Will managing for climate variability also manage for climate change?

A southern Australian grazing system as an example

CSIRO Climate Adaptation Flagship

Andrew Moore

Australian Government
Department of Agriculture, Fisheries and Forestry

mla

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Adaptation – how to get there from here?

- Pannell (2010) on adaptation policy in agriculture:
  - Climate change will be slow, uncertain, masked by variability
  - “At any point in time, farmers will use those practices that suit current perceived conditions ... the pace of climate change is predicted to be easily slow enough for pre-emptive action to be unnecessary...”

- To what extent do these arguments hold in livestock production?
  - Constraints on the rate of management change, imposed by:
    - Longer-term consequences on (e.g.) flock or herd structure
    - Less scope to adapt key profit drivers to seasonal conditions

- Is recent history a good guide to “current perceived conditions”?
  - If so, at what time scale?

A case study using the GRAZPLAN models

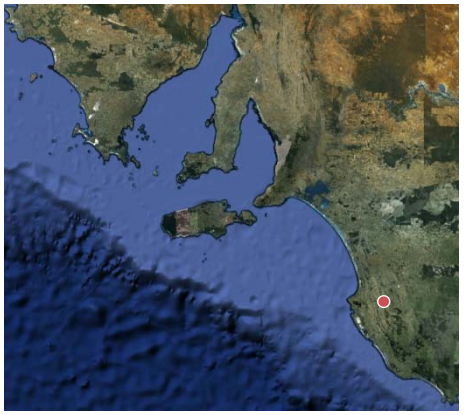
Dual-purpose Merino enterprise at Lucindale

- Self-replacing flock + 1st cross lambs
- Mediterranean climate, duplex soils
- Annual grass-clover pastures
- Confinement feeding in poor years

Simulated with the GRAZPLAN models

- Historical weather data 1970-2009
- 2010-2099 projections from ECHAM5/MPI-OM and NCAR-CCSM3 under SRES A1B
- 4 realizations/GCM
- Downscaled after Zhang (2009)
- Stochastic prices for each realization

Stocking rates & joining dates were varied



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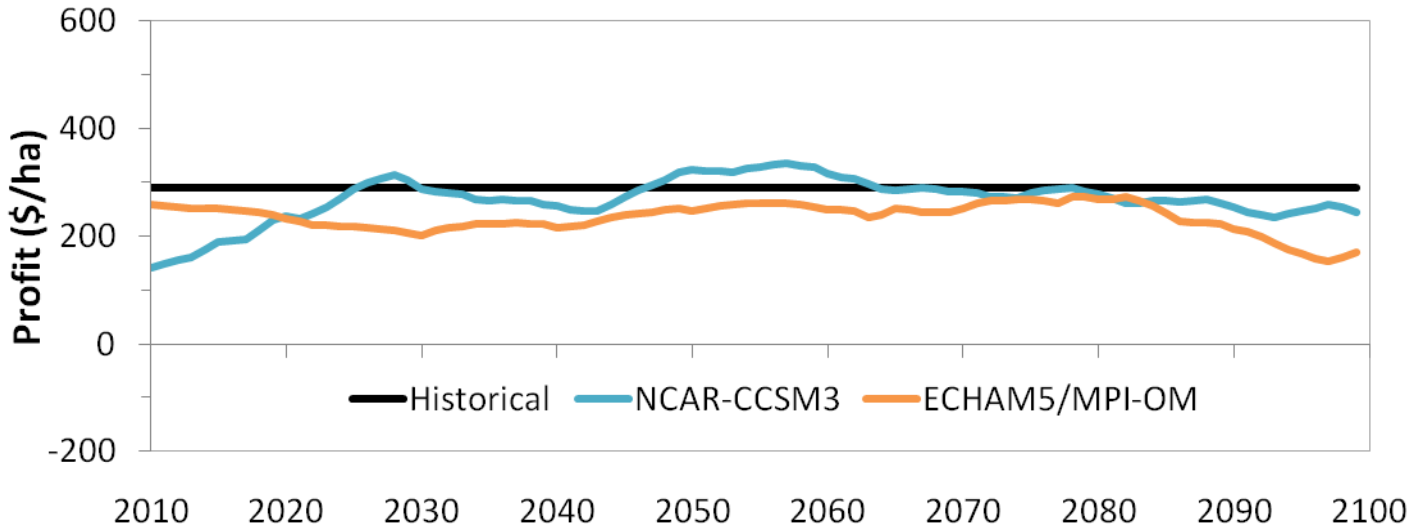
Adaptation policies

Traditionalist	Continue with the optimal policy from **1970-2009** (7.5 ewes/ha, mid-Jan)
Incremental	Each year, make a **small change** in either stocking rate or joining date **based on the last 5 years**' performance
Step-change	Every 15 years, change to the policy that would have performed best **over the previous 15-year period**
Forecast	Smoothly changing policy that maximizes expected performance across all realizations (i.e. using an **accurate long-term forecast**)

- Each policy evaluated for 2 GCMs x 4 realizations
- "Profit" here is gross margin less an operator allowance
- Risk-averse producer assumed when defining "performance"
- Conditional value-at-risk used as the risk measure

“Traditional” policy: impacts of climate change

- Comparing GCMs, averaged over realizations, 15-year running averages
- ECHAM5/MPI-OM, 4 realizations, 15-year running averages



- Inter-decadal variability is a major source of uncertainty across realizations
- Expected pasture production stays fairly stable
- Clover-dominant pastures in the model (earlier in NCAR-CCSM3)

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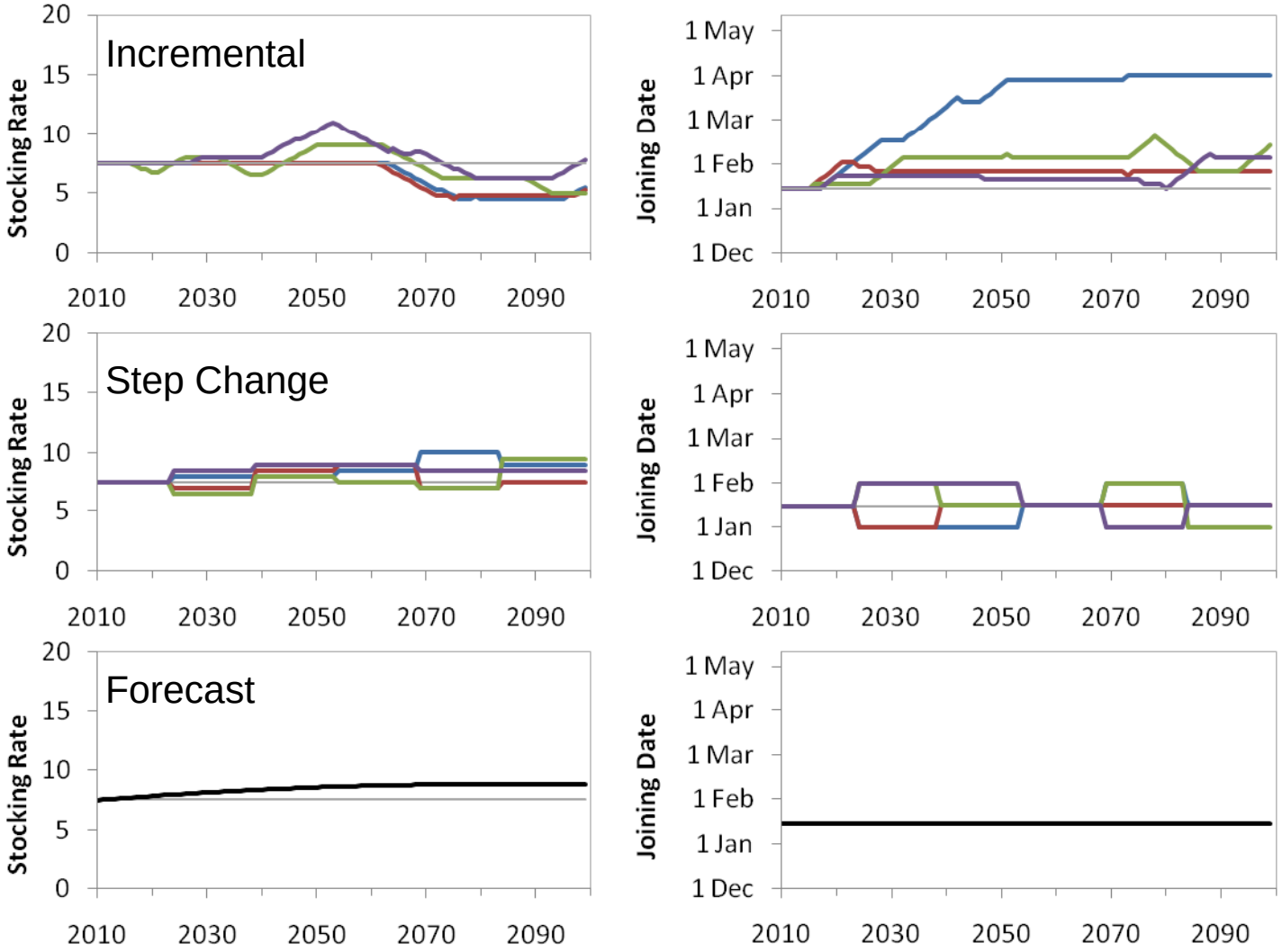
S.R. & joining dates over time: NCAR-CCSM



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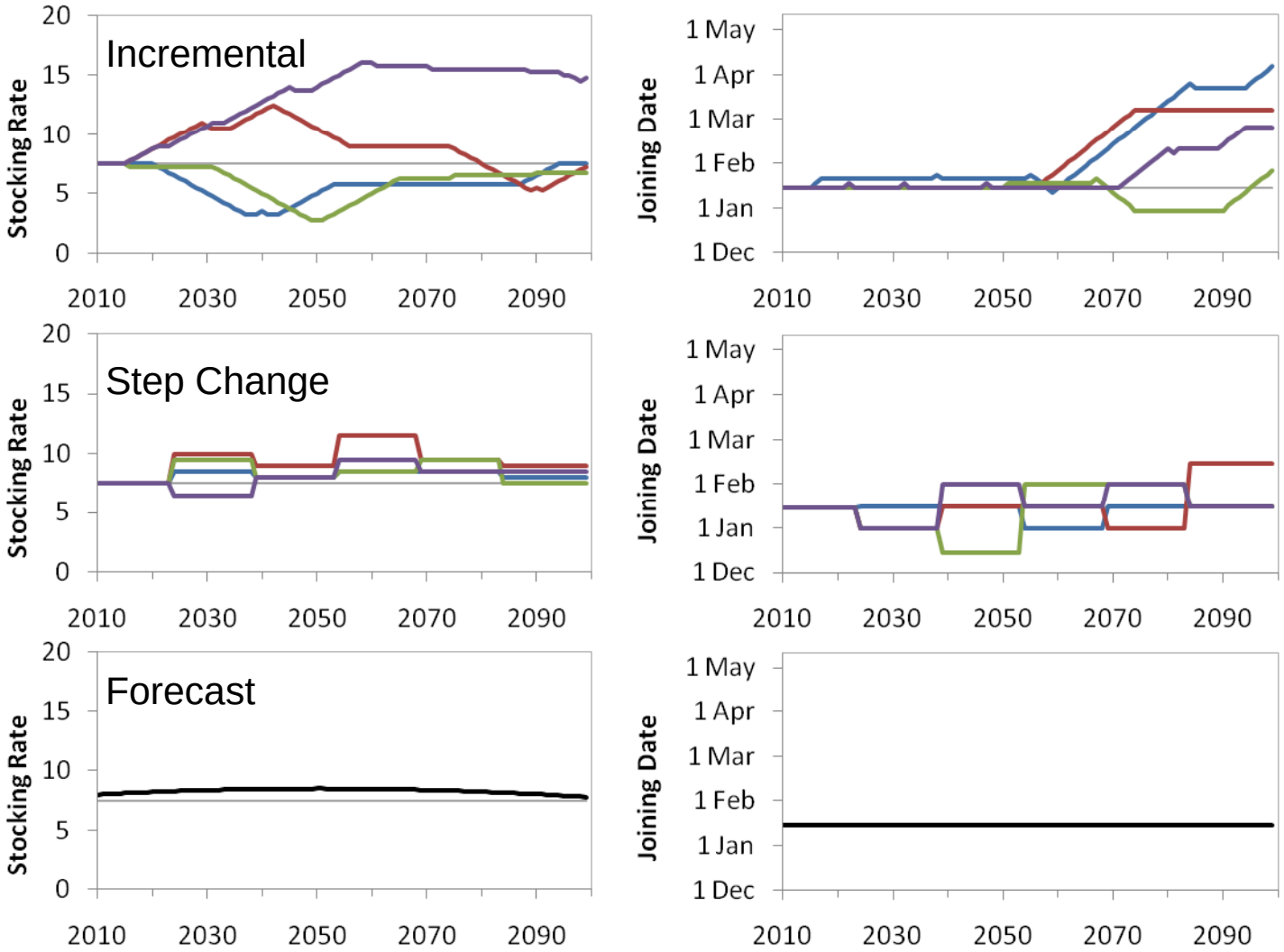
S.R. & joining dates over time: ECHAM5/MPI-OM



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Long-run-average profit & its variability

		Traditional	Incremental	Step Change	Forecast
Mean 1970-2009	Historical	**290**			
Mean 2010-99	CCSM	**267**	**242**	**252**	**262**
	ECHAM5	**236**	**265**	**244**	**250**
RMSD Across Years	CCSM	76	71	70	73
	ECHAM5	63	53	77	73
RMSD Across Realizations	CCSM	107	74	95	96
	ECHAM5	96	157	120	111

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Lessons learnt

For this particular livestock production system:

- climate change will be slow and uncertain
- climate change won't be masked by climatic variability
- confinement feeding is a promising adaptation

Inter-decadal variability is important

The "incremental" and "forecast" approaches may work better than the "step change" approach

- but no policy consistently outranked another over all 8 realizations
- Blend the "incremental" & "forecast" approaches?

Adaptation studies focussed on (e.g.) 2050 may need to work with ensembles of GCM realizations

- We await CMIP5 with interest...

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CSIRO Plant Industry
Andrew Moore
Project Leader, Southern Livestock 2030

Phone: +61 2 6246 5298
Email: Andrew.Moore@csiro.au
Web: www.csiro.au

Australian Government
Department of Agriculture, Fisheries and Forestry

mla

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