Seasonal Prediction, Stakeholder Interaction, Decision Support, Discussion Support - Australian case studies

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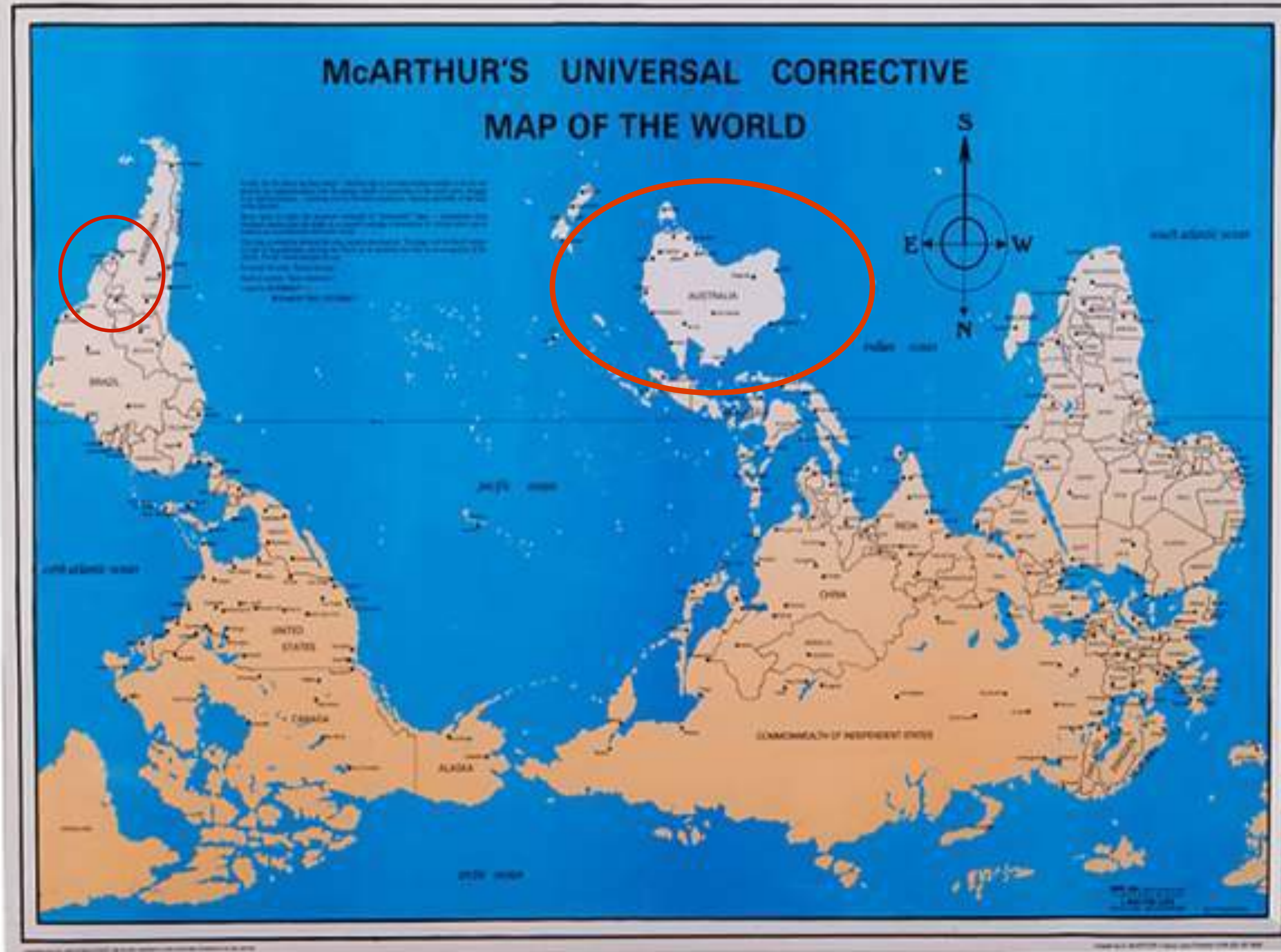
GRDC
Grains Research & Development Corporation

Australian Government
Sugar Research and Development Corporation

Grains Research UPDATE

ECOM

QSL
WE EXPORT AROUND THREE MILLION TONNES OF RAW SUGAR PER ANNUM FROM AUSTRALIA TO SUGAR REFINERIES AROUND THE WORLD ON BEHALF OF SEVEN MILLING COMPANIES AND MORE THAN 3,000 CANE GROWERS.


McARTHUR'S UNIVERSAL CORRECTIVE
MAP OF THE WORLD
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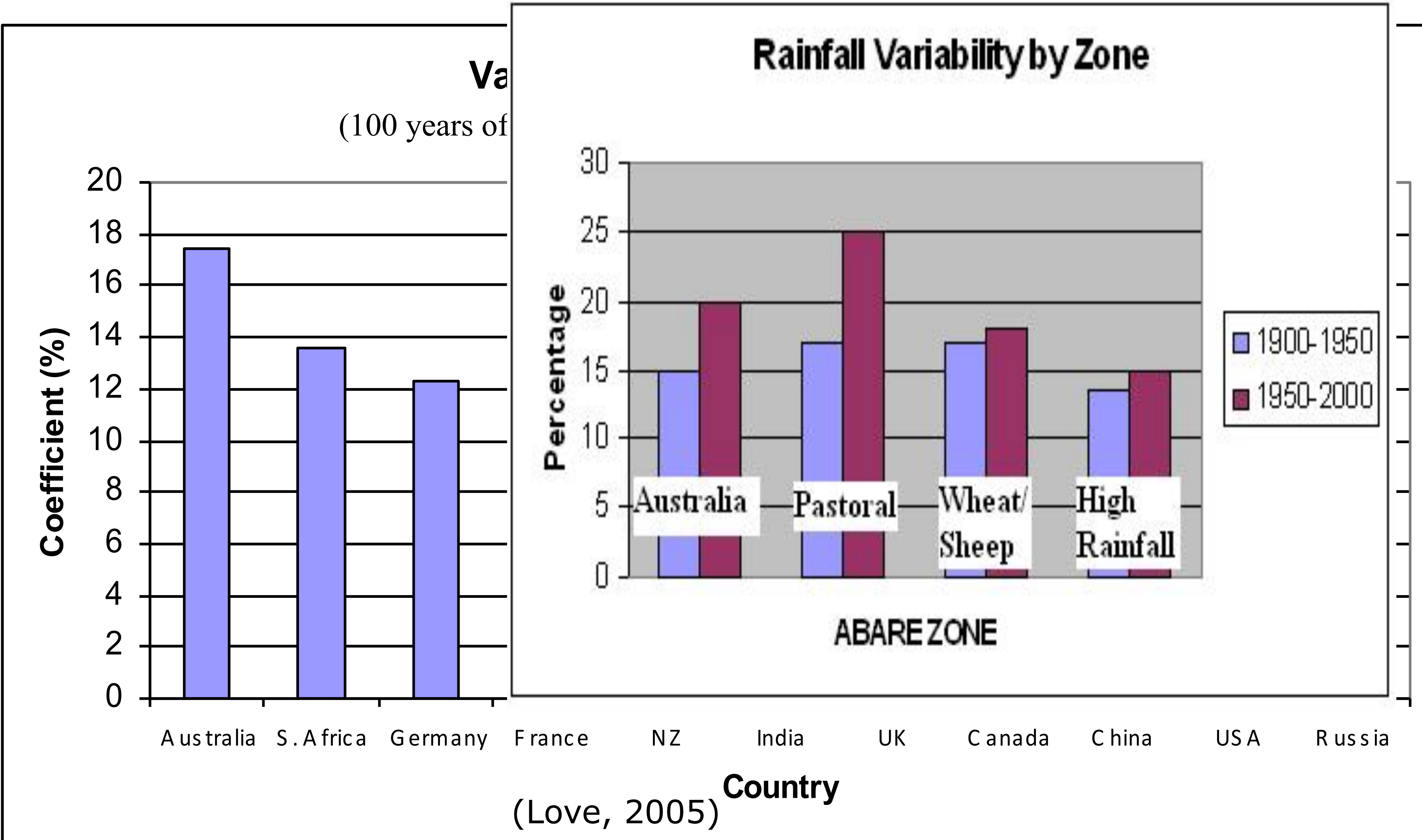
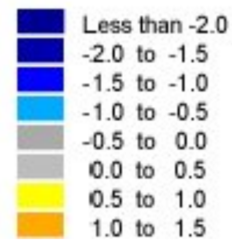
E
W
N
AUSTRALIA
BRAZIL
UNITED STATES
CANADA
ALASKA
CHINA
INDIA
COMMONWEALTH OF INDEPENDENT STATES

Climate issues dominate - Australia has the world's highest levels of year to year climate variability

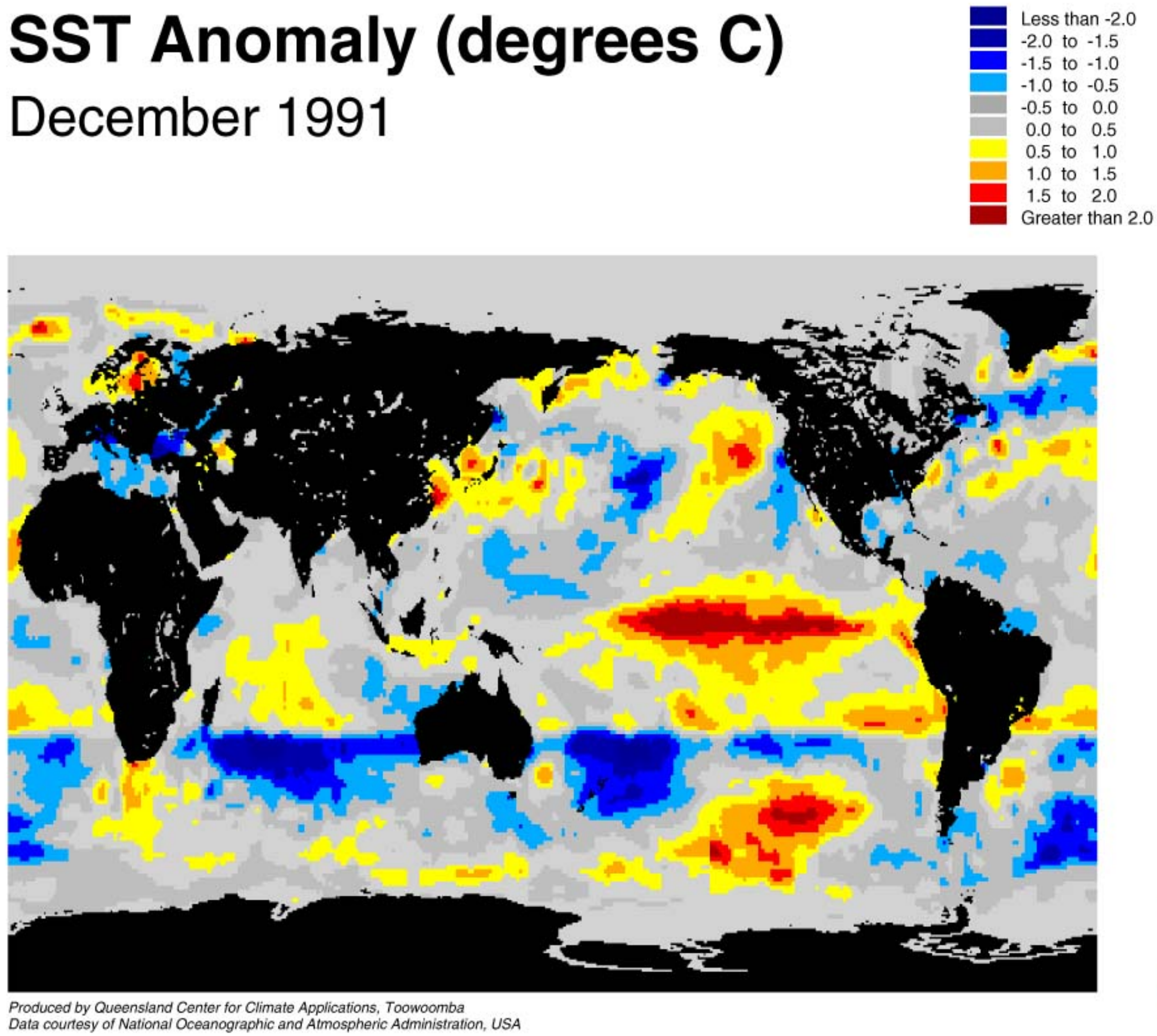


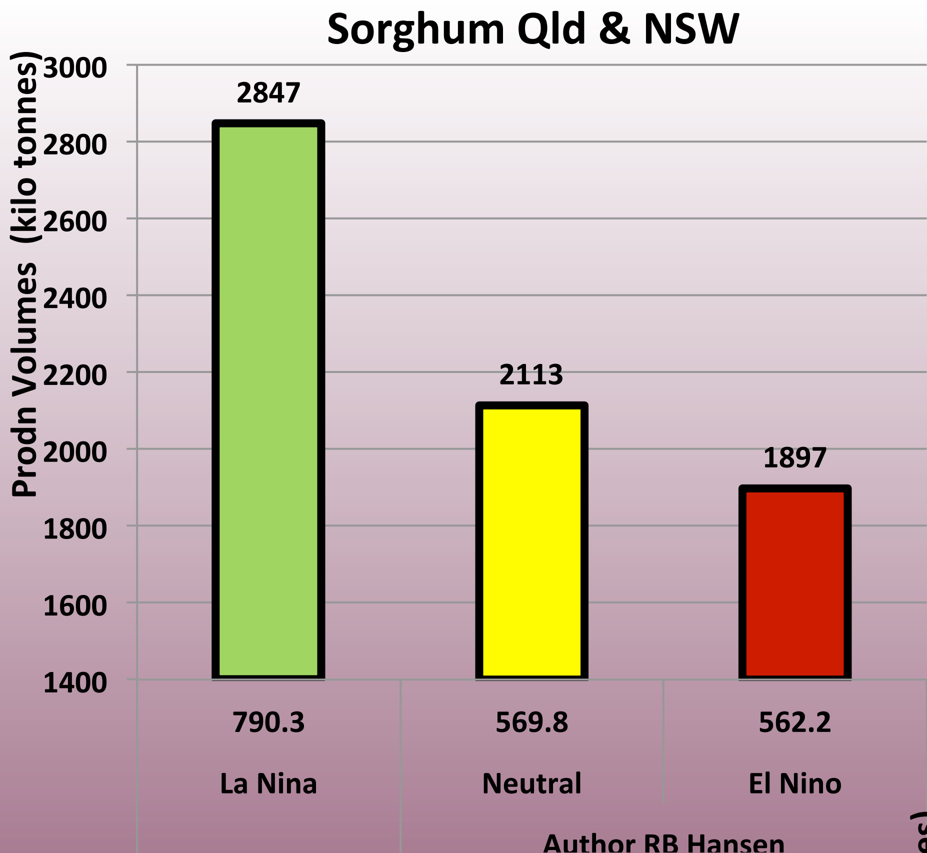
(Love, 2005)

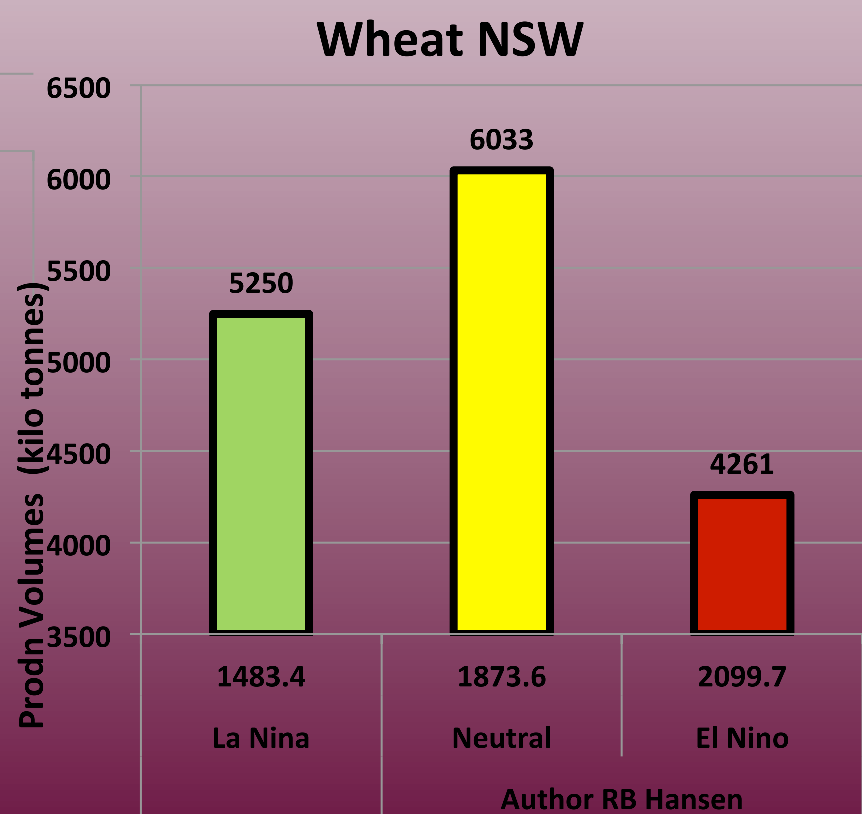
SST Anomaly (degrees C)



ENSO the main contributor. Conditions in the Tropical Pacific Ocean (example from October 1988)

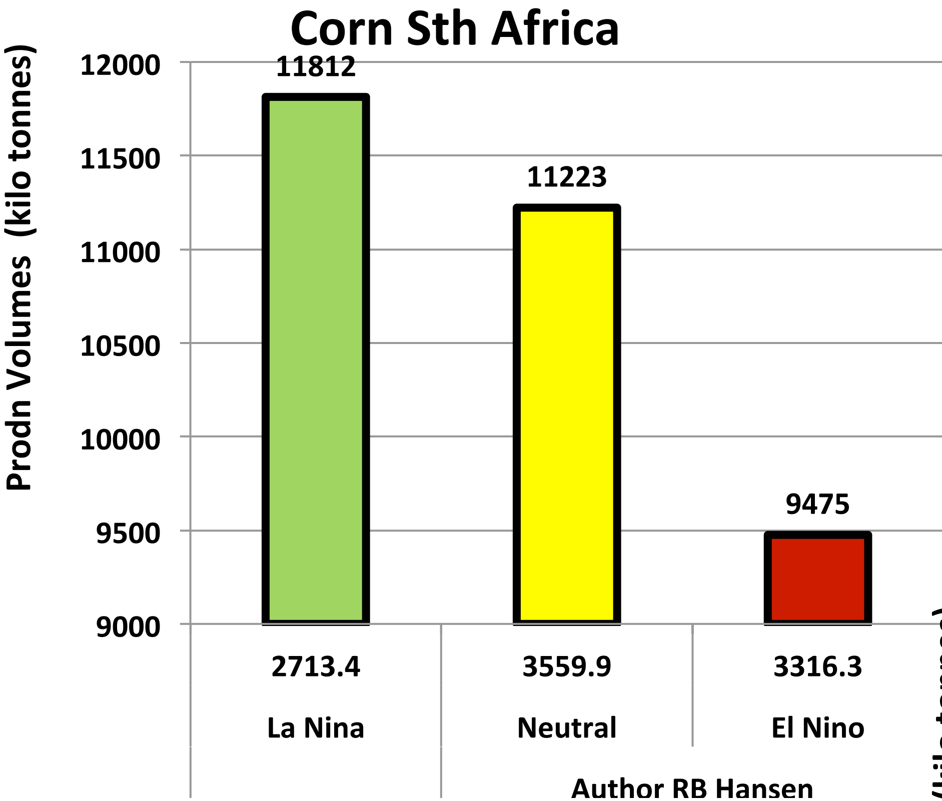


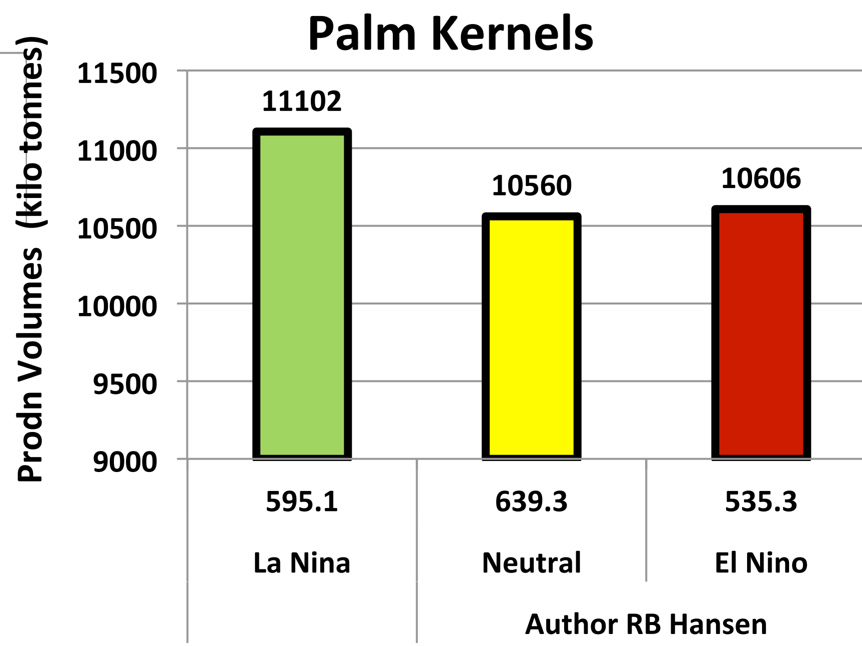




Important relationships between ENSO and national crop yields (value to commodity trading).

Mean /std production levels associated with ENSO – example for sorghum and wheat /Australia (Hansen and Stone, 2012)

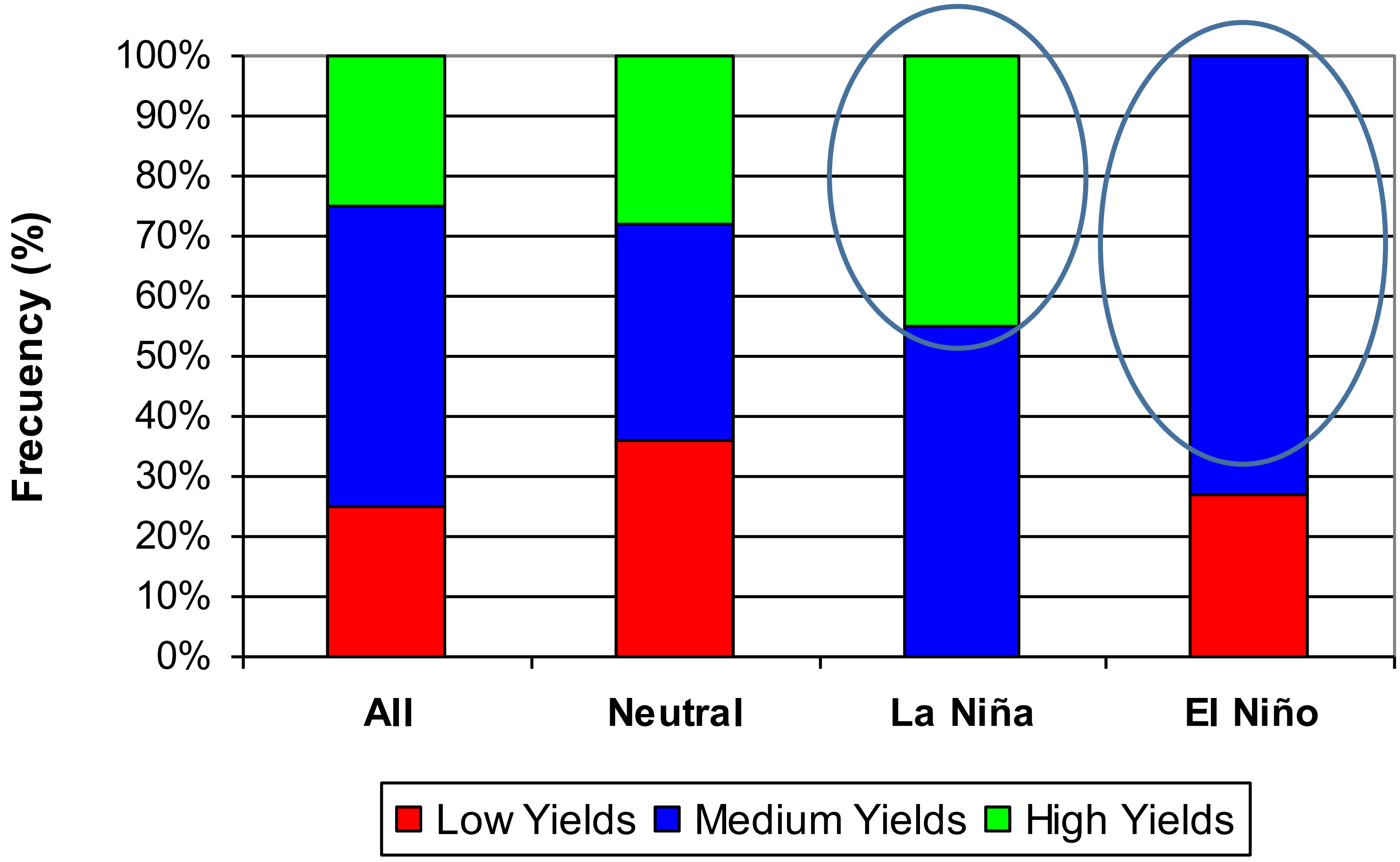




Also applies to other regions.

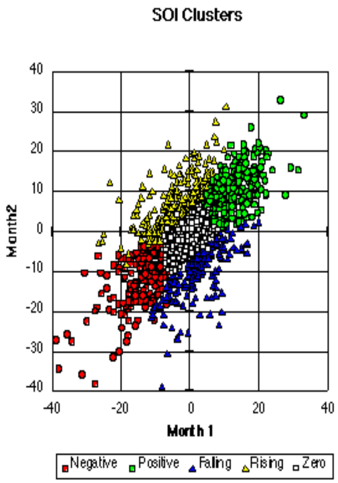
EG: mean/std corn production in RSA.
Palm Kernel production Malaysia.
Relationships with ENSO

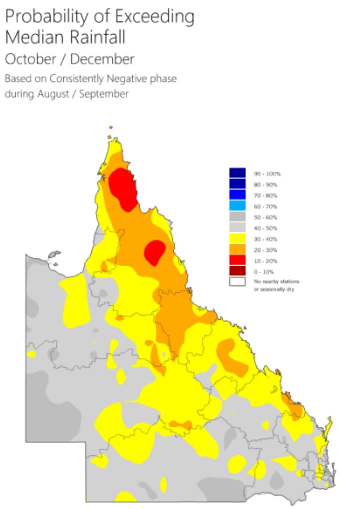
ENSO effects on Uruguayan Rice Production



Uruguay National Rice Yield Distribution and ENSO phases (1972-2003)
(Roel, 2005)

Operational climate services (are they too generalised to suit critical management decisions?)





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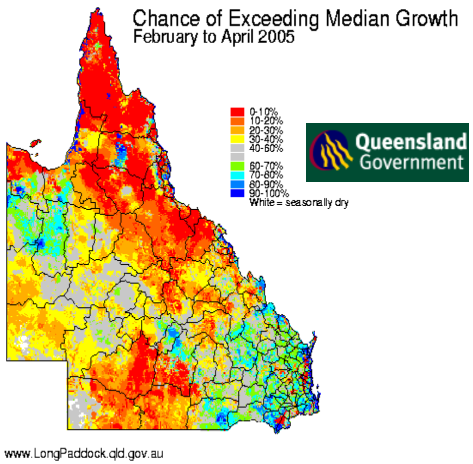
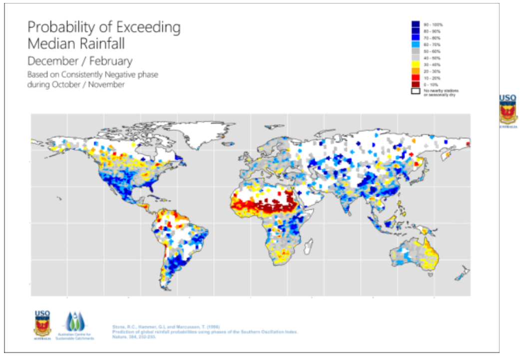
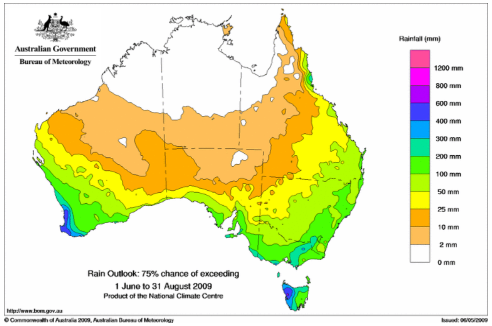
Queensland state output – focussing on specific regions – and linking to targeted requirements – pasture growth forecasts include antecedent soil moisture conditions and pasture growth modelling.

Useful to apply seasonal climate forecasting systems that can also be integrated with crop, pasture, and hydrological models.



www.LongPaddock.qld.gov.au





Commonwealth Bureau of Meteorology

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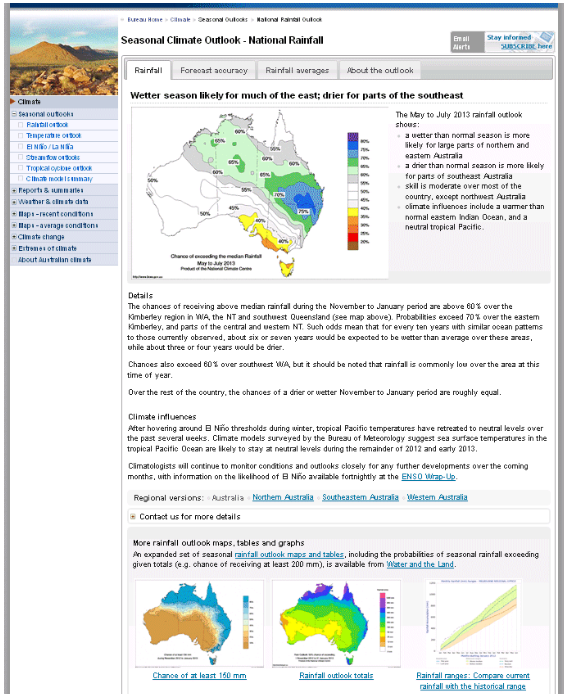


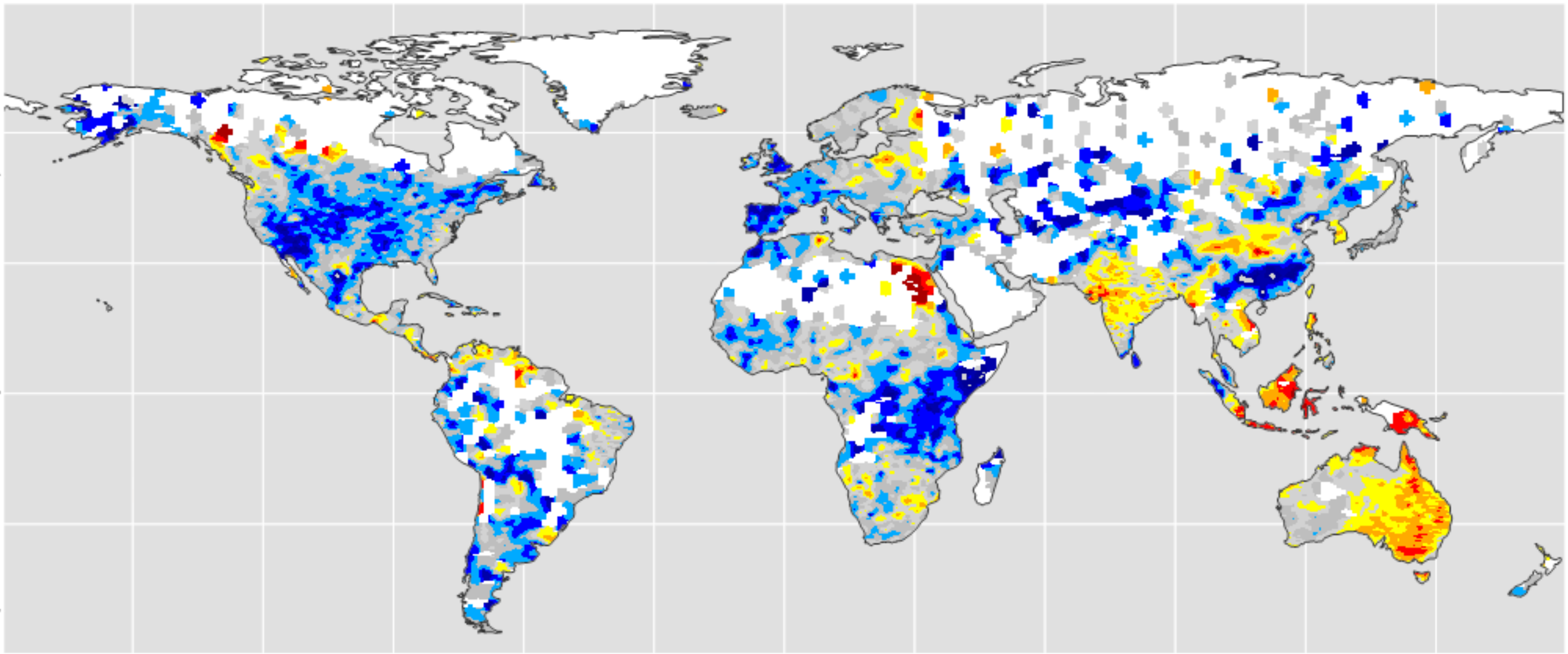
Probability of Exceeding Median Rainfall

September / November

Based on Consistently Negative phase during July / August

Issues of forecast scale: global forecasts (value to commodity trading?)

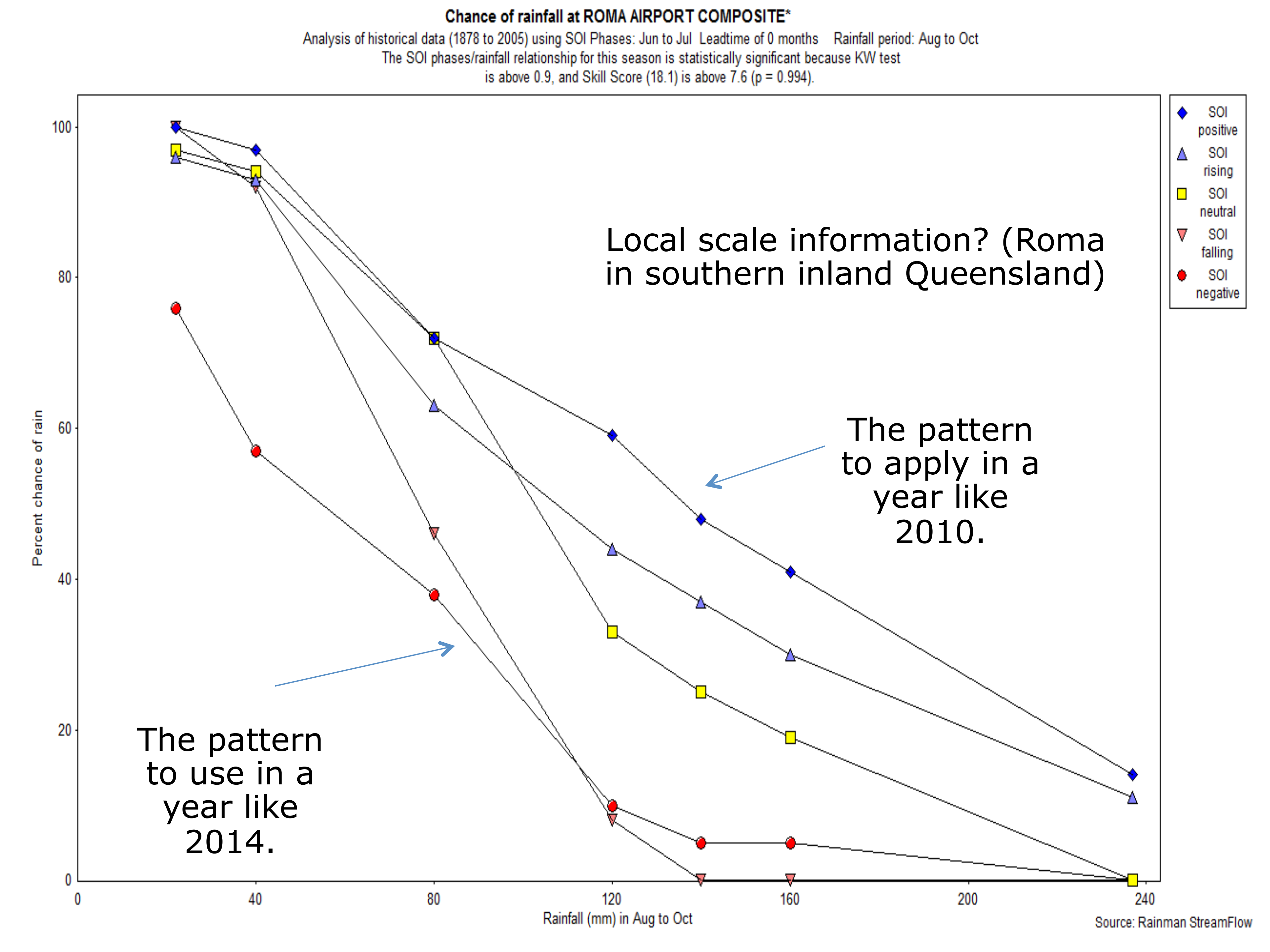
	90 - 100%
	80 - 90%
	70 - 80%
	60 - 70%
	50 - 60%
	40 - 50%
	30 - 40%
	20 - 30%
	10 - 20%
	0 - 10%
	No nearby stations or seasonally dry

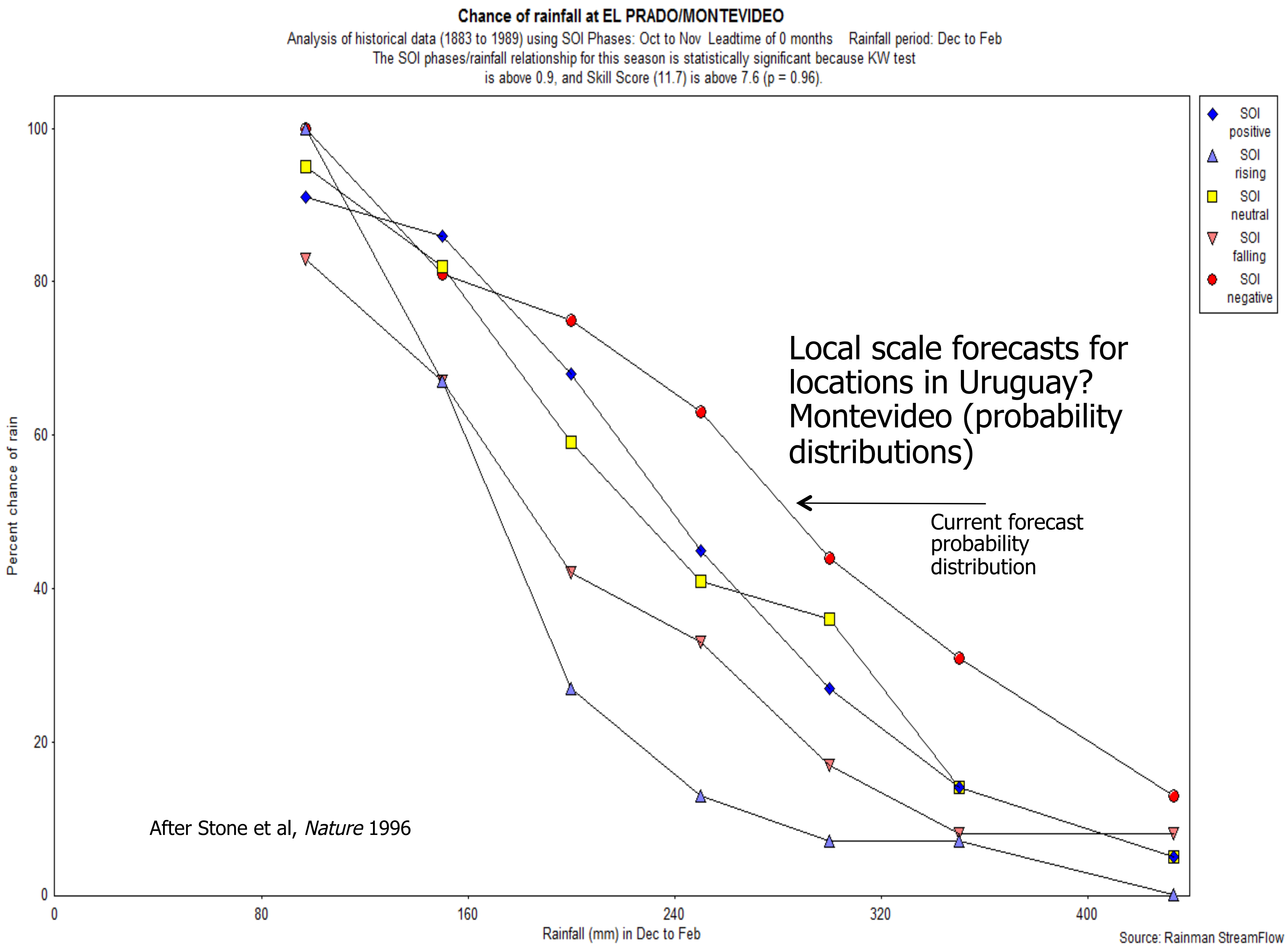


USQ AUSTRALIA

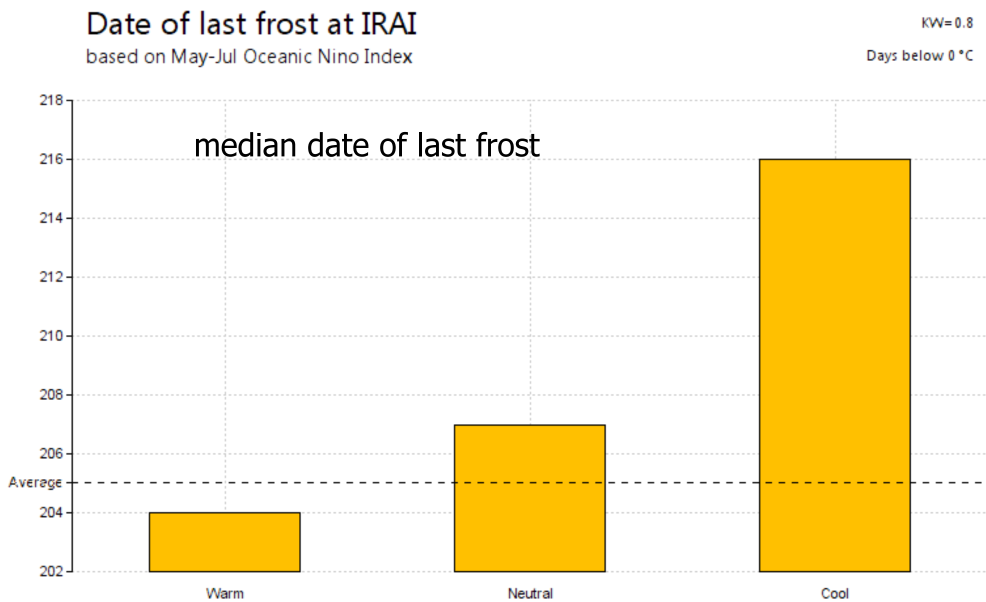
Australian Centre for Sustainable Catchments

Stone, R.C., Hammer, G.L and Marcussen, T. (1996)
Prediction of global rainfall probabilities using phases of the Southern Oscillation Index.
Nature, 384, 252-255.

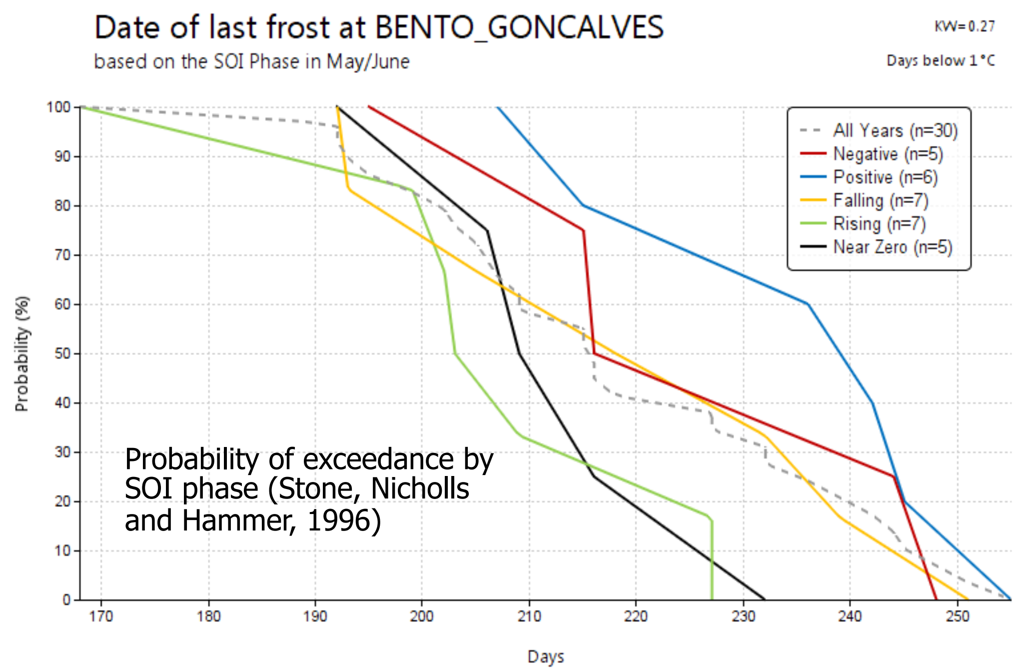

Chance of rainfall at ROMA AIRPORT COMPOSITE*
Analysis of historical data (1878 to 2005) using SOI Phases: Jun to Jul Leadtime of 0 months Rainfall period: Aug to Oct
The SOI phases/rainfall relationship for this season is statistically significant because KW test
is above 0.9, and Skill Score (18.1) is above 7.6 (p = 0.994).
Local scale information? (Roma in southern inland Queensland)
The pattern to apply in a year like 2010.
The pattern to use in a year like 2014.
SOI positive
SOI rising
SOI neutral
SOI falling
SOI negative
Percent chance of rain
0
20
40
60
80
100
0
40
80
120
160
200
240
Rainfall (mm) in Aug to Oct
Source: Rainman StreamFlow



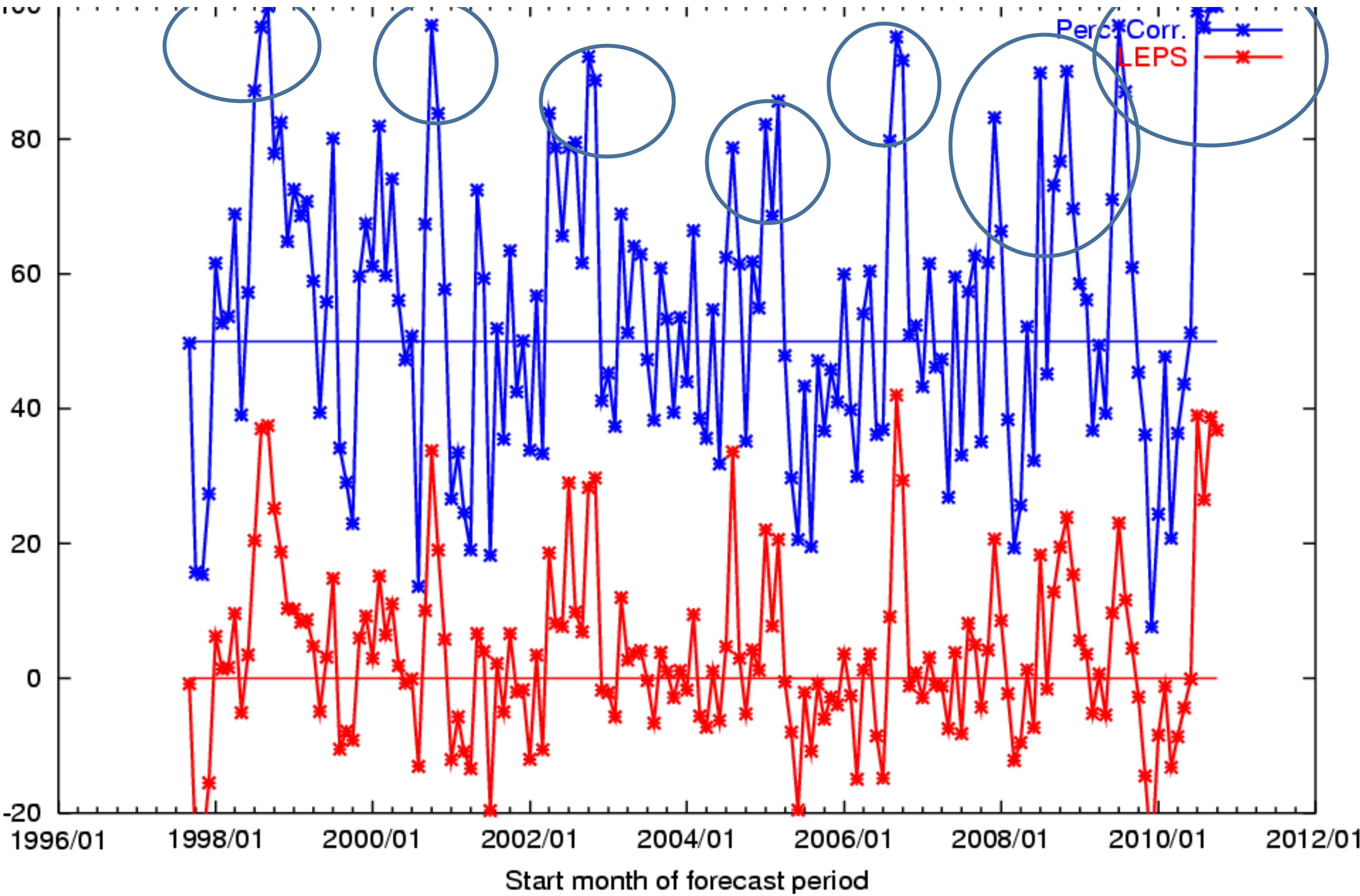
Chance of rainfall at EL PRADO/MONTEVIDEO
Analysis of historical data (1883 to 1989) using SOI Phases: Oct to Nov Leadtime of 0 months Rainfall period: Dec to Feb
The SOI phases/rainfall relationship for this season is statistically significant because KW test is above 0.9, and Skill Score (11.7) is above 7.6 (p = 0.96).
Percent chance of rain
Rainfall (mm) in Dec to Feb
SOI positive
SOI rising
SOI neutral
SOI falling
SOI negative
Local scale forecasts for locations in Uruguay? Montevideo (probability distributions)
Current forecast probability distribution
After Stone et al, Nature 1996
Source: Rainman StreamFlow



Tailoring outputs - frost forecasts: example of forecasting the date of last frost in a Brazilian coffee region



Important to assess forecast skill over time - forecast skill over time SOI-phase forecasts



'Per cent consistent /correct' skill assessment over time (SOIP) for Queensland (BoM,2011).

Circled periods are mostly those coinciding with an ENSO event. **Independent verification in real time.**

"The value of seasonal climate forecasts to users will depend not only on climate forecast accuracy but also on the management options available to the user to take advantage of the forecasts" (Nicholls, 1991)

Consider Agricultural Management Decisions and Climate Systems that operate at various time scales (Meinke and Stone, 2005) (Stone and Plant, 2014).

Decision type (eg. only)	Climate period
Logistics (eg. scheduling of planting / harvest operations; short-term buying decisions (stock)	Intraseasonal (>0.2) MJO
Tactical crop management (fertiliser/pesticide use)	Intraseasonal (0.2-0.5)
Crop type/area/fertiliser app (wheat/chickpeas); stocking rates; agistment planning; grain supply.	Seasonal (~1.0) ENSO
Crop sequence (eg. long or short fallows); agistment	Interannual (1-2.0) SAM
Crop rotation (eg. winter or summer crop); selling due to likely drought in QBO West Phase +STR	Annual/biennial (2) QBO
Industry issues(eg. grain/cotton); land purchase	Decadal (~10) +STR
Agricultural industry (eg. crops or pasture)	Interdecadal (10-20) IPO
Landuse (eg. Agriculture or natural system)	Multidecadal (20+)
Landuse and adaptation of current systems	Climate change

Climate forecasting may have no value unless it changes a management decision…

(and is able to address issues across the value chain)

Producer → Production → Transport → Processing → Retail, Marketing & Shipping

Producer / Production

- Stocking assessments/ stocking rates
- Drought preparation
  - Looking for exit strategies.
- Selling
- Agisting
- Buying fodder.

Transport

- booking transport
  - managing transport availability in peak demand periods

Processing

- Booking processing space
- Decisions regarding supply: daily, monthly, six monthly planning.
- Winter maintenance issues.
- Shift Worker rosters.
- (avoid lambs getting sold small/lightweight)

"Going into dry is fantastic – heaps of stock, plant at capacity and decreasing prices
- Coming out of dry, often 3-5 months after season break, lack of supply: key issues regarding long term viability emerge"

Retail, Marketing & Shipping

- Assessing market signals, forward contracts
- Retaining price consistency and consumer retention based on nutrition, integrity, value, enjoyment.

(**Lamb industry**: Stone, Hancock, Davison, 2014)

Climate forecast output may have no value unless it changes a management decision: sugar industry decisions (across the 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

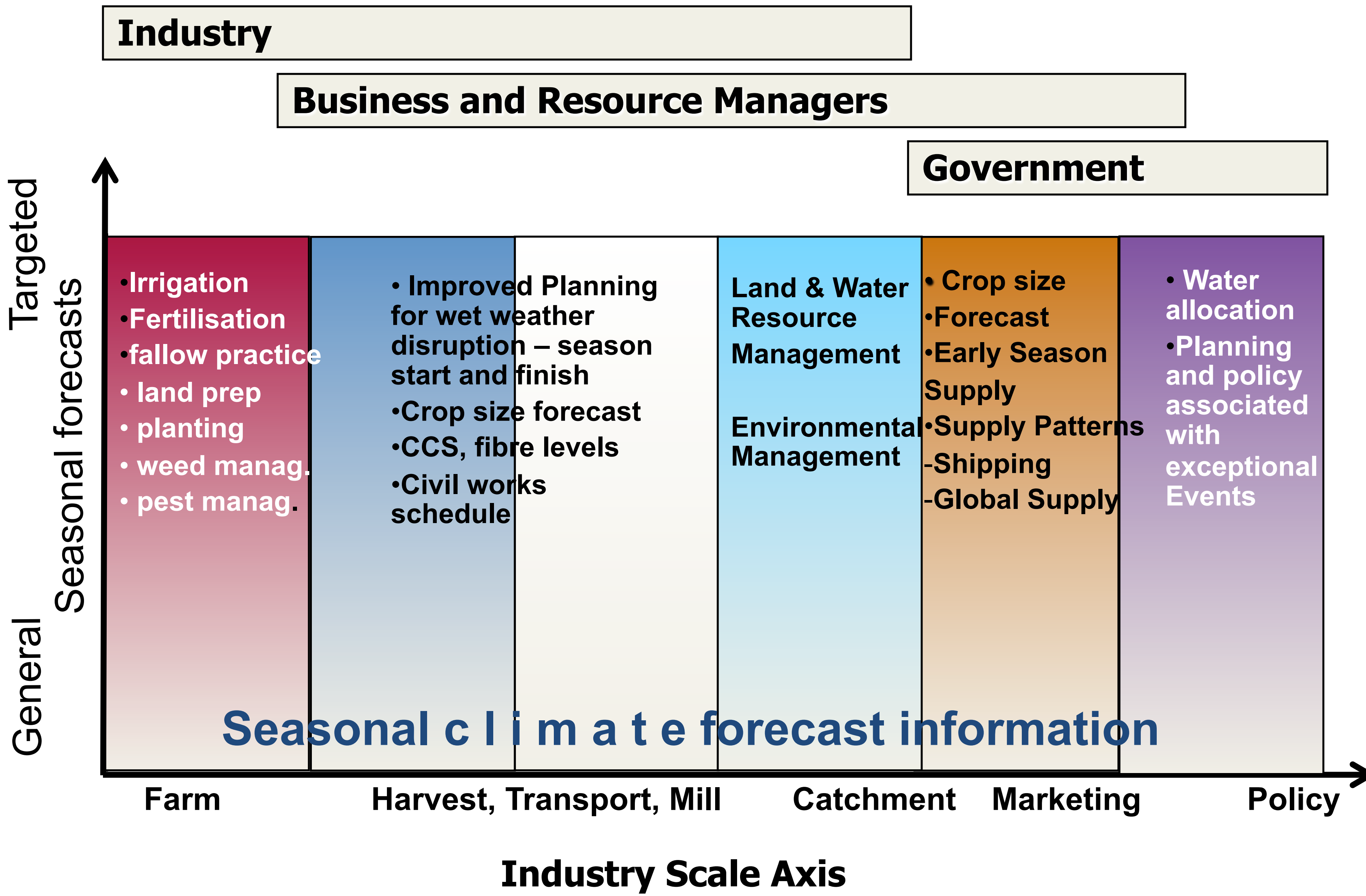
- Better scheduling of mill operations
  - crop estimates
  - early season cane supply

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

Y.L. Everingham, R.C. Muchow, R.C. Stone,
N.G. Inman-Bamber, A. Singels, C.N. Bezuidenhout (2002)

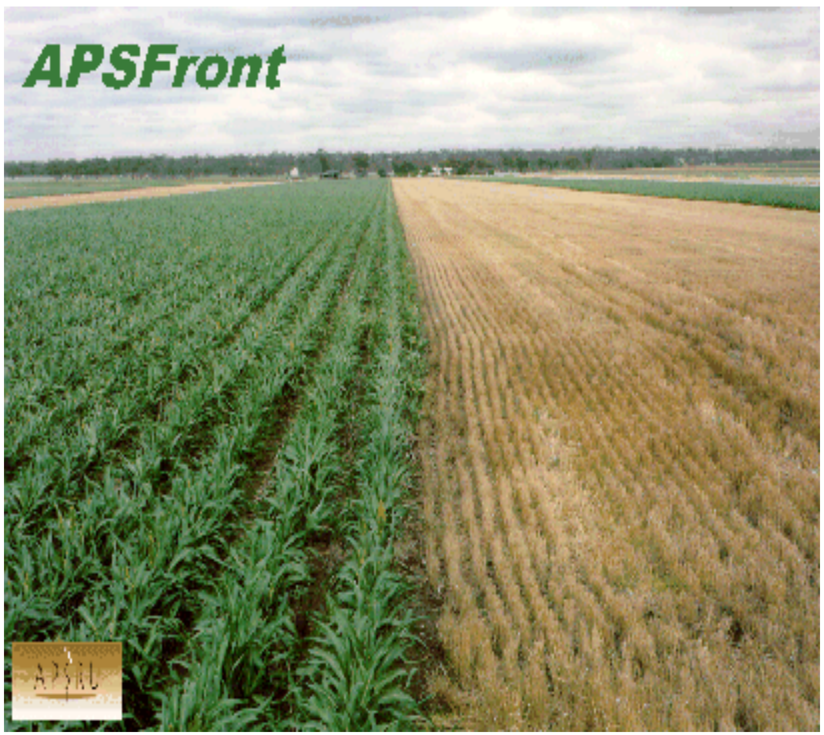
What are the decisions? Linking climate information to stakeholder decisions – complex issues of scale – targeting seasonal forecasts (sugar industry example)



For agriculture, a useful approach is to do a complete research analysis utilising the linking role of crop simulation modelling in the application of climate forecasting

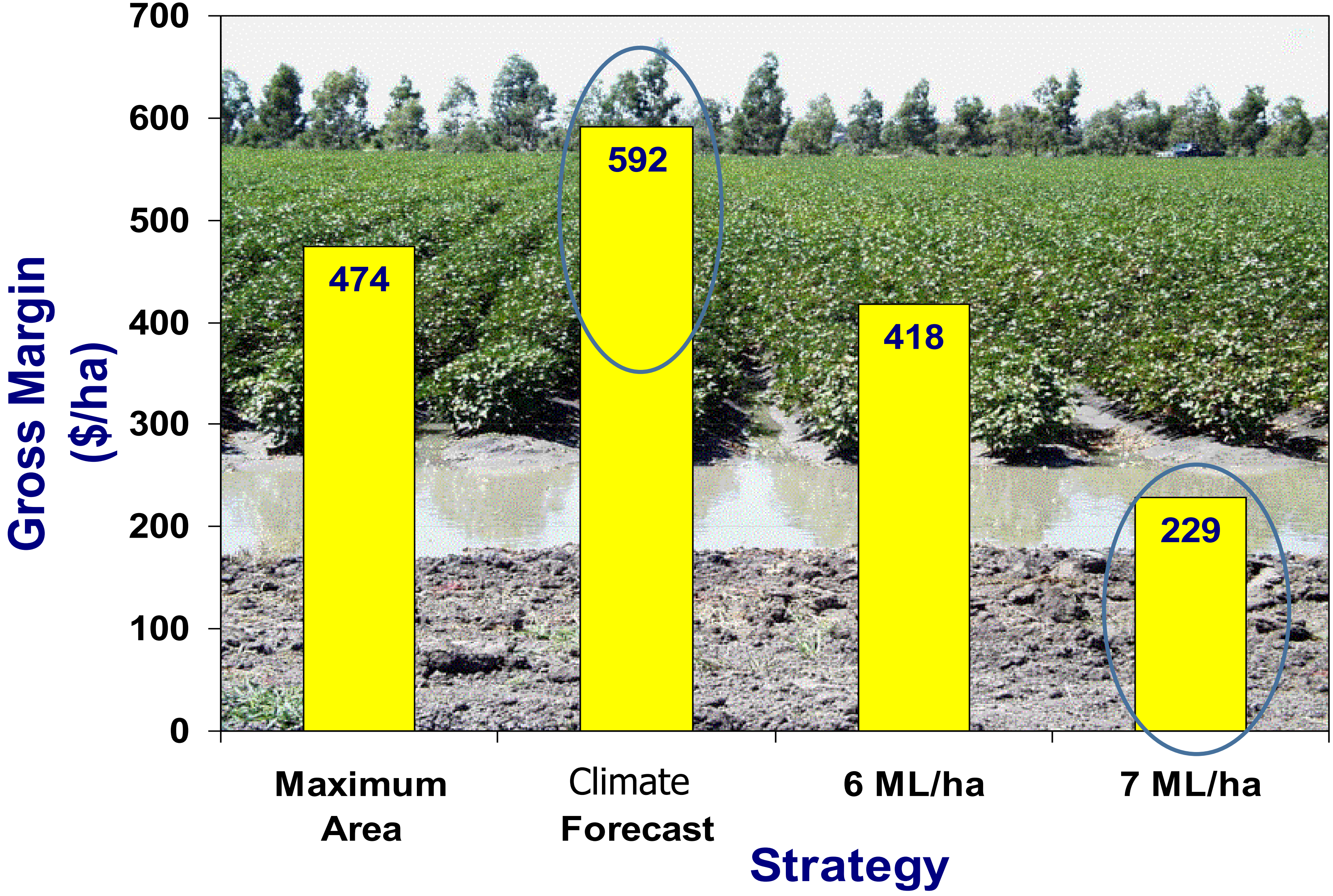
- Simulate management scenarios
- **Evaluate outcomes/risks relevant to decisions**

- Agricultural Production Systems Simulator (APSIM) simulates



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

Value in demonstrating economic pay-offs in applying seasonal climate information to irrigation decisions (Abawi, 2004).

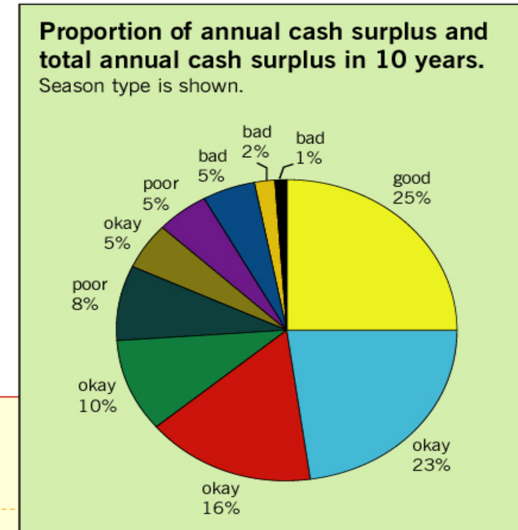


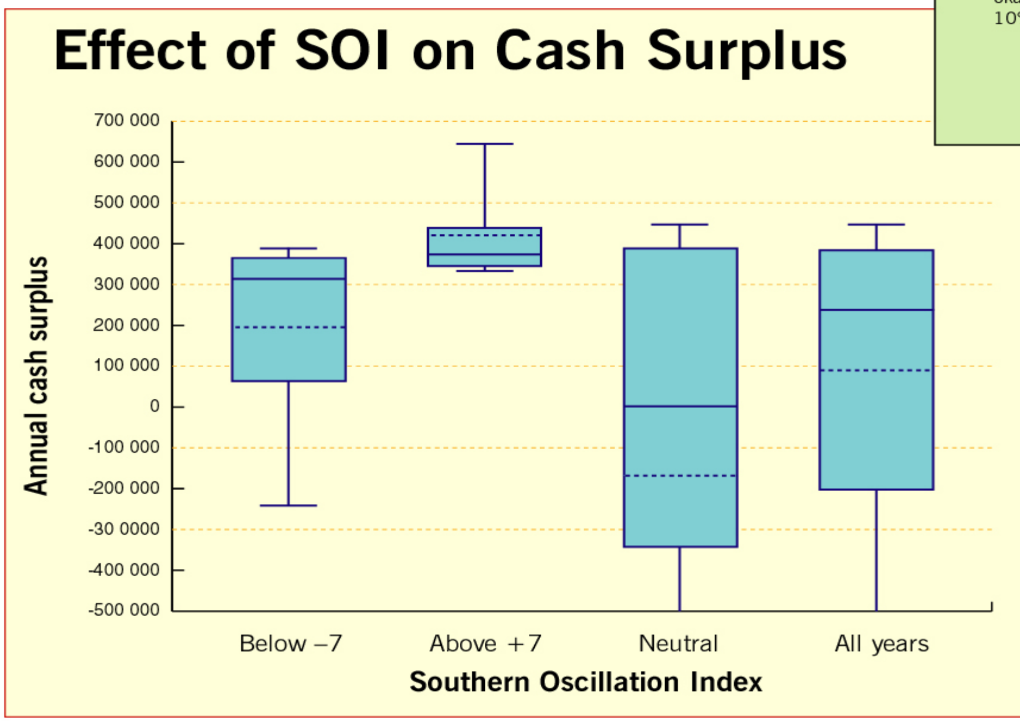
Impact of ENSO

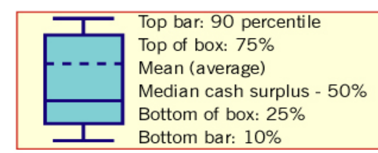
Identifying economic payoffs

Profit

Does the SOI affect wool production in western Queensland?

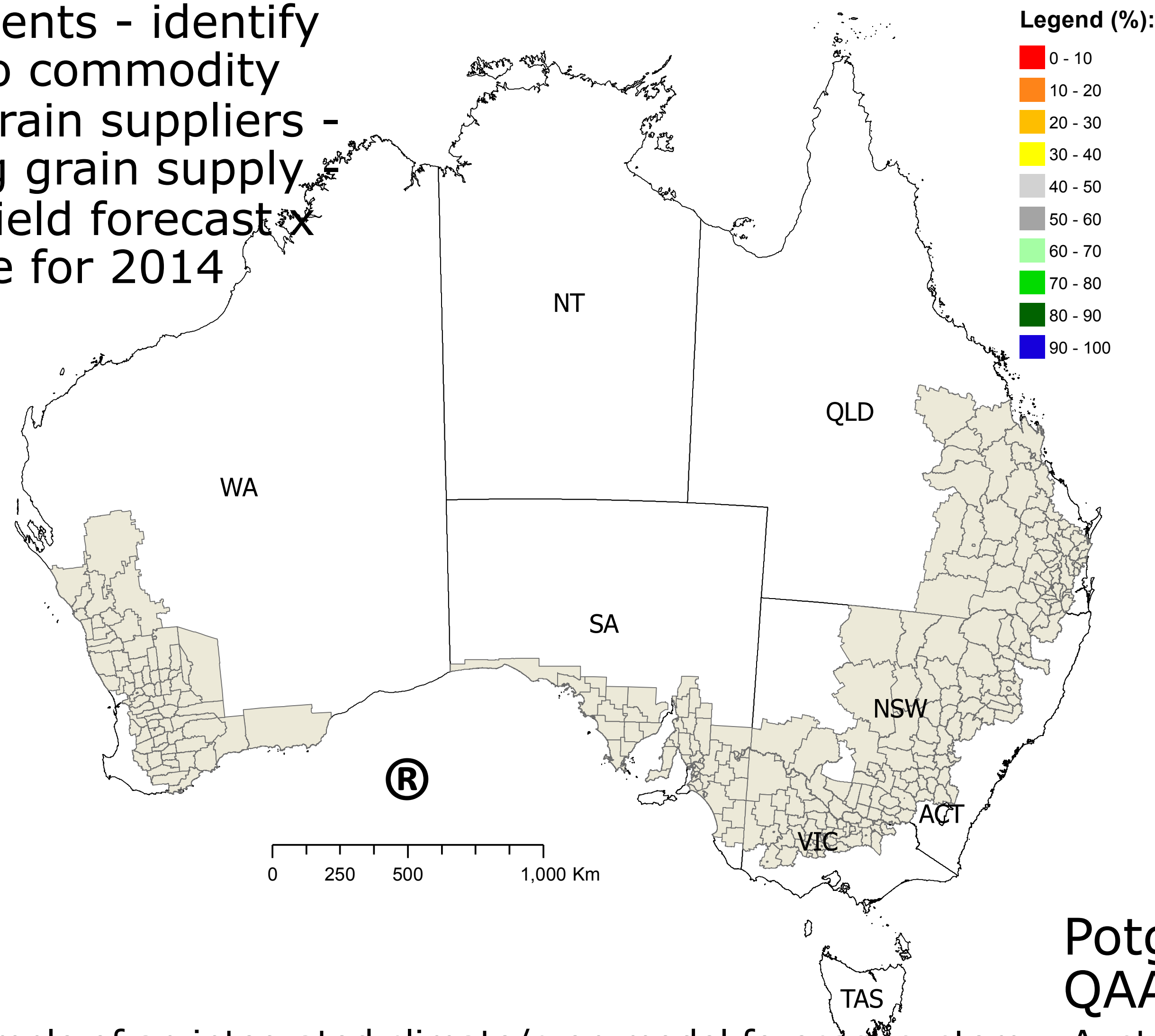






Courtesy D Cobon – 4 month lead time forecasts

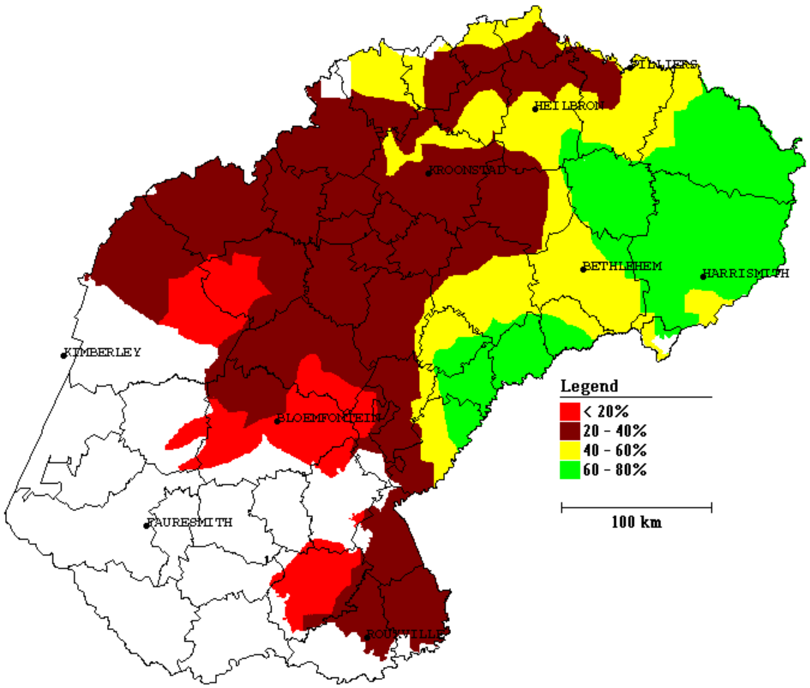
Value in national assessments - identify links to commodity trading/grain suppliers - Assessing grain supply - wheat yield forecast x shire for 2014



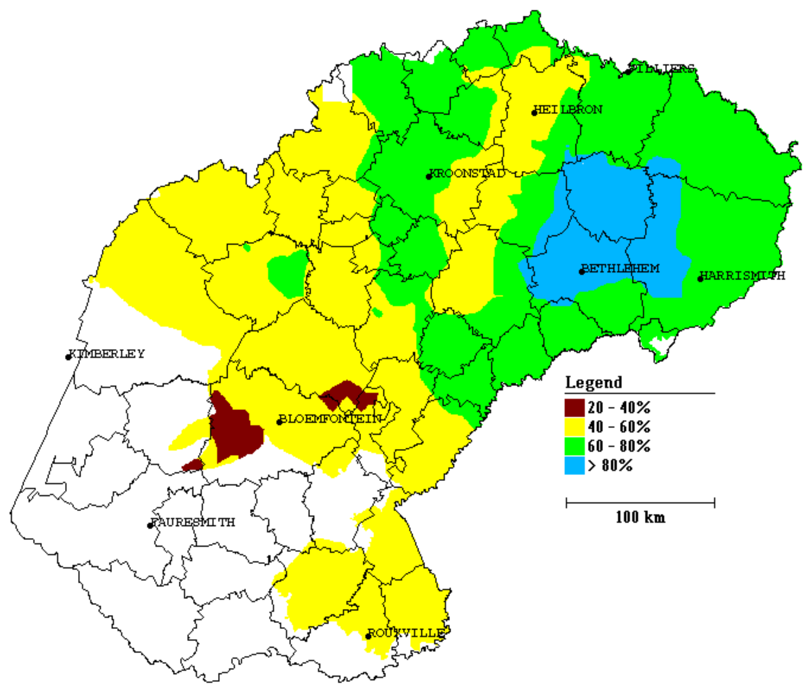
Potgieter, QAAFI

Example of an integrated climate/crop model forecast system – Australian wheat crop forecast for 2014 (OzWheat Model Potgieter, 2009; integrated with climate model of Stone et al, 1996) – issued September, 2014; first available May 2014

Value for state aid agencies as well as traders? Probabilities of exceeding long-term median maize yields for Free State, RSA, associated with a consistently negative SOI phase and a consistently positive SOI phase – output provides the probability (%) of exceeding maize yields of 2.5 t/ha (Potgieter, 1999; Stone et al, 1996a,b).



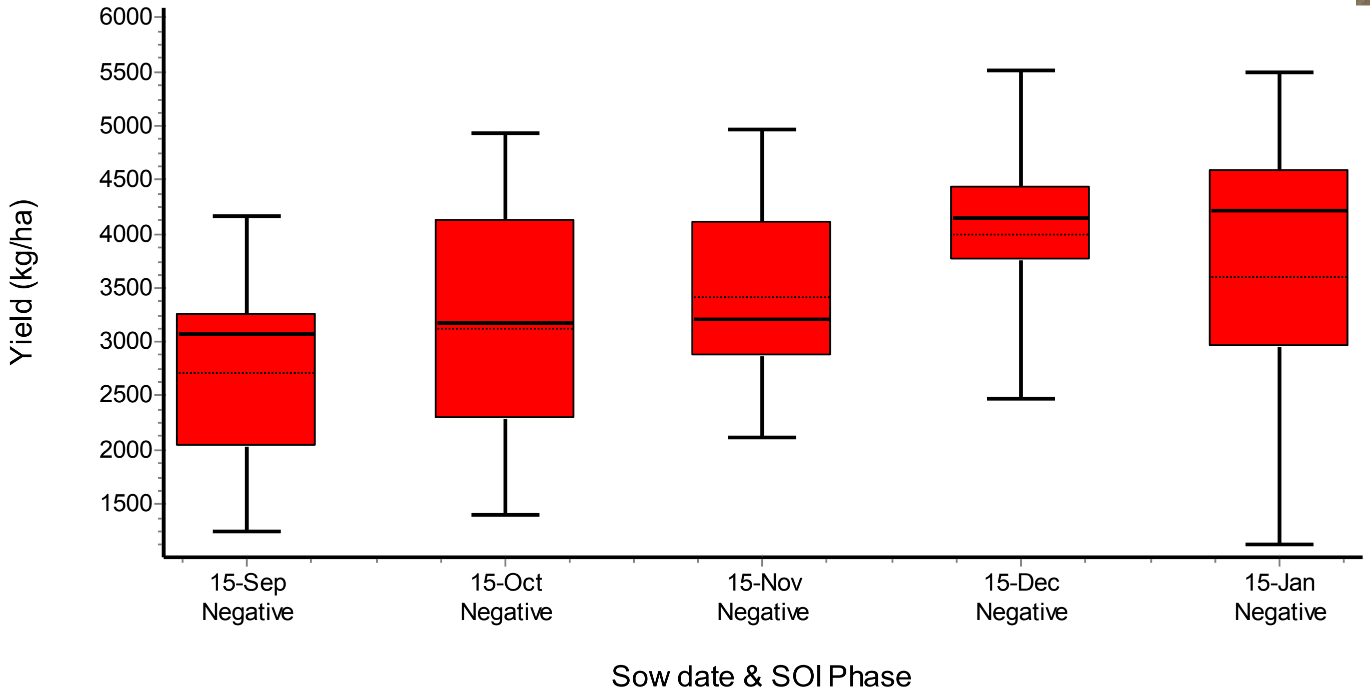
Planting date: 1 November
(Cons –ve SOI phase)



Planting date: 1 November
(Cons +ve SOI phase)

SOI phase system in seasonal forecasting (Stone et al, *Nature,* 1996)

Decision Support System: 'Whopper Cropper'



<u>**Decision-support for farm-level decisions ('when do I plant my crop'?)**</u> **- Australia - Utilising seasonal climate forecasts in management** and adaptation – eg of forecasts of potential sorghum yields associated with varying climate regimes (example for a 'consistently negative SOI phase') – varying management decisions (sowing dates) : example for Miles, Australia.

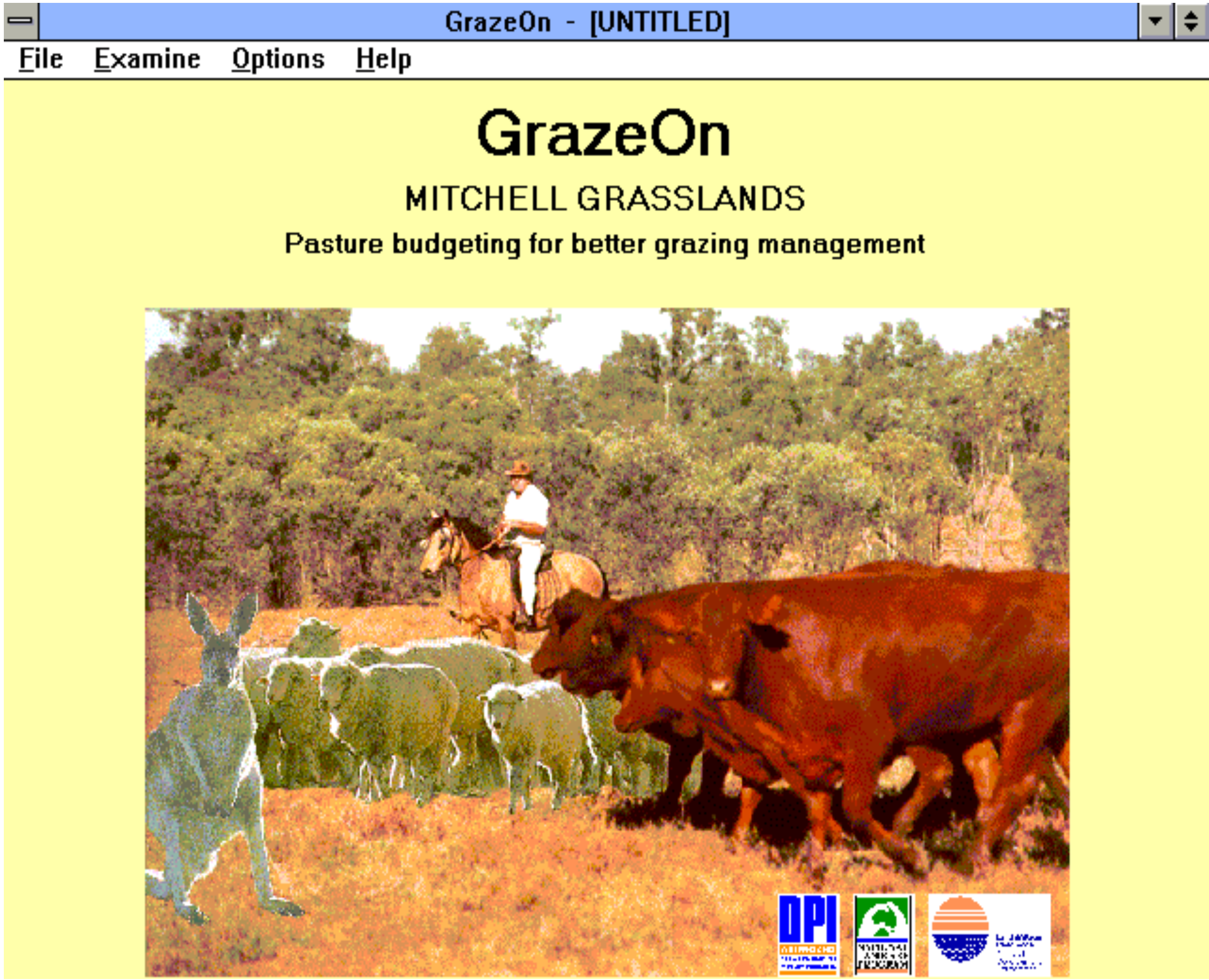
Effect of sowing date on sorghum yield at Miles South QLD with a 'consistently negative' SOI phase for September/October (Other parameters - 150mm PAWC, 2/3 full at sowing, 6pl/m2, medium maturity

('**WhopperCropper' decision-support system to be used in a discussion support environment) (Nelson et al, 2002)**

Decision-support systems: GrazeOn – grazing systems information

(Grass production simulation model (GRASP))

- Decisions related to estimation of future stocking rates
- Decisions related to pasture budgeting monitoring
- Decisions related to total grazing pressure
- Decisions related to drought preparation

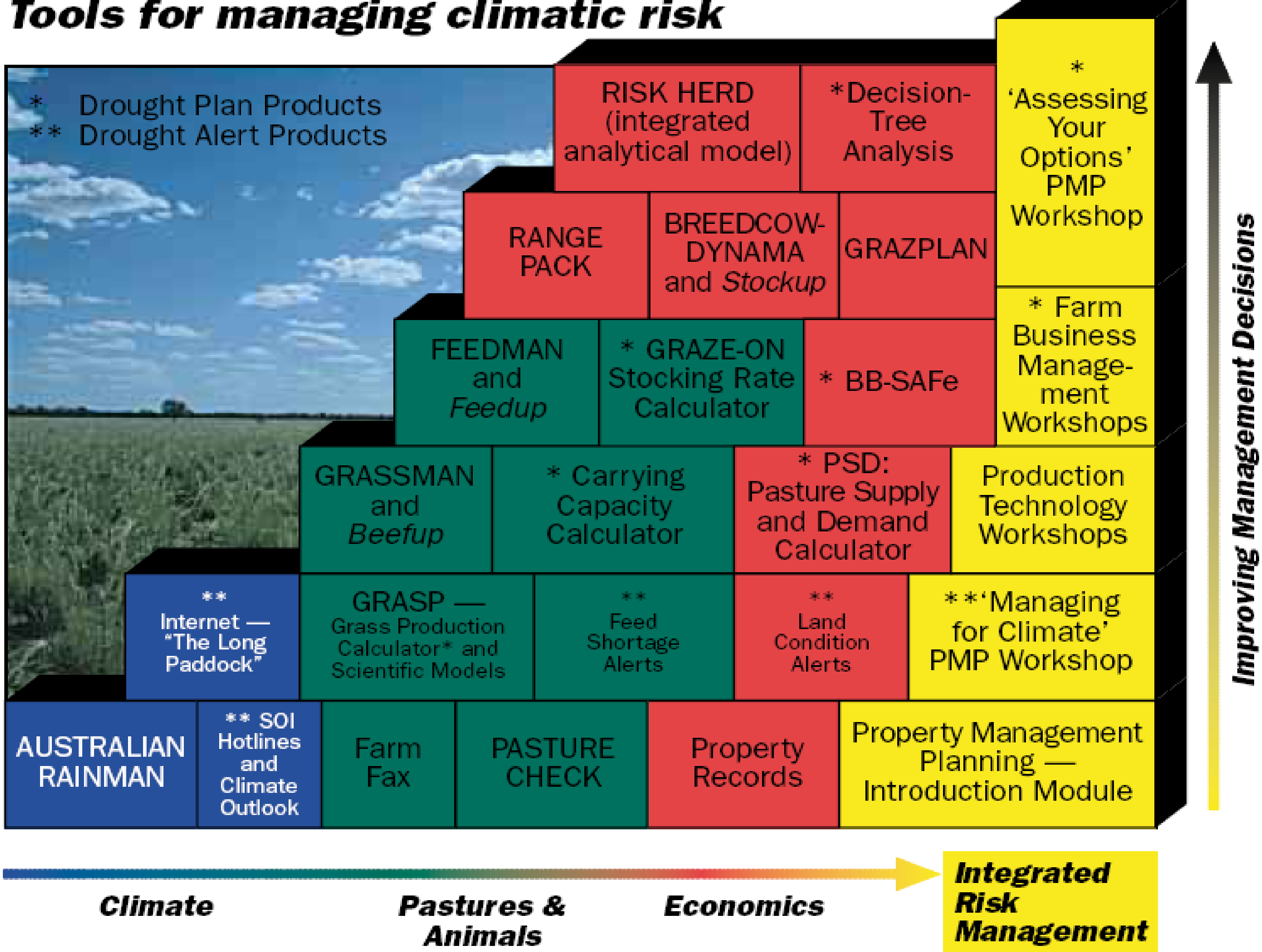


(Cobon, 2008)

***Tailored* decision-support systems** to assist complex management systems (Abawi, 2009).

Abawi (2009)

Tools for managing climatic risk



Are all decision-support systems useful?.....

Utilise <u>discussion</u> support systems: decision support systems within a discussion environment!

- <u>Early expectations</u> of computerised decision support systems (DSS) as the connecting vehicle between research and practice *may have gone unrealised* – although some valuable lessons have emerged from the attempts.

- *The most significant contribution of these attempts at decision support has not been the actual production of decision support systems, but rather the <u>bringing together of researchers and users</u> (farmers) to improve farm management (Cox 1996).*

- “The notion of *<u>stakeholder partnerships</u> to generate the relevance of research and analysis to decision-makers* ***through a discussion environment*** has emerged as a common theme in discussions on effective intervention in farming practice” (Hammer, 2000; Keating and McCown, 2001; Meinke et al., 2001; McCown, 2001, Nelson et al., 2002; Stone et al, 2012).

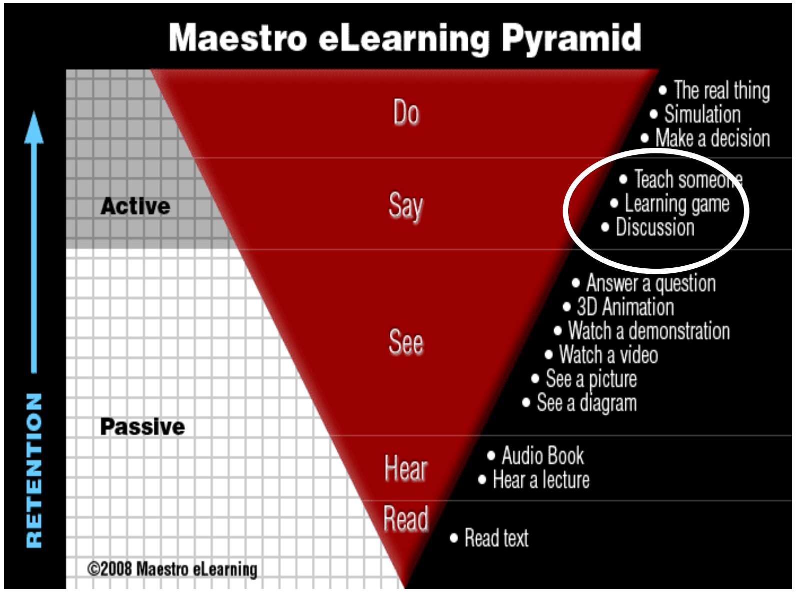
- Background: the ‘FARMSCAPE’ project provided an example of the approach with the notion and consequent rich imagery of **‘kitchen table discussions’.**
- **Scientists directly interact with local farmers in a farmer’s home to discuss outputs/management options derived from both recently run crop simulation models and climate forecast outputs, often also using decision support systems.**

(McCown et al., 1998; Carberry, 2001; Stone et al, 2012; McKeown, 2010).

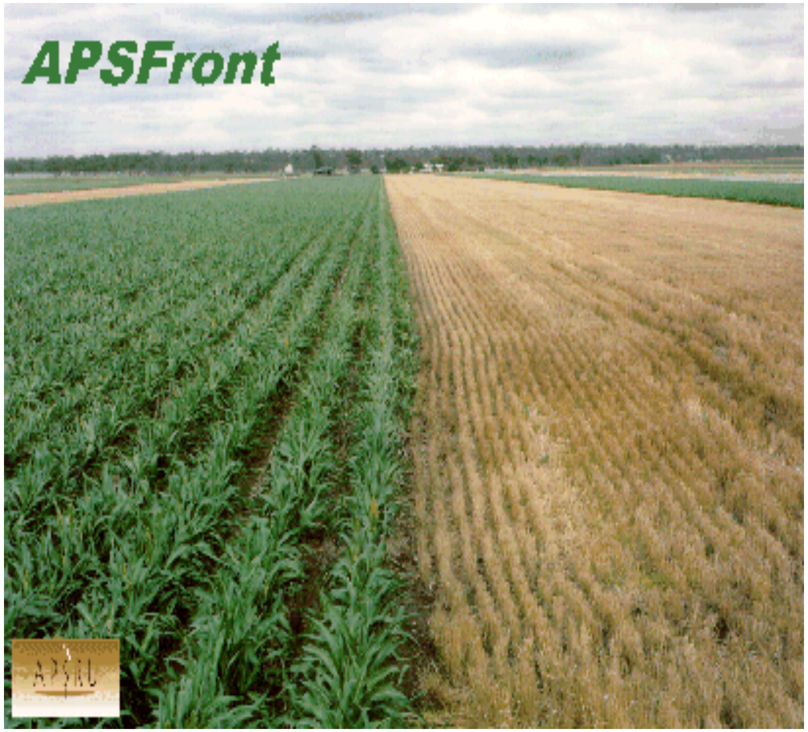
- “Following the "kitchen table discussions" participants go back into their real worlds to plan and act”.

- “Importantly, this multi-faceted component utilises scientific researchers with a new appreciation of the "people" content of systems research and new skills for para-professional practice in this area” (McCown et al., 1998).

- **Use of eLearning!** The 'Maestro eLearning Pyramid' *moves the user/ farmer/manager from simple, passive reading of some information through to* *<u>discussions</u> and making a decision* – key attributes required of a 'discussion-support' system.



- ***The simulation-aided discussion about management is at the heart of this methodology*** - for farmers the venue is most often the kitchen or dining table of a farm home.



- *A simulator* (such as APSIM/APSFront) which can reliably predict the consequences of management actions for the range of weather/climate conditions represented in historical records, very practical experiments for periods of decades can be "conducted" *during the discussion* in response to participants' "what if.. ?" questions.

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Using a virtual world to enable real world decision making

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Background

The economic and environmental viability of farming enterprises depends on good decision making. However, seasonal conditions and weather events can play a major role in determining the outcome of such decisions. Ready access to targeted climate information at time scales appropriate to on-farm decision making and knowing how best to use this information is of growing importance, particularly in regions subject to increasing climatic variability and risk.

'Discussion support' systems in agriculture are designed to foster topical discussion between stakeholders to enhance knowledge and awareness, skills development and improved decision making; they are effectively the basis for participatory workshops and field days common to agricultural extension programs. However, declining funding and policy support for face-to-face extension is driving a search for alternative tools and information delivery modes. Digital technologies now provide a viable and cost-effective option with potential to complement and expand the reach of conventional extension services.

Virtual worlds & sugar farming

This project is developing and evaluating an innovative web-based discussion-support system, accessible by a range of mobile digital devices, aimed at:

(i) enhancing access to targeted agri-climate information and

(ii) building capacity to integrate this information into practical farming operations in the Queensland sugarcane farming industry.

It uses cutting-edge educational web-based tools, including 'machinima' (virtual world animations) created in Second Life™. These present lifelike avatar actors and scripted conversations about real-world climate-based scenarios relevant to the lives and practices of sugarcane farmers (Fig. 1). They are designed to stimulate discussion amongst farmers around how to better incorporate an understanding of climate risk into their decision making.

The project will also create contextualised virtual group discussion environments in which to host on-line climate risk management events (e.g. virtual field days/workshops). This initiative has the potential to transform the delivery of extension services. It will eliminate some of the constraints (e.g. distance, time, cost) often associated with real-world meetings. It will also provide increased opportunity for sugarcane farming groups to initiate and organise their own meetings with expert advisors, thus enhancing rapid and effective needs-based knowledge exchange regardless of location.

Potential for global application

These platforms provide engaging technology-rich learning environments. They are able to be readily adapted for different farming systems and situations by using appropriate clothing, language and settings to ensure their relevance and acceptance to target communities (e.g. Fig. 2).

With increasing access to and adoption of mobile technologies, such tools can be readily disseminated both widely and cost-effectively. As such, they also have the potential to reach millions of farmers in developing regions and to provide valuable opportunities for learning and skills development.

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Second Life

Second Life is a sophisticated online 3D virtual world which provides a popular medium for creating movies (machinima) using gaming software. Second Life avatars (characters or 'actors') and settings can be readily contextualised by creating custom content or reusing items made by other users. Users retain copyright for any content they create and the Second Life internal currency, the Linden dollar (L$), can be used to purchase items from other users.

Second Life is currently used by a wide range of educational institutions, including universities, libraries and government agencies. For example, Virginia Tech Biomedical Imaging Division uses Second Life as a virtual training environment for the use of CT scanners; University of San Martin de Porres of Peru has developed Second Life prototypes of Peruvian archaeological buildings; and a number of countries (e.g. Sweden, Serbia, the Maldives) have Second Life virtual embassies.

In the context of this project, Second Life characters and machinima will be created to deliver consistent scripted conversations designed to stimulate discussion about using climate information to address climate risk. Once created, these can be readily adapted for different farming systems and locations by using culturally appropriate clothing, language and settings. As such, this platform has significant potential to provide relevant engaging technology rich learning environments which can be readily adapted to different situations and disseminated both widely and cost-effectively.

Fig. 1: Sugar cane harvesting discussion machinima screenshots

Fig. 2: Indian agri-climate discussion machinima screenshots

Challenges

Key questions addressed in this project include:

(i) whether this system is acceptable to Australian and/or broader international farming communities; and

(ii) whether such discussion support systems influence decision-making and make measurable changes in terms of on-ground outcomes.

This project is supported through the Australian Government's Collaborative Research Networks (CRN) program.

Discussion support via distance learning - 'eLearning' in Australia and India - provision of climate information through web-based 'discussion support' tools (courtesy APN, Kobe)

Discussion support via eLearning

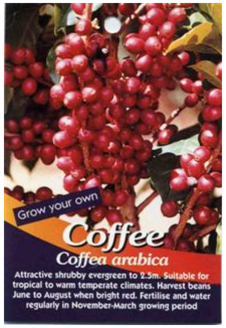
- Contextualized settings - Qld sugar cane farm & landscape
- Customised avatars – sugar farmers
- Back stories – incorporate decision-making types (Jorgensen *et al*. 2007)
- Decision making scenarios – can utilise decision support output
- Scripted conversations – incorporating industry Best Management Practices

Summary: A systematic approach in applying climate forecasts to decision-making (after Hammer, 2000).

•Understand the system and its management: it is essential to understand the system dynamics and opportunities for management intervention i.e. *identify those decisions* that could influence desired systems behaviour or performance;

•Understand the impact of climate variability (seasonal to decadal): it is important to understand *where in the system climate is an issue;*

•Determine the *opportunities* for tactical/strategic management in response to the forecasts. If forecasts 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?



- Evaluate the worth of tactical or strategic decision options: 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.

- 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 climate forecasting research in the NMHS/ State Agency/university: rather than just accepting a given climate forecast, consider what specific improvements would be of greatest value in the agricultural/hydrological/financial/industry system. This can provide some direction for the style of delivery of forecasts and for climate research of value for the particular sector.

- "Climate information doesn't have to be perfect to be useful; it just needs to support a decision" (Hammer, 2000; Hammer *et al*., 2001; Stone and Meinke, 2007; Rodriguez, 2010; Stone, 2012).

Conclusions…

- Climate forecast output and information has reached a mature stage in many regions: care must still be taken in relation to scale issues – spatial and temporal (eg: 3 month seasonal or intra-seasonal; local, regional, global?)

- Useful to provide information on forecast skill to users: but the key aspect will always be whether the SCF can **fit the management options available to the user**…if we miss this point the entire system can be seen by the user to fail..

- Seek out as many key decision-points as possible for a particular industry enterprise – and aim to meet these points with fully relevant information…

- Decision-support systems (DSS) and tools can be very useful: however, the best application of DSS maybe as a tool to be used within a broad <u>discussion</u> environment (eg: workshops – or even electronic media; 2nd Life etc).

- Provide as much information as possible back to the climate/ocean modellers/ forecast agencies (useful to have them all working together, perhaps in a dedicated institute) - Provide 'ownership' to the user of the climate forecast system – create a sense of empowerment..


THANK YOU
Acknowledgements:
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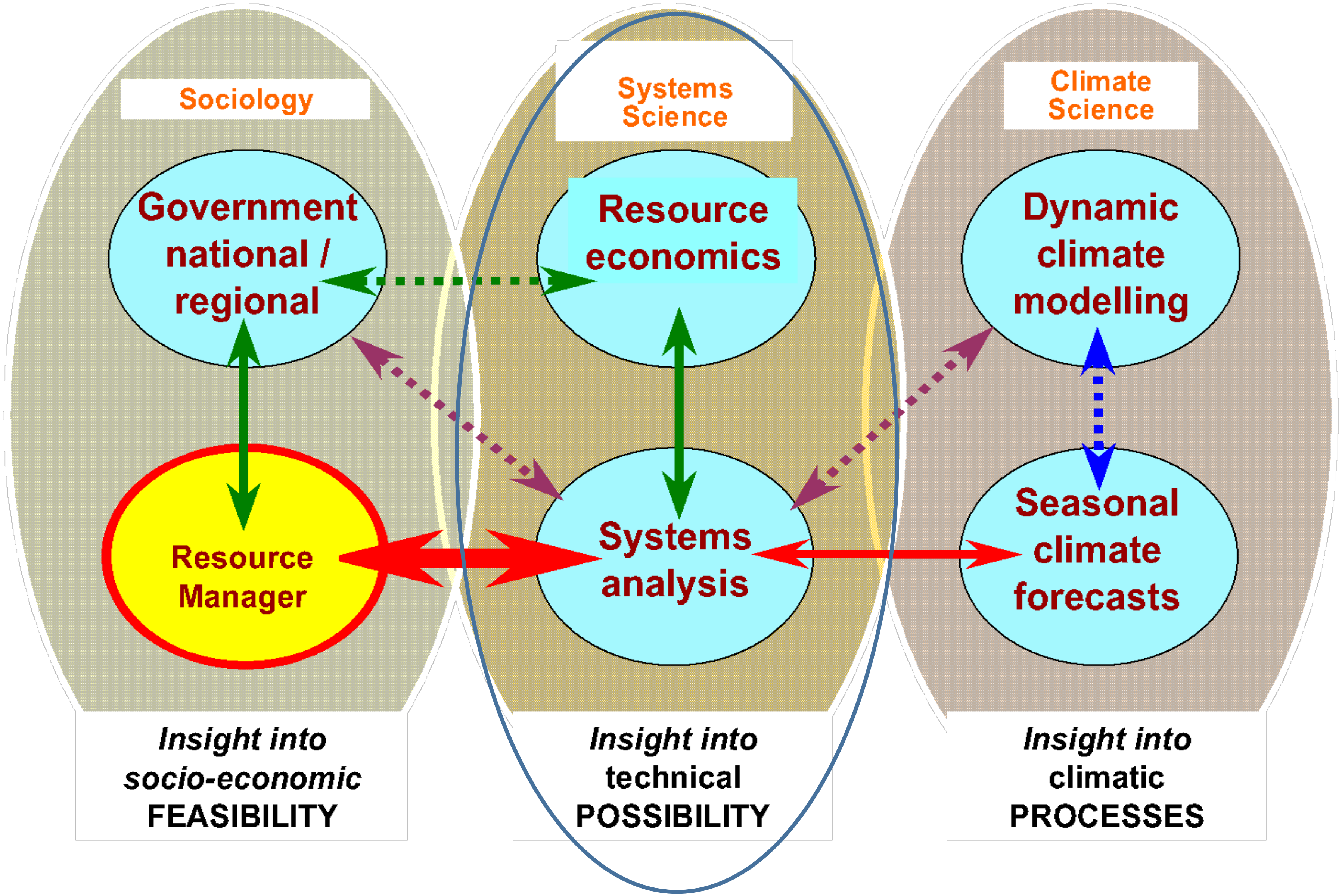
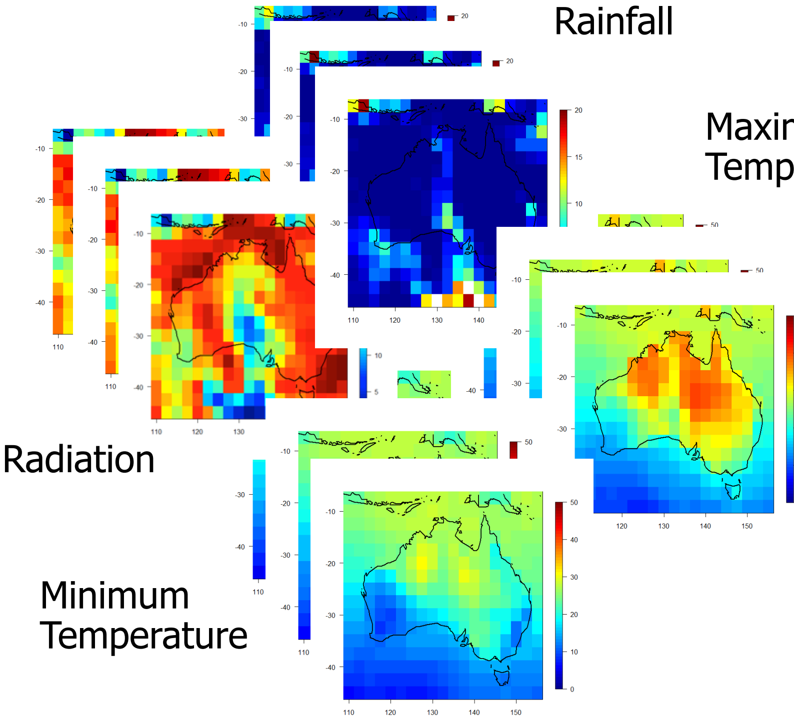
Managing Climate Variability Program
ECOM Agroindustrial P/L Singapore
Meat and Livestock Australia
Prof Yahya Abawi; Dr Kate Reardon-Smith

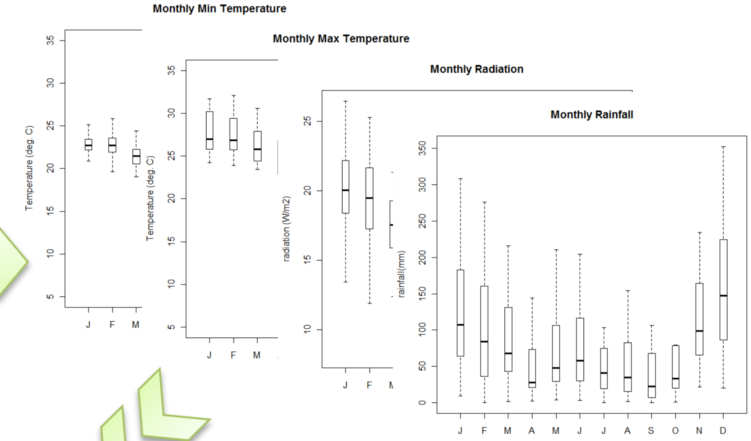


A dedicated centre? The need for an interdisciplinary, systems science approach : Aim to convert insights gained into climatic processes via systems analysis and modelling into the socio-economic feasibility of decision options (after Meinke and Stone, 2005). Need for a specialised centre or unit?

Multiple Gridded POAMA/UKMO (+ECMWF?) Realizations

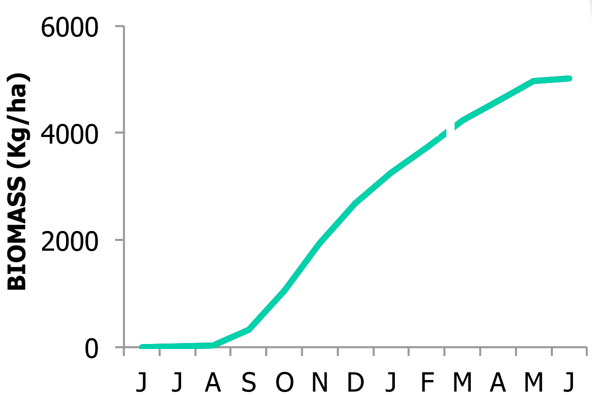


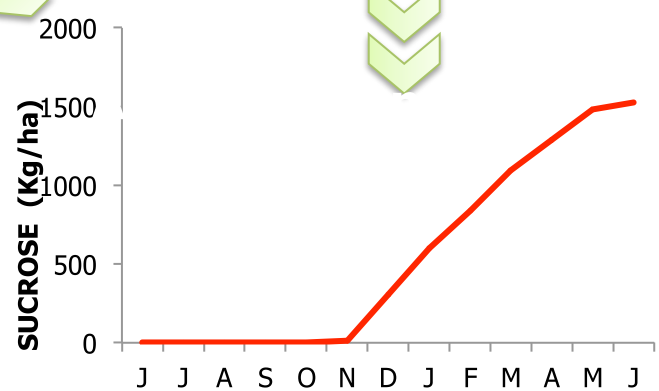
Distributions of Station Climate Data

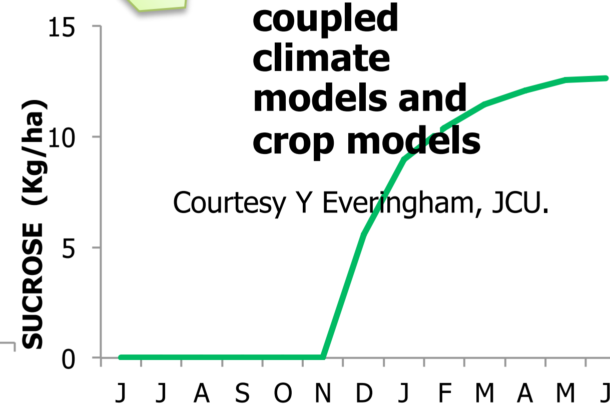


Run APSIM for each ensemble member for 30 years

AGRICULTURAL PRODUCTION SYSTEMS SIMULATOR







Key challenge: projects to develop linkages between fully coupled climate models and crop models

Courtesy Y Everingham, JCU.

Science-based tailored climate information - key requirement: stakeholder *involvement across the value chain*:

<u>Examples of various stakeholders</u> consulted within a focused meeting environment (Australian sugar industry) (also a need to recognise the differences in educational backgrounds):

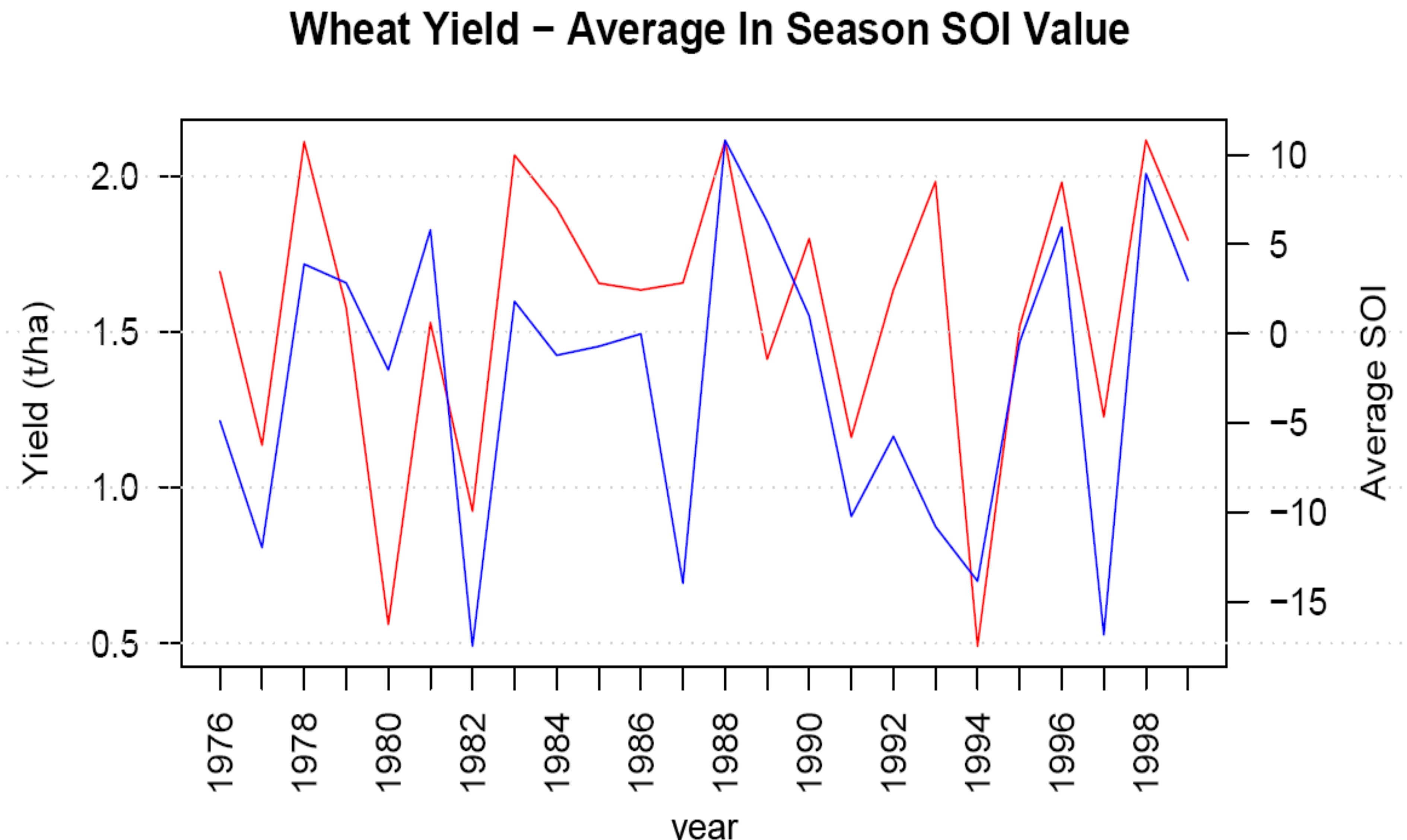
•Queensland Sugar Limited (exporting/trading agency; single desk selling),

•Queensland Cane Growers' Council plus *each of its local branch offices (grower representatives, plus other lobby organisations),*

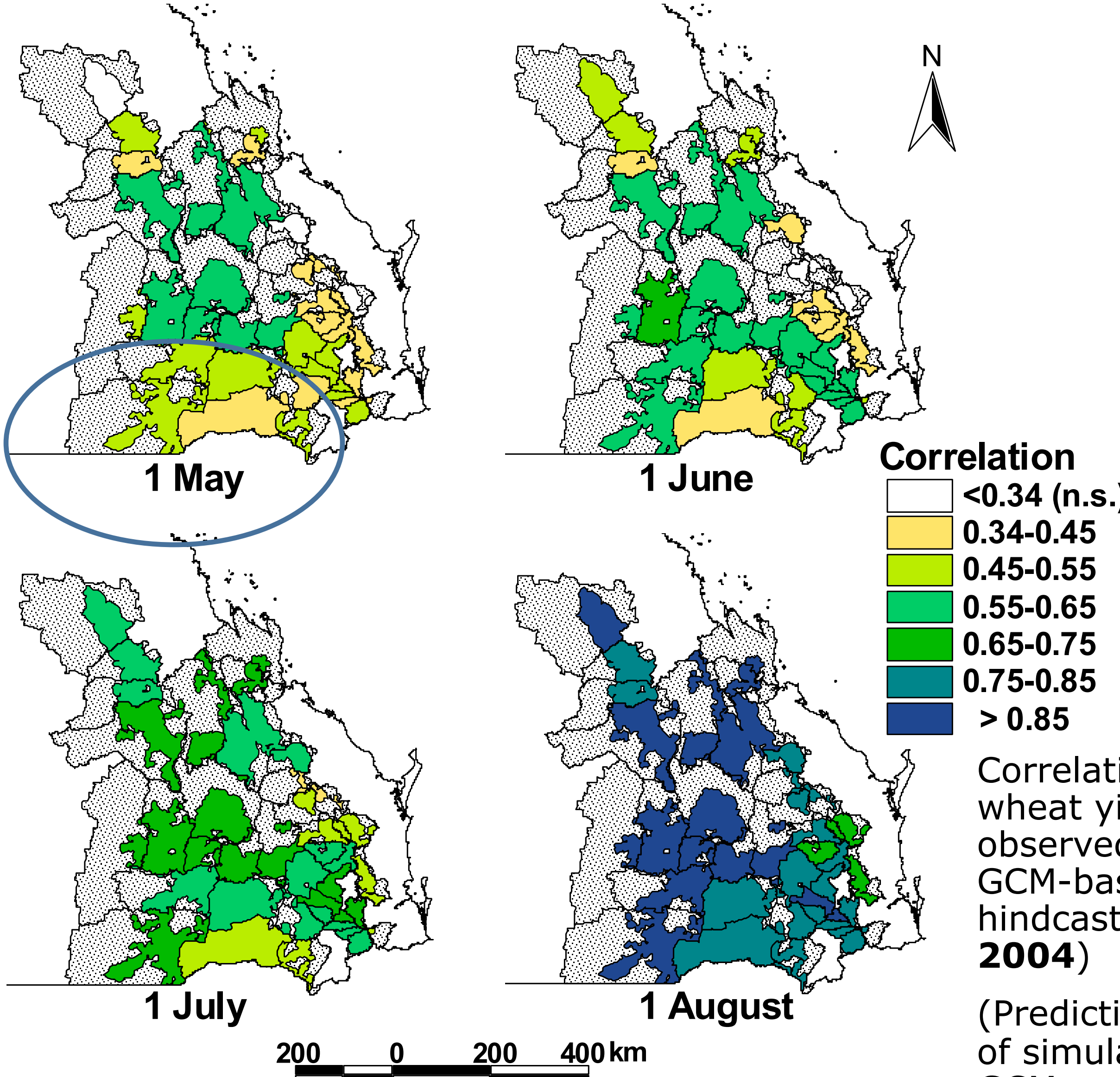
•Australian Sugar Milling Council (all the core sugar mills)

•Each of eight sugar mill managers: key operational/engineering staff

•Individual growers - often already known to the research project managers (Stone et al, 2012).



Value to insurance aspects (index based insurance) - Seasonal and longer term climate variation - relationship between annual variation in the SOI and annual Moree Plains wheat yield (Stone and Donald, 2007) Also value to growers if time to make decisions.



Using GCMs to predict wheat yields –

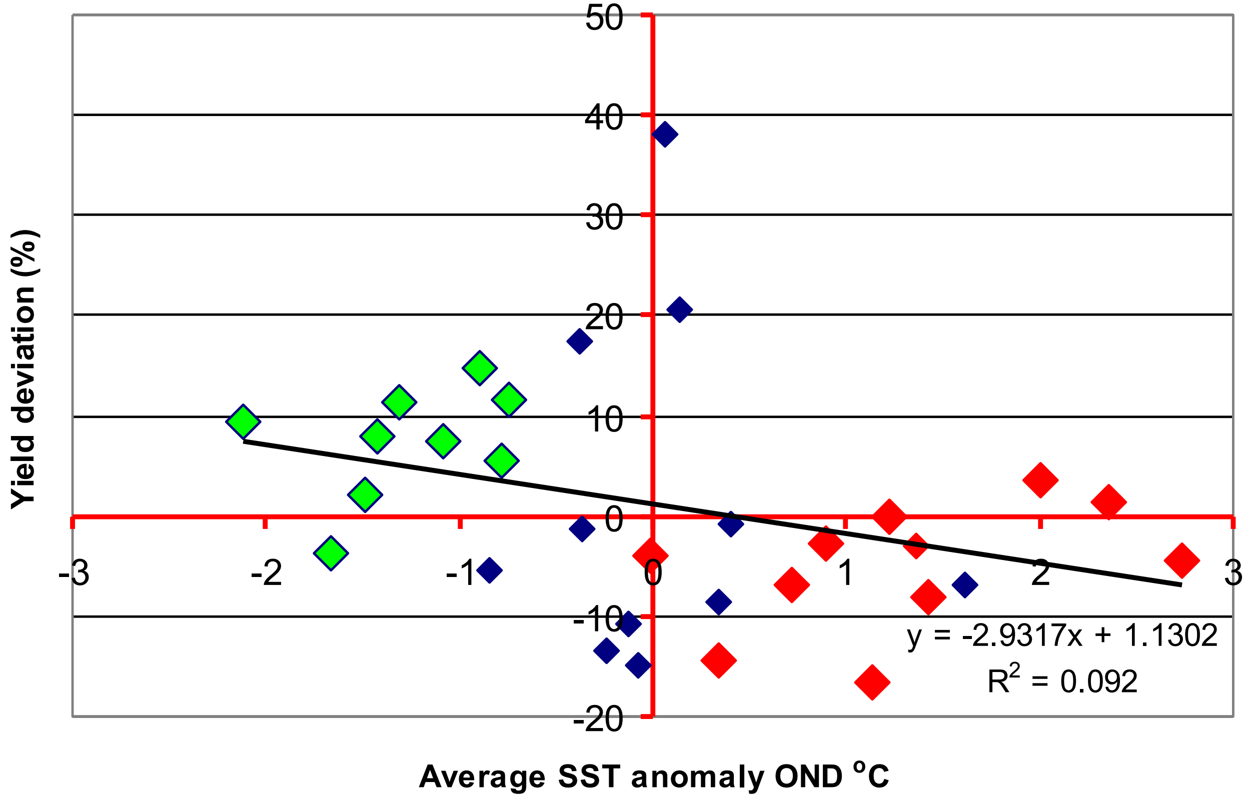
enormous value in just one month's extra lead time

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).

RESULTS
OBJECTIVE 1

Evaluate ENSO effects on Uruguayan Rice Production



National average yield deviations (1972-2003) Vs Average SST anomalies for October, November and December. Green dots La Niña Years, Blue Dots Neutral years and Red dots El Niño years (Roel, 2005)

COSPPac – Healthcare projects – **value of partnerships**
Climate Variability and Vector-borne Illness:
Malaria in the Solomon Islands

Outcomes:

• Malaria incidence from 1975 to 2007 was correlated with corresponding rainfall and temperature data over this period.

• **Variations in inter-annual malaria incidence and rainfall were found to be significantly correlated, with drier wet seasons leading to an increase in malaria incidence**.

• A prototype malaria early warning bulletin was trialled by the Solomon Islands Meteorological Service for an upcoming El-Niño event in 2009.

• **The project has strengthened *partnerships* between COSPPac and key international health organisations such as WHO, PacMI and the Red Cross, leading to a more coherent approach to climate risk management in the health sector**.

• The project has raised the profile of the National Meteorological Service and demonstrated the potential value of climate information in the health sector.

•It is expected that this will lead to implementation of an operational Malaria Early Warning System in in the Solomon Islands.

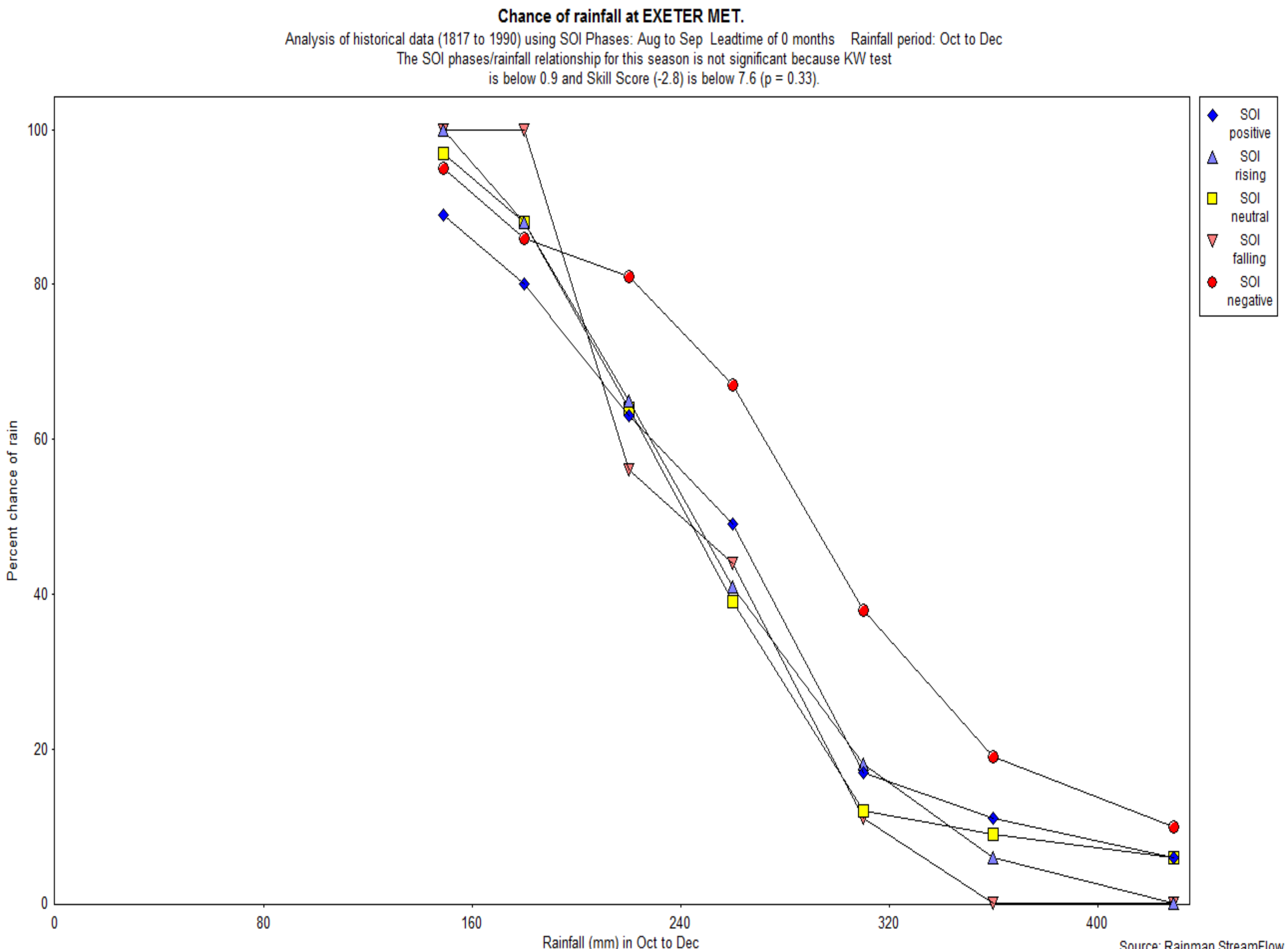
•The methodology could be further extended in other islands where malaria remains prevalent such as Papua New Guinea and Vanuatu (Abawi, 2012).

•PACIFIC ISLANDS JOINT PROJECTS – example of inter-country collaboration:

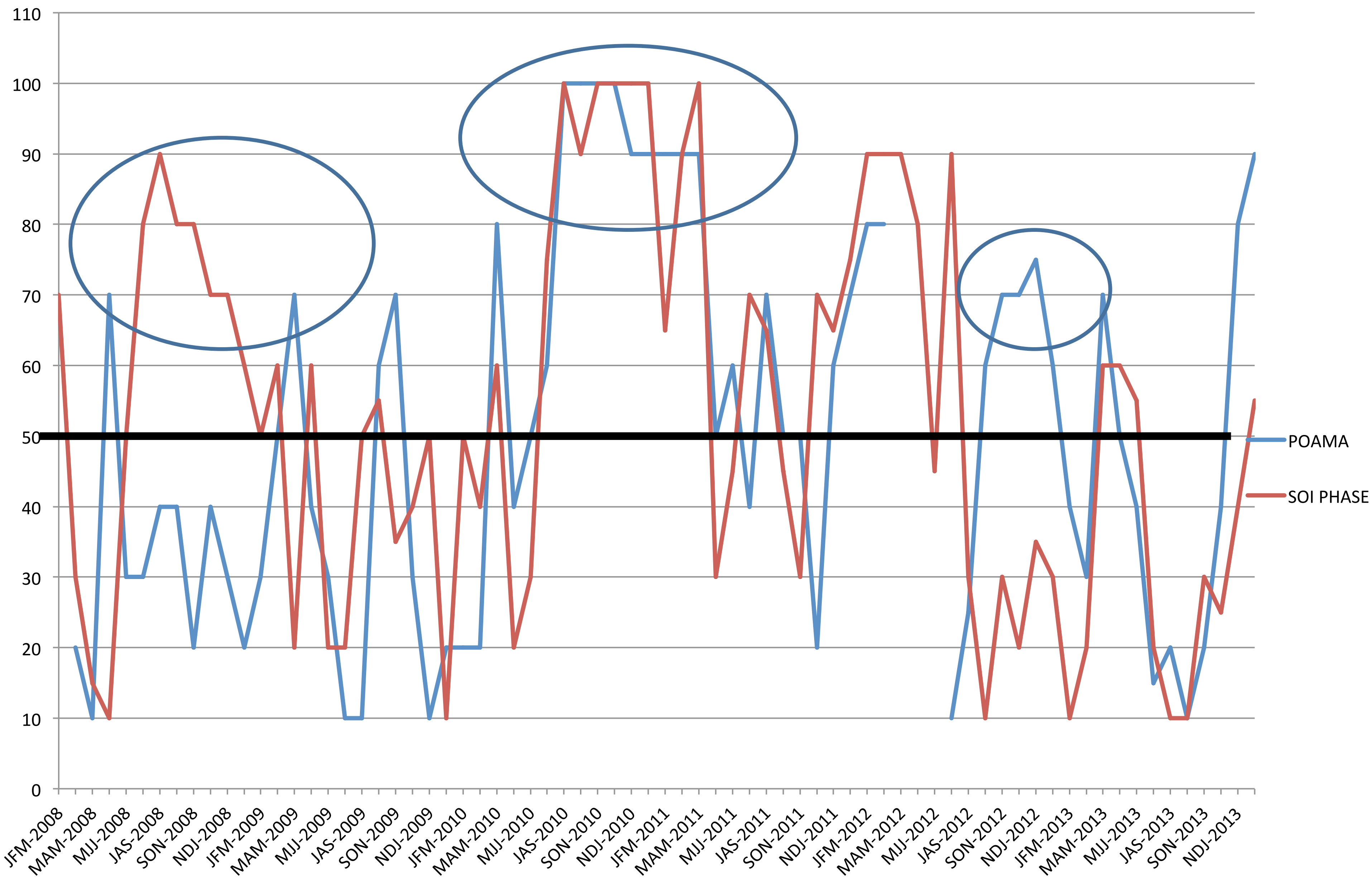
•Pilot Project: Application of climate forecasts for improved management of drought and crop production (sweet potato) in Papua New Guinea

•Pilot Project: Application of Climate Forecasting in Water Management ….

•Objectives: To develop the capability of NMS staff to provide climatological information including forecasts of droughts and their likely impacts on water resources to water agencies and other stakeholders through the enhancement of the SCOPIC software package.


Chance of rainfall at EXETER MET.
Analysis of historical data (1817 to 1990) using SOI Phases: Aug to Sep Leadtime of 0 months Rainfall period: Oct to Dec
The SOI phases/rainfall relationship for this season is not significant because KW test
is below 0.9 and Skill Score (-2.8) is below 7.6 (p = 0.33).
Percent chance of rain
100
80
60
40
20
0
0
80
160
240
320
400
Rainfall (mm) in Oct to Dec
SOI positive
SOI rising
SOI neutral
SOI falling
SOI negative
Source: Rainman StreamFlow


“The value of climate information and seasonal climate forecasts to users will depend not only on climate forecast accuracy *but also on the management options available to the user to take advantage of the forecasts*” (Nicholls, 1991).



Queensland region – POAMA and SOI phase-based statistical system

“Climate forecast information may have little value unless it changes a management decision” - utilising climate forecasts in decision making

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

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

Dot points:

MOHC GloSea4 / ECMWF data (SYSTEM3 from the ENSEMBLES project)

- Monthly forecast showing 7 months (or 214 / 210 days) outlook
- Quarterly forecasts showing 12 months outlook
- Forecasts from 1961 to 2005 (ENSEMBLES), GloSea4 to current
- 54 separate experiments per forecast
- 2.5 degree resolution

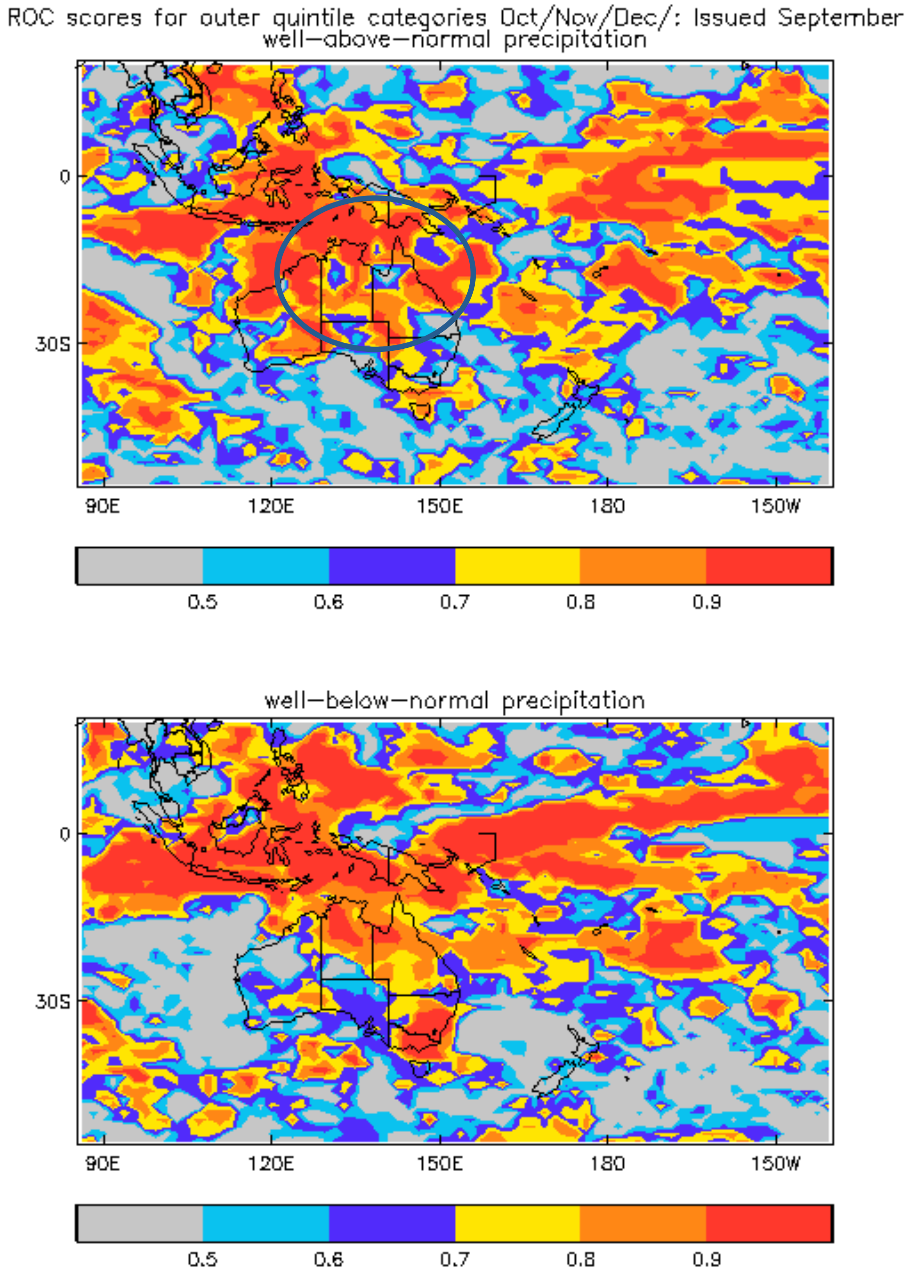
- Latest ECMWF SYSTEM4 data has 51 experiments at much higher resolution

- Downscale grid-scale outputs to paddock scale using Empirical-Statistical Downscaling (or other statistical or dynamical downscaling techniques), or
- initialize model using regional predictors from AWAP, leaving the predictions at a regional scale

- APSIM - Agricultural Production Systems Simulator
  - Models – Barley, Canola, Cotton, Sorghum, Wheat, Sugar, Rice, etc….
  - Climate input – Daily Tmin, Tmax, Rain, Radn, etc
  - Recalibrate models using hindcast data and/or bias adjust model data to match observed as models require initial conditions
  - 54 experiments = 54 separate model runs for each grid point throughout Australia / Global
  - Usage of recently acquired USQ HPC to perform each experiment asynchronously
- Outputs will mimic those produced by MOHC / ECMWF
  - Probability of Exceeding Mean
  - Probability for lowest 20%
  - Probability for highest 20%
  - etc


ఎస్.పి 1037
ఆచార్య ఎన్.జి. రంగా అగ్రికల్చరల్ యూనివర్సిటి హైద్రాబాద్
ంటర్‌నెట్ ద్వారా వాతావరణ ఆధారిత వ్యవసాయం పై
చర్చా కార్యక్రమం
తేది:29-09-2010
హసన్‌పర్తి జి॥ వరంగల్

The value of forecast verification forecasts for NE Australia (Oct-Nov-Dec) – capability to forecast well in upper or lower terciles (courtesy UKMO)..



Creating ownership of seasonal forecasting for users – discussion support – decisions - perhaps an example of interaction between NMHS, university researchers, extension specialists, agricultural specialists, champion farmers…..

Australian Sugar Farmer - Darren Reinaudo <u>22 April</u> <u>2002.</u>

‘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 Niño 3 region’.

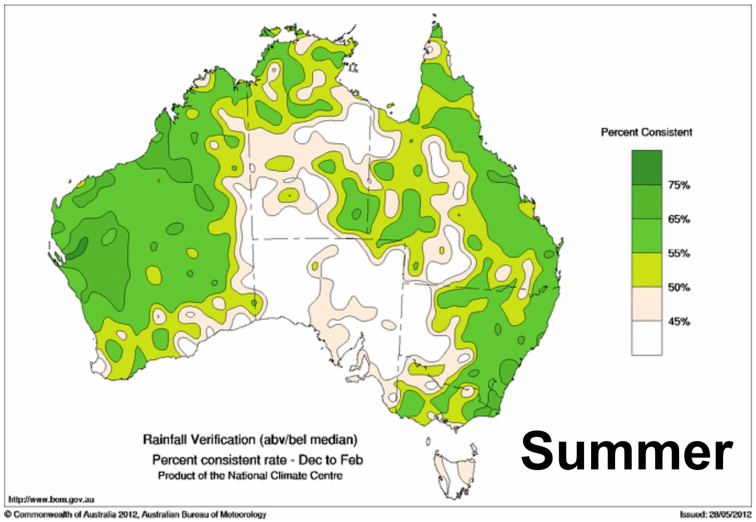
‘There is currently (2002) some indications of warming in the Niño 3 region which hints at a possible El Niño pattern’…..

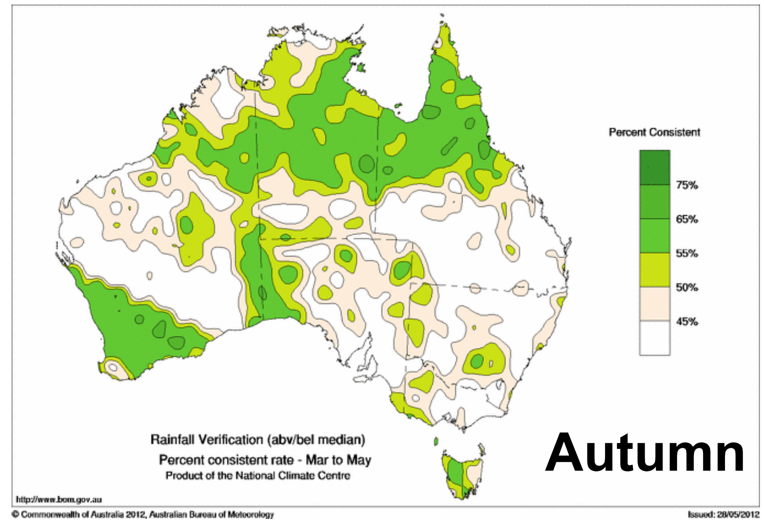
Decisions: Sugar-cane replant would be kept to a minimum

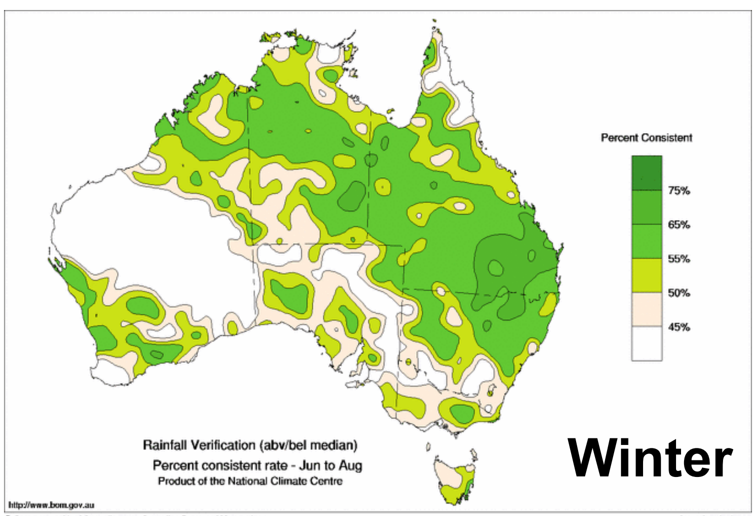
Harvest drier areas earlier, even if CCS may be effected.

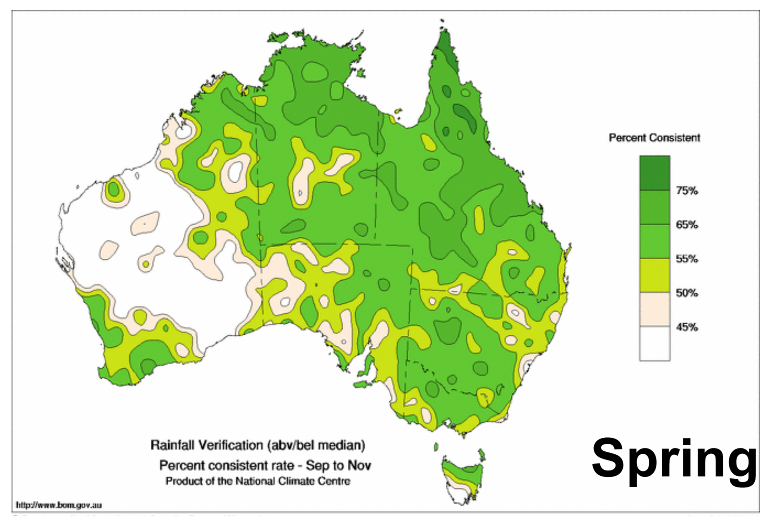
“We don’t run the farm based solely on climate information and forecasts, it’s just another tool to consider when making decisions”.

BoM SCO Model (Statistical) - Rainfall









Moving from statistical to dynamical seasonal climate outlooks

Andrew Watkins, Catherine Ganter, William Wang, Luke Garde, Andrew Charles, Milton Woods, Griff Young, Caroline Andrzejewski, Helen Bloustein, Luke Shelley, David Jones

Australian Government
Bureau of Meteorology

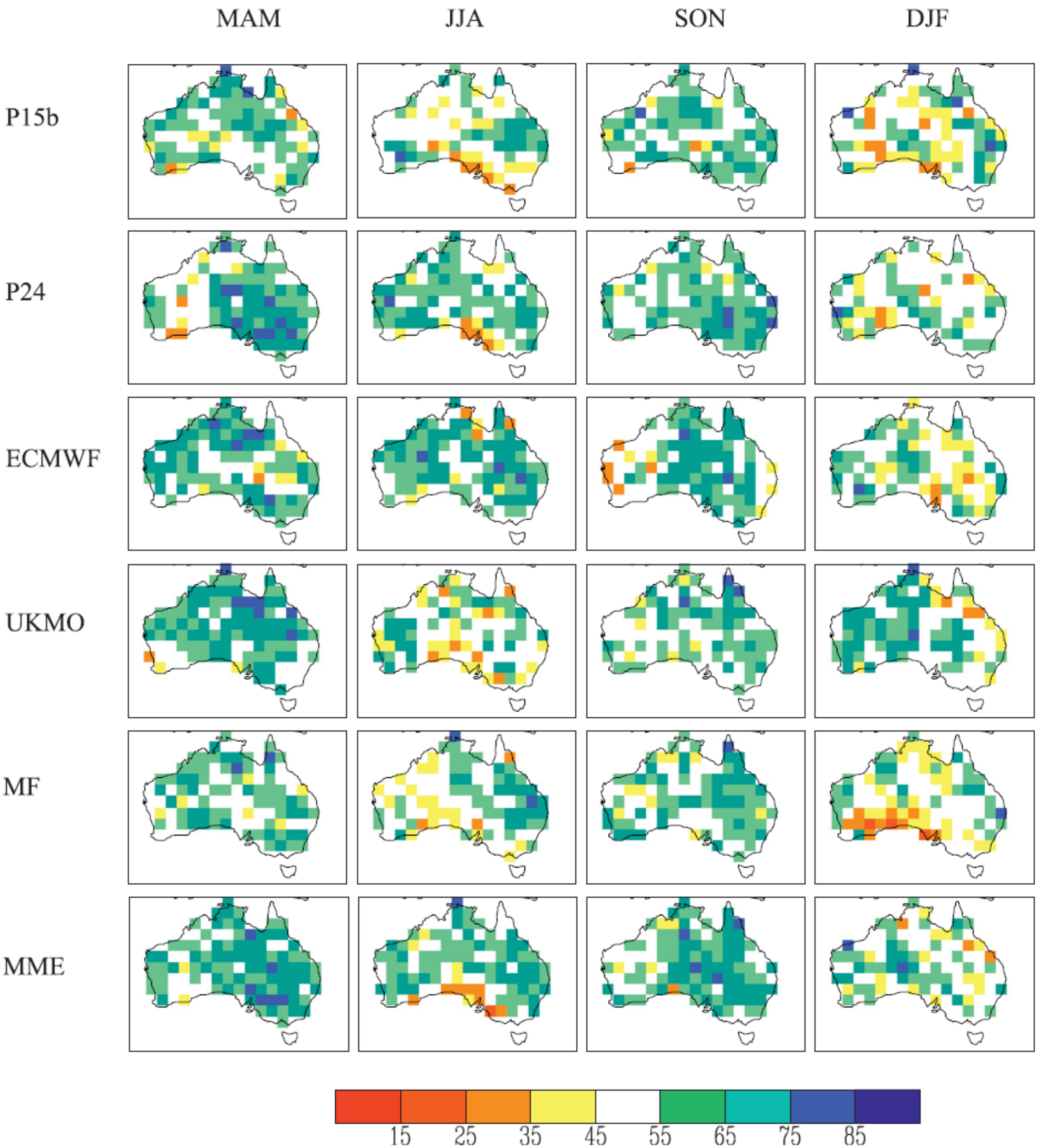


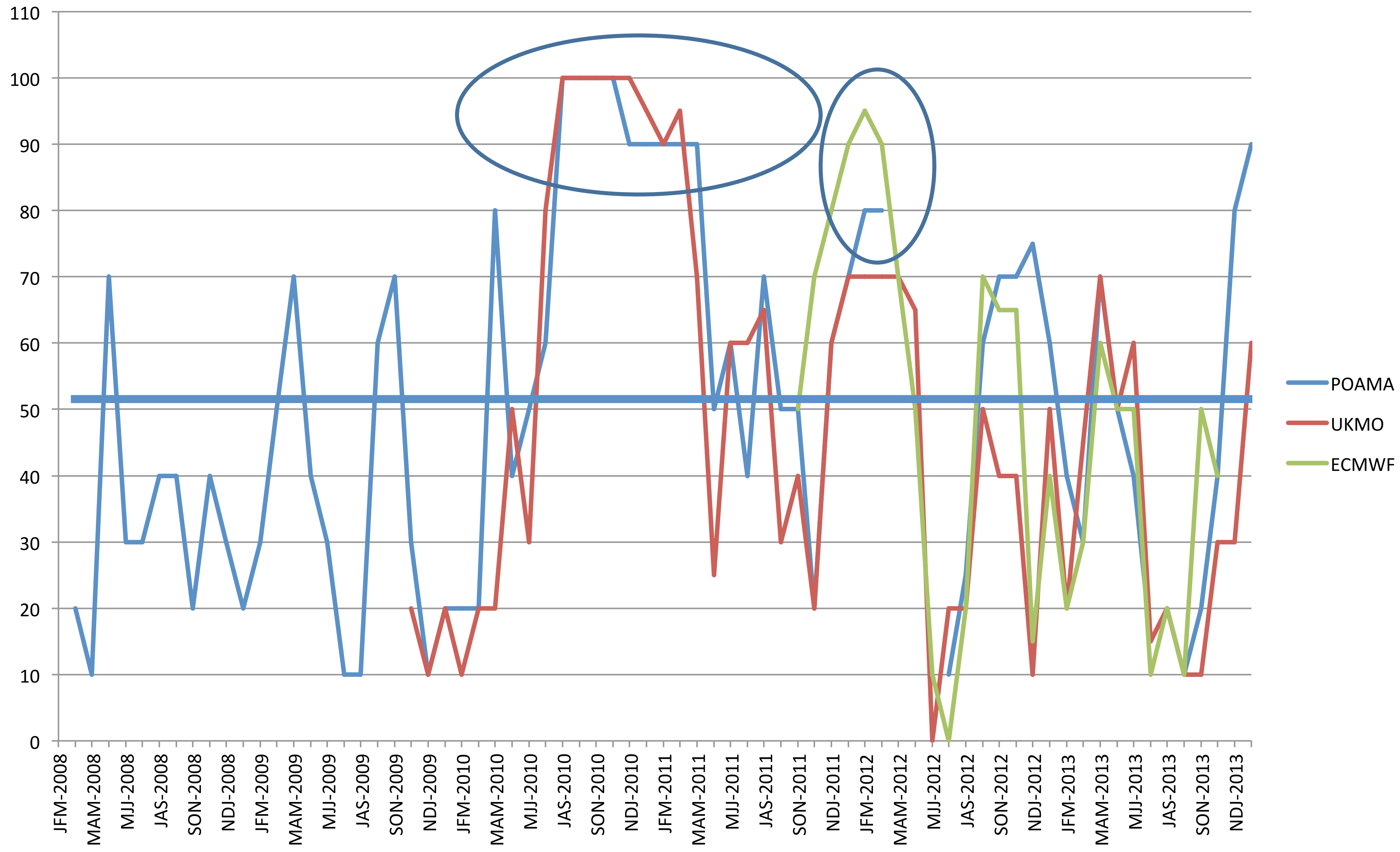
FIG. 1. Accuracy score for above/below-median seasonal rainfall for P15b, P24, ECMWF, UKMO, and MF models, and the multimodel ensemble using P24, ECMWF, UKMO, and MF models (MME; 54 members total). Lead time is one month. An accuracy score greater than 50%, as indicated by green and blue shades, is considered skillful.

Value in skill assessments.

Comparison of a number of general circulation models - including POAMA 1.5 and 2.4 - and their forecast skill over Australia: 1980

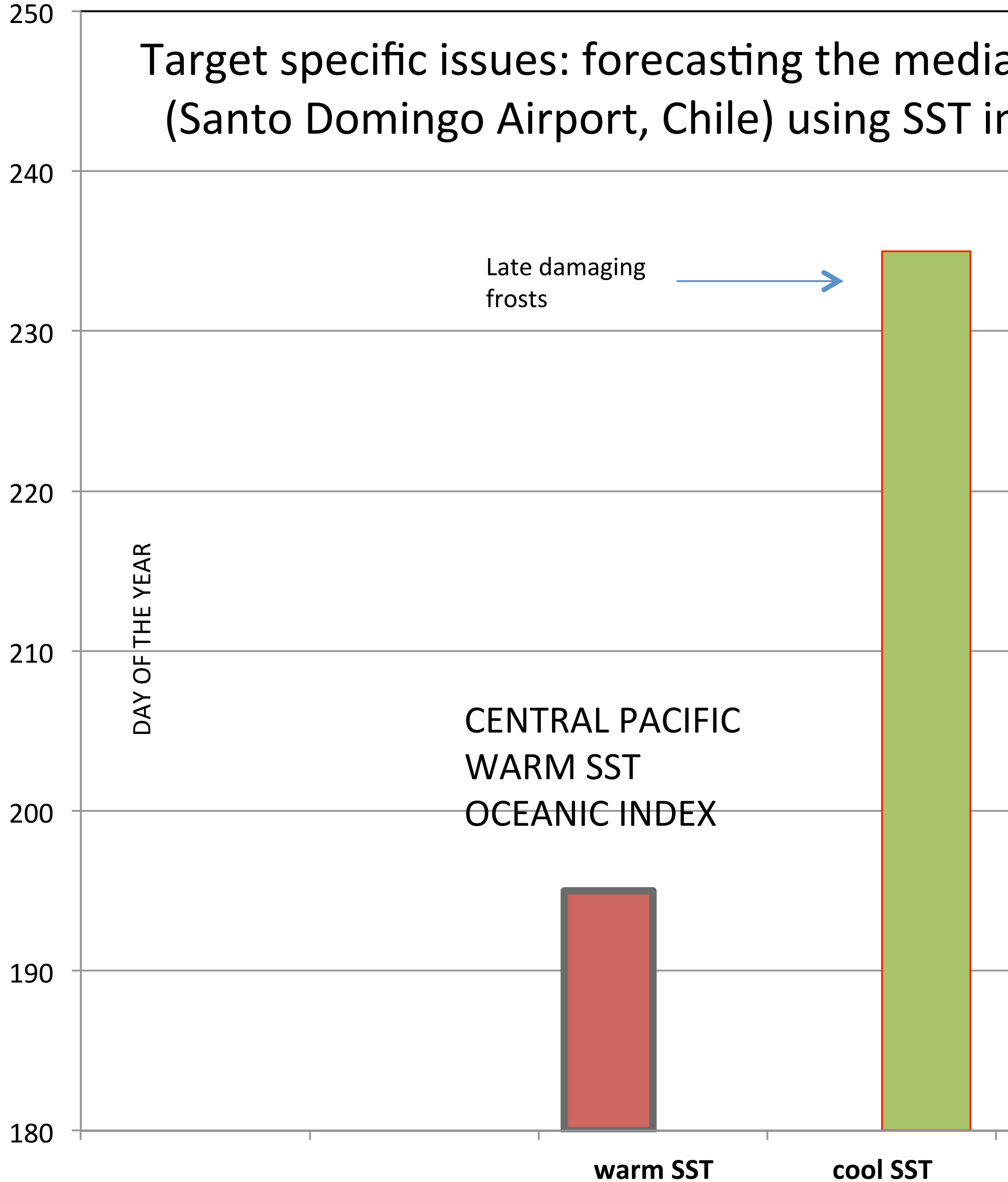
(Langford and Hendon, 2013)

The power of GCM-based forecasts – value of long lead times!!



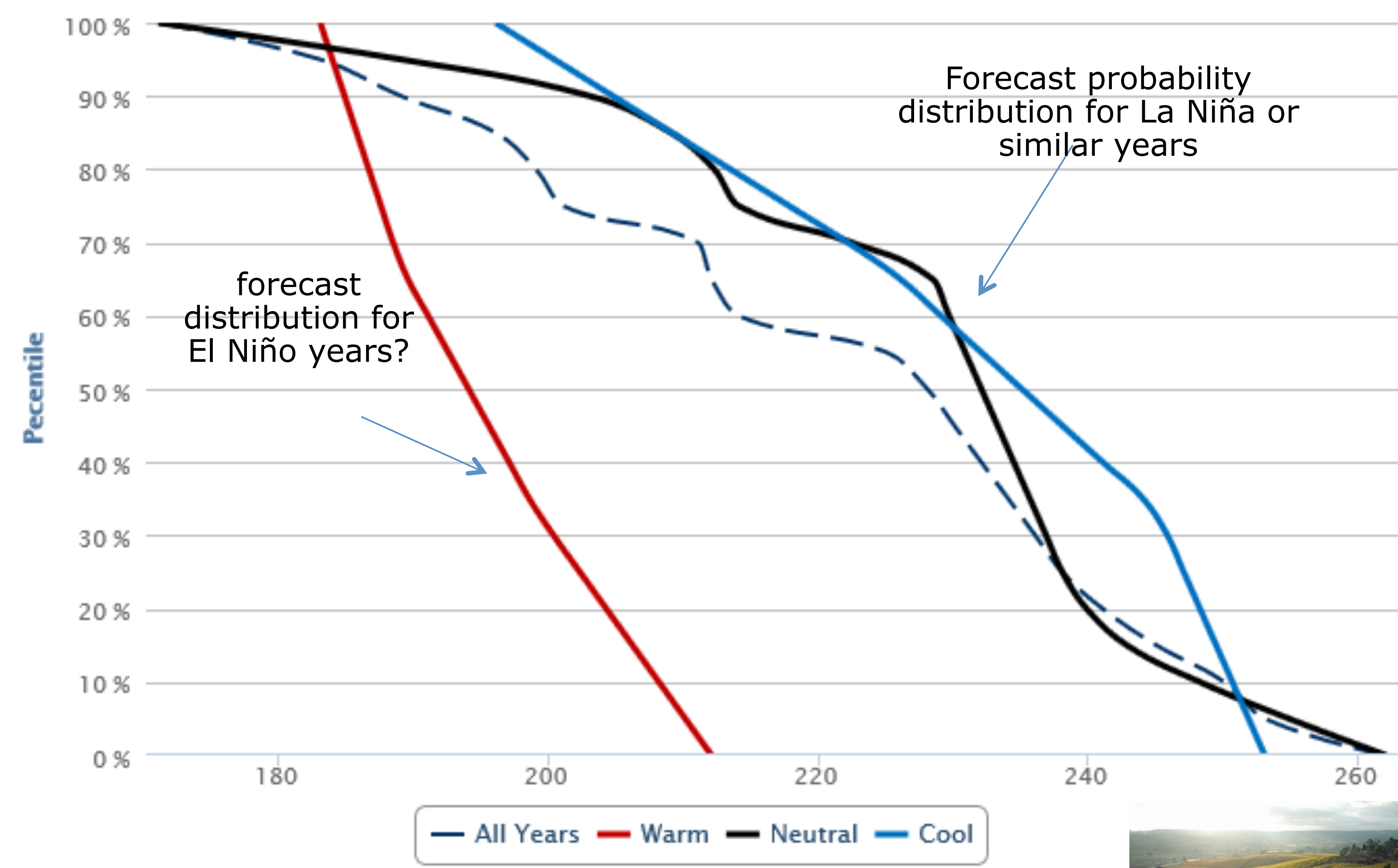
Pastoral regions verification – all GCMs - Queensland

Target specific issues: forecasting the median date of last frost (Santo Domingo Airport, Chile) using SST indices in <u>May-July</u>



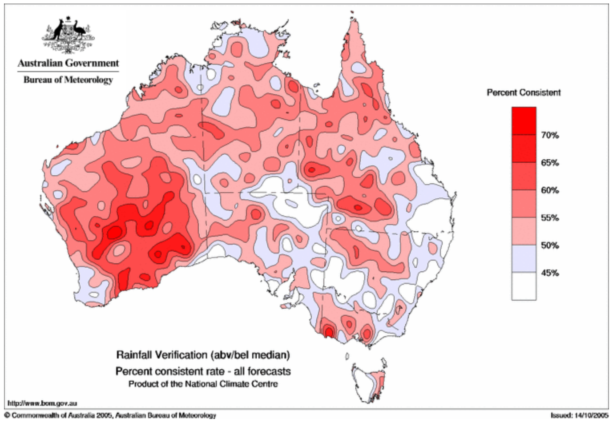
After Stone, Nicholls and Hammer, *J Clim* 1996)

Frost issues: Tailoring may require a variety of output approaches

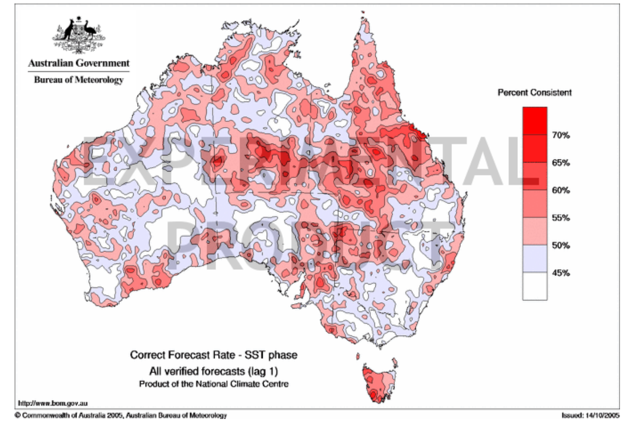


(after Stone, Nicholls and Hammer, 1996)

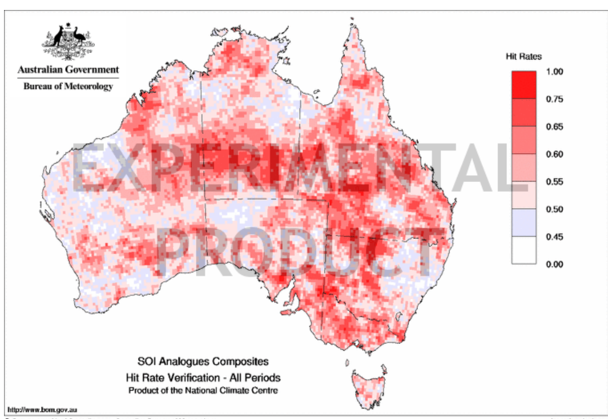
Statistical Climate Model Comparison – Real time hit rate verifications (BoM) – forecasting 3 month rainfall across all years studied.



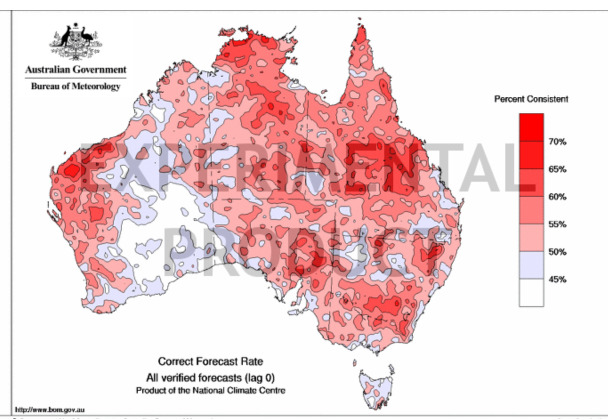
BoM forecast model (2c)
JJA 2000 – JAS 2005



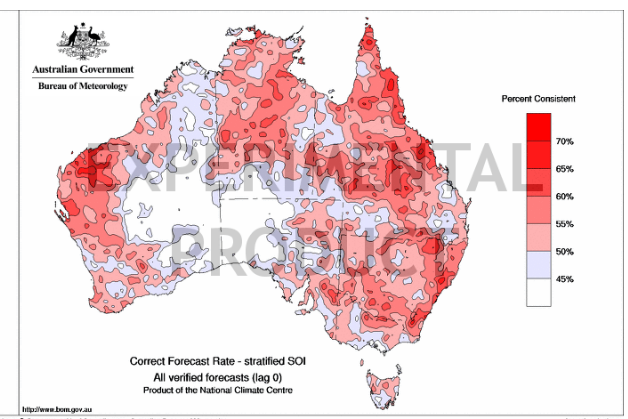
WLD SST phase scheme
JFM 2000 – JAS 2005



SOI analogues scheme
JFM 2001 – JAS 2005



SOI phase scheme (Stone)
SON 1997 – JAS 2005



3-cat. (+5/-5) SOI strat.
scheme SON 1997/JAS 2005