CliMag

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Friend or foe: flooded farmer still saves water for two years in advance

By Sarah Cole

Planning for dry times remains part of risk management planning

Linton Brimblecombe, Lockyer Valley vegetable farmer, was affected by the devastating floods in south-east Queensland earlier this year.

However, despite the extreme wet, Linton decided against changing his two-year water management plan. Normally, Linton manages water for the risk of extreme dry periods.

Linton's property is at Forest Hill, where he says he has noticed changes in extremes of temperature and rainfall over the years.

'That's why we store two years of water. That is part of my business risk management plan—having water security for two years', Linton says.

'If we get more rain, we could store just one year's worth of water and increase our productivity by watering more. But it's very difficult to predict seasonal climate changes and balance a water resource.'

Linton is aware that climate scientists are suggesting there will be more extreme weather events for Australia. However, he thinks that his region is already experiencing it.

Both climate and costs are driving on-farm change

Linton believes that on-farm responses to climate variability are linked to rising farm costs. 'There's a constant battle between climate variability and economic cost pressures in our farming operation. Which is driving which?' he asks.

'For example, for a grain farmer, as the cost of diesel goes up, it's cheaper to plough less. The farmer might change to minimum-till farming. But did the farmer change just because of cost or to retain more soil moisture?'

'It's hard to pick out whether climate change is a driver for increasing costs or whether costs help drive our response to climate variability', Linton says. 'I think we'll increasingly see on-farm climate change responses being driven by economic pressures.'

Photo: Econnect Communication

Linton Brimblecombe grows vegetables in Queensland's Lockyer Valley.

In this issue

MANAGING CLIMATE VARIABILITY R & D PROGRAM

Win-win:
how drought conditions can improve pastures and reduce salinity

John Ive is a Merino wool producer in the Yass Valley, half an hour north of Canberra. He is only one of a handful of ultra-fine wool producers in Australia.

The soil on John's property *Talaheni* is shallow, rocky and of poor quality. Most cropping soils, for example, can hold from 150 mm to 240 mm of rainfall. 'Our soils can hold about 60 mm of moisture', says John.

If the region does not get good rain in early autumn, John says the property is 'in for a pretty bleak winter.'

To make the best of these dry times, John has two moisture-saving strategies.

'We have to retain as much soil as possible to minimise the run-off and make sure we have the right mix of pastures so that they can use as much of the rainfall, whenever it falls', John says.

During the recent droughts, John restricted his sheep to the stony ridges of his property by opening and closing gates at critical times. They were hand-fed instead of grazing the more productive pastures.

This strategy had multiple benefits for John: the manure left behind helped regenerate the pasture on the hills quickly, which later helped reduce weeds and allowed the native tree seedlings to take over—promoting the natural regeneration of about 250 000 trees.

When the drought broke, the stock were moved back to the more productive, flatter pastures.


Photo: Econnect Communication

John Ive is an Merino wool producer in the Yass Valley.

Another challenge that John deals with at *Talaheni* is dryland salinity. The salinity was just one issue among others to fix when he bought the property. 'We needed to work on a lot of other things at the time, such as re-fencing and establishing pasture. We couldn't concentrate on just reducing salinity', John says.

But John says he always dealt with re-fencing and establishing pasture with salinity in mind. In this way, even restricting sheep to the rocky hills on his farm has helped—the regenerated natural trees on the ridges have drastically reduced this salinity problem, especially in lower paddocks.

Trees with deep roots absorb and use rainwater before it drains through the soil. If water drains through to lower levels of soil (a variable depth, but for example deeper than five metres) this is known as 'deep drainage'. Deep drainage makes the watertable rise. If the watertable is too high, it can bring salt to the surface, which can kill plants and adversely affect soil structure.

'Our flat paddocks, which were badly saline affected, have now recovered. Some of them now have our best pastures', John says. 'One paddock used to support only 2.5 sheep per hectare, but can now support up to seven sheep per hectare.'

Other advantages of the trees include:

- ground cover for areas which do not have good pasture potential
- shelter for stock and native birds


Photo: Econnect Communication

The long view: using climate outlooks to manage a mixed enterprise

Royce Taylor is a farmer at Lake Grace in the south-west of Western Australia.

He crops wheat and barley, and some canola, lupins and peas. He also runs Merino sheep.

Royce says they have had some hard years lately—two droughts, and the year before that, a bad frost. 'We were lucky. Our country is a little bit more tolerant to frost. But we still needed to be wise in our decisions', he says.

For Royce's cropping enterprise, he has used four main strategies to cope with the extreme droughts and reduce losses:

1. *Implement a very tight nitrogen-fertilising regime*. Royce does soil testing, puts nitrogen on at seeding and then tops up nitrogen levels later. He says: 'It means a little more work for me, but that's ok if it means more dollars at the end of the day.'
2. *Sow at a reduced seeding rate*. Even if the season is good, Royce says, the yield is still good, with extra grains in each head. 'If the season is a bit drier, it won't stress the crop as much at the end', Royce says.
3. *Be vigilant to spray weeds in summer*. Royce keeps on top of the weeds to retain precious soil moisture. 'Not losing the moisture far outweighs cost of the chemicals, and it's common practice to do this now.'
4. *Carefully watch rainfall outlooks*. Royce says: 'We go on rainfall, looking at the decile ratings for rain, and compare them to what stage the crops are at.'

'If we make these small changes, we can back off on the risk. We work with the season to save as many dollars as we can. We look for every little advantage we can get', says Royce.

'The biggest thing is planning to minimise expense so you're not throwing money away. We try to only feed our crops when they need it.'

Royce says it is not like a typical year's routine. 'We watch what happens instead of putting the usual amounts of fertiliser on,' he says.

As for dealing with his sheep during the droughts, Royce sent half of them off farm for agistment. His property had very little ground cover during and after the droughts.

'We needed to take the pressure off the farm. The pastures are recovering nicely now. I think you need to be proactive and send sheep away or sell them. One place I saw that still had sheep: that farm's topsoil just blew away because there wasn't any stubble left.'

Royce says he still had expenses to agist his ewes, but that was outweighed by the benefit of keeping his topsoil.

While it may seem that farmers are conservatively planning for the worst, Royce has a long-term plan for making the best of the good years, too.

'We have a long-term plan for the land and we are expanding our off-farm investments where we can, when we can afford to. It gives us safety', he says.

Royce Taylor uses paddock planning to manage risk from climate extremes.

Climate Kelpie is a website for rounding up tools for Australian farmers. You can learn about weather, regional climate, and also find decision-making tools for climate risk management.

Photo: Econnect Communication

Peter Holding runs a mixed cropping and sheep operation in south-east New South Wales.

Do you want to learn about your local climate?

Peter Holding, a participant in the Climate Champion program, runs a mixed cropping and sheep operation at Harden, in south-east New South Wales.

He uses Climate Kelpie <www.climatekelpie.com.au> for checking out weather forecasts, learning about his region's climate drivers, and more.

Peter finds that Climate Kelpie is a good shortcut to finding climate information—'especially if you're just starting out.' It will lead you to Bureau of Meteorology websites and other sites. 'Climate Kelpie also explains what different climate terms mean', Peter says.

'The Climate Kelpie website links to the main model I use on-farm: the 8-day forecast <www.climatekelpie.com.au/see-forecasts/weather-and-climate-forecasts#WATL>.

'I'm also trying to get a handle on the Indian Ocean Dipole <www.climatekelpie.com.au/understand-climate/defining-climate-terms/indian-ocean-dipole> as well', Peter says.

But the weather sites <www.climatekelpie.com.au/see-forecasts/weather-and-climate-forecasts> are the main ones that Peter keeps an eye on.

'Then you'll have a better understanding and can make up your own mind about the weather', Peter says.

Anybody that is interested can visit Climate Kelpie and get information about weather, climate and decision-making tools.

Project updates

The following table lists our current projects.

Project title	Time	Summary of research objectives	Progress to date	Research contact
Improving seasonal forecasts for south-west WA Project now complete	2008–11	Increase the accuracy and value of seasonal forecasts for farmers in south-west WA.	Australia's seasonal climate forecast model, POAMA, has proven skill at forecasting seasonal rainfall in the southern part of the WA wheat belt. However, its skill in the northern part of the wheat belt is only marginal. In these regions where POAMA has skill, the value to farmers in adjusting N application is more than $50 per hectare, providing a realistic, conservative N strategy is used. With this knowledge from south west WA, more research will continue where POAMA forecast skill can further advance. This will be by improvements to modelling methods and rain bearing weather simulation systems and reductions in climatological model biases.	**Dr Peter McIntosh** Centre for Australian Weather and Climate Research Peter.Mcintosh@csiro.au 03 6232 5390
Critical thresholds and climate change impacts/ adaptation in horticulture Project now complete	2009–11	Understand the critical temperature thresholds for specific horticultural crops and production regions in Australia. Identify commodities and/or regions which will be significantly impacted by increasing temperatures. Assess the impacts and resilience of production systems and/or regions, and identify adaptation strategies to address these impacts.	The key outcome of this project is a better understanding of the temperature thresholds affecting lettuce, cauliflower, banana, apple, citrus, pineapple, tomato, macadamia, capsicum, sweet corn, avocado and pumpkin; and the impact further temperature rises will have on these crops in a changing climate. Growers have managed past climate changes quite well and are optimistic they will continue to manage projected temperature increases into the medium-term future. After 2030 the vegetable industry is forecast to become more vulnerable because of reduced seasons. More adaptable varieties will be the long-term solution where agronomic practices are not appropriate or cost-effective.	**Dr Peter Deuter** Department of Employment, Economic Development and Innovation (DEEDI) peter.deuter@deedi.qld.gov.au 07 5466 2233
Extremes, climate modes and reanalysis based approaches to climate resilience	2008–10	Use the latest atmospheric reconstructions of the last century of worldwide weather to help manage extreme weather events in Australian agriculture. Management options include adaptation, insurance, seasonal forecasting and future strategic projections for heatwaves, hail and other exceptional circumstances.	The project has used the newly-created record of 135 years of gridded weather information to characterise several severe weather risks relevant to Australian agriculture. Many extreme measures have statistically robust and widespread associations with reconstructed regional climate indices and more local parameters such as soil moisture. These associations between extreme measures are used to price prototype business continuity insurance contracts that provide payouts based on weather triggers, not demonstrated loss.	**Dr Peter Best** University of Southern Queensland cindualpk@bigpond.com 07 3844 1777
Assessing and managing heat stress in cereals	2008–13	Investigate the meteorology and climatology of spring heat events on the southern grains wheatbelt. Develop a risk management package for growers.	During 2010, heat chambers were used to heat wheat at six different growth stages—from stem elongation, through flowering and grain fill, to early grain ripening. This season, researchers will focus on the influence of water stress on yield loss, suffered after a single heat-shock event. In addition to using the custom-built chambers for applying heat in the field, a number of pots have also been planted to replicate the field heat event in a controlled environment chamber. Researchers will also continue to examine the weather patterns and climate drivers behind heat events.	**Dr Peter Hayman** South Australian Research and Development Institute (SARDI) peter.hayman@sa.gov.au 08 8303 9729
Teleconnections between climate drivers and regional climate, and model representation of these links	2010–13	Improve Australia's dynamical forecasting by investigating the connection between rain-bearing weather systems and remote climate drivers, including the El Niño - Southern Oscillation, the Indian Ocean Dipole, the Madden-Julian Oscillation, subtropical ridge and Southern Annular Mode.	Recent work has identified the cut-off low as the most important weather system for growing-season rainfall in south-east Australia. Diagnostic software has been developed that can automatically recognise cut-off lows in data and models, permitting a comparison of observed and modelled cut-off lows. Work on the simulation of cut-off lows has been performed for Tasmania. It has highlighted the difficulty that climate models have in simulating cut-off lows and atmospheric blocking.	**Dr Peter McIntosh** Centre for Australian Weather and Climate Research Peter.Mcintosh@csiro.au 03 6232 5390

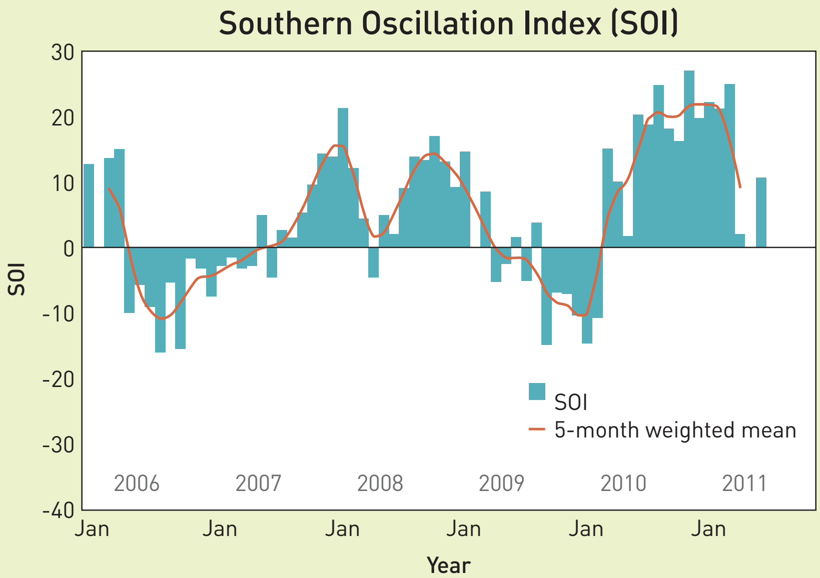
Project title	Time	Summary of research objectives	Progress to date	Research contact
Improving forecast accuracy through improved ocean initialisation	2010 –13	Improve predictions of conditions in the Indian Ocean and ultimately predictions of regional climate for western, southern and eastern Australia.	The project has shown that POAMA-2's skill is similar to the leading international coupled models, but like other models, skill in the Indian Ocean is significantly lower than skill in the Pacific Ocean. The project has shown that it should be possible to increase the skill because a large proportion of the variability in the Indian Ocean is being driven by the Pacific Ocean where there is skill. A new observing system is being investigated.	**Dr Oscar Alves** Centre for Australian Weather and Climate Research O.Alves@bom.gov.au 03 9669 4835
Improving multi week predictions	2009 –12	Improve POAMA's weather predictions for 2–8 weeks ahead to make them more useful to agriculture and water management industries.	POAMA-1.5 shows promising skill for multi-week forecasts. Rainfall is best predicted in winter and spring and over the east and south-east of Australia. Forecast skill is improved during extremes of the El Niño - Southern Oscillation, the Indian Ocean Dipole and the Southern Annular Mode. Work is now underway to upgrade POAMA to version 2. Initial results suggest that enhancements to the new version will further improve the reliability of rainfall and temperature forecasts over Australia.	**Dr Debbie Hudson** Centre for Australian Weather and Climate Research D.Hudson@bom.gov.au 03 9669 4796
Understanding frost risk in a variable and changing climate	2010 –12	Improve understanding of the variability and changing nature of frost risk at both seasonal and decadal scales for the southern regions of Australia, and implications for the wine and grain industries.	The project has sourced hourly, three-hourly and daily climate data from the Bureau to link synoptic patterns with frost occurrences. Data from 18 locations has been analysed to identify trends in minimum temperatures, number of frosts, cold wave duration, frost season length and proportion of days less than the 10th percentile minimum temperature. Also, 30 years of data has been analysed for six key sites (including Nhill, Horsham, Hopetoun, Ouyen, Walpeup and Mildura) for the period 1956 to 1987. Preliminary results show that in almost 80% of cases, frosts in September to November occurred in association with high pressure systems situated to the west and south of the station locations.	**Dr Steven Crimp** CSIRO Steven.Crimp@csiro.au 02 6242 1649
Climate drivers and synoptic features—NSW, NT and Tas Project now complete	2010 –11	Improve understanding of the links between climate drivers and synoptic features. Describe the climate drivers for the remaining states and territories (NSW, NT and Tas) and provide examples of key synoptic features from the Bureau's record of key weather events.	The climate drivers for NSW, NT and Tas are now available on the Climate Kelpie website: www.climatekelpie.com.au/understand-climate/weather-and-climate-drivers	**Ceri Lovitt** Bureau of Meteorology C.Lovitt@bom.gov.au 03 9669 4859
Multi-week forecasting products (for the Water and the Land website)	2010 –13	Using multi-week forecasts identified under the 'Improving multi-week predictions' project, make new forecasting products available on the Bureau's Water and the Land (WATL) website. The products will be tested by farmers participating in Managing Climate Variability's Climate Champion program.	The project is developing draft climate products for discussion and review by Climate Champion participants over the next few months. An online survey has been distributed. The Bureau has used an inflation of variance technique to give realistic model spread, and make a realistic 'high', 'low', and/or a range forecast possible. Initial results are encouraging, with clear improvements over the raw model output. The Bureau is also scaling the results using observed data, giving an 'Australian Water Availability Project (AWAP)-like' high resolution grid of real-world-comparable forecast values.	**Dr Andrew Watkins** Bureau of Meteorology A.Watkins@bom.gov.au 03 9669 4360
Understanding frost and heat stress extremes in the WA wheatbelt	2010 –13	Quantify the extremes and impact of frost and heat stress on the WA wheatbelt. Link with the frost and heat stress projects underway in SA and Vic to improve understanding of frost and heat stress across southern Australia.	Better simulations of regional variation of temperature extremes and weather patterns for both current and future climates have been made using Murdoch University's Weather Research and Forecasting regional model. Experiments at three grain areas of WA have also been set up to study temperature extremes in the field and analyse the risk associated with its occurrence.	**Dr Ian Foster** Department of Agriculture and Food, Western Australia ifoster@agric.wa.gov.au 08 9368 3333

Predicting 'flooding rains' and cyclones

By Jenni Metcalfe

After a season full of extremes of weather and with Queensland hard hit by devastating floods and cyclones, it is interesting to look back and see how good the forecasts were before the havoc.

Source: Bureau of Meteorology



The La Niña experienced in 2010–11 was the second strongest on record after 1917–18, and 2010–11 was the fourth very wet season in a row for Queensland. For more information on the Southern Oscillation Index and Queensland's climate drivers, visit the Climate Kelpie website: www.climatekelpie.com.au/understand-climate/weather-and-climate-drivers/queensland

'In early October last year we went public with the expectation that there was a strong chance of floods and cyclones in Queensland', says Jim Davidson, Queensland Regional Director of the Bureau of Meteorology (the Bureau).

'A combination of factors made us feel confident in these predictions. It had been very wet throughout Queensland up to that time and the La Niña was at record, or near-record, levels. Moreover, the sea surface temperatures off northern Australia were also at record levels and the Madden-Julian Oscillation was in near-record territory.

'Then, to put the lid on the trends showing above-average rainfall over summer, the Bureau's National Climate Centre predicted 60 to 80 per cent above median rainfall for a good deal of Queensland.'

Jim believes the Bureau was able to make such confident predictions because the signals, especially La Niña, were so strong.

'If we are headed into a neutral season, it's not so easy to make predictions with the same level of confidence', he says. 'It would be difficult to provide useful information for districts and communities, especially about rainfall.'

But even when the signals are strong, the climate and weather models are not yet able to forecast reliable rainfall predictions for localised areas such as the south-east corner of Queensland. They work better at a larger scale, such as the southern half of Queensland.

'However, the models are improving and it has surprised me how good they can now be at times', says Jim. 'For example, with Cyclone Yasi, the better computer models were showing—seven days before it made landfall and even before any cloud clusters were evident—that a cyclone would form well east of Fiji and move towards the north Queensland coast. We didn't have that level of predictability until very recently.'

Dr Blair Trewin, a senior climatologist with the Bureau's National Climate Centre, agrees. He is working to sort out the historical database on cyclones, which relies mostly on satellite observations since the 1970s.

'The historical information gives us a better handle on what changes occur over time and helps us to make better seasonal predictions', he says. 'We can look at the historical relationships between cyclones and El Niño and La Niña. For example, Australia gets more cyclones in a La Niña year, whereas the central Pacific countries get more in an El Niño year.'

In the past, numerical weather prediction models could not handle tropical cyclones but now they are getting much better at predicting a cyclone and its intensity.

The Bureau's forecasters and climatologists are using a suite of global climate models, along with the Australian ACCESS model, which also includes POAMA (Predictive Ocean Atmosphere Model for Australia) to make forecasts. If different models are showing similar weather patterns, especially in successive model runs, then the Bureau can attach a fair level of confidence to its predictions. If not, then the atmosphere is seen to be chaotic in nature, with low predictability.

'Each situation is different and it depends to some extent on whether the atmosphere is chaotic or predictable in nature', Jim says. 'The 'Holy Grail' is of course the perfect forecast. Over time, the Bureau will improve its models, home in on significant threats and give more advanced warnings. Improving the models is an incremental but steady process.'

For Jim Davidson's report to the Queensland Flood Commission of Inquiry: *Meteorological and hydrological overview of the widespread rainfall and flooding in Queensland during December 2010 and January 2011* see: www.tiny.cc/DavidsonFloodReport

Contact: Jim Davidson, Queensland Regional Director, Bureau of Meteorology
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[1] The Madden-Julian Oscillation is a large-scale, slow-moving band of increased cloudiness that travels eastwards in the tropics. For more information see: www.climatekelpie.com.au/understand-climate/weather-and-climate-drivers/queensland#MJO

Outstanding warning performance for severe Tropical Cyclone Yasi

Tropical Cyclone Yasi offers a great example of how early warnings and community preparedness can help reduce the impacts of natural disasters. One indirect death was recorded as this very significant storm moved over a populated stretch of the Queensland coastline in February.

Yasi made landfall at the southern tropical coast near Mission Beach between midnight and 1am early on Thursday 3 February 2011.

Computer modelling gave forecasters excellent guidance on which to base their forecasts for Yasi.

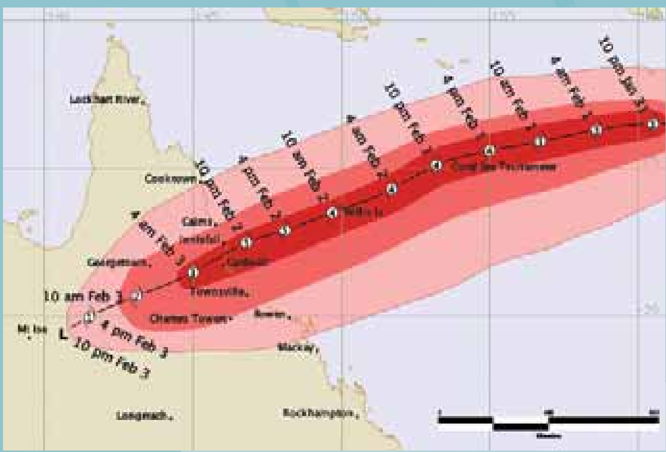
As early as seven days before landfall, and three days before Yasi even formed, guidance was suggesting a major cyclone would affect the tropical Queensland coast. This allowed forecasters a chance to give a very early 'heads-up' to potentially affected communities.

On 30 January the system was named by the Fiji Meteorological Service. Satellite data was used to monitor its location and to estimate intensity while information was shared between the Bureau of Meteorology and the Fiji Meteorological Service.

On the morning of 2 February, Yasi passed over the Willis Island Meteorological Office giving forecasters valuable radar, wind and pressure observations and also confirmed the strength of the cyclone.

Closer to landfall, radar, satellite, automatic weather station data and cooperative observer reports helped to assess the current location and intensity of the system. This information was then used to structure warnings—issued on an hourly basis—around the time of landfall.

More information on Tropical Cyclone Yasi can be found at the Bureau of Meteorology website: www.bom.gov.au/cyclone/history/yasi.shtml



Source:
Bureau of Meteorology

Tropical Cyclone Yasi was predicted seven days before it hit south of Cairns and before any cloud had formed in the atmosphere

Australian farmers need better forecasts

By Ian McClelland,
Chair, Managing Climate Variability

We have all heard of the so-called devastating droughts in Europe or the United States in the past. Surprisingly, when their harvests are measured, the decreases in production are usually no more than 15 to 20 per cent below average yields. But when we experience a drought in Australia, production can decrease by as much as 50 per cent nationally.

Australia has the dubious distinction of having the greatest coefficient of variation of rainfall of anywhere in the world. In the Victorian Mallee where I live, the variation is even greater than for the rest of Australia's grain-growing regions.

This variation in rainfall is probably the greatest challenge that farmers have to manage on their farms. Making the most of the good years, limiting the losses in the bad years and knowing the difference is the ultimate challenge.

Australian farmers have learnt to be resilient to this variation in rainfall by being flexible in their production systems. Many have learnt to use every millimetre of water—by storing it through stubble retention and by total weed control. And they have the knowledge and skills to increase inputs when the wet seasons come.

The dream of having more accurate multi-week and seasonal forecasts cannot be overstated. Even though our short-term forecasts are now highly regarded, seasonal forecasts still have some way to go, and Managing Climate Variability research investments are helping make this a reality.

Photo: Econnect Communication

Ian McClelland, pictured at the Climate Champion workshop in South Australia earlier this year.

Research that can turn prediction into profit

Improved forecasting in northern Australia for the all-important onset of the rainy season

By Alison Binney

Come 2013, the agricultural industry across northern Australia will have access to better weather forecasts and climate prediction methods for the onset and variability of the rainy season.

Early estimates presume that as a result of the new research, increased profitability could total in the millions of dollars industry-wide, and more than 2000 farmers across northern Australia could benefit. This includes in excess of 200 sugar cane farmers, 300 grain producers and 1500 graziers.

Senior research scientist Dr Matthew Wheeler, from the Centre for Australian Weather and Climate Research (CAWCR), is leading the work supported by Managing Climate Variability on monsoon-related predictions on a multi-week to seasonal timescale.

The purpose of the research is to investigate, with a specific focus on agriculture, the climate variability and predictability in tropical Australia. The ultimate goal is to improve the simulation and prediction of this variability, which will in turn improve the forecasts.

Dr Wheeler and Dr Wasyl Drosdowsky, fellow climate research scientist at CAWCR, are looking at improving the prediction outputs of the Predictive Ocean Atmosphere Model for Australia (POAMA).

POAMA is a dynamic modelling system that uses physics to simulate the atmosphere and ocean. Advances in the forecasting skill of POAMA will mean more accurate multi-week and seasonal forecasts.

Developments in the forecasting skill of dynamic models, together with knowledge of the El-Niño - Southern Oscillation and the Madden-Julian Oscillation (MJO) climate drivers, will then guide the delivery of monsoon-related climate prediction products.

Being able to replicate the week-on-week monsoonal variability in weather and climate models is necessary to simulate and accurately predict the all-important onset and break periods of monsoons.

'Amazing progress has been made in dynamic modelling of monsoon intraseasonal variability, but there is still a lot of work to do to be able to realise the full potential of these models', Dr Wheeler says.

The MJO is a key climate driver to watch

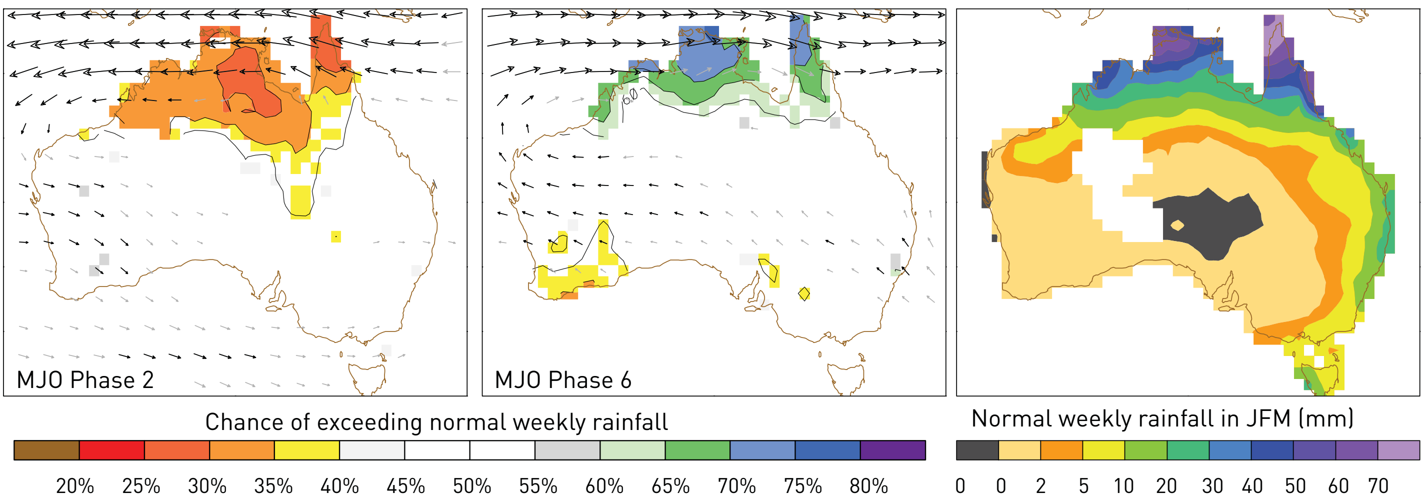
Previous research work on the forecasting of intraseasonal variability by Dr Wheeler has shown that there is a strong correlation between intraseasonal variability and the MJO climate driver.

'The MJO is the most dominant source of intraseasonal variability in tropical regions and provides an important source of predictability', Dr Wheeler says.

The phases of the MJO are a significant area for researchers to extract useful information from, that will help improve predictions.

'One interesting detail is that during MJO Phase 4 (during the northern Australian wet season), there is often a tendency for wet conditions to extend from northern-central Australia all the way down to the south coast of South Australia near Adelaide. This is an interesting aspect of the MJO-rainfall composites that could be exploited for prediction', says Dr Wheeler.

For this project, Dr Wheeler aims to use POAMA and this increased understanding and predictive capability of the intraseasonal-to-seasonal surface climate over tropical Australia.



The maps show monsoon rainfall changes associated with the extreme 'dry' (Phase 2) and 'wet' (Phase 6) phases of the MJO. These were computed using weekly rainfall values from the January-February-March seasons 1974–2009. Also shown are the alternating easterly and westerly wind anomalies at the 850 hectopascal level (about 1.5 kilometres above the ground). Making use of this existing knowledge of the rainfall changes associated with the MJO will be part of this project.

The longer-term view is that characterising monsoons will become a routine process of POAMA and of multi-week forecasting.

Probability maps will be tailored for northern Australia

In 2007 researchers met with landholders and industry groups in northern Australia to find out how they could deliver better forecasting products for the area's wet season. Ultimately, farmers want prediction products that allow them to make decisions with lower risk.

The resulting products that northern-Australian agricultural industries will have access to include maps showing the:

- wet season onset and whether it is occurring earlier or later than normal
- likely breaks or bursts of the monsoon weather patterns
- other improved climate attributes such as predicted rainfall, wind and temperature

The major benefit for the Australian agricultural sector, according to Dr Wheeler, is for growers to have access to information which will enable them to make better informed decisions, which will in turn increase profit.

For the grazing industry, better decisions can be made about mustering times, stocking strategies and fire management. For horticulturalists, timing of harvests and irrigation can be better scheduled. For those in the sugar cane industry, plans for harvesting, milling, chemical or fertiliser applications, or property developments can be better controlled.

Dr Wheeler says that there is still a lot of work to be done to improve monsoonal forecasting capabilities. He has been researching weather behaviour in the tropics for more than 18 years and says there are some fundamental issues that drive the research. These include:

- a lack of theories that can describe monsoon behaviours
- the inability of models to robustly simulate observed features
- a need to develop prediction frameworks that focus on the timescales of a monsoon

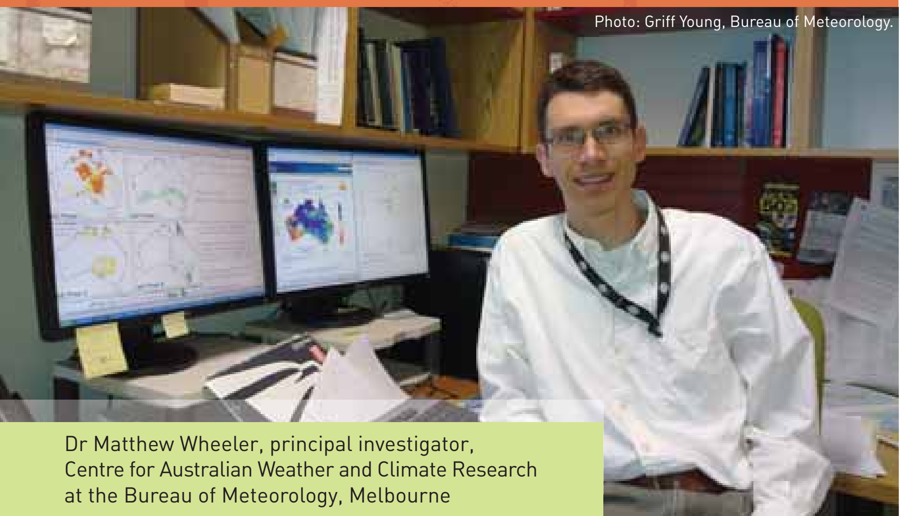


Photo: Griff Young, Bureau of Meteorology.

Dr Matthew Wheeler, principal investigator, Centre for Australian Weather and Climate Research at the Bureau of Meteorology, Melbourne

User testing will measure the success of the products

The products developed from the research are expected to be available in early 2013 at the Bureau of Meteorology's Water and the Land website. Dr Wheeler says use of the website plus Bureau surveys and feedback from the agricultural industry will be used to measure the success of their work.

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For more information: www.bom.gov.au/climate/mjo/

From the farm to plant and climate science

Introducing Managing Climate Variability's new science coordinator: Dr Beverley Henry

Growing up on a tomato and veggie farm at Redland Bay on the southern outskirts of Brisbane, Dr Beverley Henry has always been interested in plants and how they respond to stresses such as water shortage.

'I remember Dad battling drought with our tomatoes, beans and cabbages', she says. 'For me it was a natural progression to study plant physiology to understand the impacts of stress factors on plant function and growth.'

After gaining her PhD in plant physiology at the University of Queensland, and a break while raising four children, Dr Henry went on to the Australian National University to research the effects of climate and increased carbon dioxide on plants. This was followed by positions with the Queensland Government, including the Queensland Climate Change Centre of Excellence. One of her key achievements during this time was to coordinate AussieGRASS, a national pasture growth and rainfall program for drought management.

'Working on AussieGRASS reinforced to me the importance of forecasting. I have a strong interest in climate and sustainability, and that's what attracted me to working with Managing Climate Variability', she says.

More recently, Dr Henry worked for a few years as manager of Meat & Livestock Australia's Sustainability and Climate Change program and now works half-time for the Institute of Sustainable Resources (ISR) at Queensland University of Technology. Her ISR research seeks to better understand greenhouse gases, the impacts of climate on productivity of agriculture and to provide policy and land managers with useful information. She believes that while the current political focus on climate change is confusing for many farmers, it also provides an opportunity to do more about climate risk management.

'You can't draw a line to separate climate variability and change—they merge over the timescales that farmers have to make decisions on. We can take advantage of the focus on climate change to look at better managing variability. We can also integrate managing climate risk into the broader research- and land-management agenda. This will mean working with farmers, scientists and conservation groups to reach a shared understanding.'

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Climate forecasting
—how good will it get?

By Colin Creighton, departing as Managing Climate Variability science coordinator, June 2011

Photo: Colin Creighton

Cyclone Ului—an extreme event for the Eungella Tableland and 10 per cent of Colin's hoop pine plantation.

Sometimes just for curiosity, when I'm out at sea sailing the reef or using a GPS to map my forestry plantation, I check how many satellites are being received. The number is rarely less than nine —so position fixing is more accurate than we ever thought possible, than even a few years ago.

Of course, these satellites do much more than just tell me there is a rocky islet nearby. The satellites are part of a global array of sensing instruments, including buoys that drift in our oceans while automatically submerging, recording, and then resurfacing and transmitting ocean temperature profiles to balloons drifting across the atmosphere or to weather stations. Supercomputers, which are getting more 'super' each generation, translate this vast array of data into increasingly accurate climate forecasts. What is the prognosis for the next 10 years, and how accurate is it?

Firstly, let's dwell a moment on climate change. Globally, the climate has always changed, but what is compelling and creating imperatives for policy, research and development (R&D), adaptation and mitigation is the speed of climate change and the projections for further change. I believe the evidence is compelling about human impacts on climate. The evidence also suggests to me that we could talk equally—and in more basic language—about reducing pollution and seeking efficiencies in our use of energy, fertiliser and water.

So let's recognise there is climate change and focus on what is compelling and important for agriculture, which is responding to climate variability. Climate variability is the timescale for most of our current actions and most of our industry and management needs.

For years we have talked about climate risk management and now we talk about 'adaptation', which is the same thing in different words. On farm, two of the main risks are commodity price and weather—after all, without the right weather, there's no crop, and without the right price, no profit.

Our climate forecasts are already far more skilful than our commodity price forecasts and they are getting better all the time, which is where the remote sensing array and supercomputers come in. Increasingly, we have the data to be much more empirical in our forecasting. We are gaining the inputs to run competent dynamic climate models. Of course, the models need to continually improve (and they do) but the bottom line remains that our weather and climate forecasts are getting more and more skilful.

Using weather as an example: 10 years ago in the southern hemisphere, our skill in weather forecasting two to three days out was debatable. Now we are very confident in getting it right four days out, and sufficiently confident to be able to deliver seven-day forecasts skilful enough for on-farm use. With investment from the Australian Government, seven-day forecasts will be rolled out to all of Australia over the next few years.

Our multi-week forecasts, the area where Managing Climate Variability (MCV) R&D is principally focused, are also improving dramatically. I anticipate that with our investment, the work of the Bureau of Meteorology, and CSIRO 'smarts', we will have competent forecasts for four weeks out available within the next four years.

However, with significant additional investment over the next five years, we could also deliver:

- climate forecasts for at least eight weeks out, with 70 per cent (or better) prediction accuracy, Australia-wide and at spatial scales suitable for user application. These will complement the seven-day weather forecasts.
- climate forecasts from eight to 16 weeks out, of varied but explicitly detailed accuracy levels, Australia-wide. The accuracy of prediction will vary with time of year and location, but will vary between 50 and at least 70 per cent.
- a range of climate forecasting products, routinely delivered to the Water and the Land part of the Bureau of Meteorology website, that meet users' priority needs (e.g. rainfall; weekly temperature and wind; growing-season rainfall; likelihood of heatwaves, extreme rainfall and wind events) and have been tested with users
- increased awareness and use of these climate forecasts across Australia's agriculture and emergency services sectors. More MCV Climate Champion farmers and their activities will help with this.

Many people would benefit from these outcomes, which would lead to smarter, more resilient agricultural systems—which is what MCV is all about. They would also help Australia's irrigated agricultural enterprises to make water savings by scheduling water applications to synchronise crop needs and climate conditions.

There are spin-off benefits for emergency services: having more time to be prepared for storms and floods. And energy and water authorities would be better able to schedule increased power and water availability during heatwaves and to manage water supply and dam levels.

Perhaps someone out there thinking a touch more laterally about the climate change debate could locate a lazy $10 million—we could sure use it, and the benefits are far and above those that will accrue to Australian agriculture.

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What should rainfall look like —on a weather map?

Researching the visual value of multi-week forecasts

By Alison Binney

The work of Australian scientists in advancing the skill of multi-week and seasonal forecast modelling for weather and climate has gained kudos worldwide.

But how can the data be converted from the model's world into the real world, with usable values? And how should the data from this state-of-the-art modelling be presented to the agricultural producers of Australia in order for it to be useful?

These questions are what climate scientists Grant Beard and Catherine Ganter from the Bureau of Meteorology's National Climate Centre are working to answer.

Their research investigates possible ways of producing and delivering rainfall forecasts over a four-week period.

They are looking at how to convert raw fortnightly model data, as well as data for the individual weeks, into values which are directly comparable to typical rainfall values received at locations around Australia. They are also looking at how rainfall can be presented as a total for week one to week four, and as a percentage of average monthly rainfall, over various forecast periods.

Also in development are maps that show the number of rain days in a given period as well as the likely percentage of getting above a certain amount of rainfall. These will be similar to the Bureau's Water and the Land (WATL) rainfall forecasts.

Visualising concepts such as frequency, chance, anomalies and thresholds is a tough ask. But according to Grant, it will be the data identified by farmers as having the most benefit that will ultimately determine how the products will be delivered.

The team is conducting a survey with participants of the Climate Champion program to find out what preferences different agricultural industries have for learning about upcoming weather conditions.

Readers can complete the survey at:
www.surveymonkey.net/multi-weekrainfallsurvey?

'Initial feedback suggests farmers will welcome this new suite of forecasts, given rainfall forecasts for two weeks to a month in advance has long been asked for', Catherine says.

'It's important that we try and meet the demand for outlooks that bridge the gap between weather forecasts and climate outlooks, especially for rainfall.'

Two such examples of how multi-week data can be displayed are shown here in Figures 1 and 2. Figure 1 shows rainfall in mm as a fortnightly total across Australia, with the total as the key variable. Figure 2, by comparison, maps the rainfall forecast as a percentage of the monthly mean.

There are pros and cons for visualising rainfall

Generally, an image of predicted rainfall is the most basic way of presenting the information and does not require interpretation. People in agriculture or farming generally know the rainfall requirements of their crops, while others may just want to know whether it will rain.

But as Grant says: 'The difficulty in these maps is that the user is unable to tell whether this rain will occur over several days, or in a single hit. We hope to overcome this by including the number of rain days for the outlook period.'

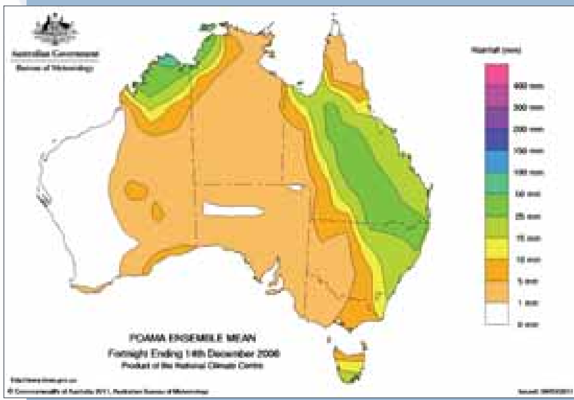

Figure 1: Rainfall shown in mm as a fortnightly total across Australia

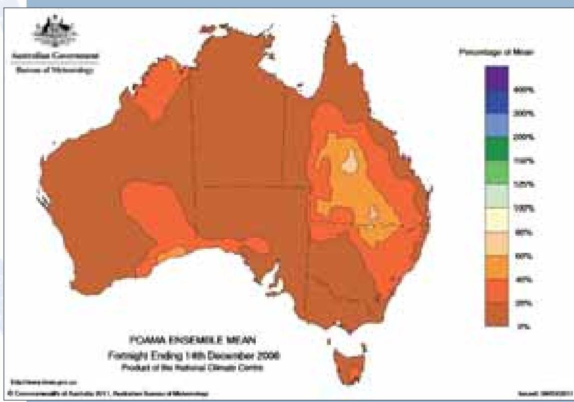

Figure 2: Rainfall forecast as a percentage of the monthly mean

'The difficulty in these maps is that the user is unable to tell whether this rain will occur over several days, or in a single hit. We hope to overcome this by including the number of rain days for the outlook period', says Grant.

He says the benefit of using maps showing the percentage of monthly mean is that the user can see how much of their monthly average they can expect during the forecast period.

'However, the potential snags with this form of display are: firstly, users need to know what their average rainfall is; secondly, users will need to remember that the rainfall period such as a week or fortnight is being converted into a percentage of the entire month', Grant says.

A further difficulty will arise when the forecast period starts in one month but ends in another. The question would arise: which monthly mean should be used?

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Mapping chance as the fraction of 10 predictions

Predicting the chance of rainfall is done by using what is termed an 'ensemble of forecasts' (see Figure 3).

'We base the rainfall forecast on the average, or the ensemble mean. Then, the likelihood of getting totals above a certain level can be derived from the ensemble spread', Grant says.

'The way we work out prediction outputs such as the chance of getting rainfall is based on not just one prediction for the period, but 10 predictions', Grant says.

'Say a fraction of the 10–20 per cent of the total ensemble at a particular location had rainfall in excess of 50 mm —well, then we'd just plot 20 per cent as the chance for getting 50 mm at that particular location.'

To generate this data, the scientists are also working closely with their colleagues at the Bureau and the CSIRO on the Predictive Ocean Atmosphere Model for Australia (POAMA). The current version (1.5) of the model is expected to be replaced by the newer version (2.4) before the end of the year.

POAMA is a dynamic model, the type of system that scientists across the globe have tagged as the inevitable multi-week and seasonal prediction tool of the future. The model uses pure physics, rather than historical relationships, to simulate the earth's atmosphere and the oceans, and this includes rainfall and temperature.

Grant says that although POAMA 2.4 is a seasonal outlook model, it will have a component dedicated to producing prediction information on a one- to two-month timescale.

'The project will capitalise on the improving skill in multi-week forecasting and deliver prototype products for selected users via the WATL website', says Grant.

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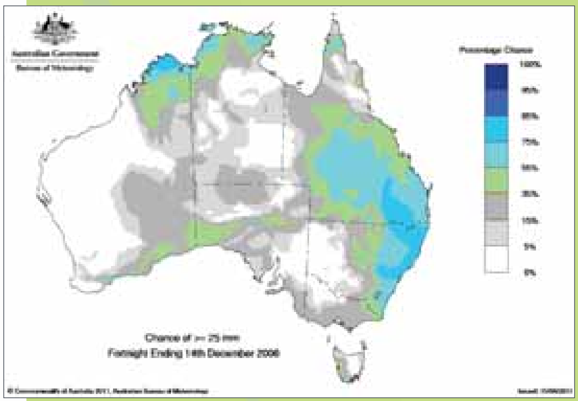

Figure 3: Chance that rainfall will exceed 25 mm over the period 1–14 December 2006

'We are currently producing some test products and resolving various technical issues involved in translating the dynamical model into real-time and useable forecasts.'

Grant says the ultimate objective is to deliver quality products that are valued and meet the needs of various users.

The scientists will analyse results from their farmer survey, and the final outcomes of their work are expected to be available to selected users on the WATL website towards the end of the 2011/12 financial year.

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GRDC
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MEAT & LIVESTOCK AUSTRALIA

Australian Government
Department of Agriculture, Fisheries and Forestry
Rural Industries Research and Development Corporation
Sugar Research and Development Corporation

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