“The value of climate forecasting in assisting the agricultural community's ability to cope with climate variability and climate change - with reference to the Australian experience”

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Outline of presentation:

•"The value of climate forecasting in assisting the agricultural community's ability to cope with climate variability and climate change with reference to the Australian experience"

•High climate variability in Australia is linked to strong climate forecasting capability.

•However, there is a need to link climate forecasting to decision-making and management in agriculture.

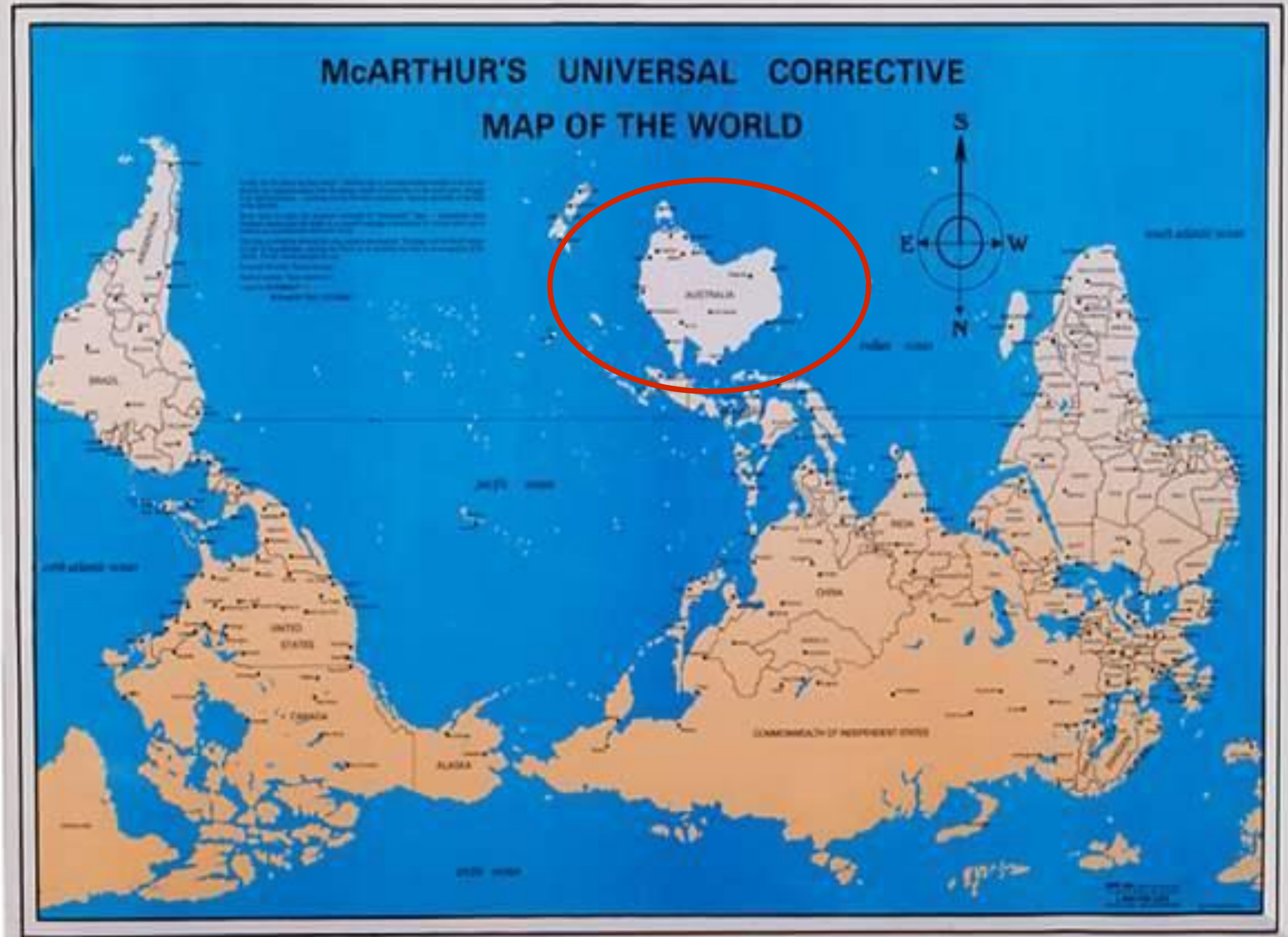
•Applying climate forecast systems–the issue of the application of more general outputs vs more targeted outputs - the optimal combination seems to be a combination of the two for the best results.

•The value of simulation modelling to aid in the provision of scenarios in more targeted climate forecast systems.

•The value of integrated systems –the need to understand value chains in agricultural production.

•Participative approaches and interdisciplinary approaches are valuable.

• A systematic approach to applying seasonal climate forecasting.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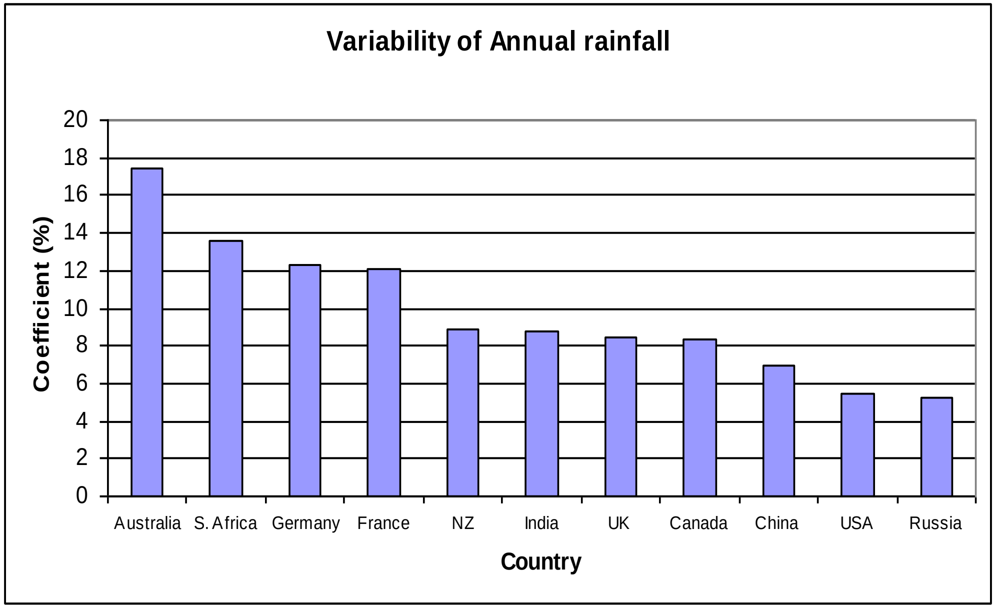
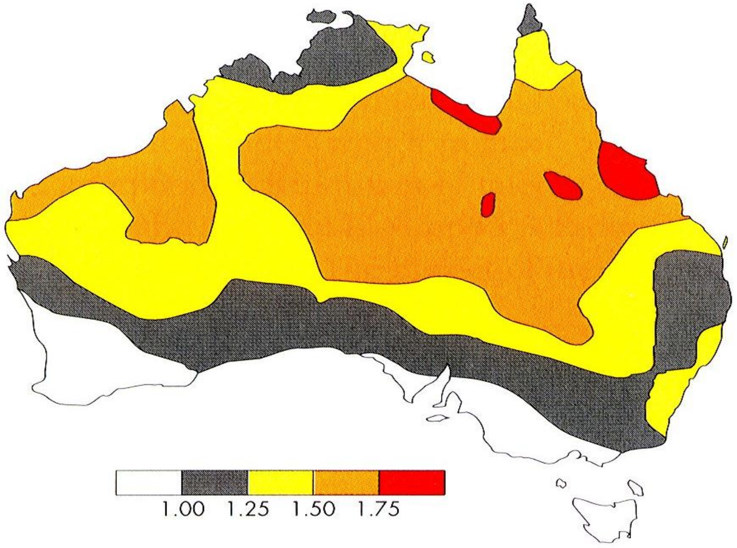
Australia has extremely high year to year rainfall variability (Love, 2005)

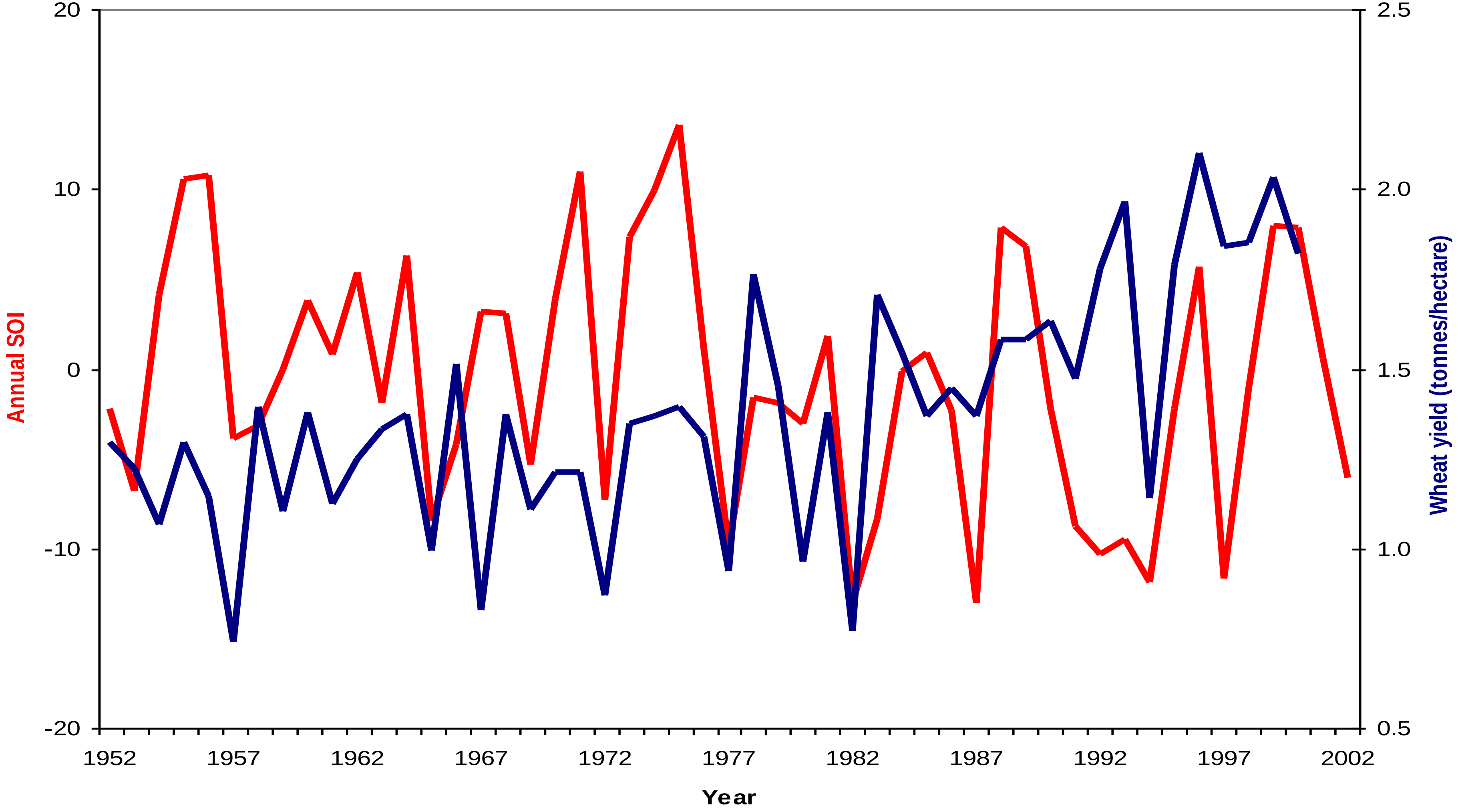


Together with the importance of regional variability within Australia (Nicholls et al, 1999)

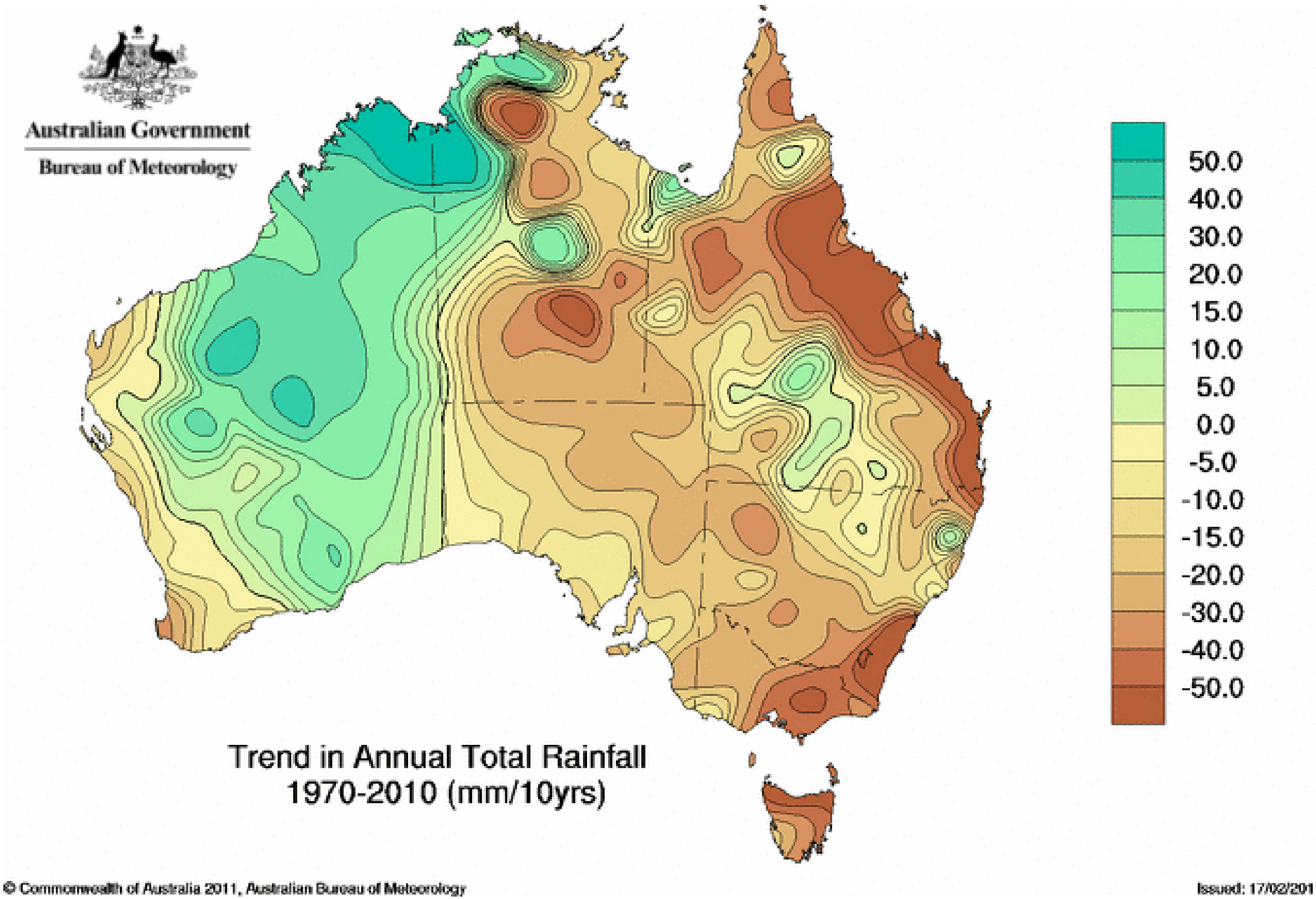


Source: Nicholls, Drosdowsky and Lavery, Bureau of Meteorology Research Centre, from a paper 'Australian rainfall variability and change', yet to be published.

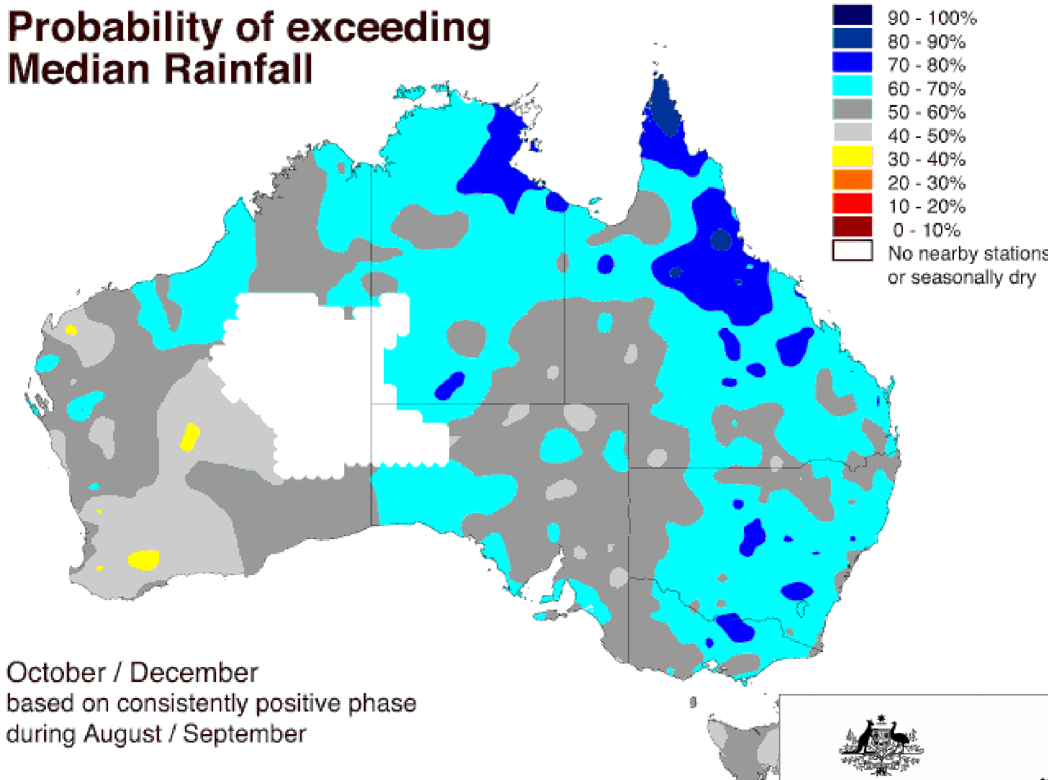
High rainfall variability links to high wheat yield variability



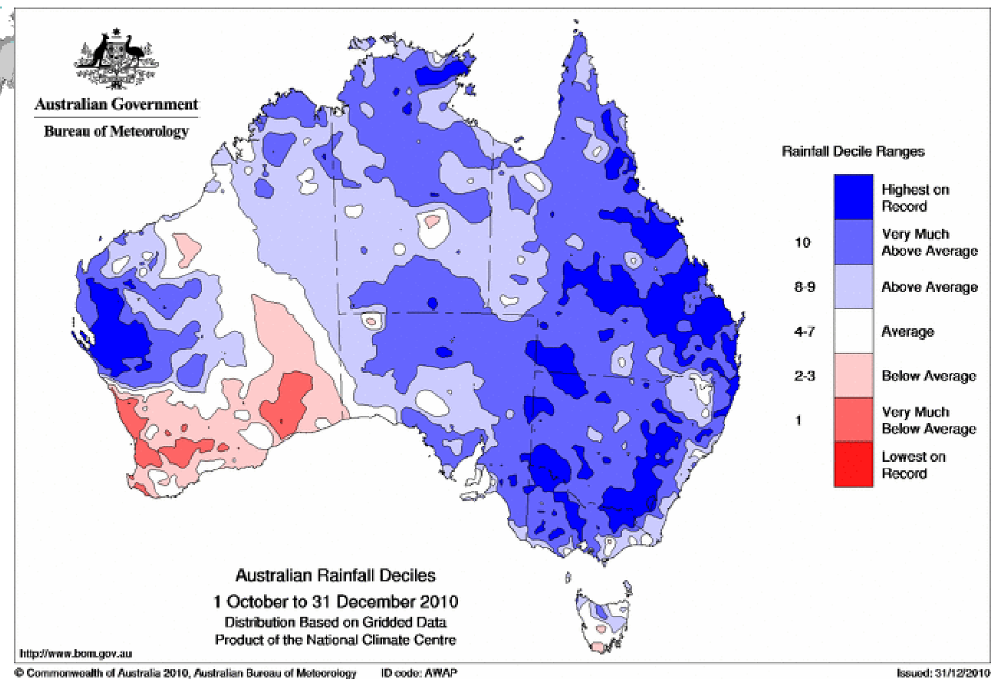
Ability to cope with climate variability and climate change: the relationship between annual variation in the SOI and annual Australian wheat yield (N Nicholls). *However, to cope there is need to modify actions <u>ahead</u> of likely impacts.



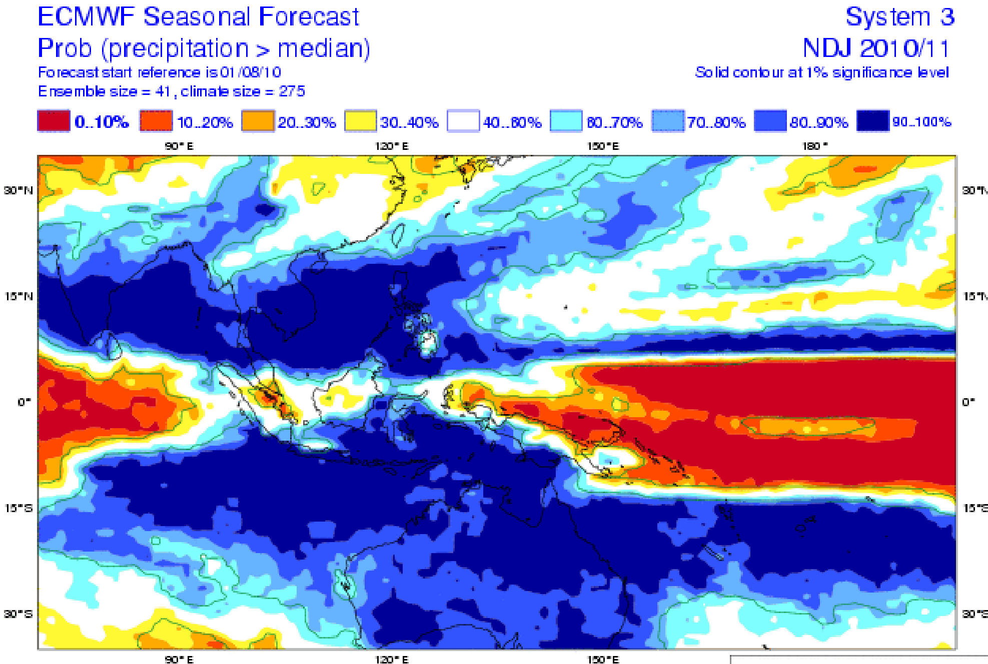
Rainfall variability is coupled with longer-term trend in rainfall.



Climate forecast capability - Probabilistic climate forecast output for Oct-Dec, 2010

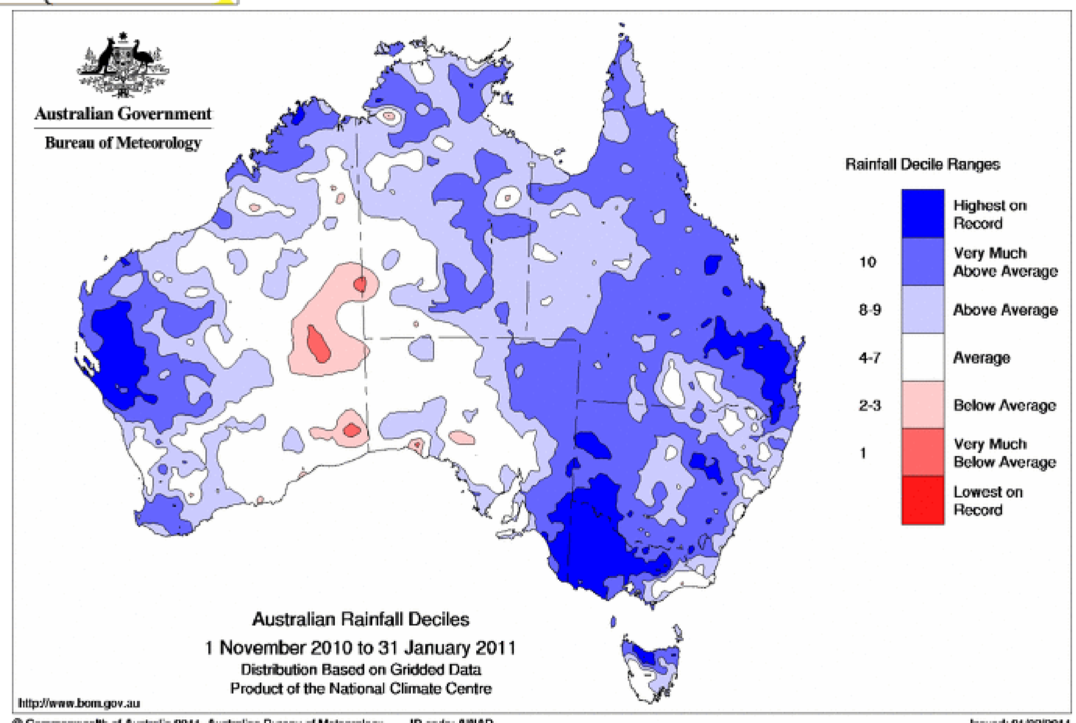


Actual rainfall - decile range



Forecast issue date: 15/08/2010

Are accurate and reliable climate forecasts enough to link to farm management decisions (Nov-Jan, 2010)?

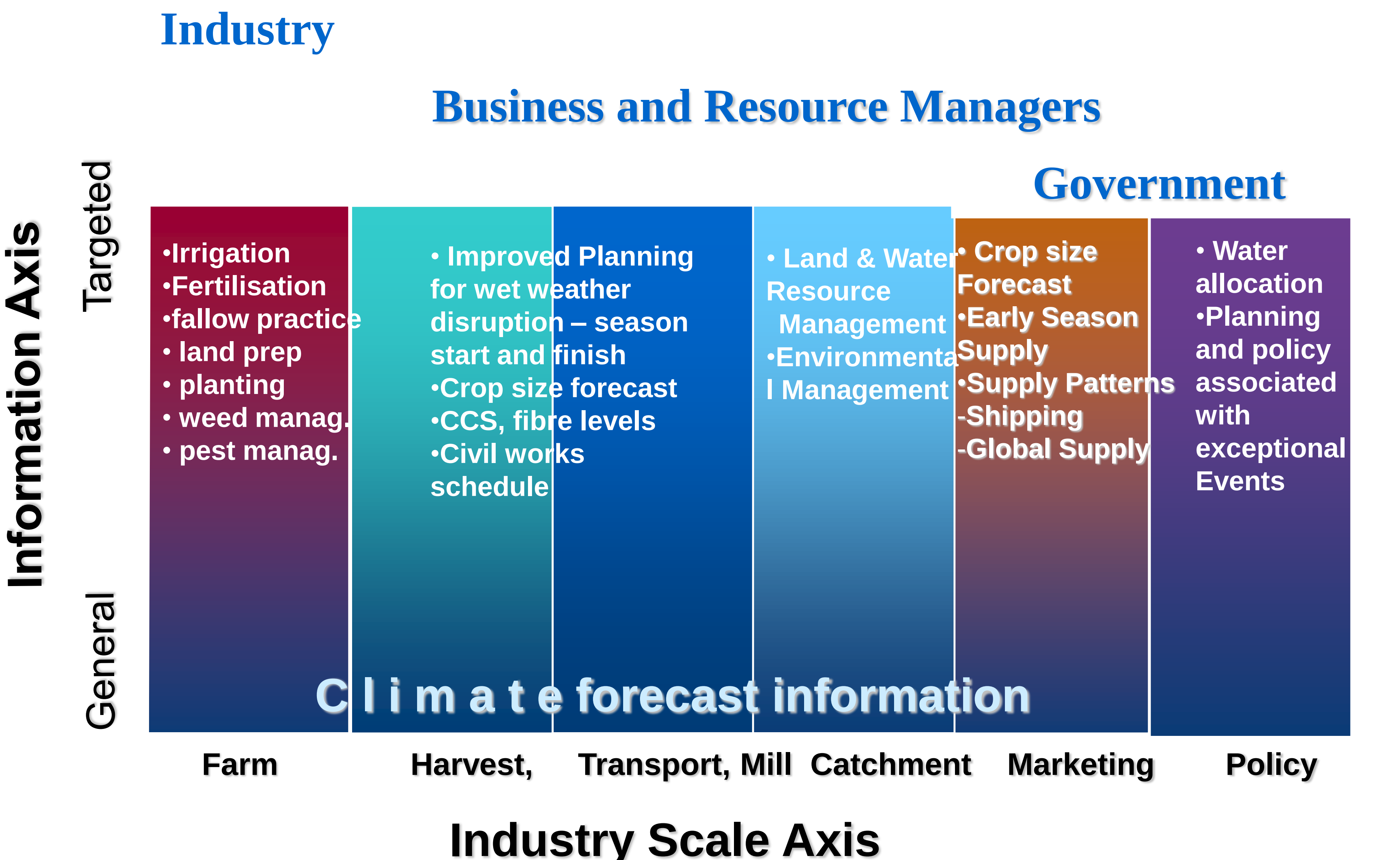


However, ‘climate forecasting may have no value unless it changes a management decision’ – in other words, how do we link climate forecasting to real management decisions?

How much Nitrogen to apply given current low soil moisture levels and low probability of sufficient in-crop rainfall?

Which variety to plant given low rainfall probability values and high risk of damaging frost and anthesis?

The complexity of linking with a huge range of management decisions - application for the sugar industry – issues of scale – strong need for more targeted outputs.



To assist coping strategies - the need to consider the whole value chain in agricultural production

Climate related issues across the whole value chain

The Cane Plant → Sugarcane Production → Harvest & Transport → Raw Sugar Milling → Marketing & Shipping

The Cane Plant / Sugarcane Production:
- Best use of scarce/costly water resources
- Better decisions on farm operations

Harvest & Transport:
- Improved planning for wet weather disruption
- Best cane supply arrangements
  - crush start and finish times

Raw Sugar Milling:
- Better scheduling of mill operations
  - crop estimates
  - early season cane supply

Marketing & Shipping:
- Better marketing decisions based on likely sugar quality
- More effective forward selling based on likely crop size
- Improved efficiency of sugar shipments based on supply pattern during harvest season

Everingham *et al*, 2002

Need to address agricultural management decisions and climate systems at many scales

(Meinke and Stone, 2005)

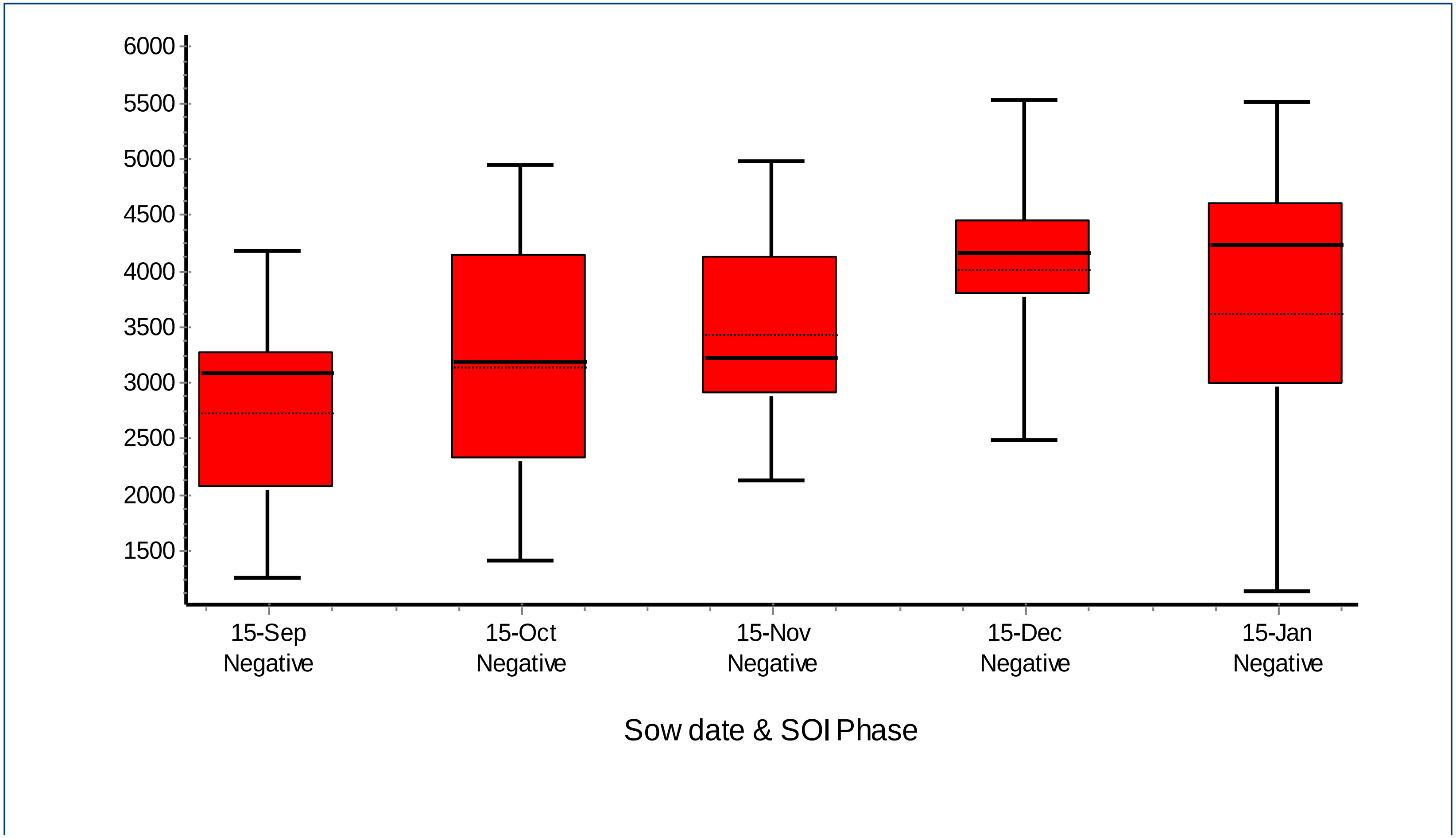
Decision type	Frequency (year)
Logistics (eg. scheduling of planting / harvest operations)	Intraseasonal (>0.2)
Tactical crop management (eg. fertiliser/pesticide use)	Intraseasonal (0.2-0.5)
Crop type (eg. wheat or chickpeas)	Seasonal (0.5-1.0)
Crop sequence (eg. long or short fallows)	Interannual (0.5-2.0)
Crop rotation (eg. winter or summer crop)	Annual/biennial (1-2)
Crop industry (eg. grain or cotton, phase farming)	Decadal (~10)
Agricultural industry (eg. crop or pasture)	Interdecadal (10-20)
Landuse (eg. Agriculture or natural system)	Multidecadal (20+)
Landuse and adaptation of current systems	Climate Change

To assist - the linking role of modelling in the application of climate forecast information for agricultural production –

- **Simulates management scenarios using analogue years**
- **Evaluate outcomes/risks relevant to decisions**

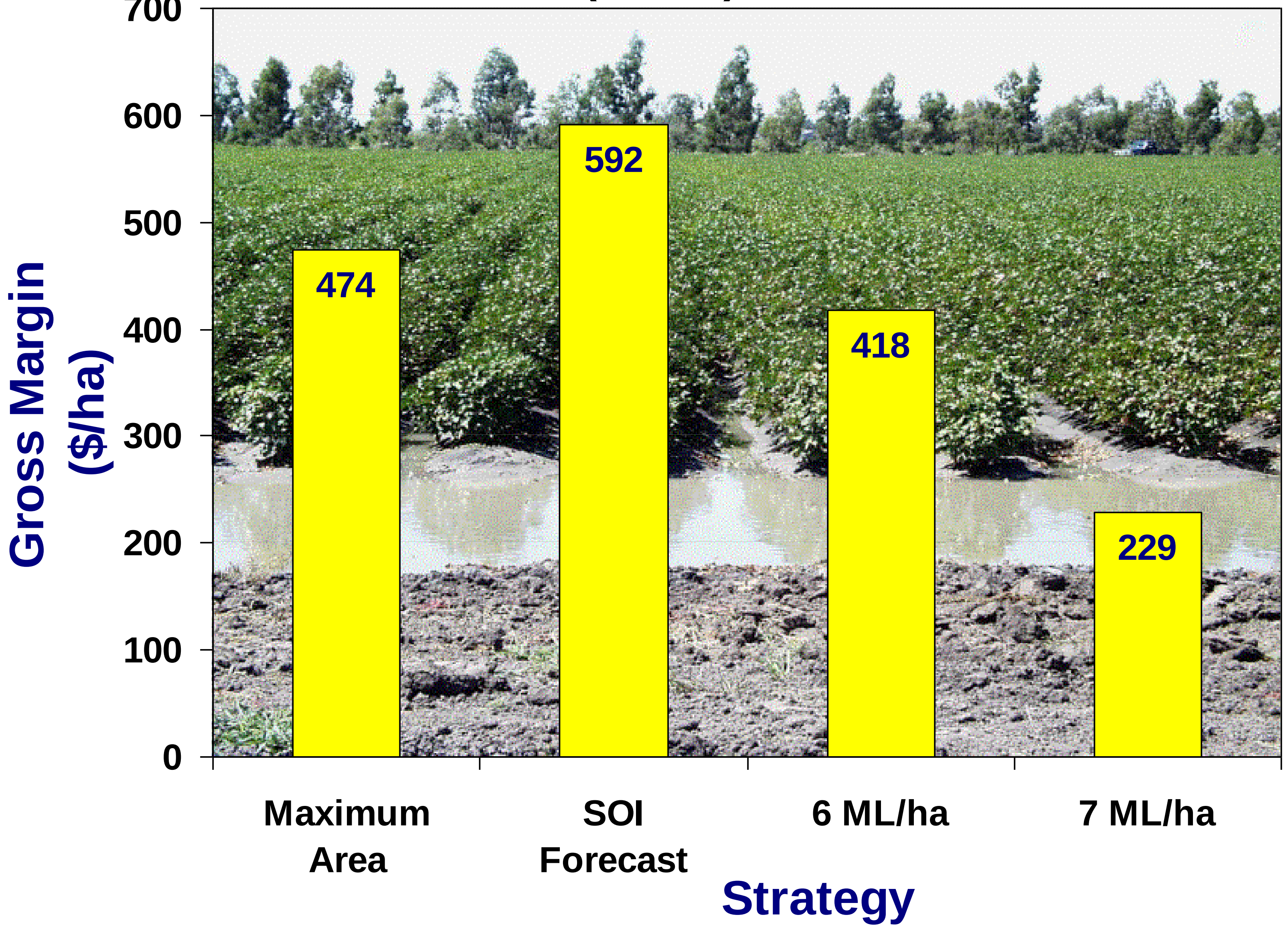
- **Agricultural Production Systems Simulator (APSIM) simulates**

- **yield of crops and pastures**
- **key soil processes (water, N, carbon)**
- **surface residue dynamics & erosion**
- **range of management options**
- **crop rotations + fallowing**
- **short or long term effects**



Using climate forecasts to assist coping and decision making - “When to sow my sorghum crop”? Effect of sowing date on sorghum yield range at in Southern QLD with a ‘consistently negative’ SOI phase for September/October (50mm PAWC, 2/3 full at sowing, 6pl/m2, medium maturity. (WhopperCropper)

Te value of seasonal climate forecasting in irrigated cotton – decision points refer to amount of irrigation – max possible area, adjusted according to climate forecast, fixed strategies such as 6ML/ha or 7ML/ha (Abawi)



Enhancing coping strategies - develop useful decision-support systems that link climate forecast information, agricultural models and user decisions …however, this needs to be done as part of discussion groups

Estimate:

- **future stocking rates**
- **pasture budgeting**
- **total grazing pressure**

- **Assist in drought preparation**

Use of participatory approaches to achieve coping strategies - use of new technologies (incl eLearning)…

The value of a participatory approach with users – a ‘discussion-support’ system

A useful formulae? - A systematic approach in applying climate forecasts/projections to decision-making to assist coping strategies (after Hammer, 2000).

- **<u>Understand the system and its management</u>: it is essential to understand the farming system's dynamics and the opportunities for management intervention i.e. identify those *key decisions* that could influence performance;**
- **<u>Understand the impact of climate variability/climate change</u>: it is important to understand *where* in the system climate is an issue;**
- **<u>Determine the *opportunities* for tactical/strategic management in response to the forecasts and projections</u>. If forecasts/projections are now available, what possible *options* are there at relevant decision-points? How might decisions be changed in response to forecasts? What nature of forecast would be most useful? and What lead-time is required for management responses?**
- **<u>Evaluate the worth of tactical or strategic decision options</u>: the quantification and clear communication of the likely *outcomes* e.g. economic or environmental, and associated risks of a changing a management practice are key to achieving adoption of the technology.**

- **(To assist coping strategies) implement participative implementation and evaluation: working with managers/decision makers generates valuable insights and learning throughout the entire process: i.e. identifying relevant questions/problems and devising suitable technologies and tools.**

- **Provide feedback to the climate forecasting/ research provider: rather than just accepting a given climate forecast output, consider what specific improvements would be of greatest value in the system. This can provide some direction for the style of delivery of forecasts and for climate research of value to agricultural sector (Hammer, 2000; Hammer *et al*., 2001; Stone and Meinke, 2007).**

Conclusions:

•Climate forecasting has enormous potential in assisting agricultural managers cope with climate variability (and climate change).

•However, there is a core requirement to fully understand aspects associated with system management in the targeted sector (eg sugar, grazing, horticulture, mixed grain/cropping).

•A core requirement is to identify those ‘decision-points’ within the agricultural production regime that may be amenable to the benefits of climate forecasting.

•The climate forecast system then needs to be integrated with other interdisciplinary systems models if available - relevant scenarios are then produced and from which farming decisions are then better able to be made.

•Ensure a fully participative approach is made with the farm/agricultural sector.

•Obtain feedback from the farm sector, on the value or utility of the climate forecast system in use, feedback needs to be provided back to the climate research institute and suggestions made for more tailored outputs or other changes as may be possible.


Thank you
CANADA
NORTH
UNITED STATES
AMERICA
MEXICO
Tropic of Cancer
MARSHALL
ISLANDS
KIRIBATI
equator
International Date Line
PACIFIC OCEAN
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ISLANDS
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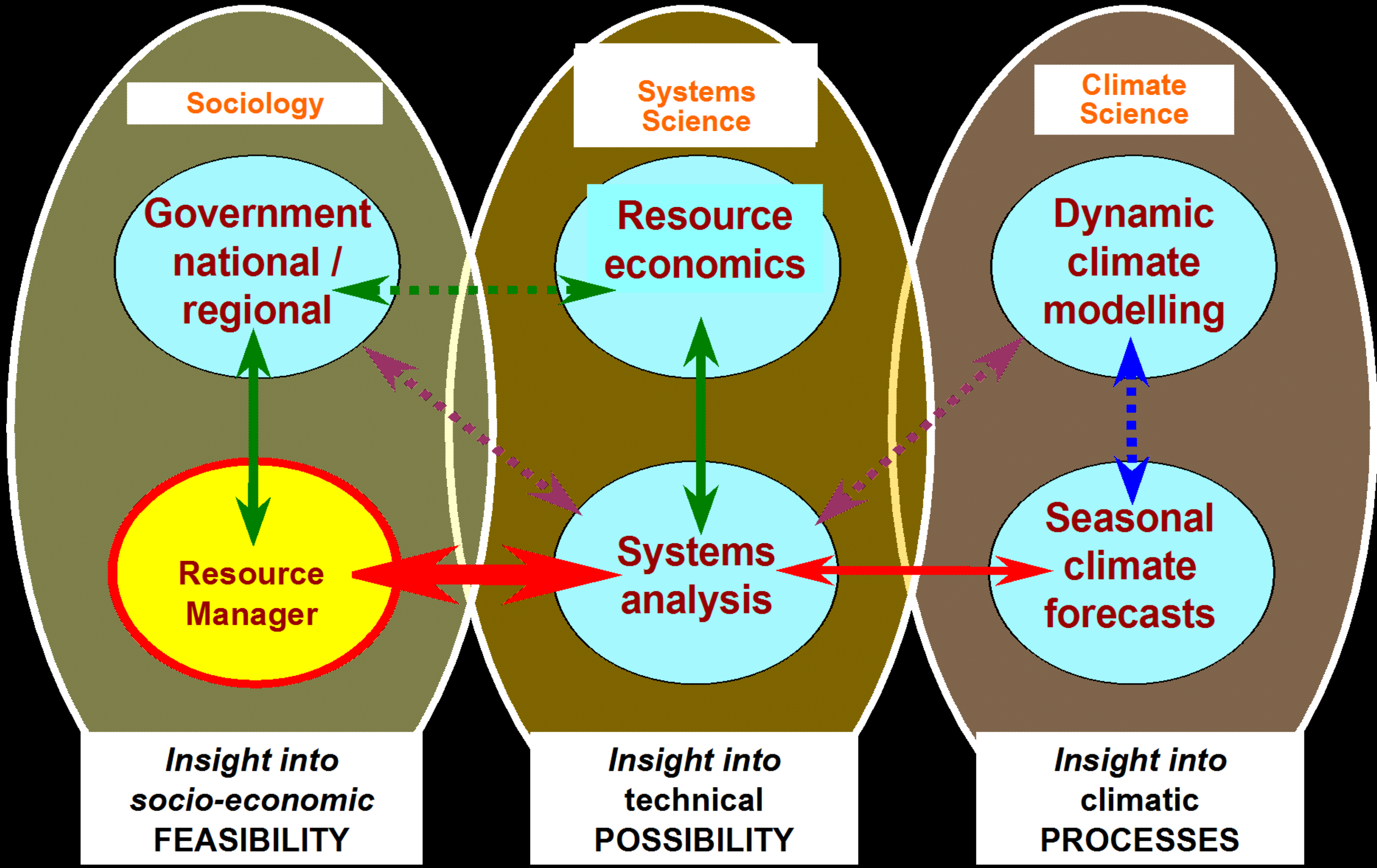
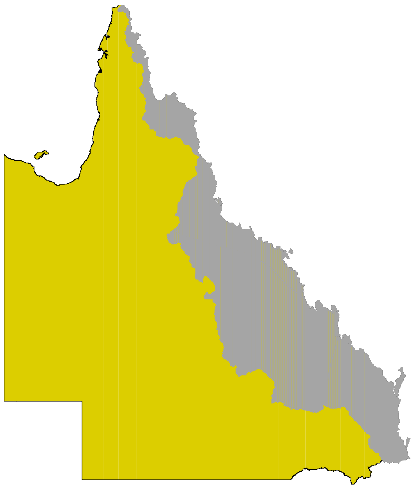
Antarctic Circle

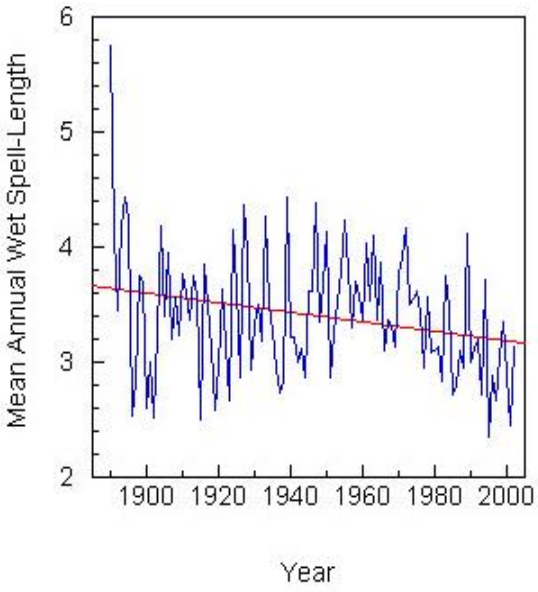


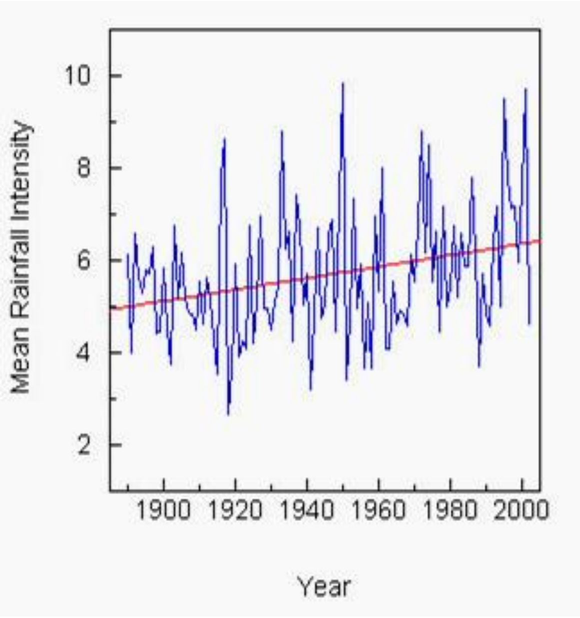
Finally, to assist coping strategies there is a strong need for an interdisciplinary approach - aim to convert insights gained into climatic processes via systems analysis and modelling into the socio-economic feasibility of decision options (after Meinke and Stone, 2005).

Historical rainfall trends ..

- Analyses have shown that while rainfall in eastern Queensland has declined (due to reduction in duration and frequency of events) rainfall intensity has increased (Crimp).

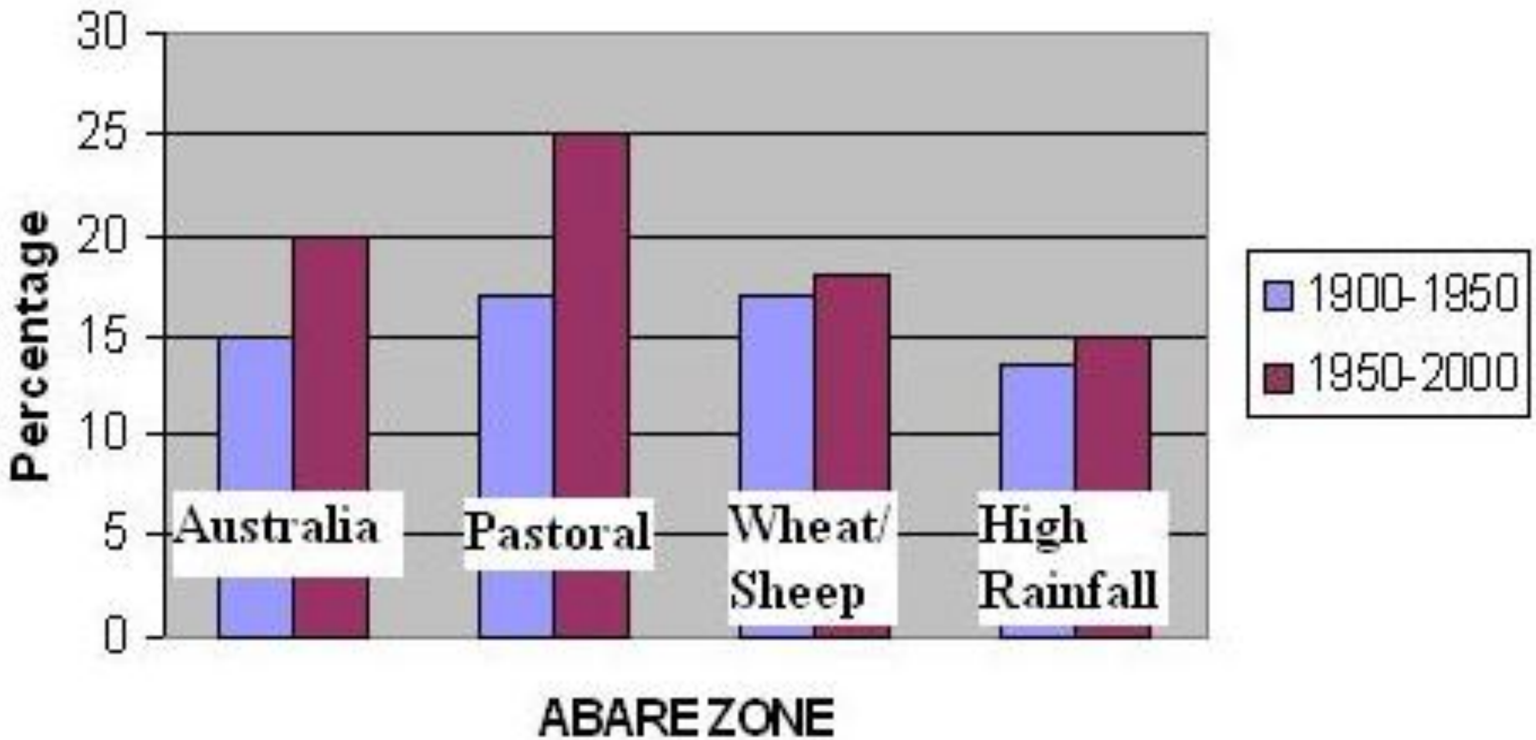






RAINFALL VARIABILITY – BY ZONE

Change in rainfall variability between the 1900-1949 half century and 1950 – 2000 (Love 2005).



The value of case studies - coping with climate variability using climate forecasting - sugar grower ("Typical Australian farmer" - 'Darren')

- 'Climate pattern in transitional stage so I keep a watchful eye on the climate updates
- I take special interest in the sea surface temperatures (SST) particularly in the Nino 3 region.
- There is currently some indications of warming in the Nino 3 region which hints at a possible El Nino pattern developing
- Replant would be kept to a minimum
- Harvest drier areas earlier, even if CCS maybe effected.
- *We don't run the farm based solely on climate information and forecasts, it's just another tool to consider when making decisions*.

Climate Variability and Climate Change Issues - Changing the Decision Environment

1. To change their management, *agricultural managers need to be convinced that projected climate changes are real* and are likely to continue - facilitated by policies that maintain climate monitoring and by communicating this information effectively, including targeted support of surveillance of pests, diseases, and other factors directly affected by climate.

2. *Managers need to be confident* that *the projected changes will significantly impact on their enterprise* – need to support research involving systems analysis, crop and pasture modelling.

3. *Extension capacity*, need for regional networks that provide this information to be strengthened.

4. Where existing technical options are inadequate, *investment in new technical or management strategies may be required* (e.g., improved crop, forage, livestock, forest, and fisheries germplasm).

5. Where climate impacts may lead to major land-use change, there may be demands to *support transitions such as industry relocation* and migration of people – this may be achieved through direct financial and material support, creating alternative livelihood options – possibly a reduced dependence on agriculture - develop contingency plans.

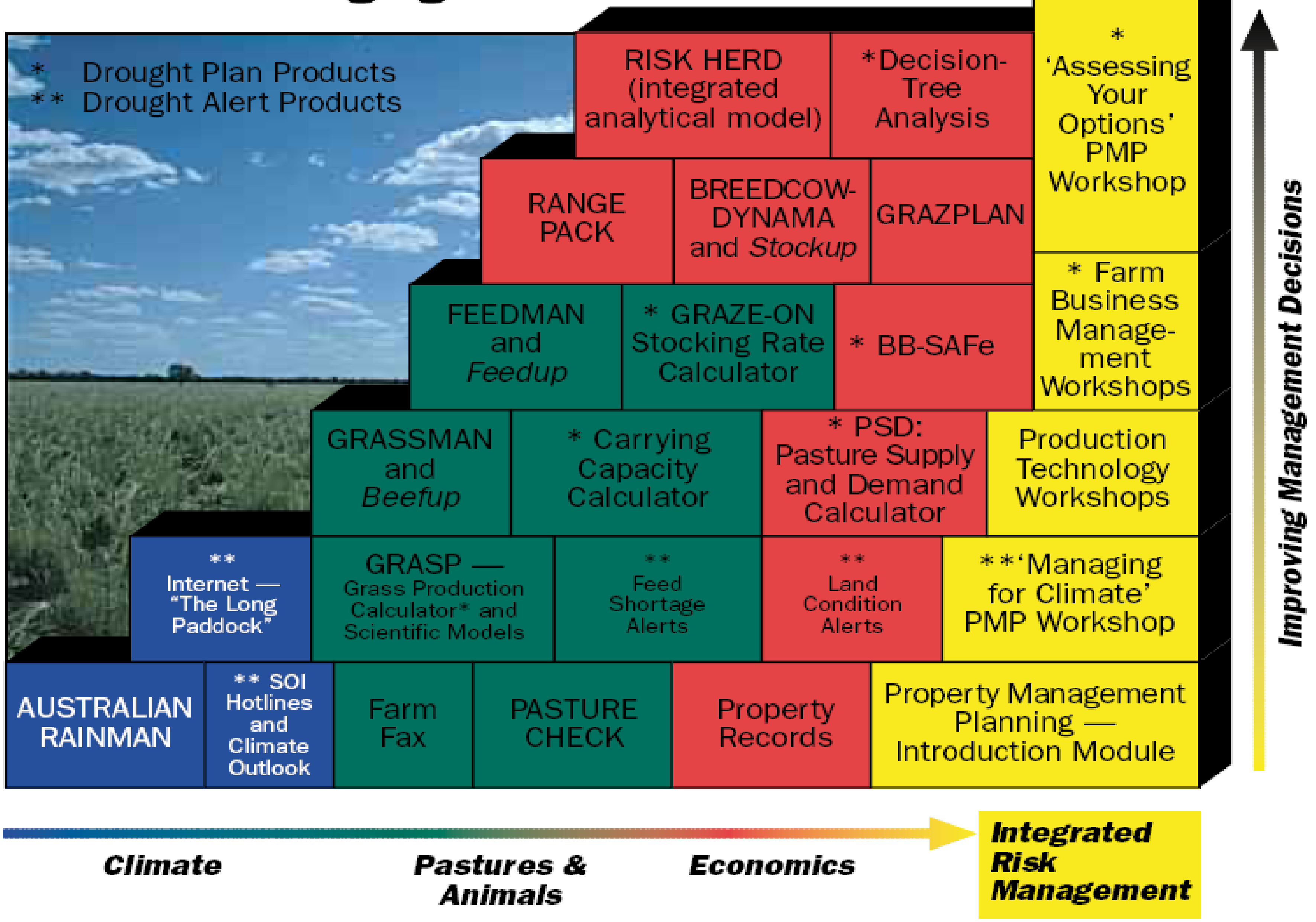
6. *Developing new infrastructure, policies, and institutions* to support new management and land-use arrangements – options include enhancing investment in irrigation infrastructure and efficient water use technologies; ensuring appropriate transport and storage infrastructure and for improved financial services, including insurance.

7. Policies must *maintain the capacity* to make continuing adjustments and improvements in adaptation by “learning by doing” via targeted monitoring of adaptations to climate change and their costs, benefits, and effects (Howden et al. 2007)

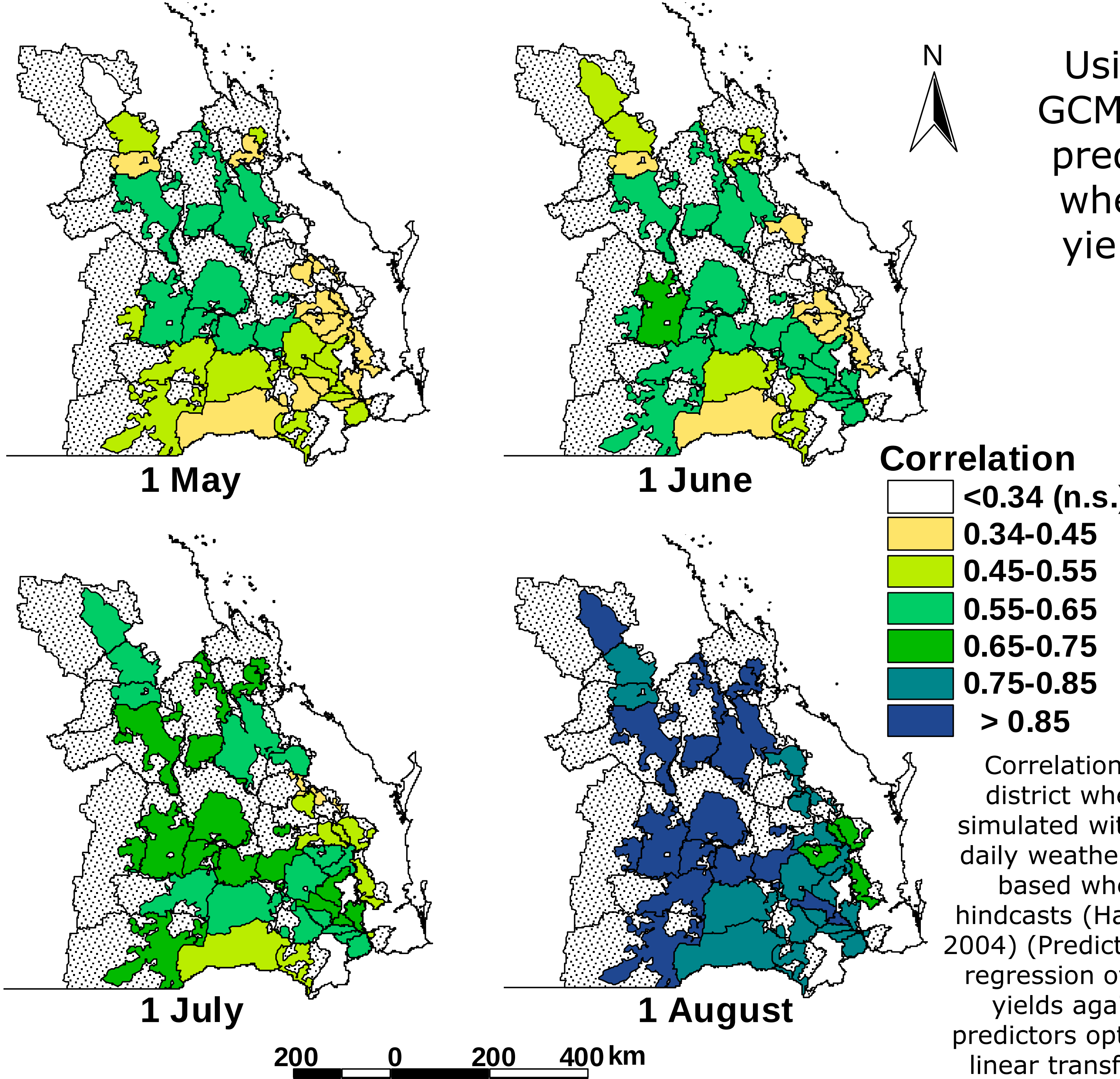
- **Climate information integrated with pasture growth models enable forward budgeting of pasture....**
- **Value in assisting coping preparedness and contingency planning for drought and reduce risk by forward budgeting of pasture (for up to 2 years)**

The value of climate science – help create ‘ownership’ for users - good example of interaction between NMHS, university researchers, extension specialists, agricultural specialist

Tools for managing climatic risk



Using GCMs to predict wheat yields



Correlation between district wheat yields simulated with observed daily weather and GCM-based wheat yield hindcasts (Hansen *et al.*, 2004) (Prediction by linear regression of simulated yields against GCM predictors optimized by a linear transformation).