EAST COAST
NRM CLUSTER

CLIMATE CHANGE IN AUSTRALIA

IMPACTS & ADAPTATION
INFORMATION
FOR AUSTRALIA'S NRM REGIONS

Climate Change and Agriculture: a study for the Hunter Local Land Services July 2014

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Climate Change and Agriculture

Hunter LLS

Background

- In the 2012-2013 period, grazing in Australia comprised 340,163,891 ha and cropping 31,610,962 ha *(Figure 1)* The country produced approximately 52,982,401 kg of avocado *(Figure 2) (ABS 2014).*
- In New South Wales there was 45,328,336 ha of grazing land and 9,098,949 ha for cropping and the state produced 4,156,603 kg of avocado *(ABS 2014).*
- The Hunter LLS region covers an area of 33,000 square kilometres east of the Great Dividing Range (Hunter LLS 2014). In the 2012-2013 period, the Hunter Valley had 928,766 ha for grazing and 60,736 ha for cropping. The region produced 43,157 kg of avocado *(ABS 2014).*

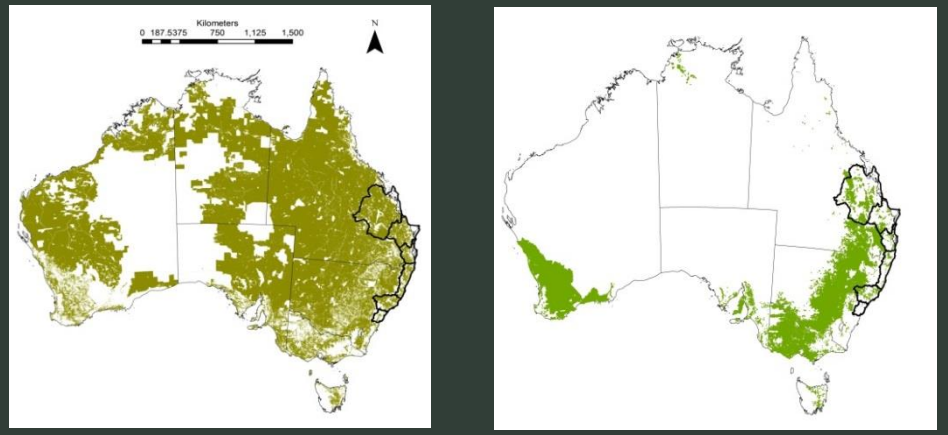

Fig. 1 Current extent of grazing (left) and cropping (right) (ABARES 2012) . East Coast Cluster NRM regions defined in black.

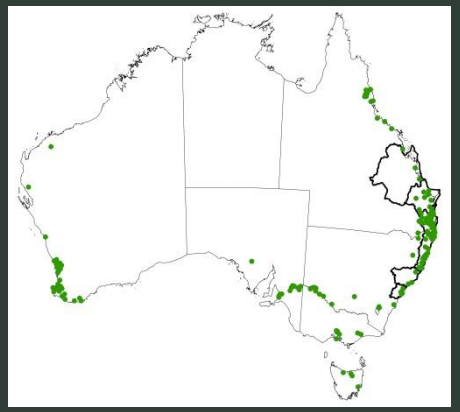

Fig. 2 Avocado production in Australia (Avocados Australia 2014). East Coast Cluster NRM regions defined in black.

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Aim

- To investigate the potential impacts of future climate change on cropping production, avocado 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.

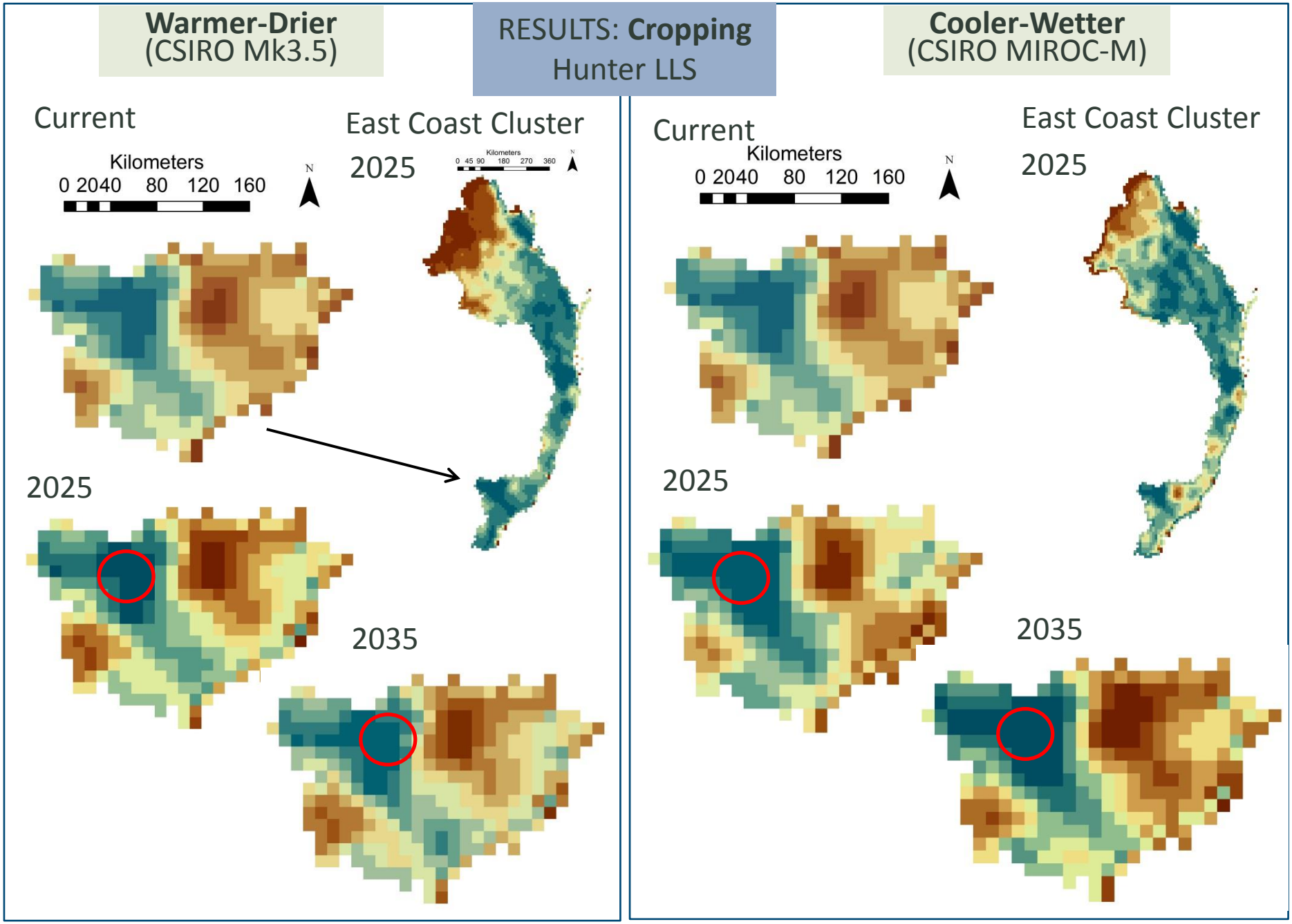
Climate data used in the suitability models

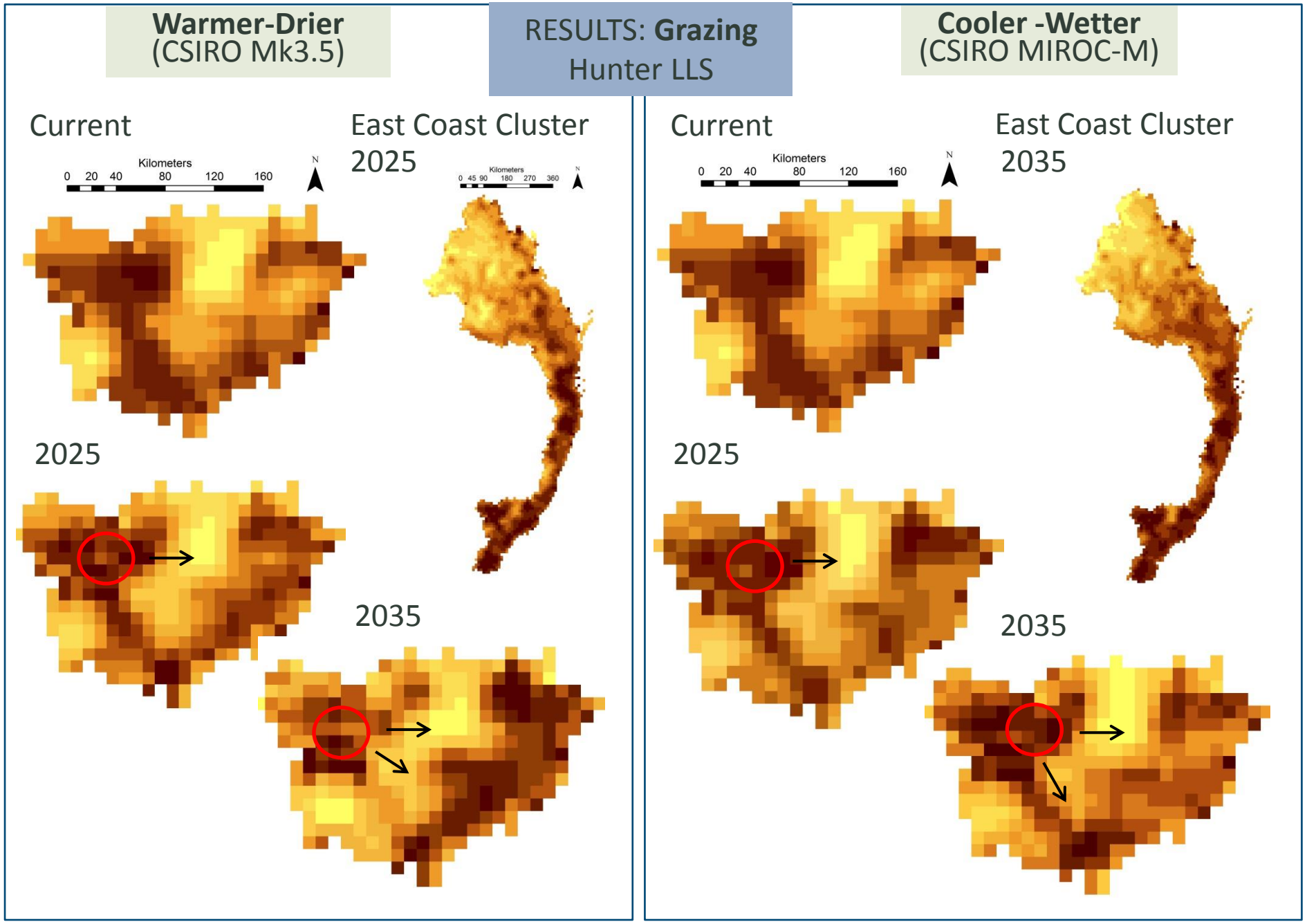
1. Warmer and drier future 'worst' (CSIRO Mk3.5)

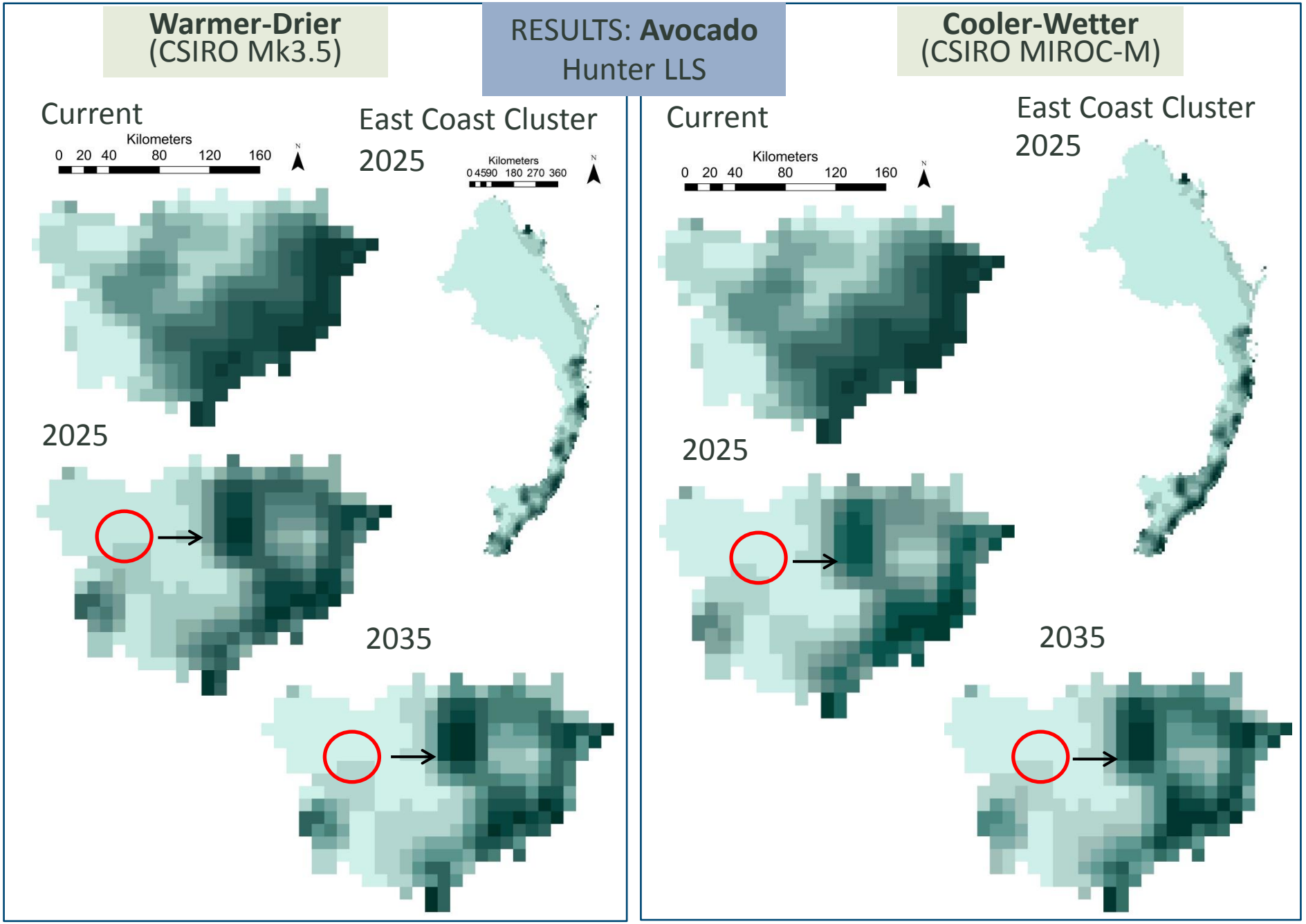
- Annual-average rainfall decreases across all of Australia, except for increases along the east coast
- Widespread rainfall decreases in all seasons, but increases in the south and east in summer and over NSW and southern Qld in autumn
- Increases in annual temperature across all of Australia, with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


Warmer-Drier
(CSIRO Mk3.5)
RESULTS: Cropping
Hunter LLS
Cooler-Wetter
(CSIRO MIROC-M)
Current
East Coast Cluster
Kilometers
0 2040 80 120 160
N
2025
2035
Lowest predicted suitability
Highest predicted suitability


Warmer-Drier
(CSIRO Mk3.5)
RESULTS: Grazing
Hunter LLS
Cooler -Wetter
(CSIRO MIROC-M)
Current
East Coast Cluster
2025
2035
Kilometers
0 20 40 80 120 160
0 45 90 180 270 360
N
Lowest predicted suitability
Highest predicted suitability


Warmer-Drier
(CSIRO Mk3.5)
RESULTS: Avocado
Hunter LLS
Cooler-Wetter
(CSIRO MIROC-M)
Current
East Coast Cluster
2025
Kilometers
0 20 40 80 120 160
Kilometers
0 45 90 180 270 360
2025
2035
Current
East Coast Cluster
2025
Kilometers
0 20 40 80 120 160
2025
2035
Lowest predicted suitability
Highest predicted suitability

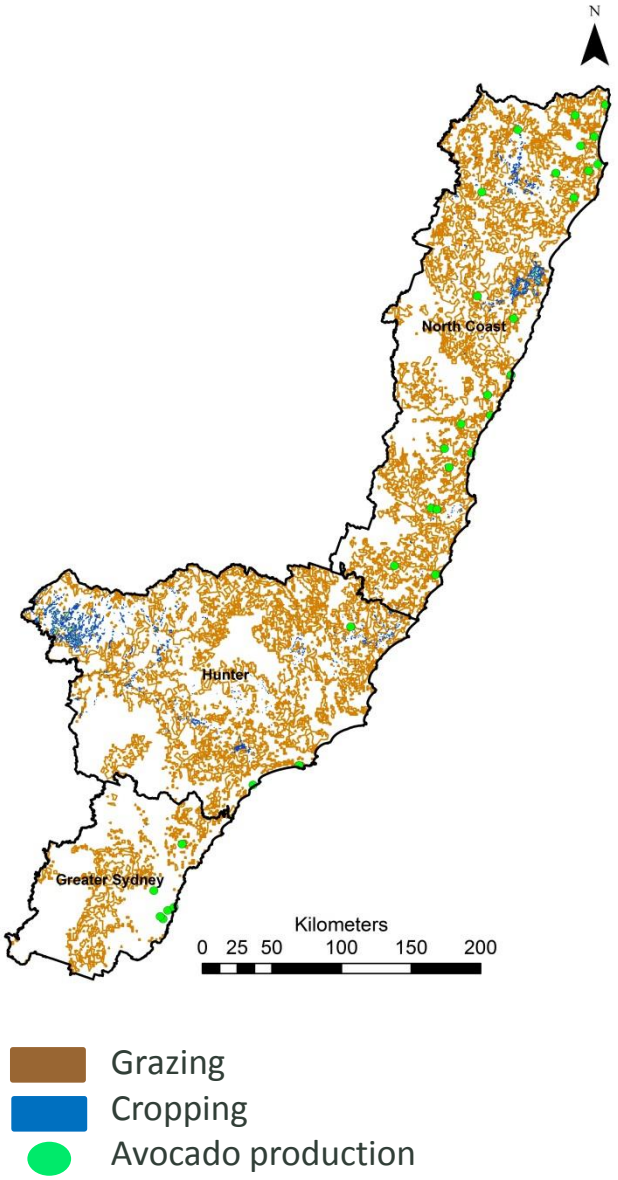
MaxEnt Results: Climate Change and Agriculture

Commodity	Variables incorporated in the model	Reason for inclusion in the model	AUC (no better than random = 0.5)	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
Avocado	Maximum temperature-November	Flowering/fruiting period	0.967	39.2
	Elevation			18.4
	Soil-yellow duplex			17.8
	Minimum temperature-July	Flower induction affected by frost		10.6
	Average rainfall summer	Growing/harvesting period		7.1
	Soil-cracking clay			2.3
	Erodibility			1.7
	Soil-massive earths			1.3
	Max temp October	Flowering/fruiting period		1.2
	Soil-red duplex			0.3
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

Key Points

- **Agriculture in the Hunter LLS Region will be impacted by climate change**
- **Cropping is predicted to remain suitable mostly in the north-western area of the region**
- **Grazing is predicted to contract in the west, but suitability of land increases in some eastern regions. There is less impact of climate change on grazing under the cooler-wetter GCM**
- **Land suitable for avocado production is predicted to contract from the west but remain suitable in many eastern regions**

- **Rainfall (May-October)** was the most important predictor of cropping
- **Average annual temperature** was the most important predictor for grazing
- **Maximum temperature (November)** was the most important variable for avocado production
- This study can help inform NRM planning for future climate change



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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

We are very grateful for the generous advice and time given by Giselle Whish and Mick Quirk (Meat and Livestock Association), graziers John and Ann Martyn, David Putland (GrowCom), John Tyas (Avocados Australia), Richard Sequeira (DAFF), Peter Long and Rachel Eberhard (FBA) and Leanne Webb (CSIRO Climate Projections).

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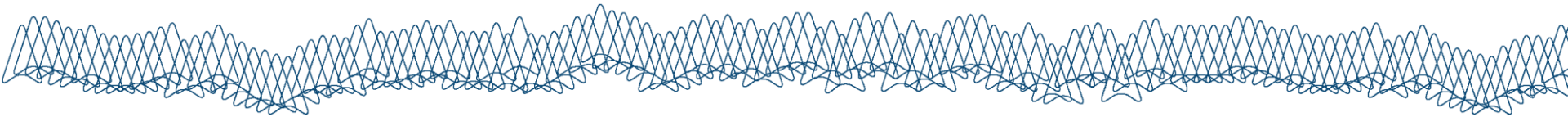
Thank you

From the East Coast Cluster



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