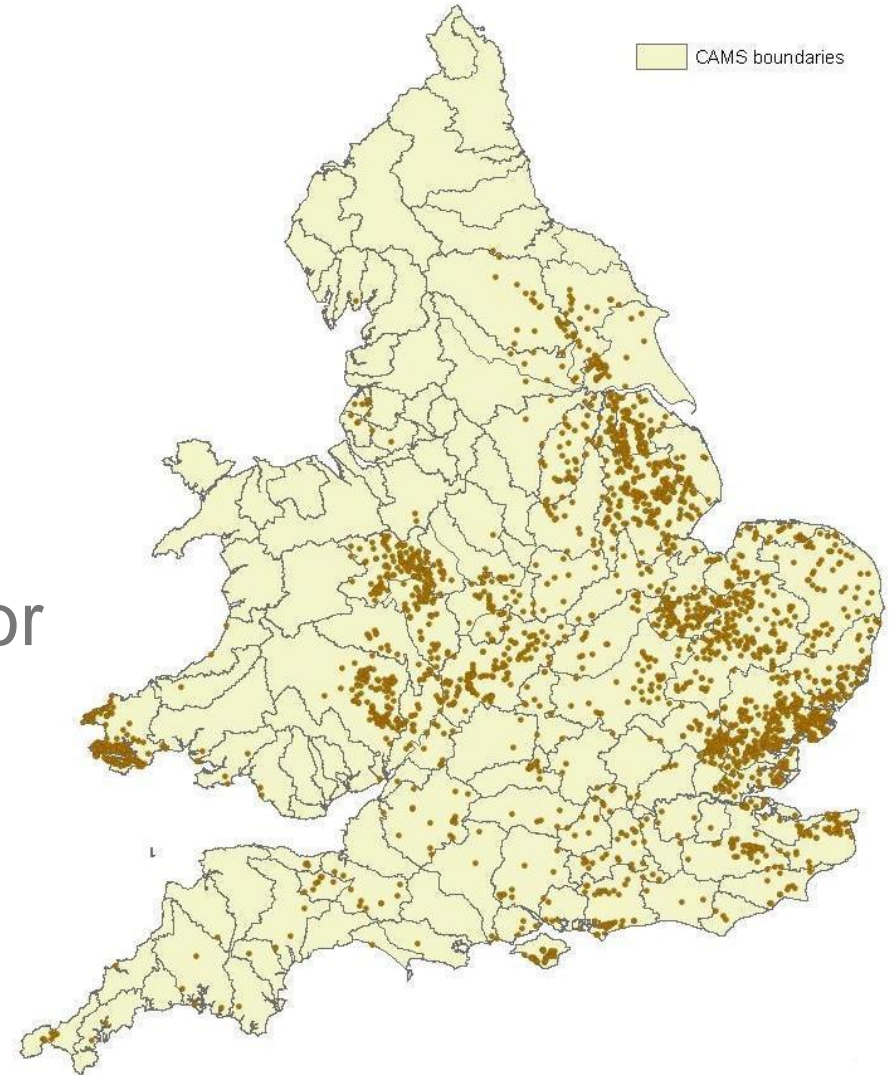
## Environment Agency NALD

“spray irrigation – storage”  
category

2306 licences

~100,000,000m<sup>3</sup>  
(30% of the total licensed for  
irrigation)

80% from surface water

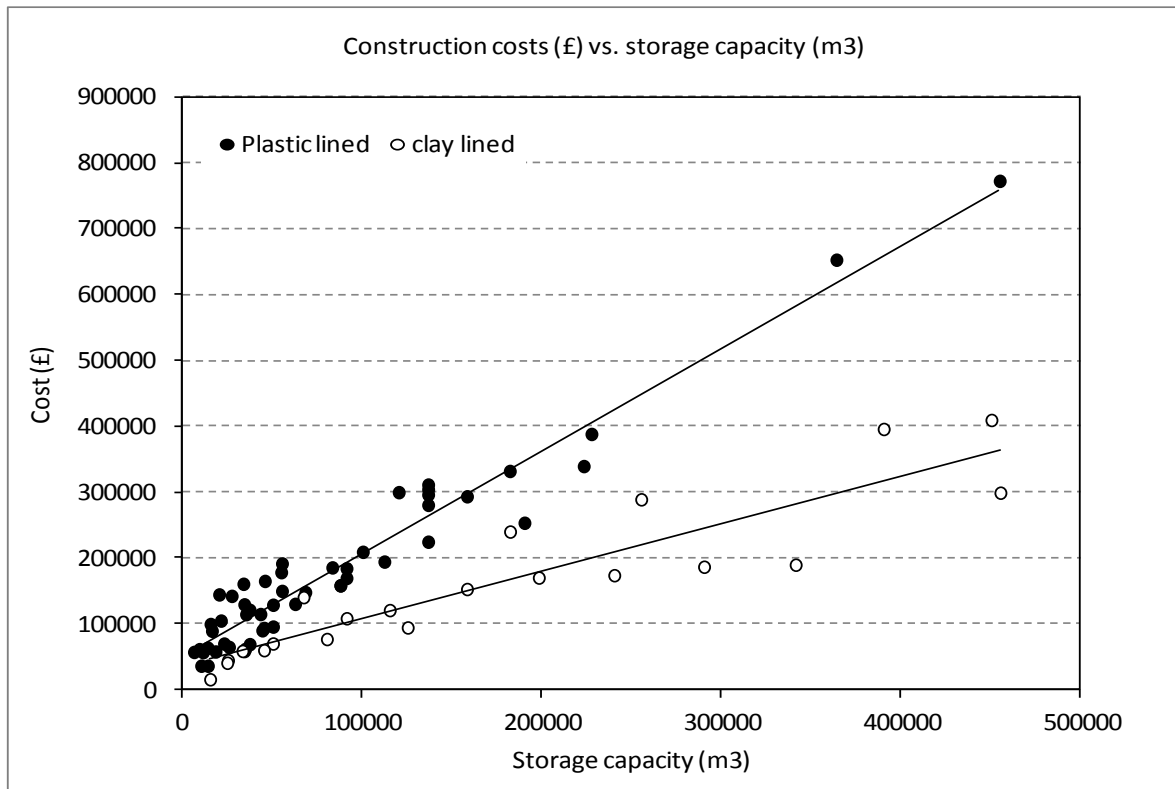


# UK farm reservoirs

1. Off-stream;
2. Balanced cut and fill – hence top above ground level;
3. Filled slowly over four winter months;
4. Typically 5,000 to 250,000 m<sup>3</sup>;
5. Unlined (clay, clay lined) or “plastic” lined.

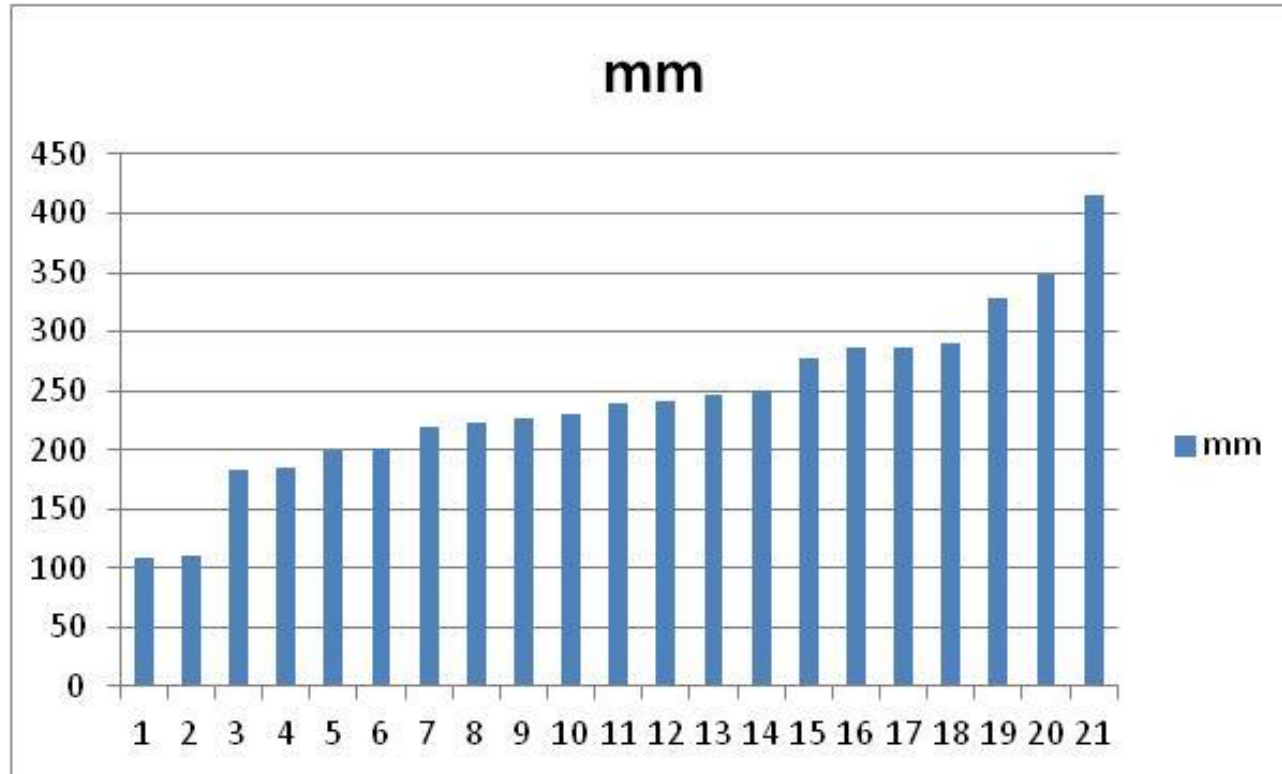


# Capital cost of reservoirs (£ v m<sup>3</sup> stored) (n=73)



	$y = a + bx$	(R <sup>2</sup> )
Lined	$y = 50,000 + 1.56x$	0.94
Unlined	$y = 34,500 + 0.72x$	0.84

# Irrigation need for potatoes near Cambridge



(wet years)

(dry years)

# Research question

The latest climate change projections for the UK are presented in a probabilistic format

For a given site, time and emission scenario:

- Previously UKCP02 dataset gave 1 projection
- Now UKCP09 provides 10,000 projections (PP)

Also 11 spatially coherent projections (11SCP)  
(Also a weather generator)

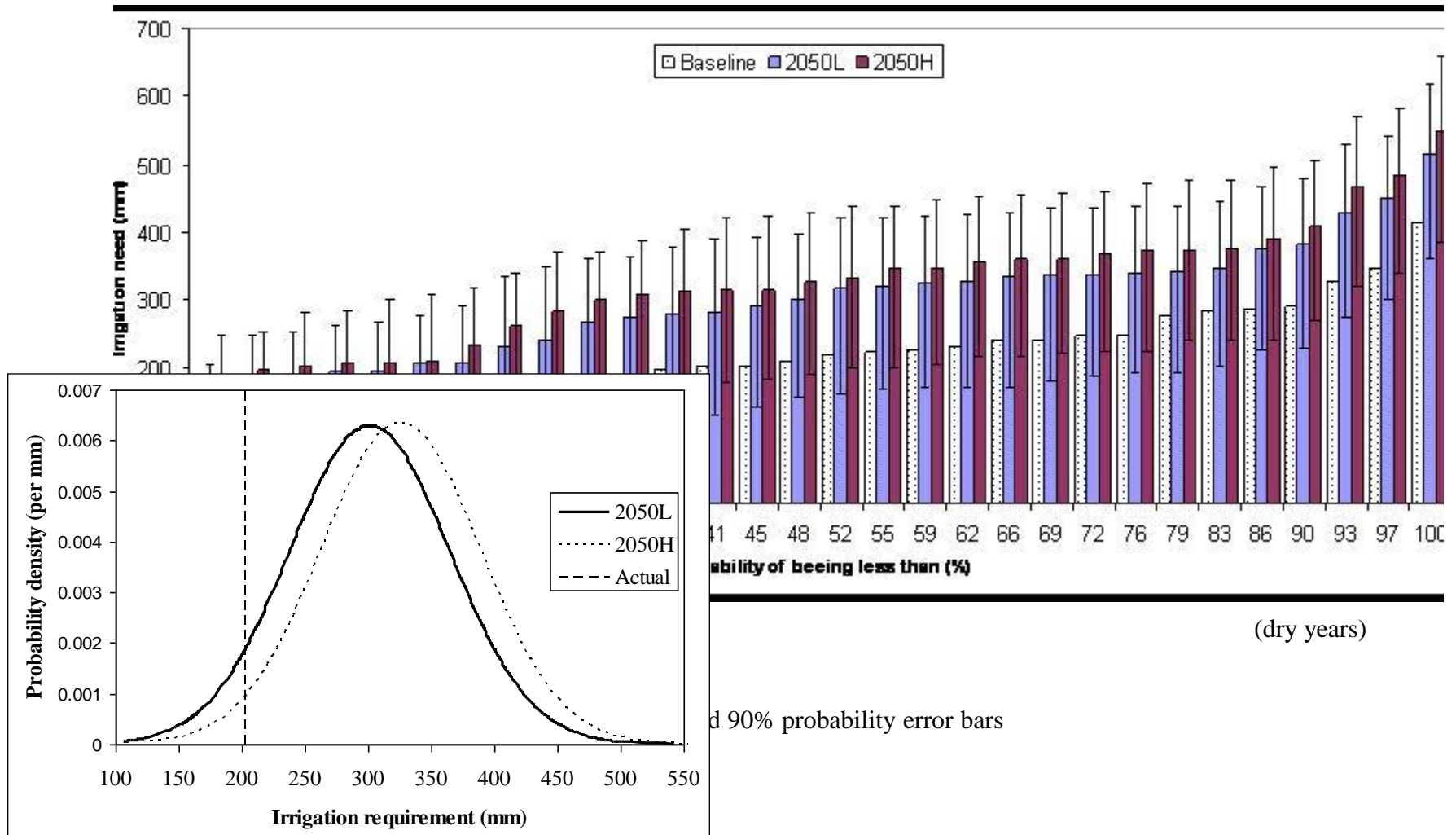
**How does this affect adaptation?**



# Methodology

- 30 year baseline daily weather data
- Perturbed with UKCP09 monthly change factors (10,000 PPs and 11 SCPs; 3 emission scenarios)
- WaSim used to calculate irrigation need
- Cost benefit model used to calculate NPV
- Decision criteria used to select “design” choice
- Results compared
- Impacts of subsampling compared

# Irrigation need for potatoes near Cambridge



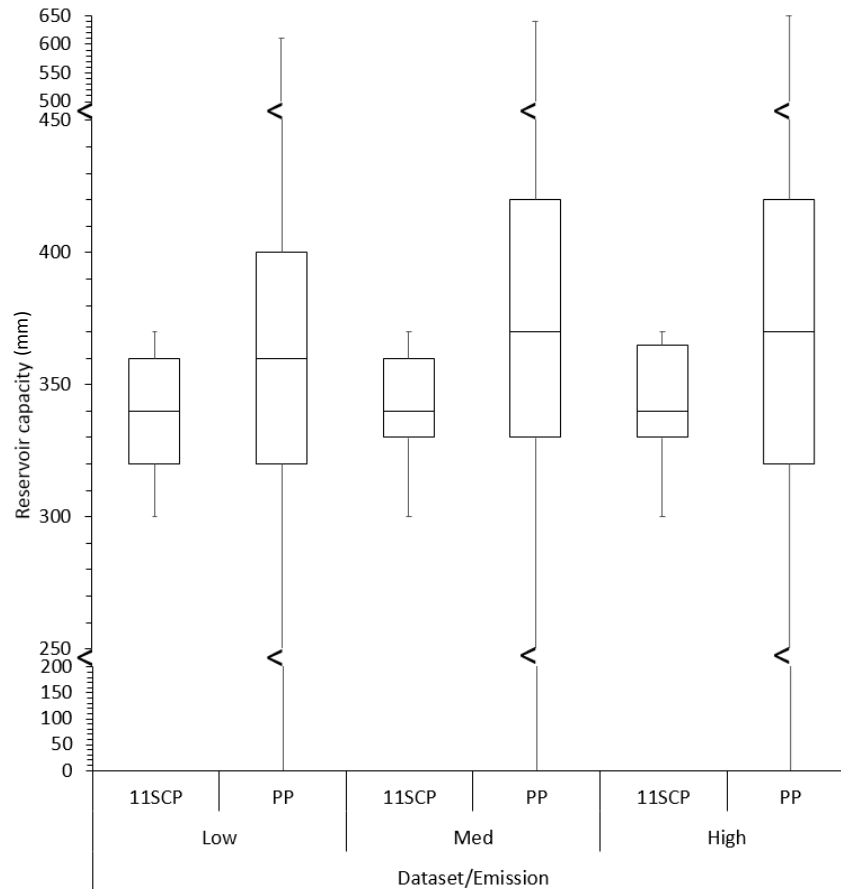
# Effect of emission scenario on optimum reservoir capacity (Laplace)

Site	Brooms barn			Woburn		
	L	M	H	L	M	H
Emission:						
PP	390	410	400	360	380	390
11SCP	350	350	360	280	280	290

Design reservoir capacities (mm) calculated using Laplace across all of the 10,000 probabilistic projections (PP) versus the 11 SCPs, for Brooms Barn and Woburn, for the 2050s low, medium and high emission scenario.

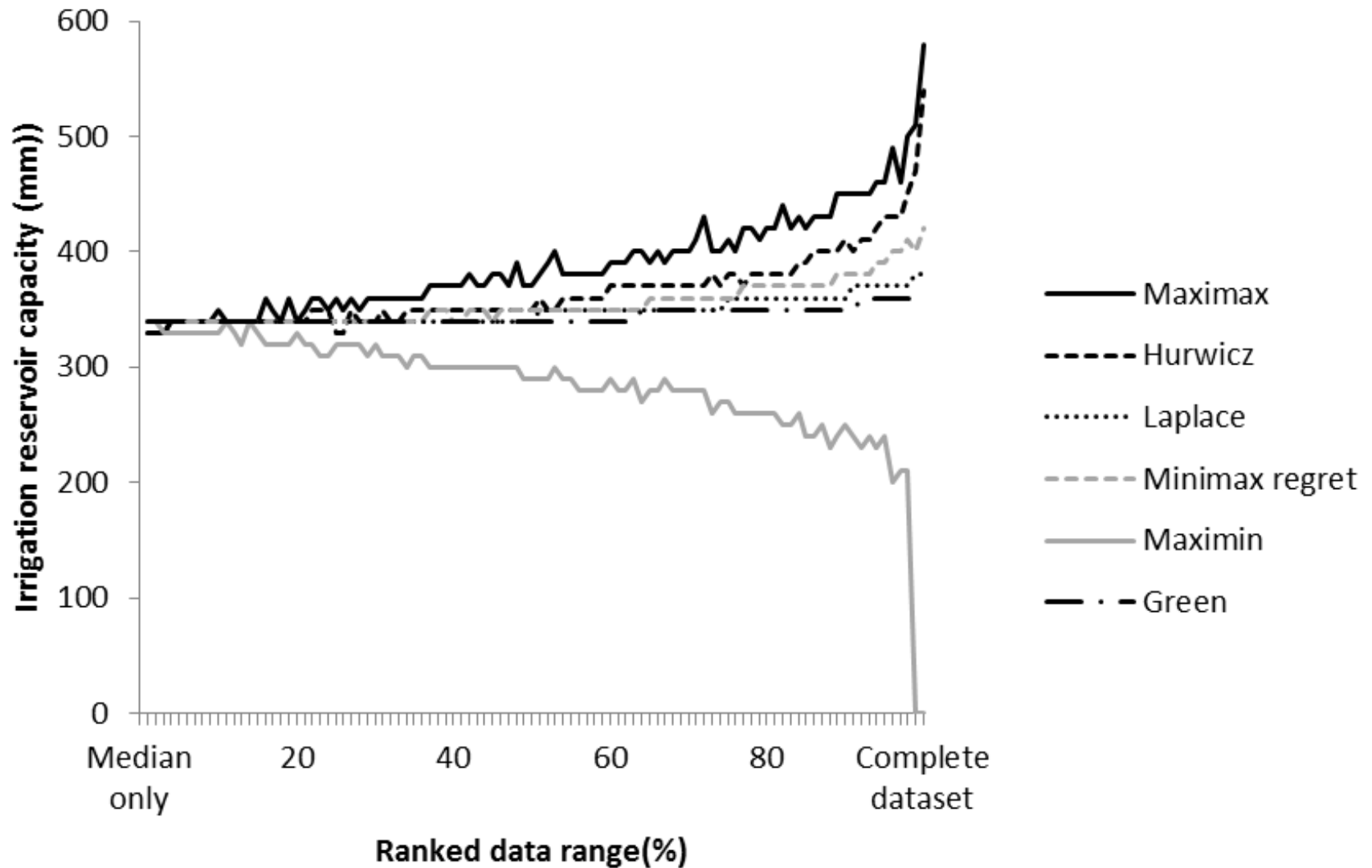
Result – Small impact; +/- ~5% on PPs

# Range of PP and 11 SCP projections



Result – Much bigger range on the 10,000 PP, and slightly larger median capacity

# Effect of decision criteria



# Effect of sub-sampling

Simple random sampling and Latin Hypercube Sampling performed comparably;

Sub-sampling highlighted the shortcomings of some of the decision methods:

- Maximin, Maximax and Hurwicz's criterion were poorly reproduced from sub-sampling
- Laplace was reproduced well from sub-sampling

# Conclusions

- Probabilistic projections highlight (some of) the potential range (uncertainty?) in future climates
- The difference between emission scenarios is small, and does not give a good indication of uncertainty;
- The 11 spatially coherent projections also show less variation than the 10,000 probabilistic projections ;
- Laplace gives a similar capacity to the median projection, but some decision criteria give extreme results when used with probabilistic projections;
- Random Sampling was as good as Latin Hypercube Sampling

- Thank you for listening
- 4 papers in publication
  
- We are very keen to join any Horizon 2020 bids

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