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Abrupt shifts in national land use and food production after a climate tipping point

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VALUING NATURE

Key Questions

- How will climate change impact agricultural land use?
- How would a climate tipping point affect agricultural land use?
- How can widespread irrigation mitigate negative impacts?

Policy	Climate change	
	Climate change **No irrigation**	**Climate tipping point** **No irrigation**
	Climate change **With irrigation**	**Climate tipping point** **With irrigation**

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Agricultural Model

DATA

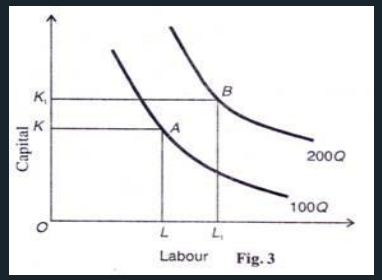
ENVIRONMENT

POLICY

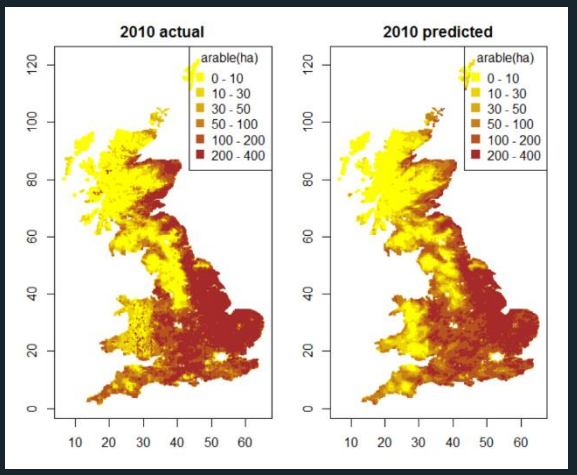
MARKET

ECONOMETRIC MODEL

ECONOMIC THEORY



OUTPUT



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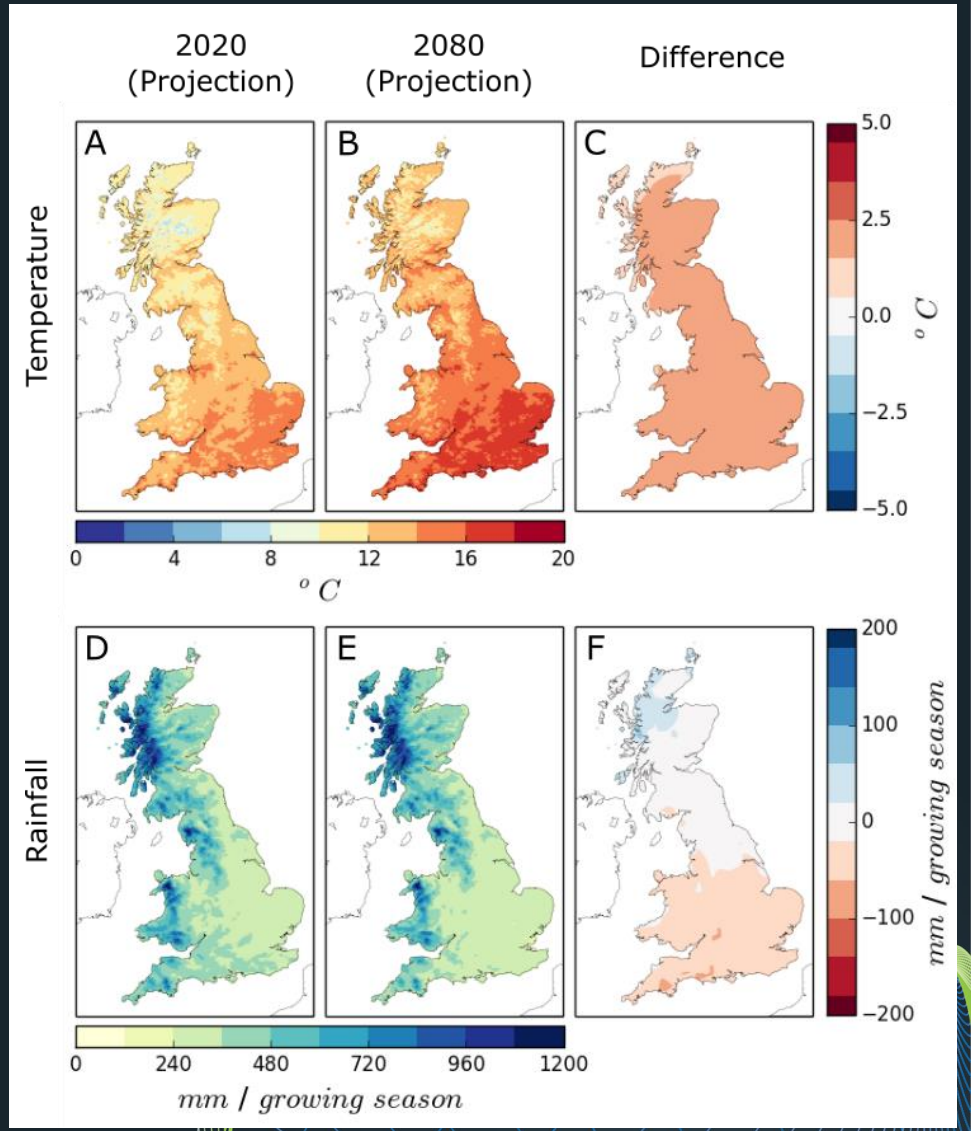
Climate change (AMOC maintained)

- Use growing season temperature and rainfall from HadRM3-PPE-UK for the time span 2020 to 2080, which forms part of the UK Climate Projections (UKCP09)
- HadRM3-PPE-UK is forced under the medium emissions scenario SRES-A1B
- Modelled climate data is bias corrected to observational climate data



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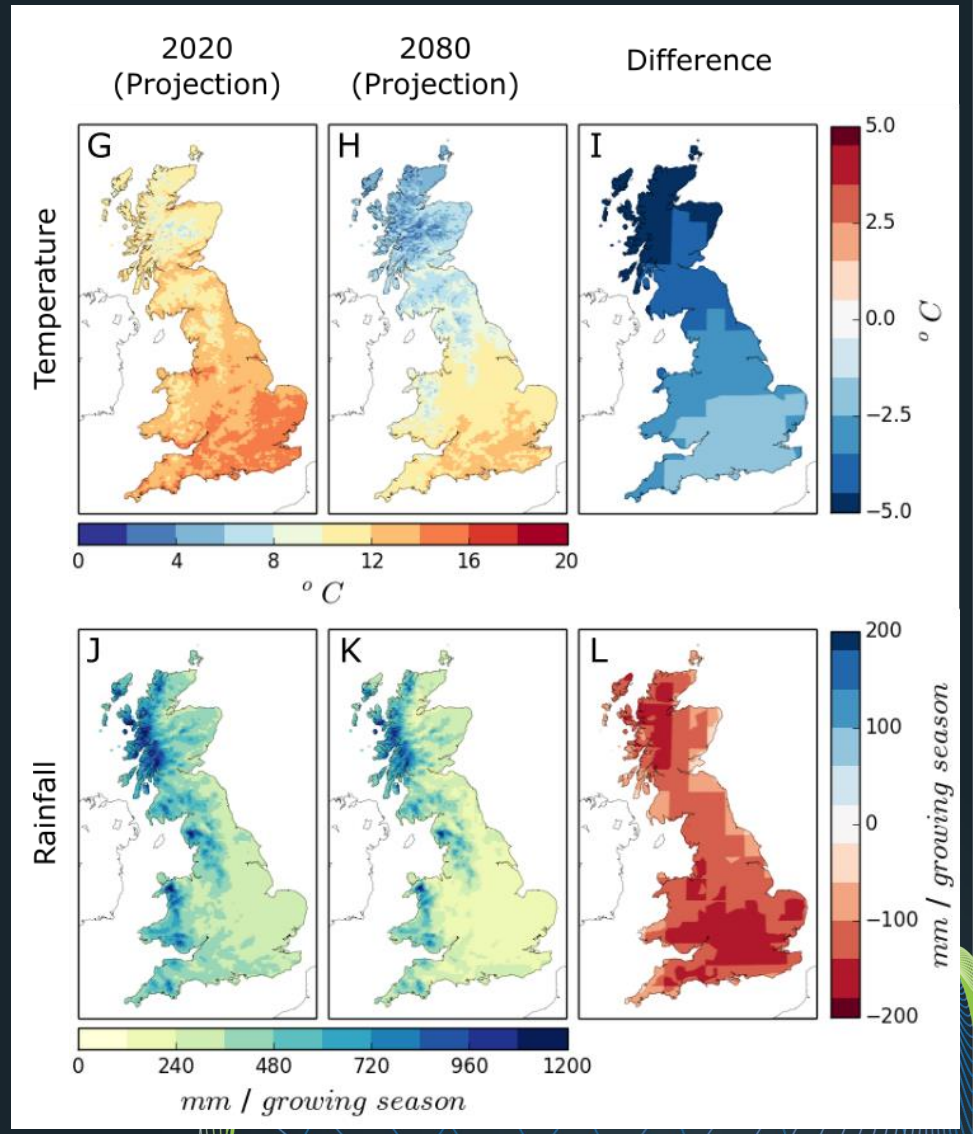
Climate tipping point (AMOC collapse)

- Use a control run and North Atlantic freshwater hosing experiment run of the HadGEM3 model to simulate an AMOC collapse
- Difference between runs overlaid onto climate change data provides future climate projection after an AMOC collapse
- Idealised AMOC collapse over the period 2030-2050



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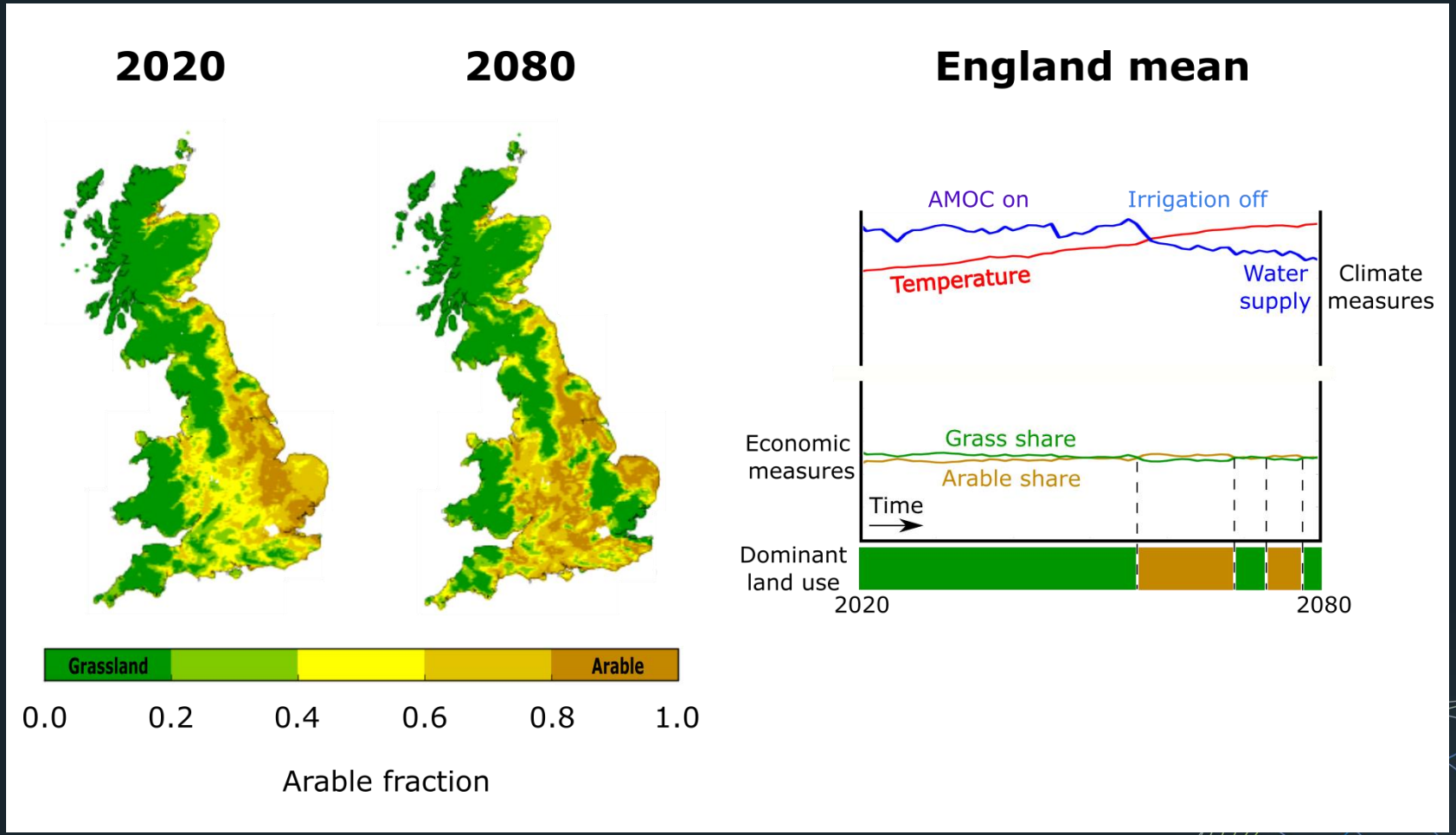
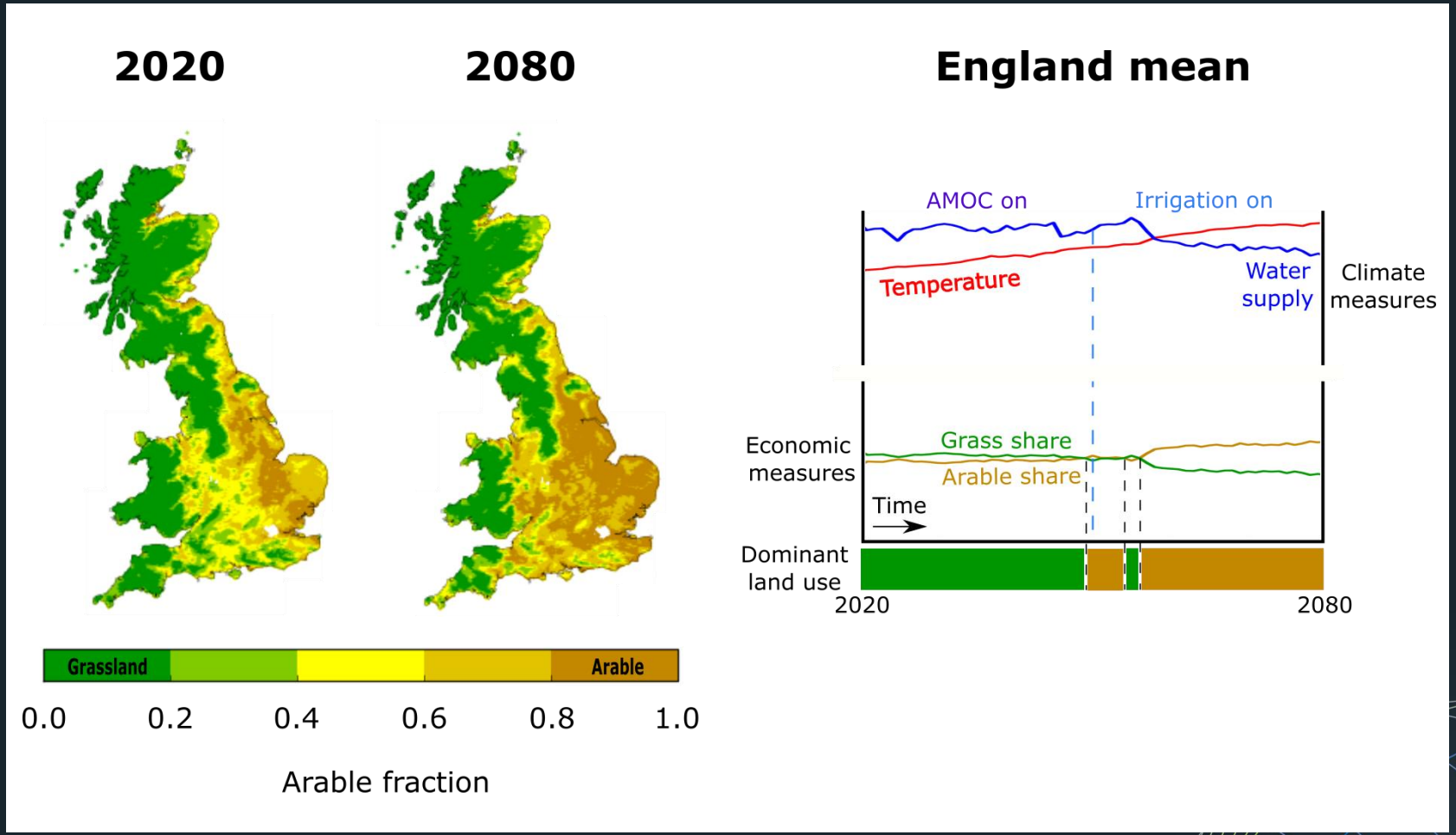
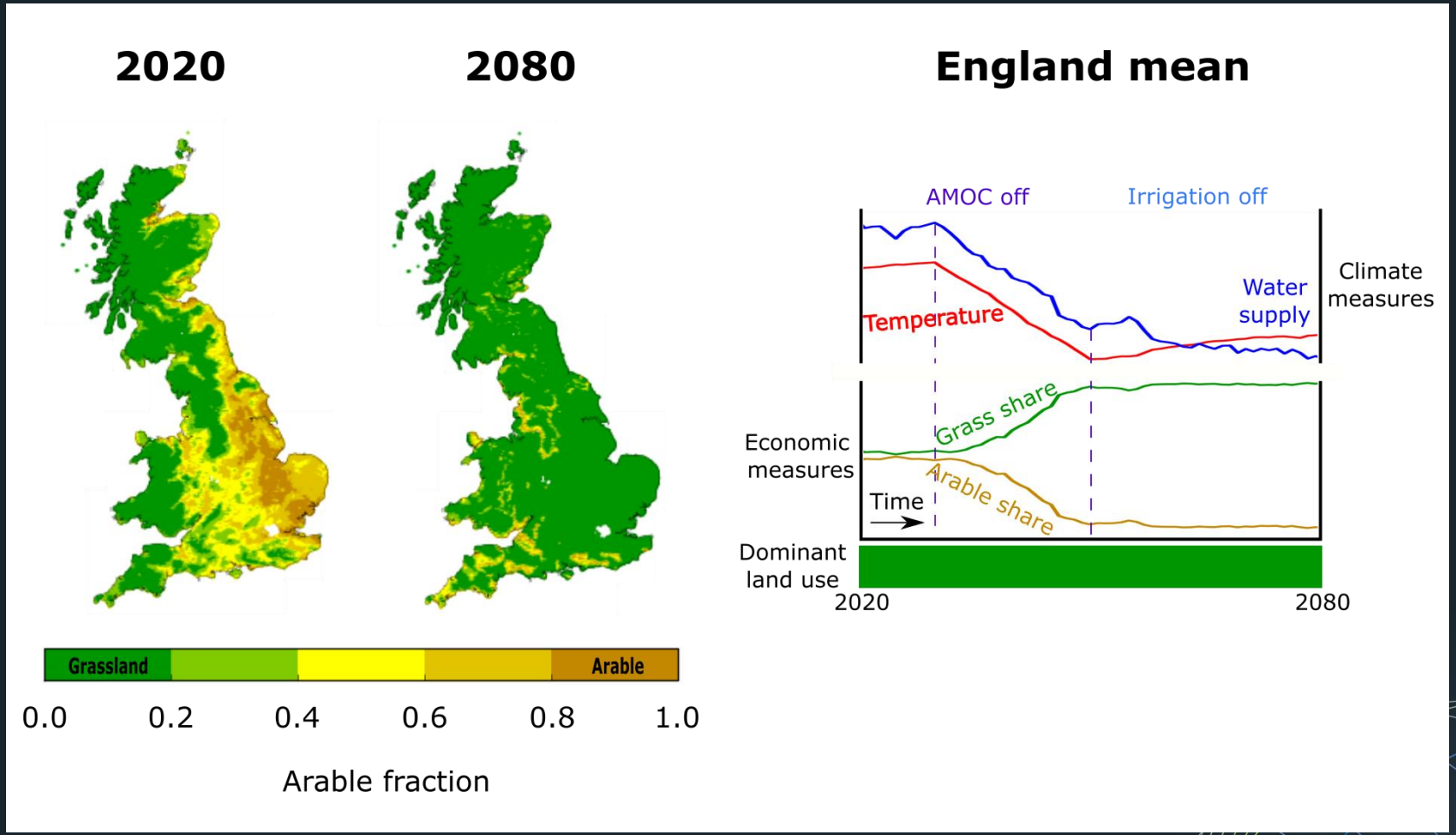
Climate change, no irrigation



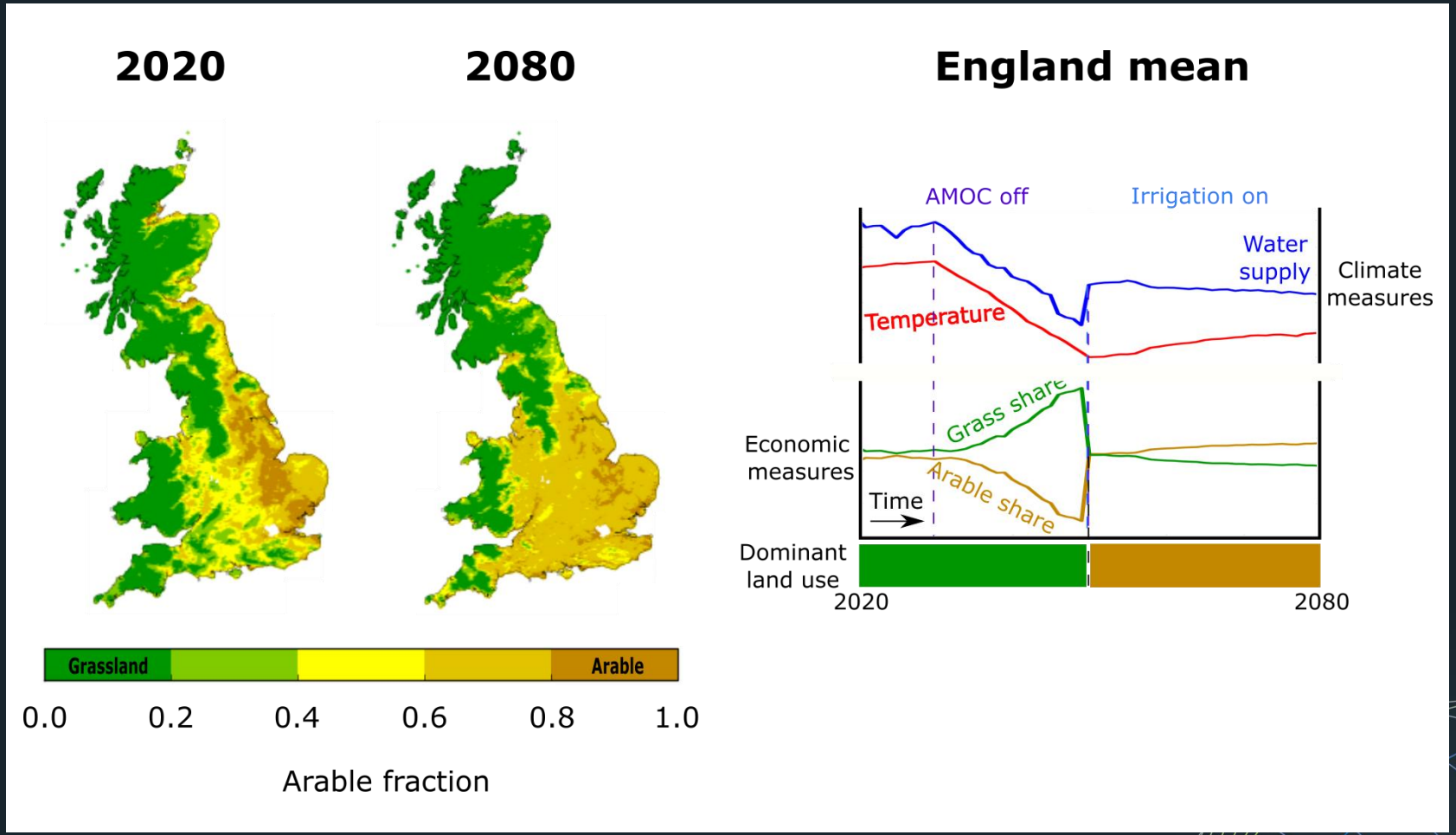
Climate change, with irrigation



Climate tipping point, no irrigation



Climate tipping point, with irrigation



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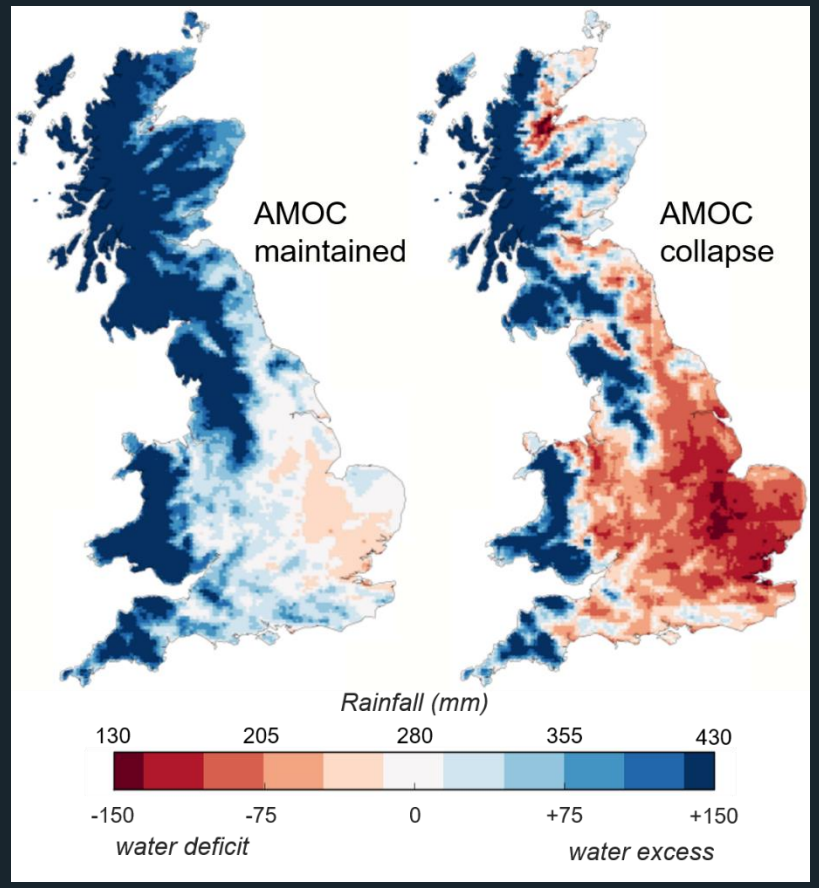
Irrigation and net impact on GB agriculture



	Climate change, no irrigation	Climate change, with irrigation	Climate tipping point, no irrigation	Climate tipping point, with irrigation
AMOC	Maintained	Maintained	Collapse	Collapse
Irrigation	No	Yes	No	Yes
Agricultural change value (£M p.a.)	40	125	-346	79
Irrigation cost (£M p.a.)	0	-284	0	-807
Net value change (£M p.a.)	40	-159	-346	-728

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Summary

- Advancement of arable land to the west and north under climate change, small loss in the south east
- Widespread loss of arable land following a climate tipping point
- One policy intervention to help mitigate arable loss is to provide irrigation to farmers
- Irrigation costs appear prohibitive and would require storage and/or large spatial redistribution of water

Reference: Ritchie et al., Abrupt shifts in national land use and food production after a climate tipping point, Submitted to Nature Food