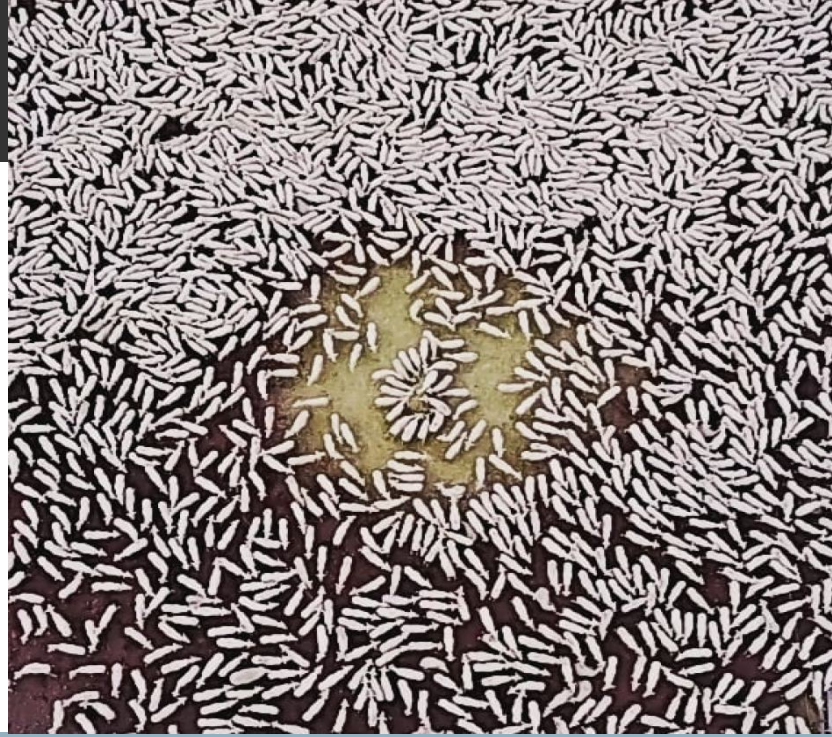
Australian National University

The climate of agriculture



Professor Mark Howden

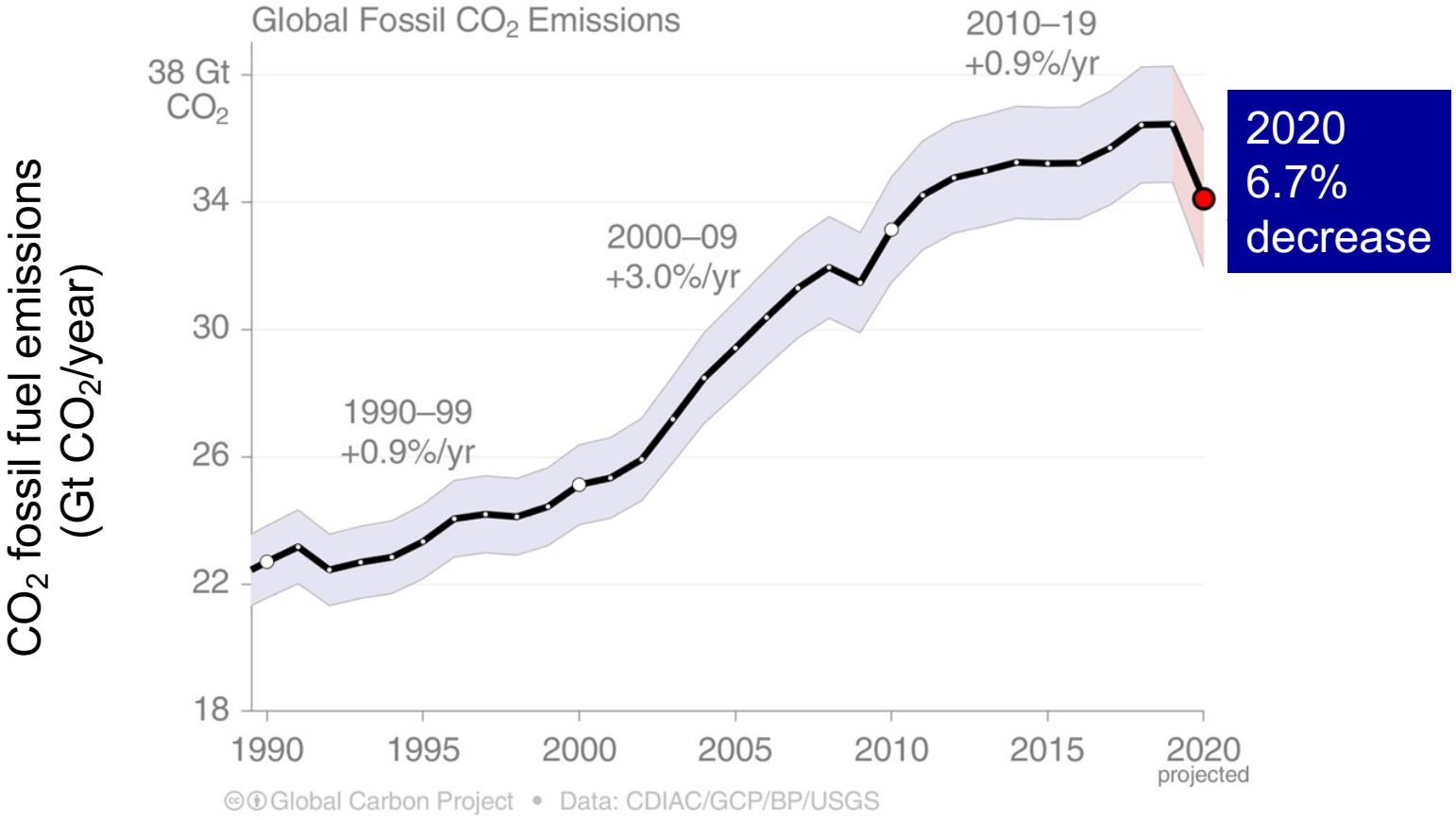
@ProfMarkHowden

ANU Institute for Climate, Energy and Disaster Solutions

ACT Climate Change Council

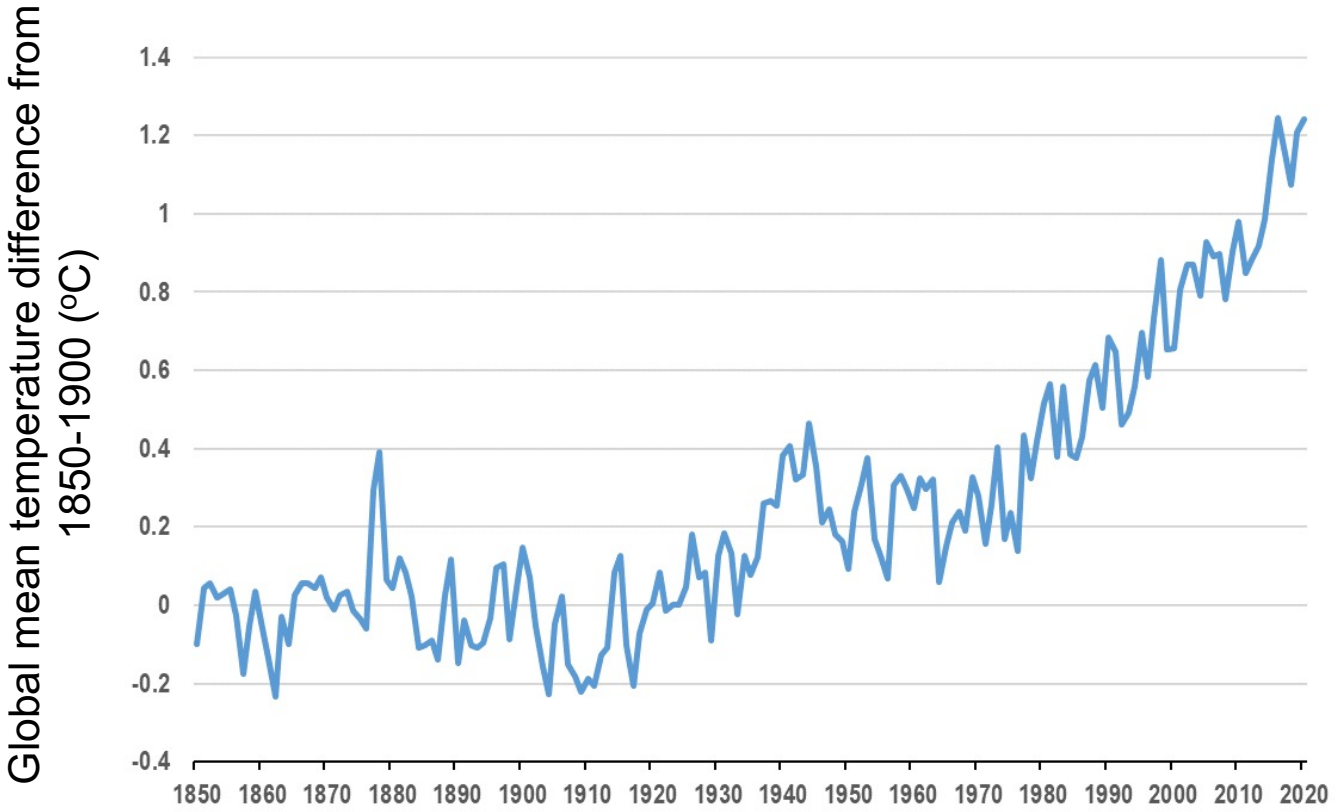
Vice Chair, IPCC Working Group II

CO_2 emissions: record fall from COVID



Global Carbon Project 2020; Friedlingstein et al. 2020

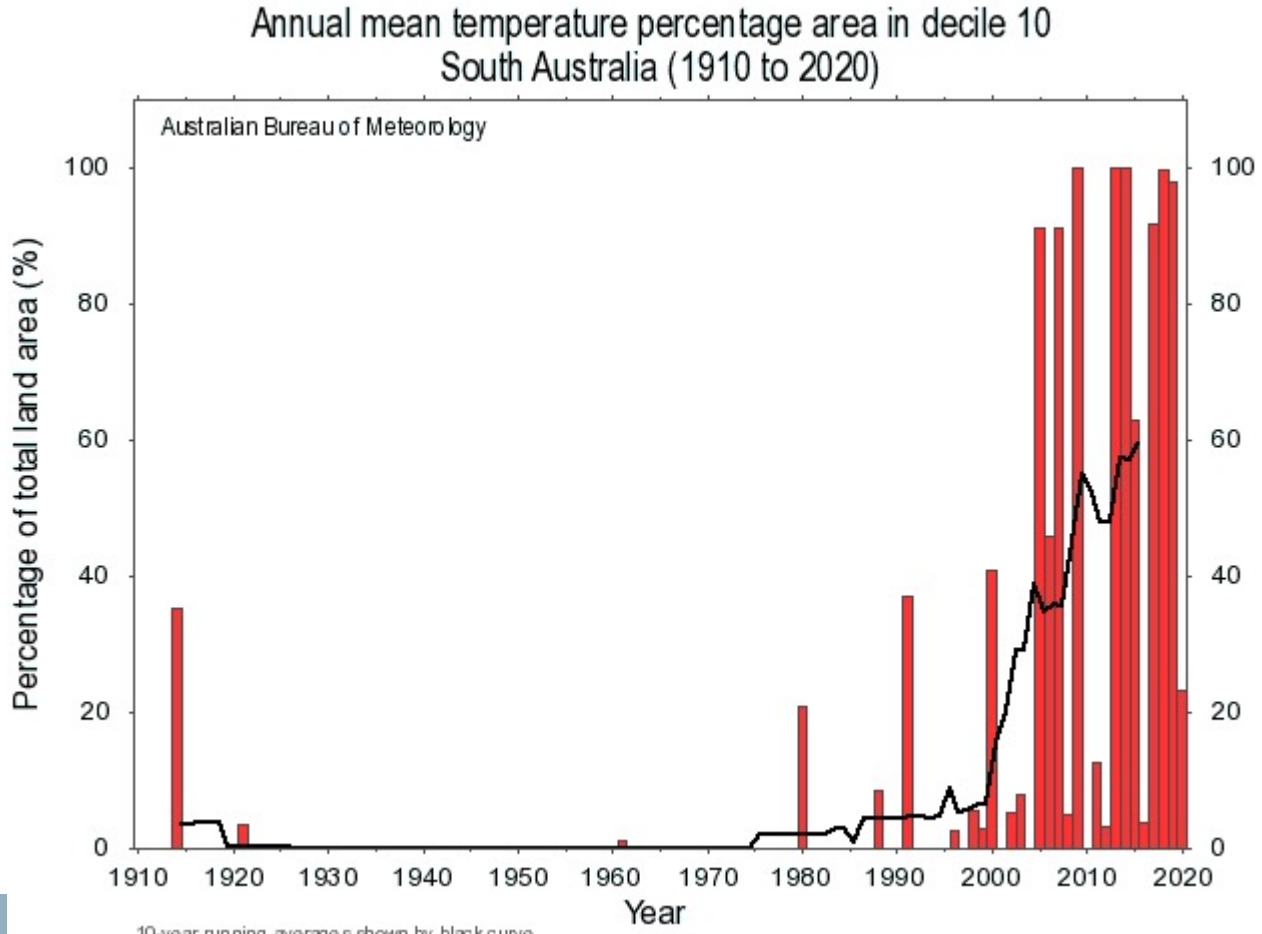
Globally – equal hottest on record



- Equal warmest year on record globally (1.24°C above the pre-industrial average)
- 4th warmest in Australia

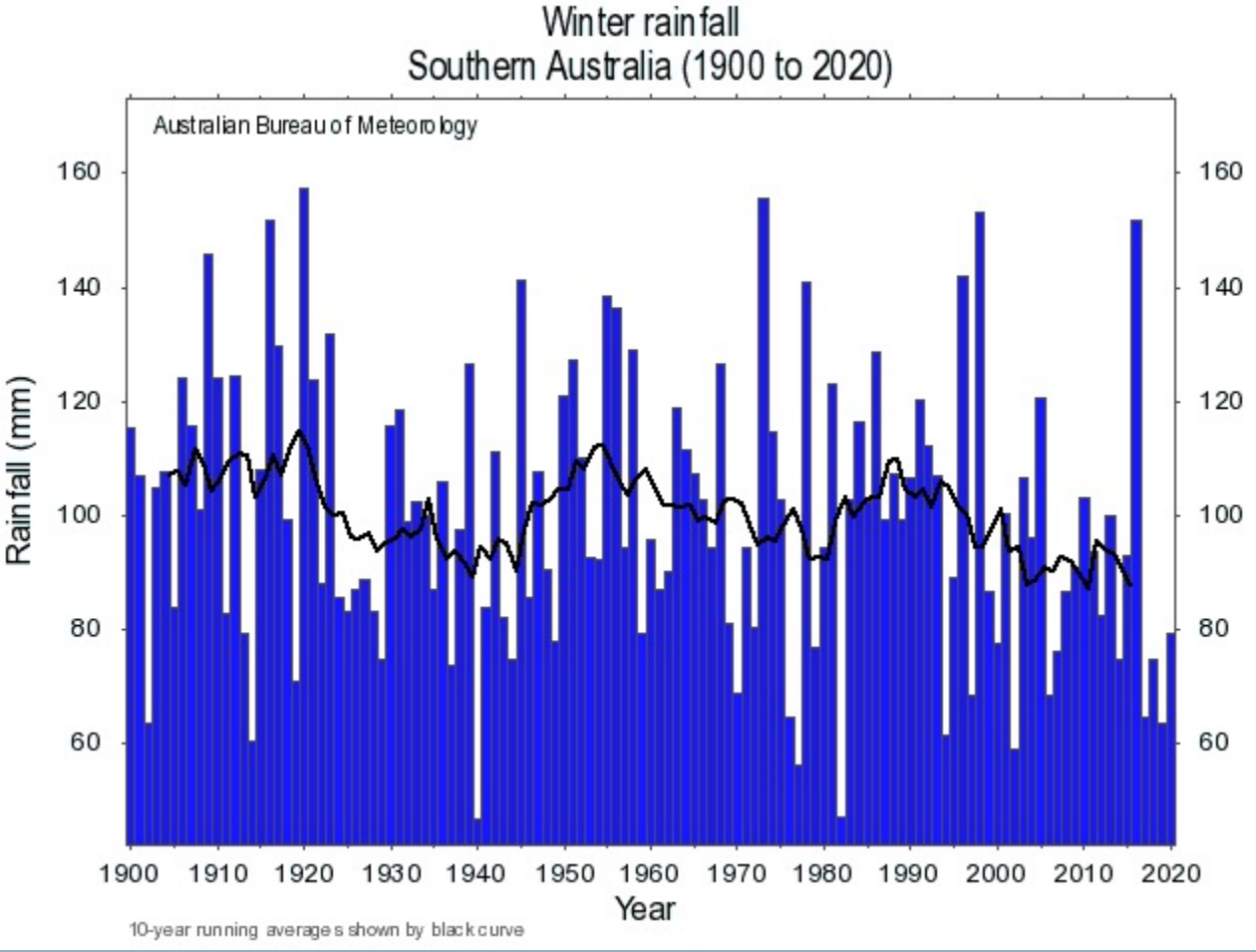
HADCRUT5; GISTEMP; NOAA; Berkeley Earth; BoM 2021

Extremes almost everywhere, all the time



BoM 2021

Less cool season rainfall

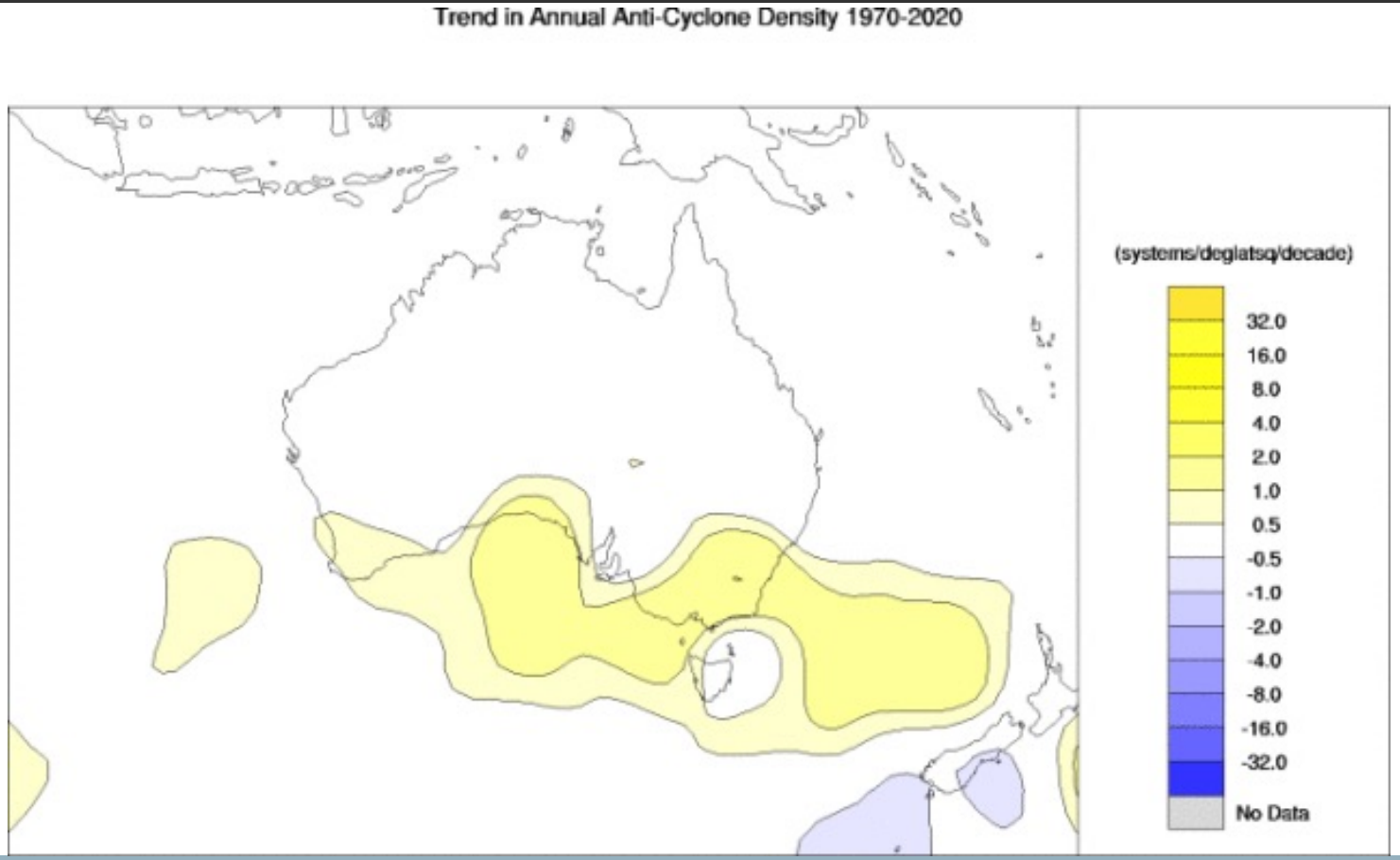


Drought

- The increase in temperature and reductions in rainfall have resulted in increasing drought in many regions globally – including SE and SW Australia

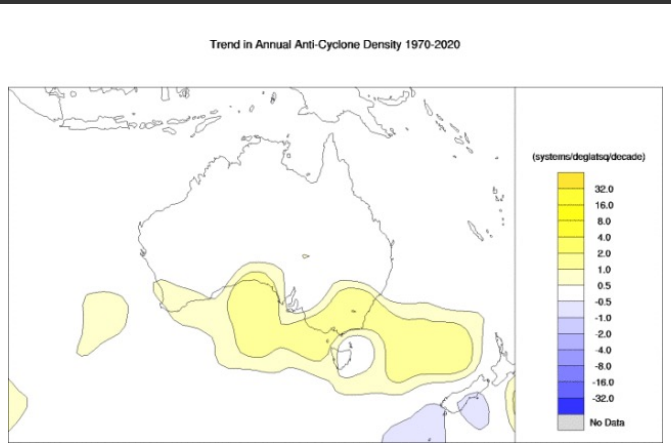
BoM 2021

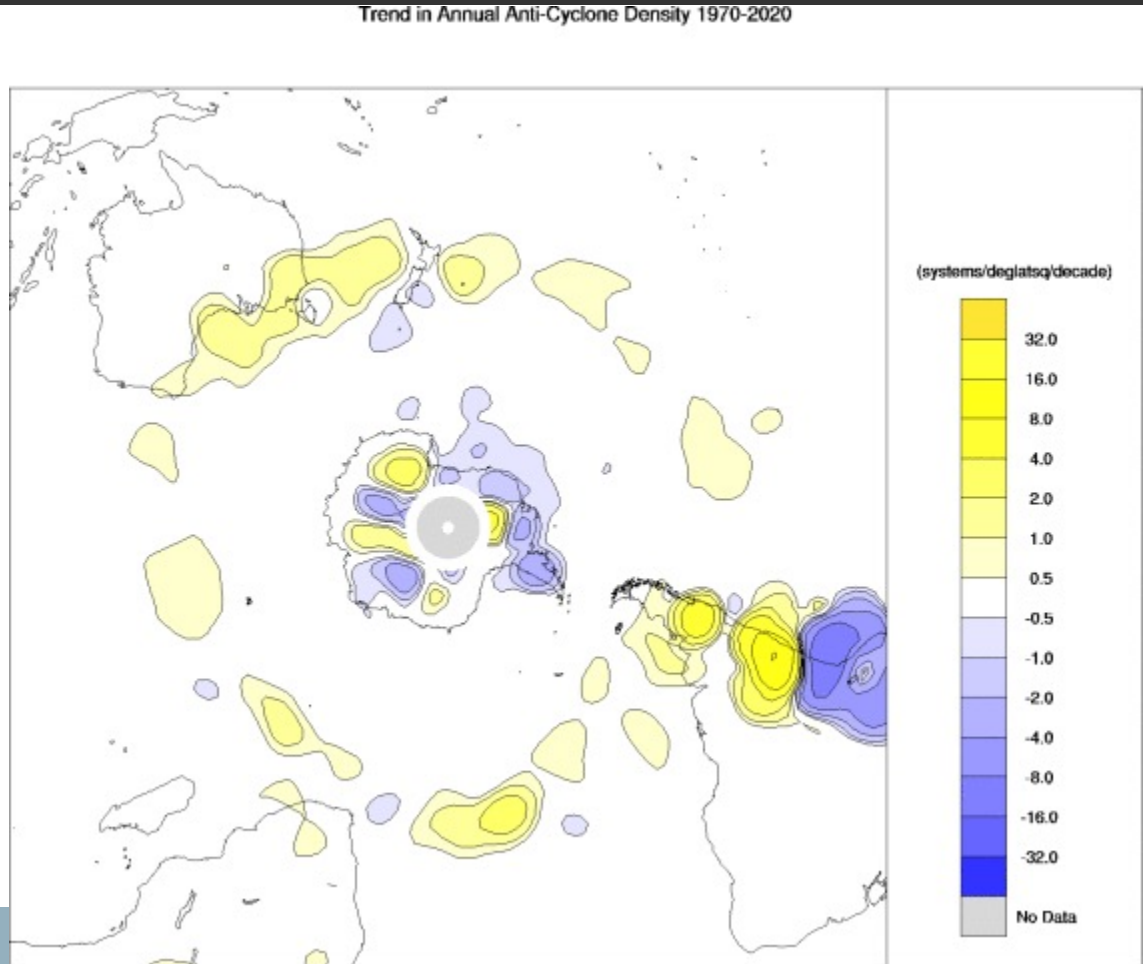
Change in pressure systems: Australia



BoM 2021

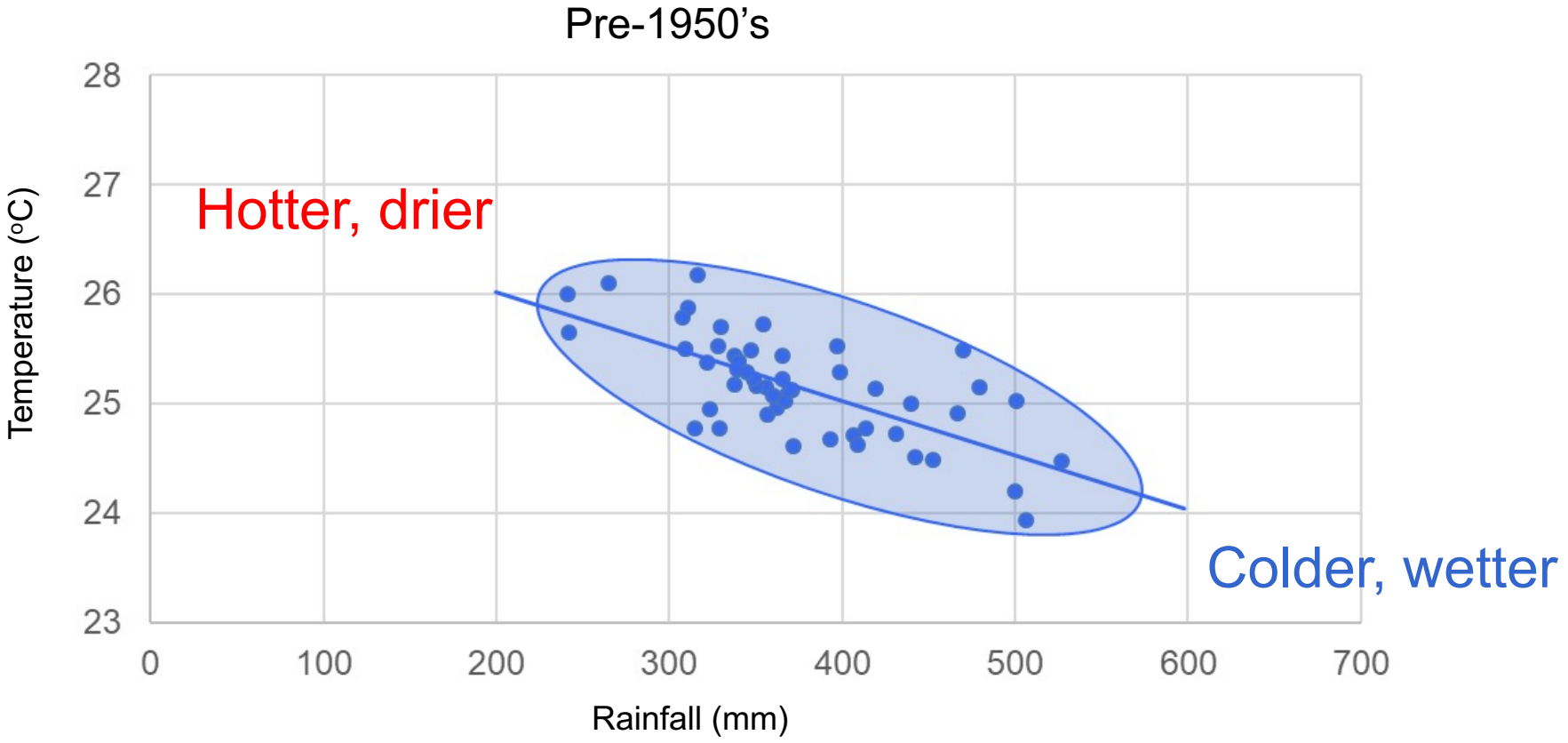
Change in pressure systems: Sthn Hemisphere





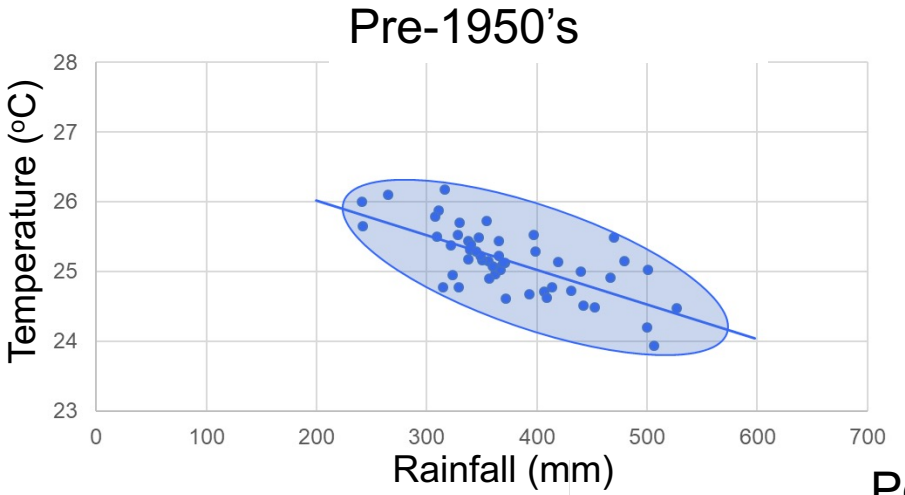
BoM 2021

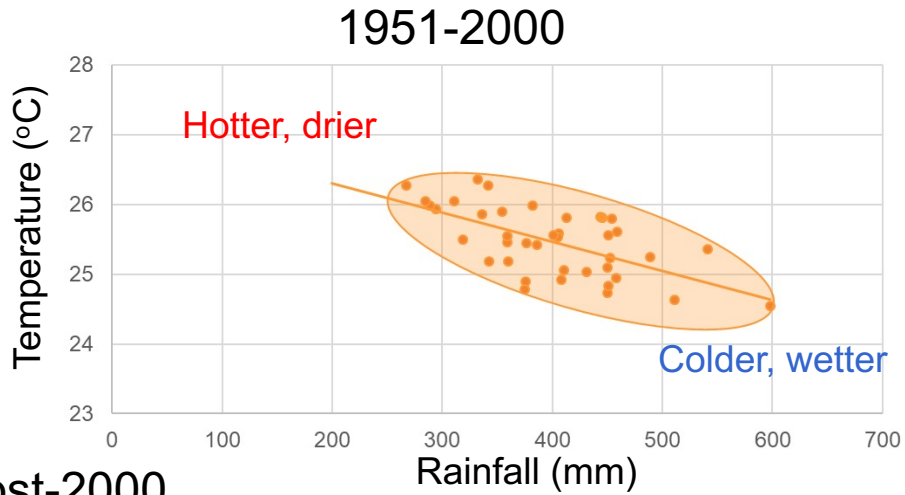
The rainfall-temperature operating envelope

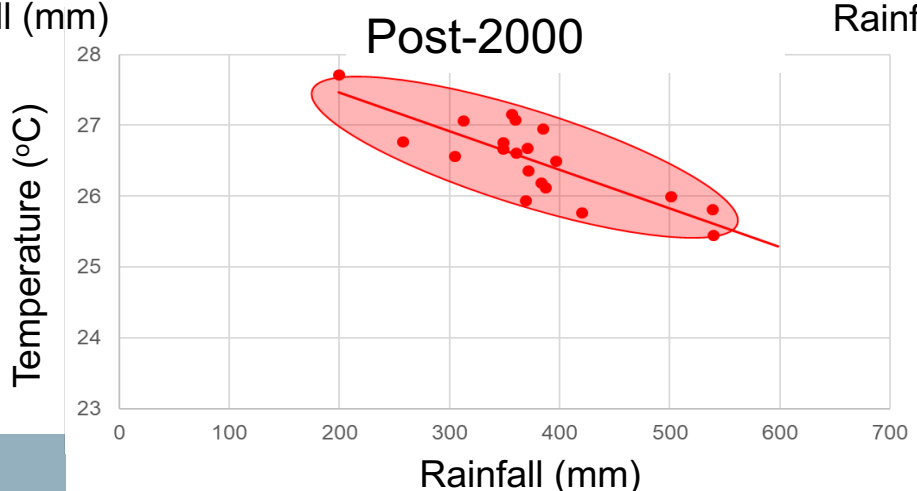


Analysis: Howden 2021. BoM data

Rainfall-temperature operating envelopes

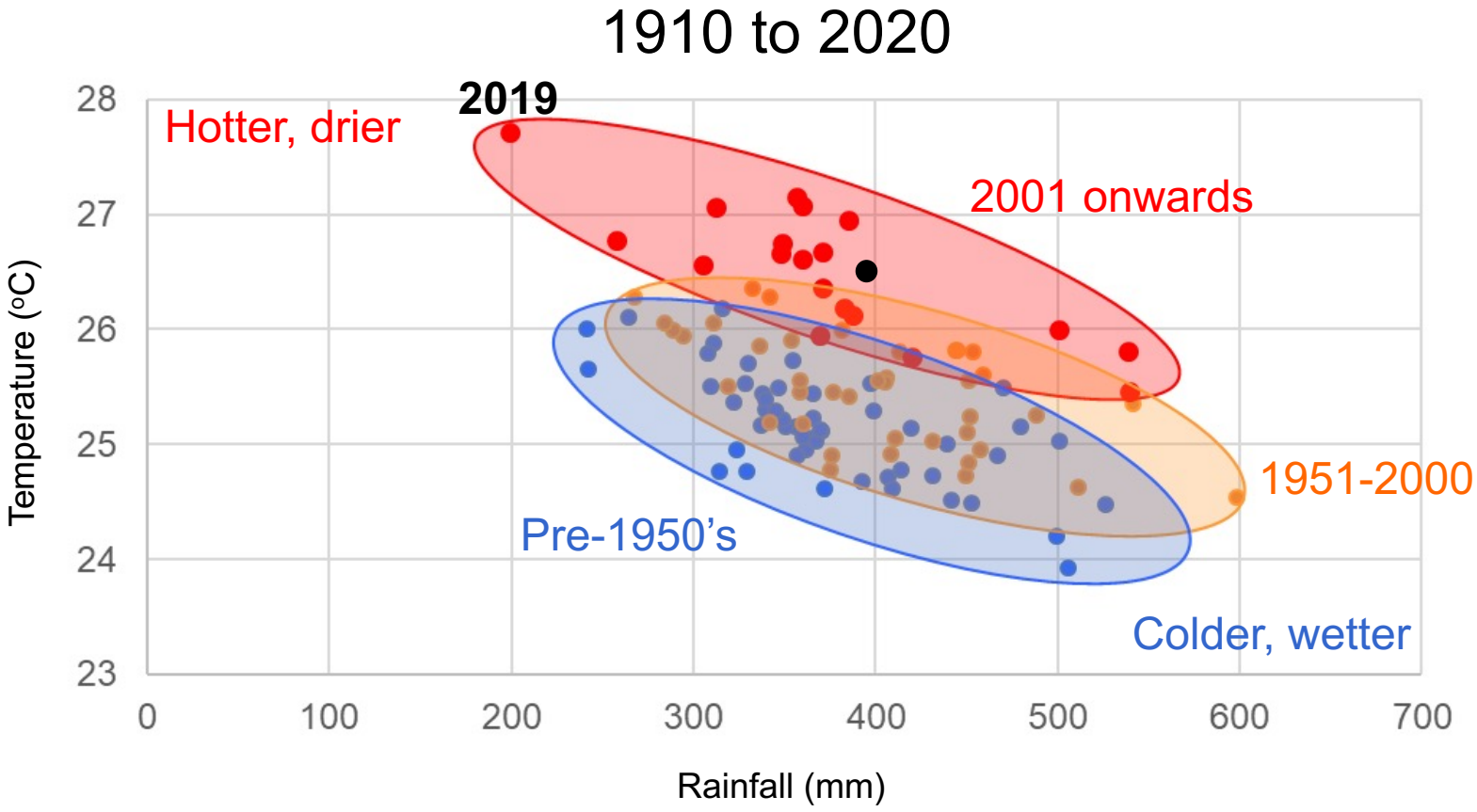






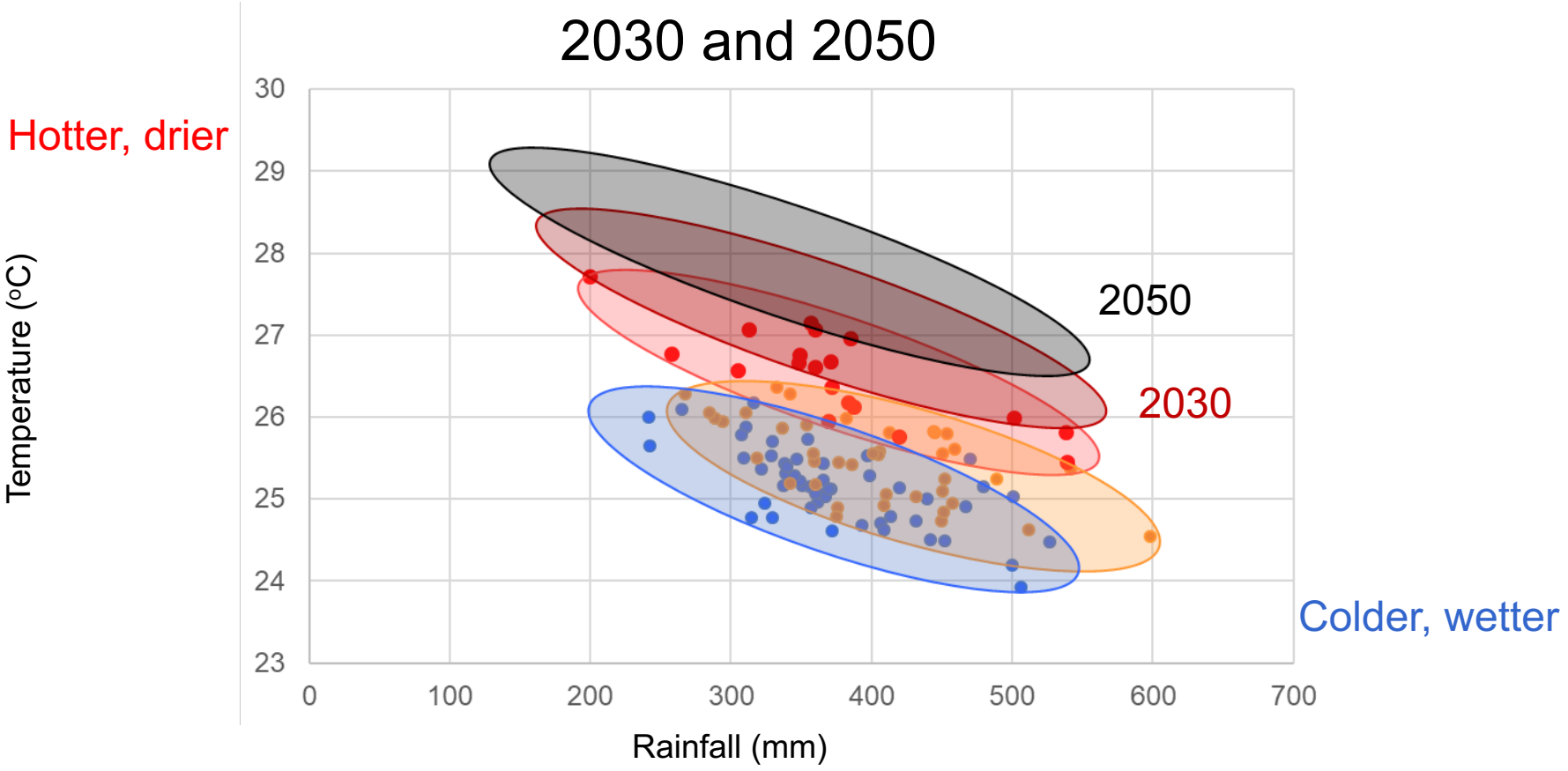
Howden 2021. BoM data

A changed operating environment



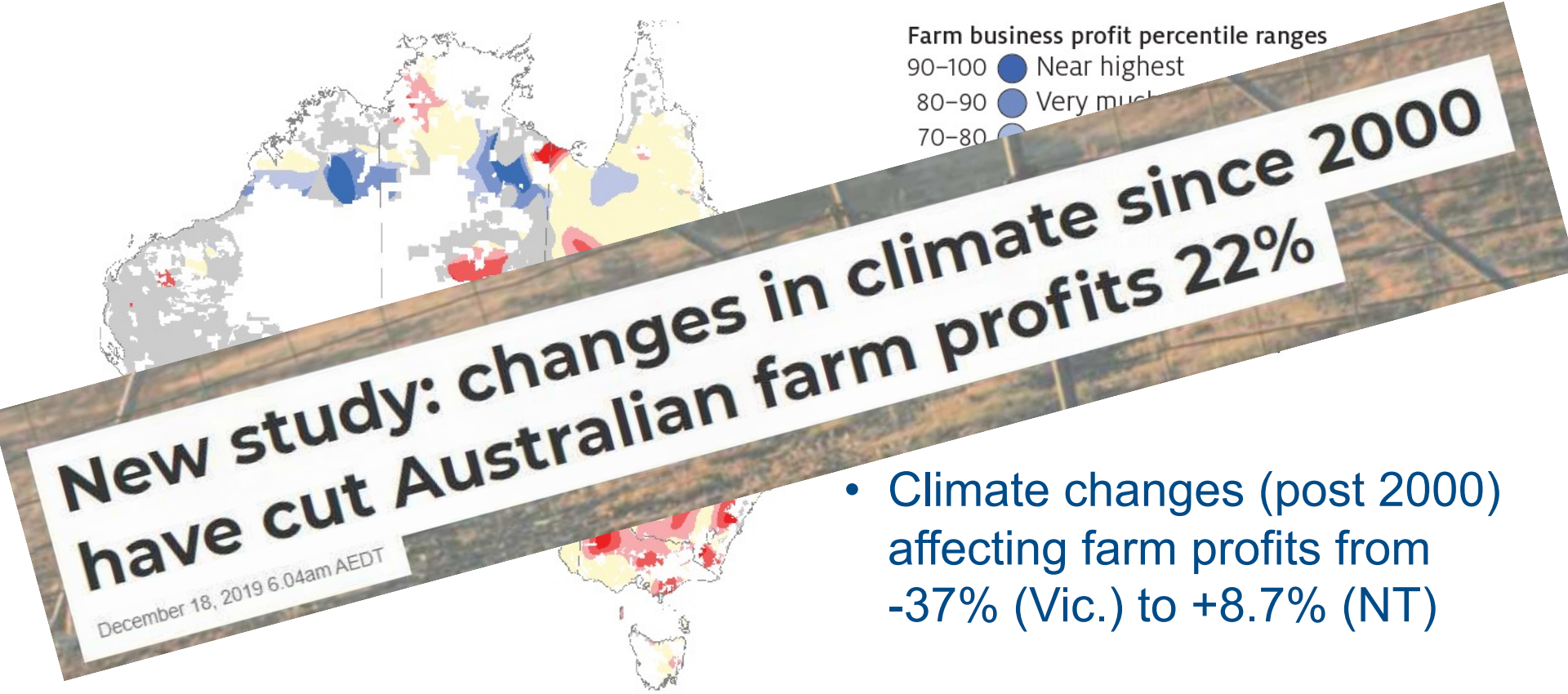
Analysis: Howden 2021. BoM data

Further changes in operating environments



Analysis: Howden 2021. BoM data; IPCC 2018

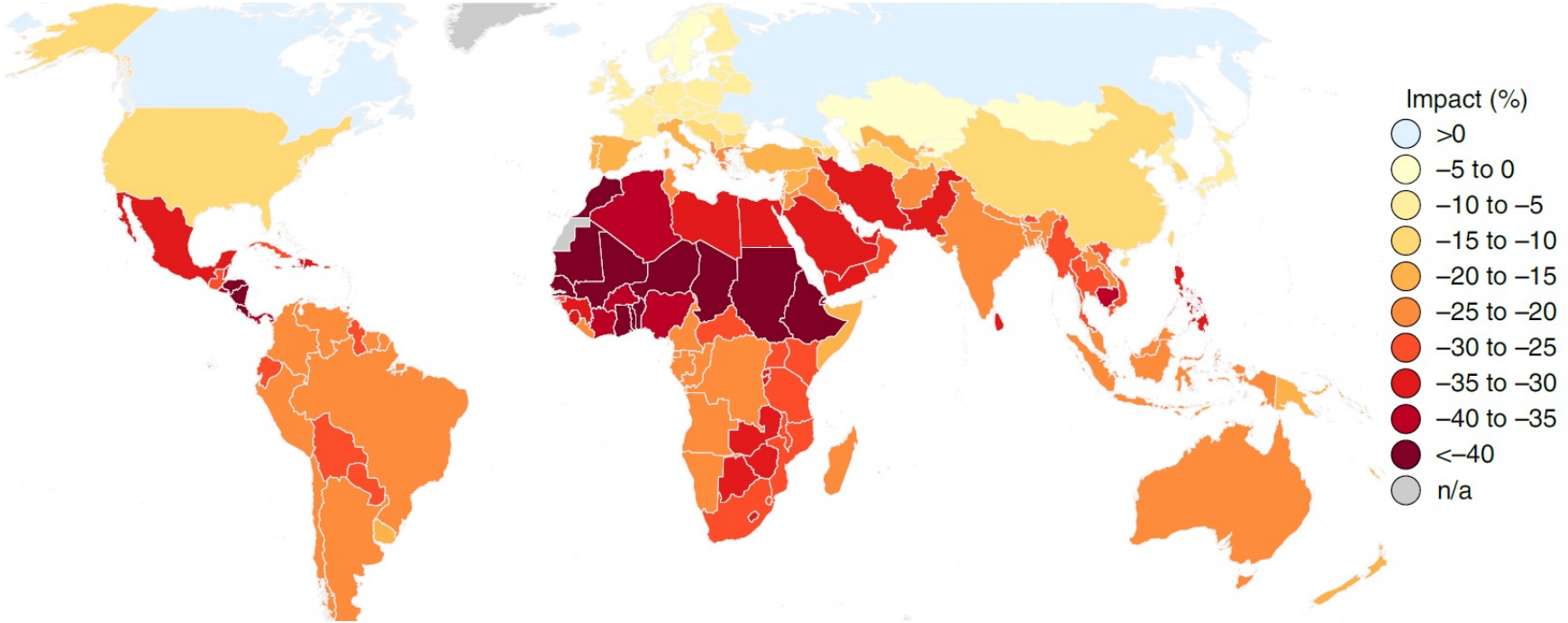
Climate changes dragging back farm profits



- Climate changes (post 2000) affecting farm profits from -37% (Vic.) to +8.7% (NT)

Hughes et al. 2020

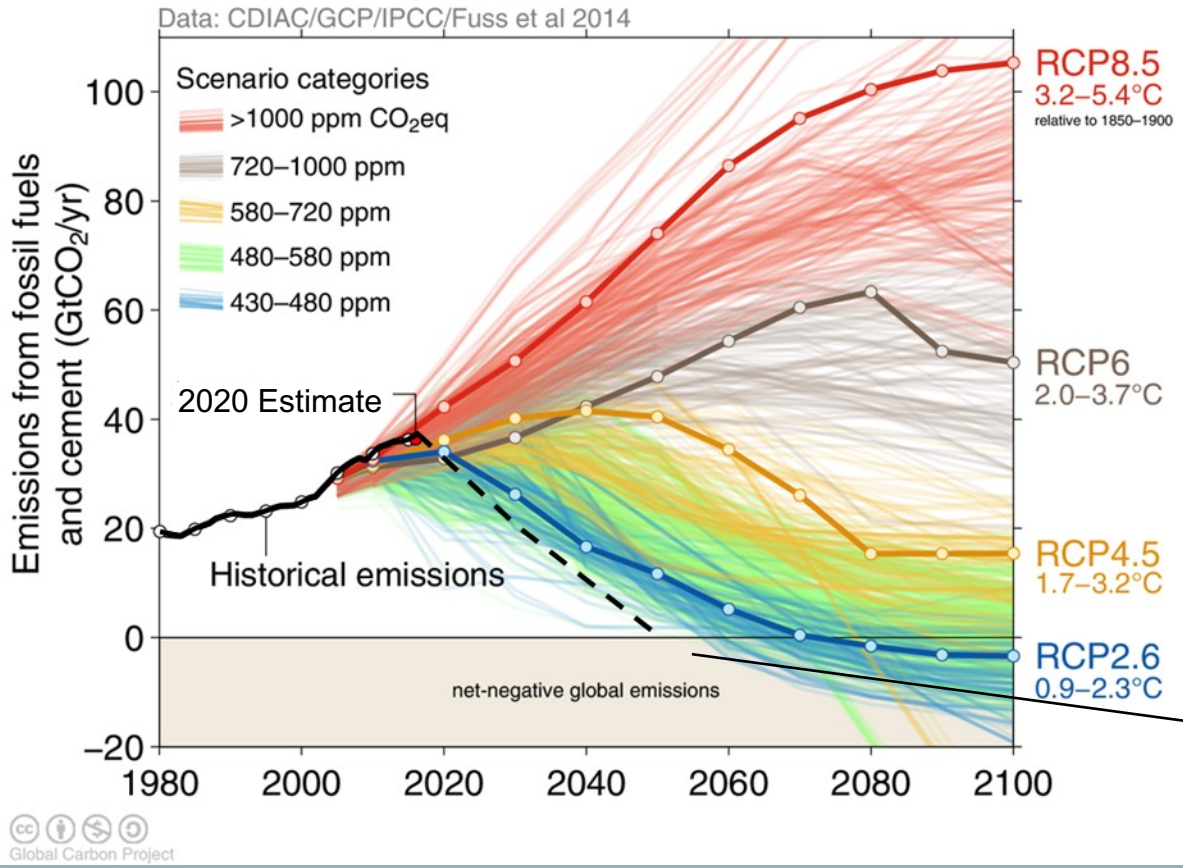
Climate changes drag back global ag productivity



- Global average agricultural productivity reduced by 21%

Ortiz-Bobea et al. 2021

Choices about our future



Current trajectory

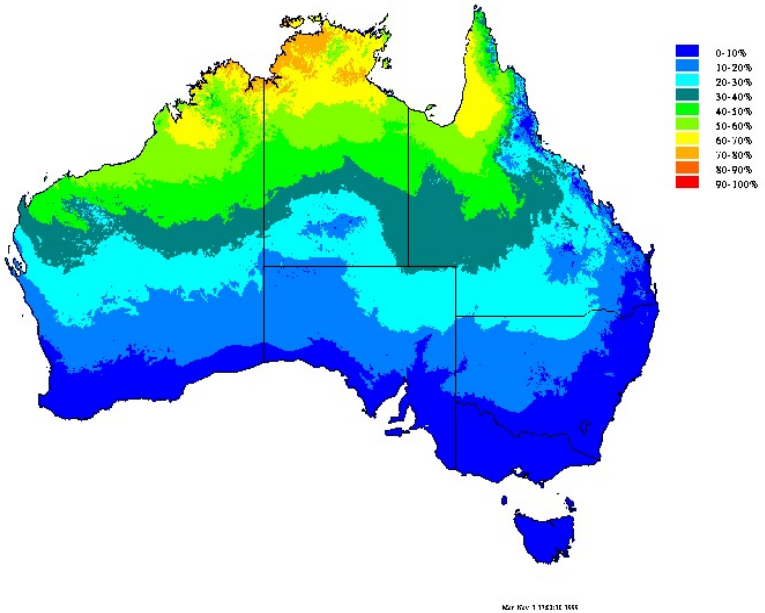
Paris Agreement commitments

2°C

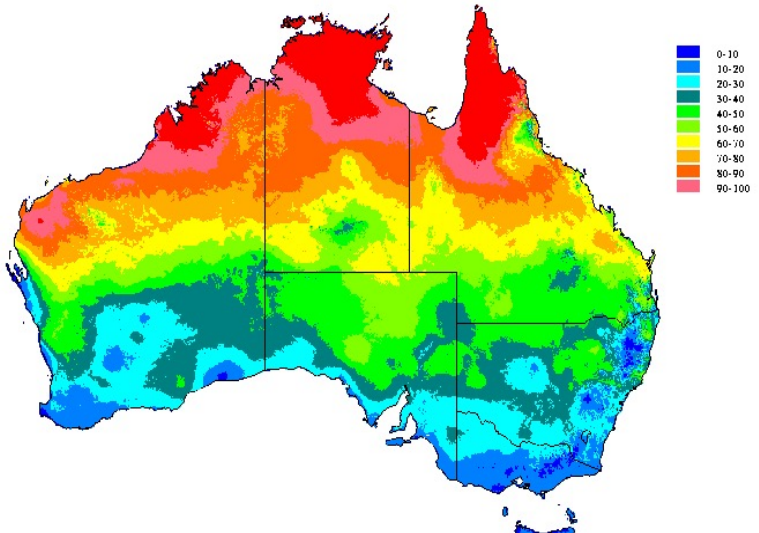
1.5°C

Changes in heat stress frequency

Historical heat stress

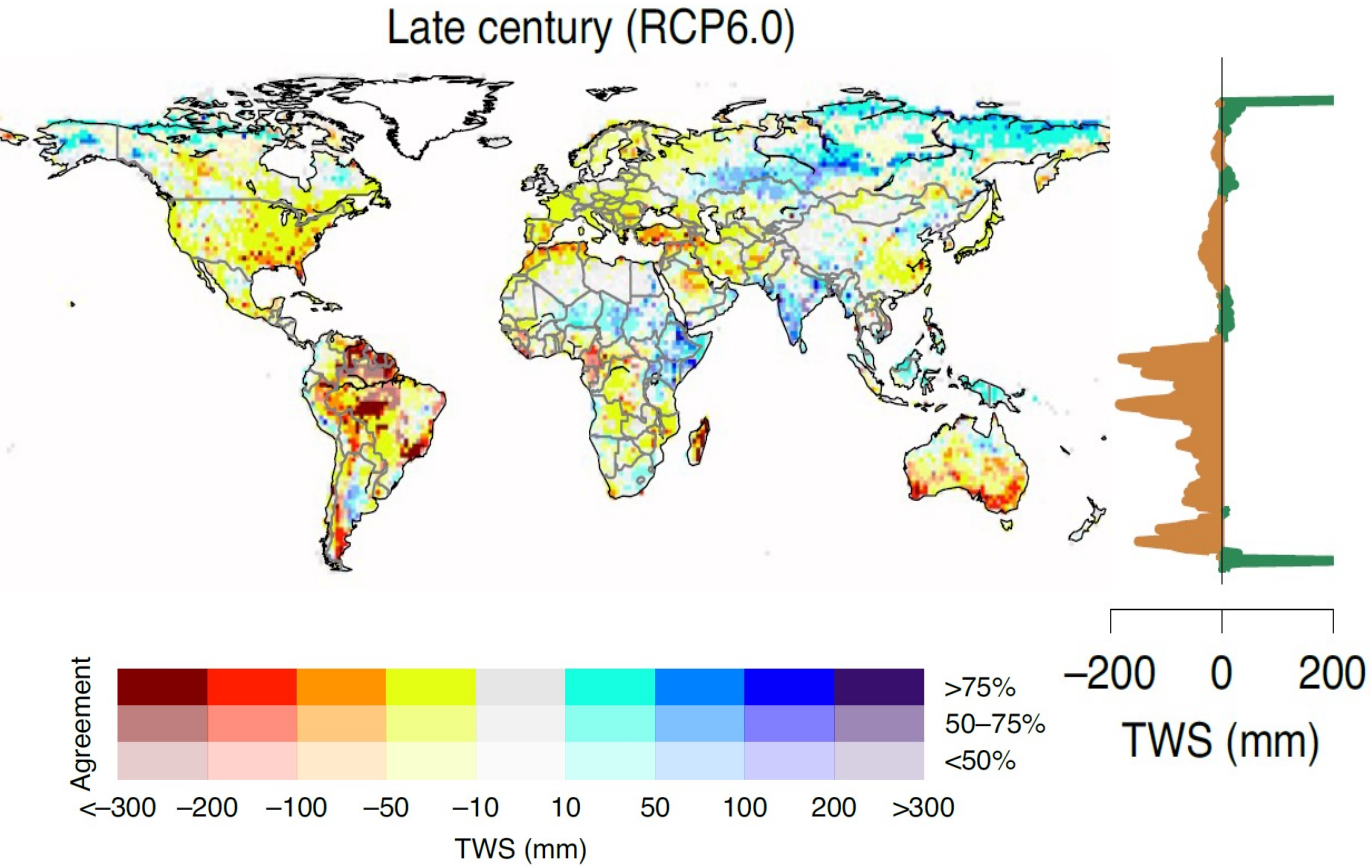


Heat stress 2.7°C warmer



Howden et al. 1999: BoM 2019

Climate reduces total water storage

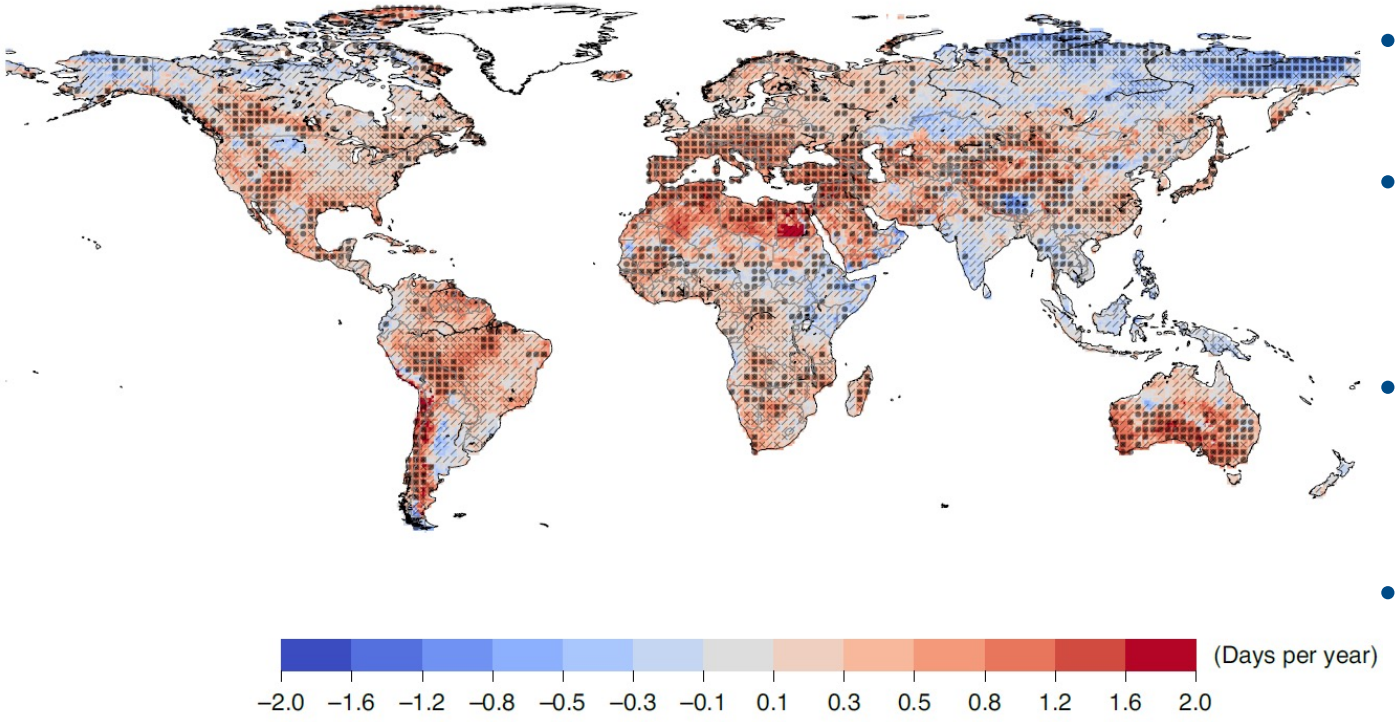


In this region:

- Proportionally more summer rain
- Higher rainfall intensity
- Increased season to season variability
- Increased vapour pressure deficit

Pokhrel et al. 2021

Drought becomes much worse: global



- Food prices likely to increase
- Food trade increase due to variability in supply
- Competitive advantage to those who adapt best
- Southwards ‘movement’ of Goyder’s Line

Pokhrel et al. 2021; Nidumolu et al. 2012

How do we adapt well ?

- Highly contextual - values
- Huge diversity of options
  - on farm and off farm, diversification
  - tactical and strategic
  - incremental to transformational
  - institutional, regional, value chain etc
- All involve costs, require some change in knowledge as well as action
- Always in anticipation of net benefits
- Empowers, reduces stress

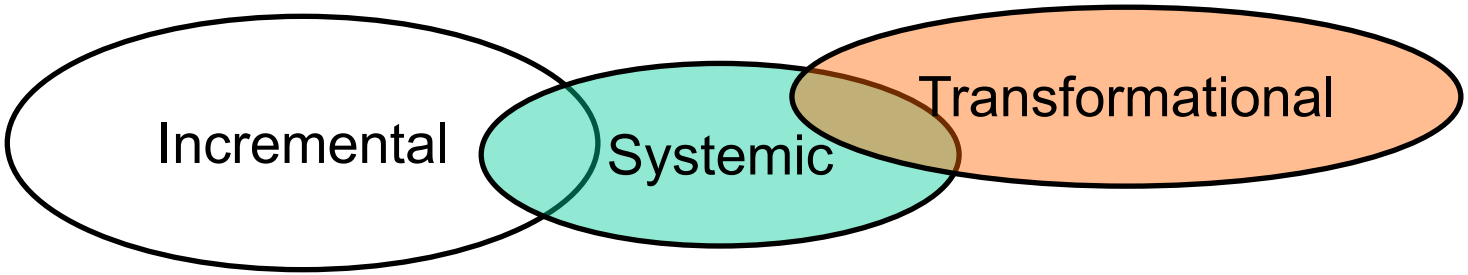
The climate adaptation journey: technical to strategic

2007	2009	2011	2012
• no cultivation, no-till and stubble retention • guidance systems • press wheels for water harvesting • inter-row sowing • opportunity cropping • less canola and pulses • hay • soil testing for N and water • sowing by the calendar not on moisture (dry sowing)	• containment areas for livestock • low P rates and N only just in time • postpone machinery purchases • no burning of stubbles • shorter season and heat tolerant varieties • variable sowing rate • improve sheep production	• canola only on soil moisture • bought and leased more light (sandy) country • concentrate on marketing (futures and foreign exchange rates) • decrease debt • off-farm income • reduce costs • improve harvest efficiency	• simplify all operations • larger paddocks – easier management • improve labour efficiency • improve financial management • requirement for more information and knowledge

Crimp and van Rees (2013)

Comprehensiveness: more than incremental

- Focus on existing systems only may result in maladaptation and in missed opportunities
- Need to consider more systemic and transformational adaptations
  - increasingly so as changes continue
- Barriers: social, institutional, psychological



Howden et al. 2010; Park et al. 2012; Rickards and Howden 2012

Strategy for a changing climate ?

- *'The game you want to play (or not play) and how you think you can win'*

- Old climate or new ?
- Valuing your assets
- Farming for commodities and/or energy and/or carbon and/or water and/or biodiversity ?

One transformational strategy

Solar farming is ‘better money, safer money, easier money than farming’ given climate changes.

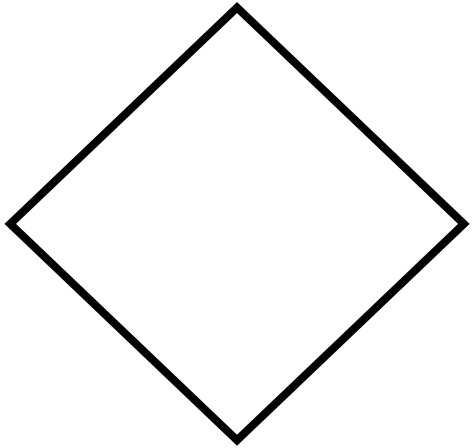
Peter Mailler

- Climate adaptation ideally integrated with net GHG emission reduction

Thinking about future climates

Modelling the future

Remembering the future



Visiting the future

Preparing for the future

Hayman and Nidumolu 2016

Thinking and acting in relation to future climate

Strategy	Method or Action
Remembering the future	Temporal analogues e.g. learn from past droughts
Visiting the future	Spatial analogues e.g. learn from warmer & drier sites
Modelling the future	Climate trend analysis, climate projections from GCMS, systems analyses
Preparing for the future	Develop adaptation technologies and management, adaptive capacity and adoption systems

Hayman and Nidumolu 2016

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Thankyou

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