EAST COAST
NRM CLUSTER

CLIMATE CHANGE IN AUSTRALIA

IMPACTS & ADAPTATION
INFORMATION
FOR AUSTRALIA'S NRM REGIONS

Climate Change and Agriculture: a study for the Fitzroy Basin Association July 2014

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Climate Change and Agriculture

Fitzroy Basin

Background

- In the 2012-2013 period, cropping comprised approximately 31,610,962 ha in Australia *(Figure 1)* and grazing, approximately 340,163,891 ha *(Figure 2) (ABS 2014)*

- In 2012-2013, Queensland had 3,270,475 ha of land mainly used for cropping, and 118,908,090 for grazing *(ABS 2014).*

- The Fitzroy Basin NRM region in central Queensland comprises 15,685,900 ha total land area. Agriculture is the major land use, with up to 90% of the landscape used to produce food and fibre *(FBA 2014).* The region has approximately 12.4M ha of land for grazing and 865,000 ha for cropping *(ABS 2014).*

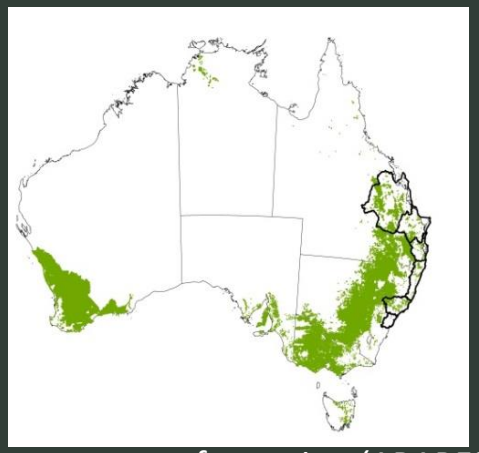


Fig. 1 Current extent of cropping *(ABARES 2012)*. East Coast Cluster NRM regions defined in black.

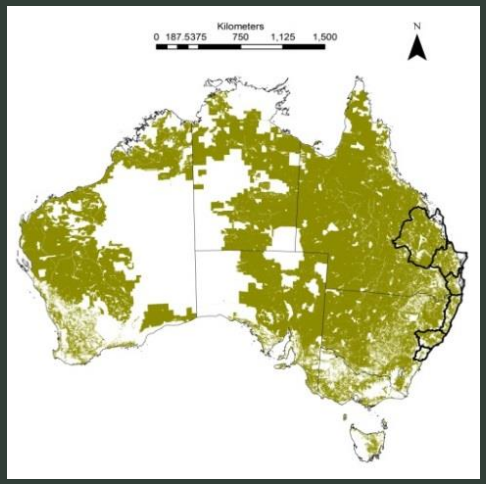


Fig. 2 Current extent of grazing *(ABARES 2012)*. East Coast Cluster NRM regions defined in black.

Climate Change and Agriculture

Fitzroy Basin

Aim

- To investigate the potential impacts of future climate change on cropping production and grazing
- To provide information to NRM groups regarding planning for climate change adaptation in a changing agricultural landscape

Methods

We developed potential 'best' and 'worst' case climate change impact distribution models for future cropping and grazing using software called MaxEnt *(Phillips et al. 2006*). MaxEnt predicts the probability that an area will be suitable for agricultural production based on changes in the climate variables most appropriate for each commodity.

We considered two Global Climate Models (GCM) under the current (baseline) climate and the A1FI emission scenario for 2025 and 2035 representing: 1) a 'worst' warmer and drier future (CSIRO Mk3.5) and 2) a 'best' cooler and wetter future (CSIRO MIROC-M) *(CSIRO 2014).*

Climate data used in the suitability models

The A1FI emission scenario

Describes a future world of very rapid economic growth, global population growth that peaks a mid-century with a fossil fuel-intensive energy system (i.e. business as usual)

Global Climate Models

Both of the climate models used here provide plausible projections of the future climate, even though they may differ considerably in their results. They were recommended by the CSIRO climate projections team and reviewed in the scientific literature.

Climate data used in the suitability models

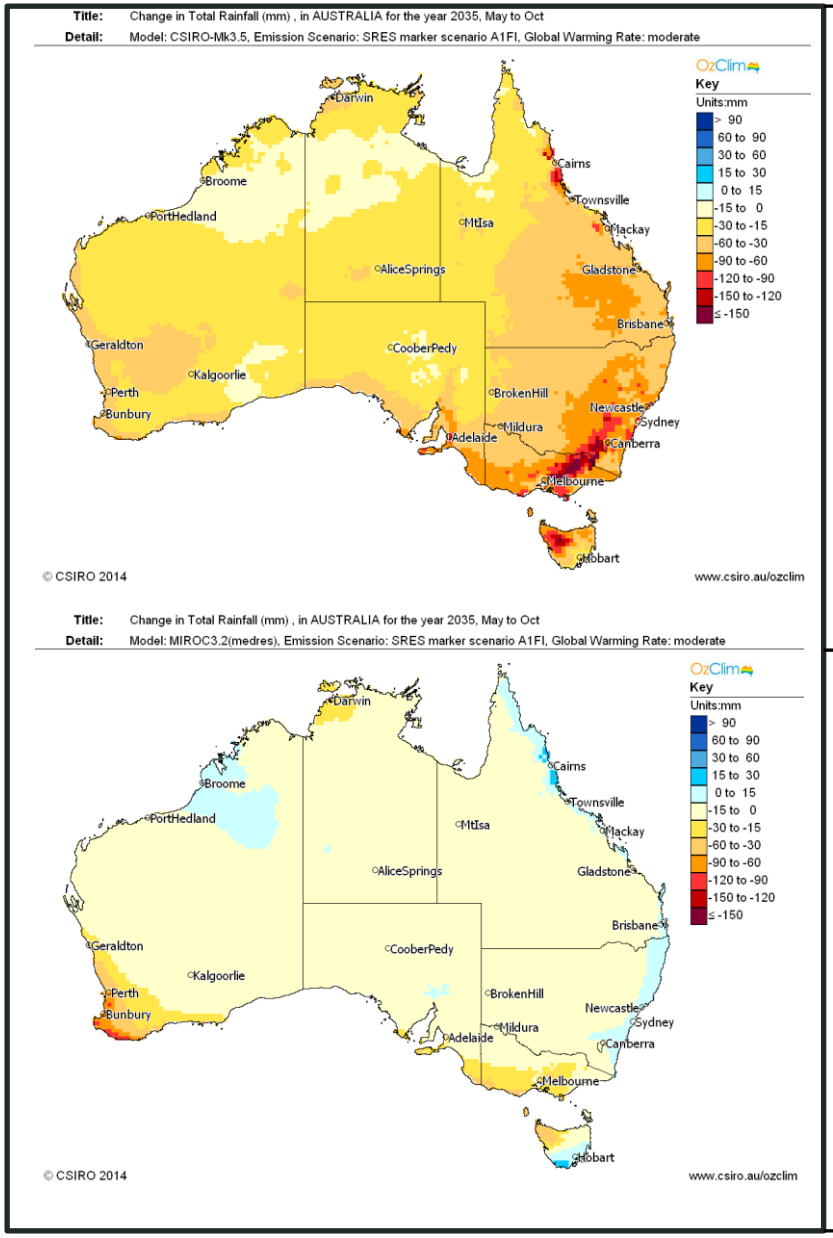
1. Warmer and drier future 'worst' (CSIRO Mk3.5)

- Annual-average rainfall decreases across all of Australia, except for increases along the east coast
- Widespread rainfall decreases in all seasons, but increases in the south and east in summer and over NSW and southern Qld in autumn
- Increases in annual temperature across all of Australia, with smaller increases along the southern coast of Australia

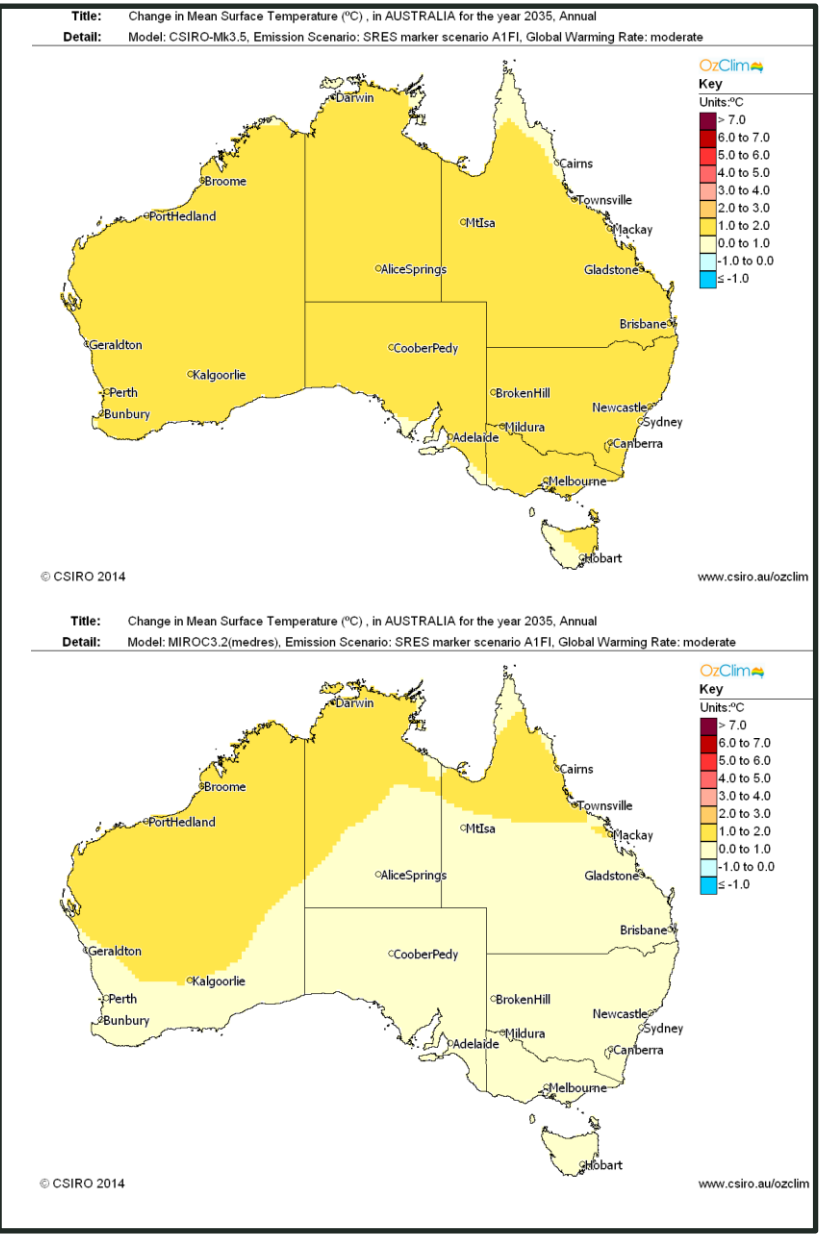
2. Cooler and wetter future 'best' (CSIRO MIROC-M)

- Decreases in rainfall to the west of Western Australia and increases elsewhere
- Moderate temperature increases across all of Australia, smaller to the south and east

Climate model examples using variables that contributed most to the models



Mk 3.5 'worst'



MIROC-M 'best'

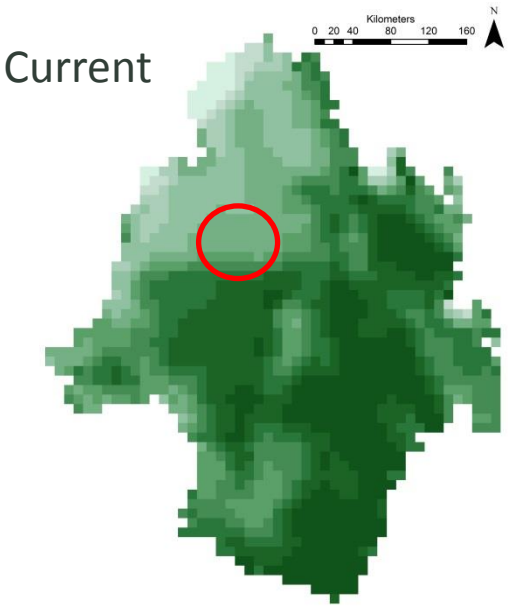
Changes in rainfall May-Oct 2035

Changes in mean annual temperature 2035

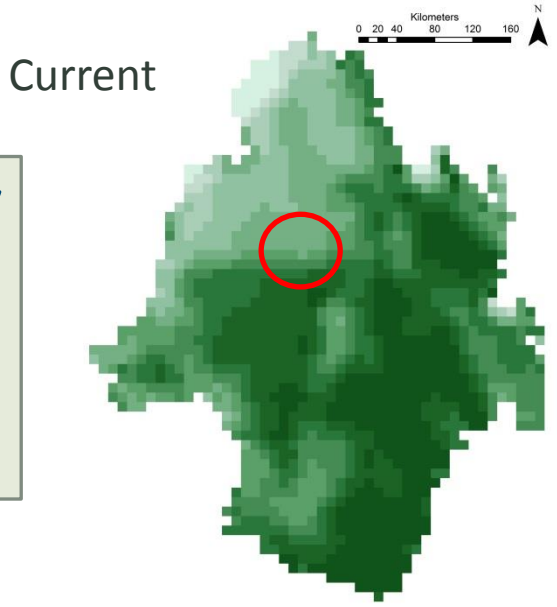
Hotter-Drier
(CSIRO Mk3.5)

RESULTS: **Cropping**
Fitzroy Basin

Wetter-Cooler
(CSIRO MIROC-M)



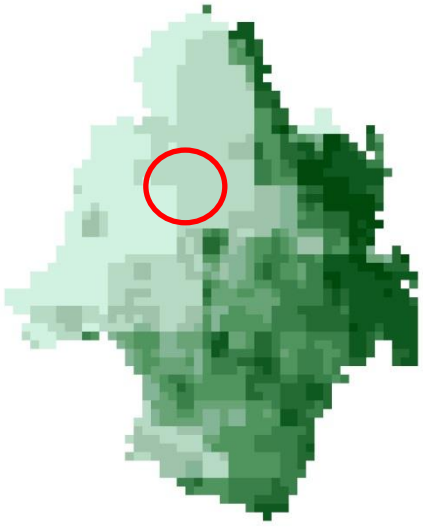
Current



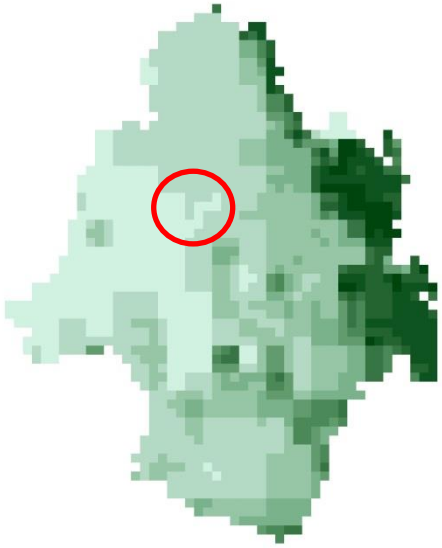
Current

Highest cropping suitability predicted to shift and contract from the west to the east, less so under the cooler-wetter GCM

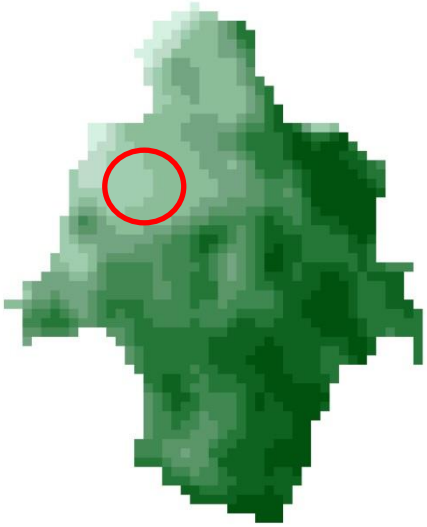
2025



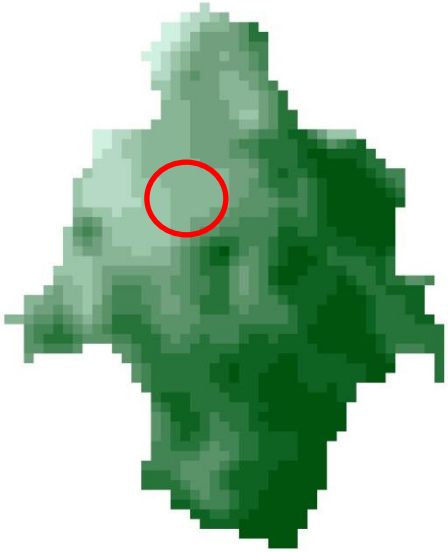
2035



2025



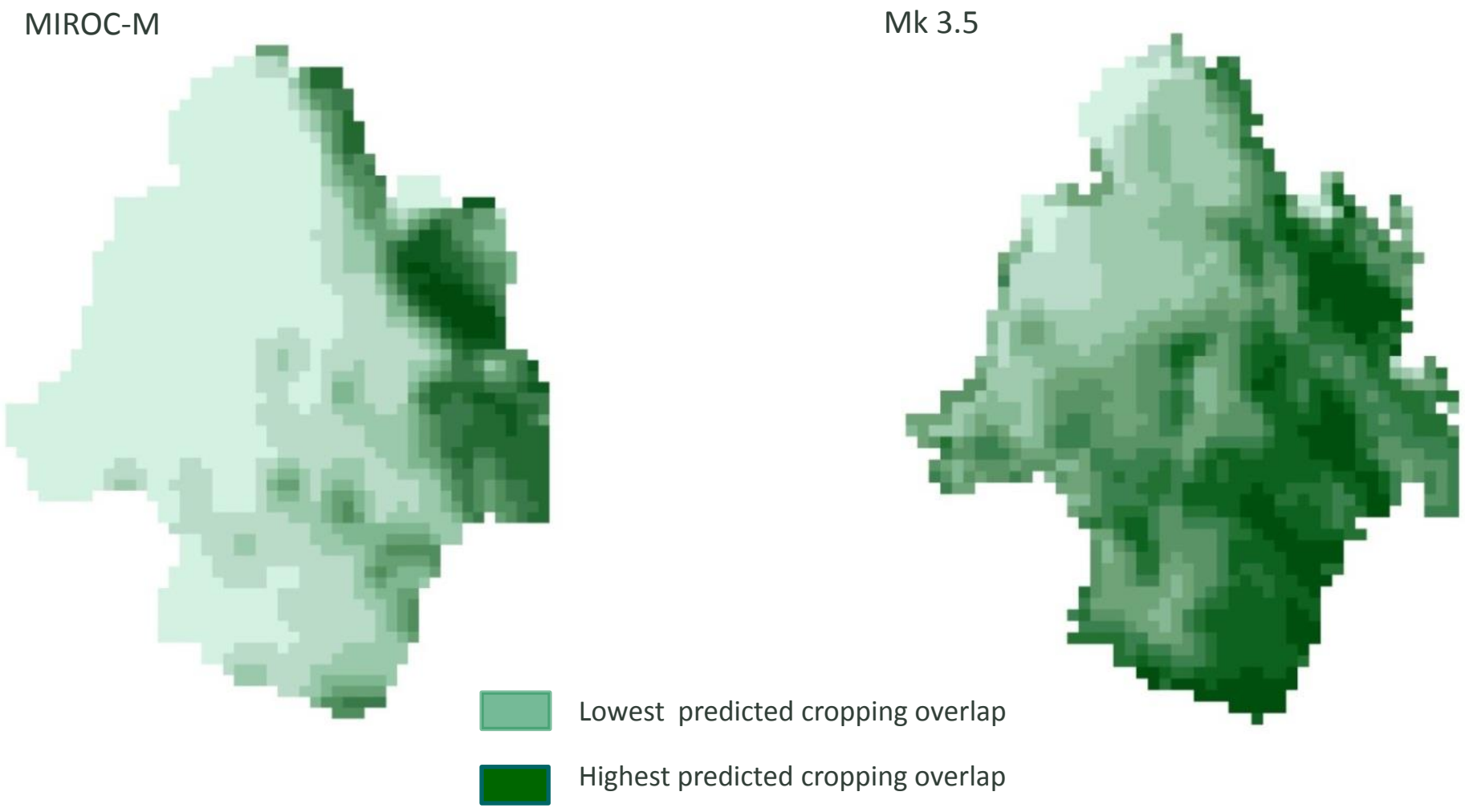
2035



Lowest predicted suitability

Highest predicted suitability

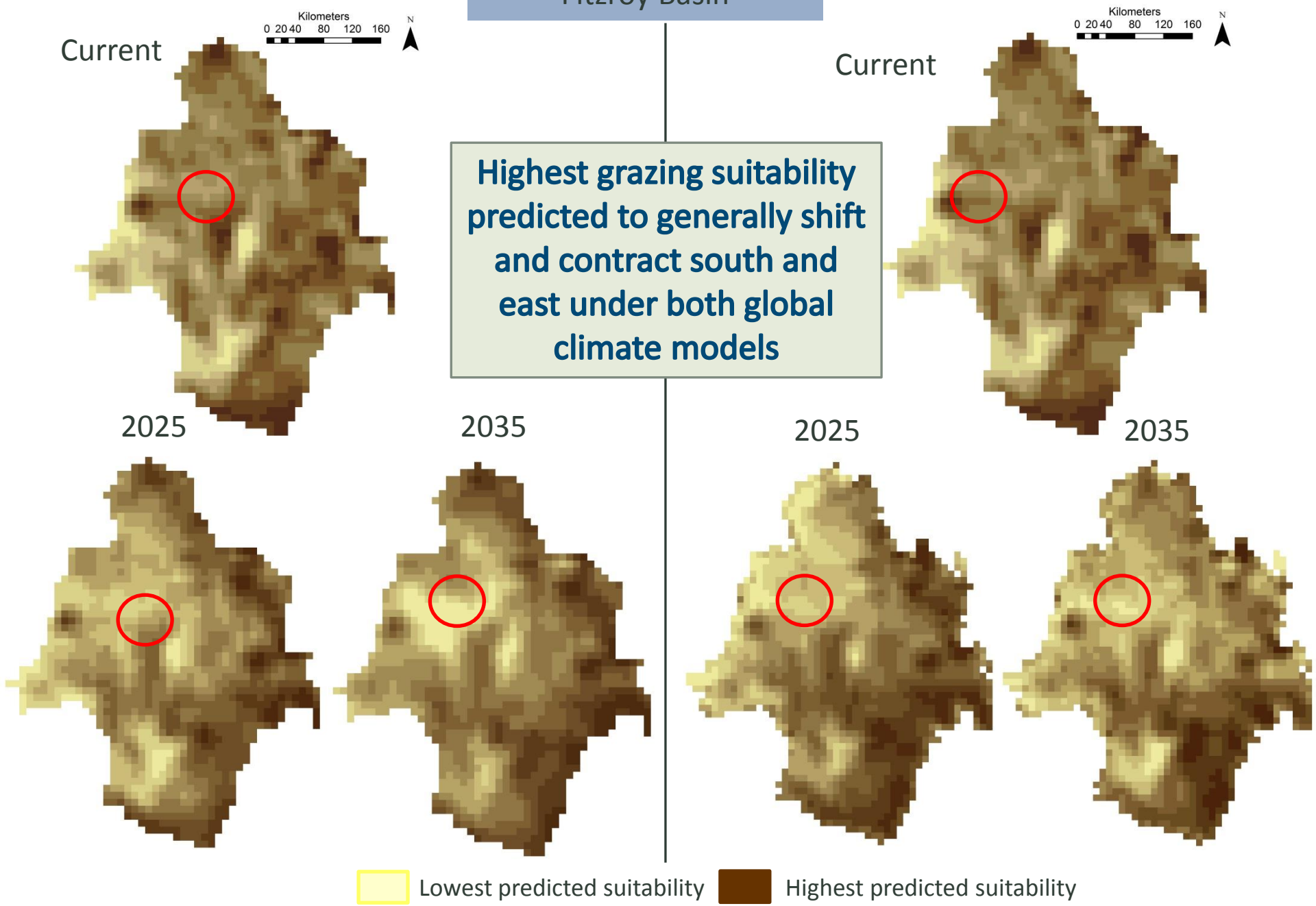
Probability of overlap for the cropping models (Current climate, 2025 and 2035)



Hotter-Drier
(CSIRO Mk3.5)

RESULTS : **Grazing**
Fitzroy Basin

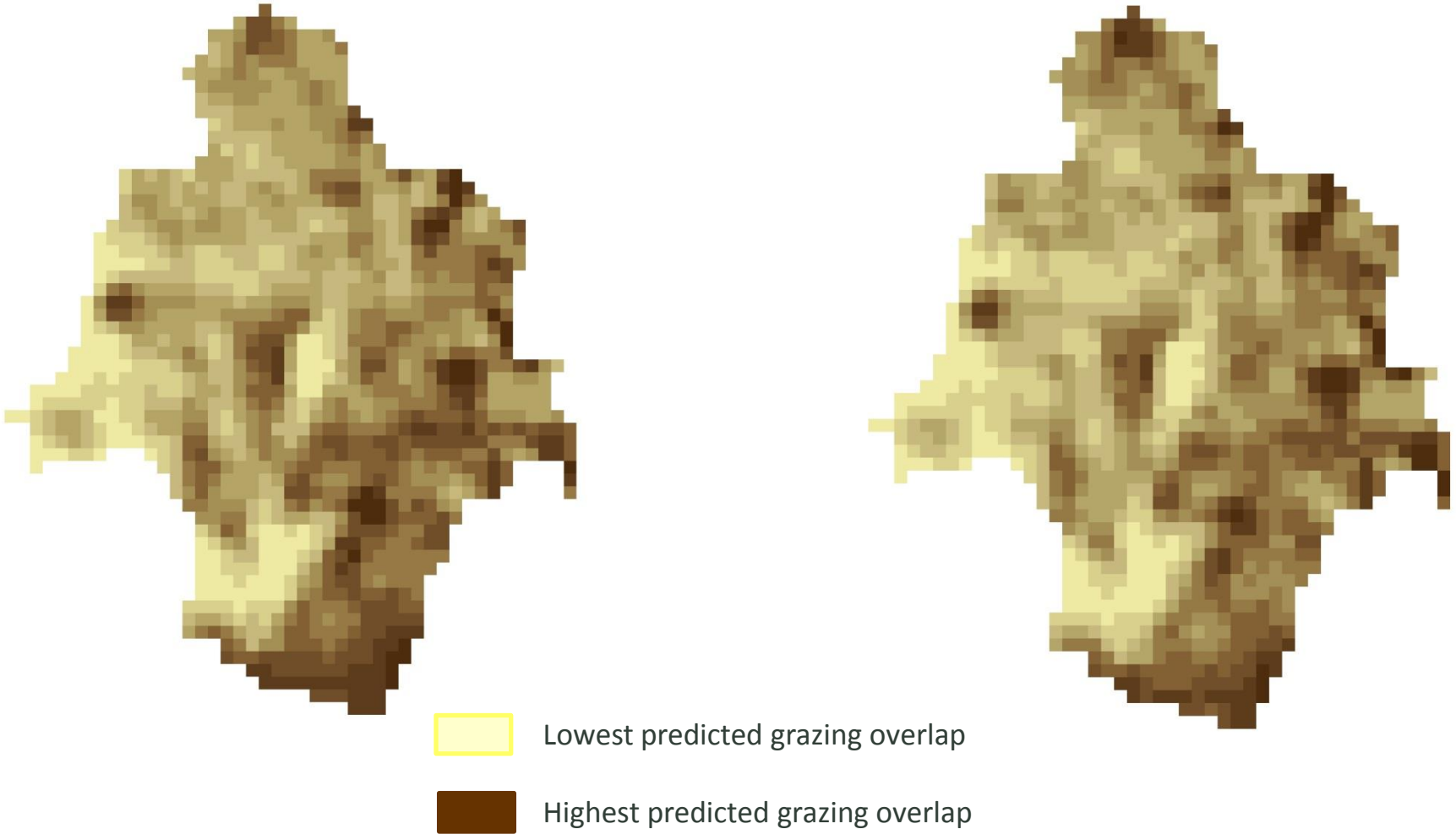
Wetter-Cooler
(CSIRO MIROC-M)



Probability of overlap for the grazing models (Current climate, 2025 and 2035)

MIROC-M

Mk 3.5



Potential ‘worst’ and ‘best’ case impact scenarios

CHANGE IN HIGHEST SUITABILITY (>50% probability) CROPPING Mk3.5 GCM				
	Current climate	2025	2035	% change (current-2035)
Area (km2)	35, 302	5, 428	2, 989	- 91
MIROC-M GCM				
Area (km2)	35, 302	15, 847	28, 102	- 20
CHANGE IN HIGHEST SUITABILITY (>50% probability) GRAZING Mk3.5 GCM				
Area (km2)	61, 249	26, 898	13, 713	- 77
MIROC-M GCM				
Area (km2)	61, 249	34, 031	37, 464	- 38

MaxEnt Results: Climate Change and Agriculture

Commodity	Variables incorporated in the model	Reason for inclusion in the model	*AUC	Contribution to the model (%)
Cropping	Total rainfall May-October	Growing period	0.761	85
	Maximum temperature-summer	Harvesting period		12.6
	Average rainfall-summer	Harvesting period		0.7
	Soil-cracking clay			0.7
	Erodibility			0.5
	Elevation			0.5
	Soil- red duplex			0
	Soil-massive earths			0
	Soil-yellow duplex			0
Grazing	Average annual temperature	Growing period	0.654	54.8
	Average rainfall-summer	Growing period		15
	Erodibility			10.6
	Soil-yellow duplex			10
	Elevation			5.3
	Soil-cracking clay			1.9
	Minimum temperature-July	Frost-induced fodder protein loss		1.7
	Soil-massive earths			0.5
	Soil-red duplex			0.2

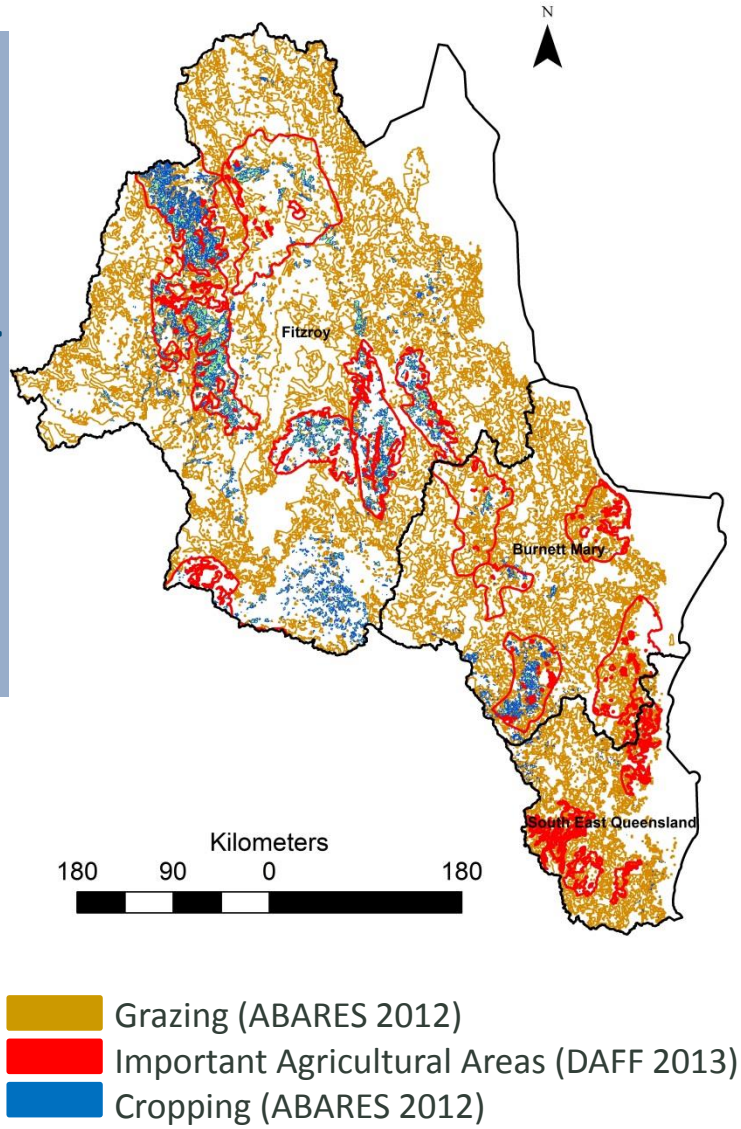
Most important climate variable for cropping: total rainfall May-October and for grazing: average annual temperature.

*The AUC value provides a measure of the model's predictive performance. A no better than random prediction AUC = 0.5. The lower AUC value for grazing is expected, due to the wide distribution of grazing in Australia.

Key Points

- **Agriculture in the Fitzroy Basin will be impacted by climate change**
- **Cropping suitability is predicted to shift and contract from the west to the east**
- **Cropping will be less affected under the cooler-wetter GCM**
- **Grazing suitability is predicted to shift and contract south and east**
- **Enterprises in the west are likely to experience stronger climate change impacts**

- **Rainfall (May-October)** was the most important predictor of cropping
- **Average annual temperature** was the most important predictor for grazing
- Understanding potential future climates can inform land management decisions at various scales



Climate Change and Agriculture
Fitzroy Basin

Assumptions and Limitations

- Future novel climates may vary from those used in this study
- The models presented here are based on the CSIRO A1FI emission scenario that reflects continuing fossil fuel dependence and high population growth, i.e. business as usual
- The two Global Climate Models that were used here were based on the best information available. Results can vary under different GCMs
- The results of this study are based on particular environmental variables chosen using the best information available. The results will vary if different climatic variables are used when developing the MaxEnt models
- MaxEnt's mathematical models do not consider human interventions such as future changes to agricultural practices or land use change
- These models were developed at a 10 x 10 km^2 scale to provide indicative information. Finer scale models would potentially provide more site-specific information

Acknowledgements

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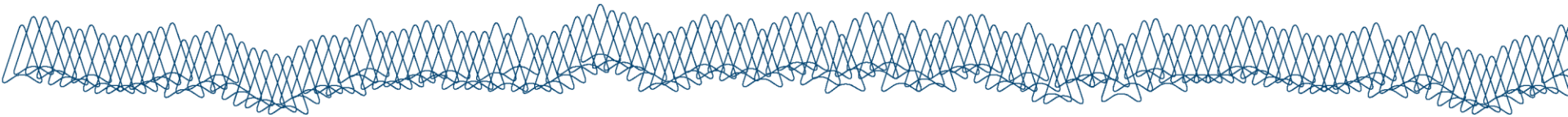
Thank you

From the East Coast Cluster



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