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Finding order in the chaos: Australia's regional climate

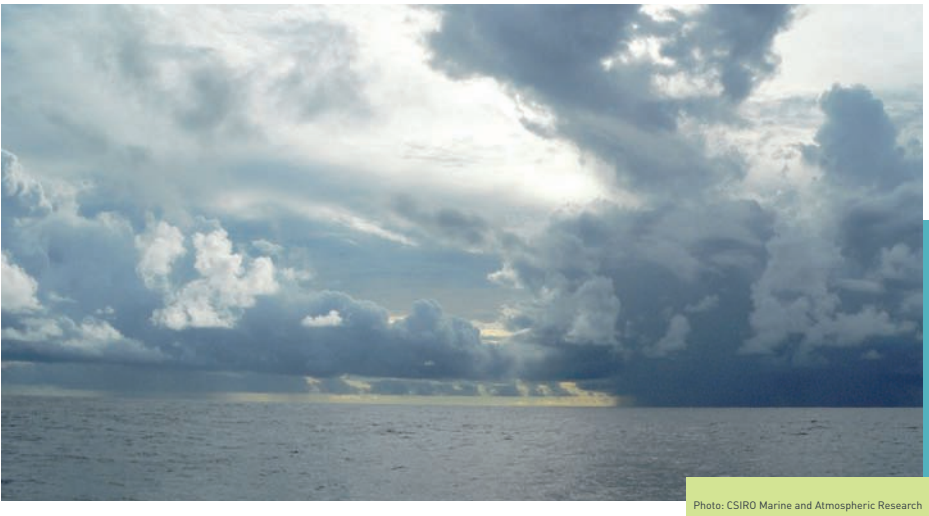

Photo: CSIRO Marine and Atmospheric Research

Analysing 35 years of data for Birchip, he and his colleagues made a startling discovery —51 per cent of north-west Victoria's growing season rainfall is caused by cut-off lows, as opposed to cold fronts and other weather systems. As much as 70 per cent of the heavier rainfall events are attributable to cut-off lows.

'A cut-off low is an isolated low-pressure system that has broken away from the low-pressure belt to its south, and that extends vertically through much of the atmosphere', explains Dr McIntosh. Seasonal rainfall variability can be the result of a varying number of cut-off lows, a varying amount of rainfall from each cut-off low, or a combination of both.

'The most critical management decision made by grain growers is when to sow', says CSIRO oceanographer Dr Peter McIntosh. 'Other decisions, such as when and how much fertiliser to apply, come a distant second.'

Dr McIntosh is working with growers from Birchip, Victoria to understand their regional forecast needs and to develop a new forecast system that better meets those needs.

'In south-east Australia, an accurate forecast is needed early in the year, for the start of the growing season', he explains. 'A forecast of rainfall distribution is as important as rainfall amount—two falls of 15 mm in the month are more valuable than daily falls of 1 mm which will quickly evaporate.'

Each of Australia's currently available seasonal forecast systems has its limitations (see Table 1). And while those based on physical processes (global climate models) are almost certain to lead to the most accurate forecasts in the long run, they have yet to deliver anything more useful than the simpler statistical techniques.

Our seasonal climate system is complicated, especially in the south and west of Australia where El Niño - Southern Oscillation (ENSO) has less influence and other factors become important. The Indian Ocean Dipole, the Southern Annular Mode (a pattern around the Antarctic), the Southern Ocean and the Tasman Sea can all affect regional rainfall.

Overlaid with climate change, we have what some have likened to Cerberus, the grotesque multi-headed guard-dog of Hades. In such a chaotic system, is it possible to ever give farmers an accurate seasonal forecast? Dr McIntosh believes it is.

'To forecast the break, we need to understand the physical processes that transport the moisture and cause it to drop as rain'.

'The decrease in north-east Victoria's rainfall since about 1995 can be explained by a decrease in cut-off low rainfall.'

Dr McIntosh found that the number of cut-off lows is influenced by sea surface temperatures to the south of Australia while the amount of rain delivered by each cut-off low is influenced by sea surface temperatures to the north.

[continued on page 2]

In this issue

MANAGING CLIMATE VARIABILITY R & D PROGRAM

A farewell
to Harm

Dr Harm van Rees has relocated to Papua New Guinea to take up a role as an oil palm agronomist with the Papua New Guinea Oil Palm Research Association based in Alotau, Milne Bay.

Over the past 10 years, Dr van Rees has had an enormous impact on farming and climate risk management in the Victorian Wimmera-Mallee and beyond, both in his role as principal consultant to the Birchip Cropping Group and as a private consultant to grain growers.

Dr van Rees was instrumental in the design and delivery of the Yield Prophet® on-line climate risk management tool.

Finding order in the chaos:
Australia's regional climate
continued

In spite of the chaotic nature of our climate and the amount of research that remains to be done, Dr McIntosh is optimistic about getting a valuable forecast system for farmers.

'Australia is at the forefront of research into applying climate science to agriculture. And when you look at how it has taken 30 years to achieve an accurate daily forecast, you can appreciate the time and effort that's needed to deliver seasonal forecasts of value to farmers.

'We now have a methodology for isolating the synoptic weather systems and a better understanding of the kind of forecasts that farmers value. But short funding cycles are not the best vehicle. What we need is sustained investment over the long term.'

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Table 1: Limitations of Australia's currently available seasonal climate forecast systems

Seasonal climate forecast system	Limitation
The Bureau of Meteorology's monthly seasonal outlook based on sea surface temperatures in the Pacific and Indian Oceans	On-farm accuracy, averaged over many rainfall stations across Australia, has recently been questioned by some scientists.
Forecasts based on the Southern Oscillation Index	Are limited to a three-month lead-time.
The Southern Oscillation Index phase system	Is more accurate in north-east Australia where ENSO has greatest impact.
The ENSO sequence system	Shows promise but, being ENSO-related, applicability may be limited to north-east Australia.
The Bureau of Meteorology's Predictive Ocean Atmosphere Model for Australia (POAMA)	Predicts Pacific Ocean sea surface temperatures up to 12 months in advance. Farmers have to know how to translate this into something relevant to their decision making.

Some forecasts can be most accurate at a time when farmers cannot react (they may have already sown). The reverse can also be true; for example, the March-May ENSO-based forecast has no accuracy beyond that time, which is when farmers most need it (for sowing); it can only be used for top-dressing decisions later in the year.

Why has 2006
been so dry?

The 2006 growing season has been one of the driest on record for much of southern Australia's wheatbelt. Most cropping areas had rainfall in the lowest five per cent of readings between May and October.

Researchers from Western Australia's Department of Agriculture and Food (DAFWA) and the University of New South Wales have looked at contributing factors to see if the dry weather could have been predicted. They found that rainfall in the wheatbelt of Western and eastern Australia is related to irregular sea surface temperature to the north-west of Australia.

If sea surface temperatures are cooler than normal to the north of Australia, and warmer than normal to the west of Perth, there is less rain. The opposite scenario brings wet weather. Research using past rainfall data indicated early in the year that there was a higher likelihood of dry conditions due to an active cyclone season cooling sea surface temperatures to the north/north-west of Australia.

So what actually happened in 2006? In May, a strong high pressure system in the eastern Indian Ocean spread eastward into the Australian region and strengthened. This caused storm activity to swing below Australia and northward over New Zealand and the central South Pacific. As a result, the Southern Oscillation Index and Mid-latitude Southern Oscillation Index became locked into negative values.

This negative pattern increased in June causing the south-east trade winds to the north of Australia to strengthen and contribute to a further cooling of sea surface temperatures in that region. Moisture movement and cloud activity from the north-west was virtually non-existent and, in combination with weaker cold fronts, meant that rainfall was well below average.

Photo: Renaye Stokes

So what are the options? DAFWA staff help growers assess late sown crop prospects at the Mullewa Spring Field Day, 23 August 2006

The close linkage between oceanic and atmospheric features in the Australian region continued through the growing season with only temporary relief from a few cut-off lows—weather systems that bring steady rain. Between May and early October, the centre of the high pressure moved only slightly eastward from south of Western Australia to a region covering south-eastern Australia and New Zealand.

Research in DAFWA funded by the Grains Research and Development Corporation found that a forecasting system that includes the sea surface temperature gradient to the north-west of Australia and local barometric pressure produces rainfall outlooks with good levels of accuracy. Such a system has the potential to improve farm risk management in future cropping systems across the Australian wheatbelt.

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Flexible feedbase options for dairy farmers

Dairy farmers in the subtropical dairy region are learning about the need for flexible management to better respond to their variable climate.

Katrina Sinclair from the New South Wales Department of Primary Industries, based in Wollongbar, is working with farming groups in Queensland and northern New South Wales to use seasonal climate forecasting to improve dairy farmers' feedbase management.

'Due to the seasonality and variable nature of rainfall in northern New South Wales, farmers are relying more and more on irrigation, even though rainfall is often above 1000 mm', says Katrina. 'And because of land pressures, farms have become more intensive and are increasing in herd size, stocking rate, fertiliser and supplement use.

'With water reforms possibly around the corner and an increased reliance on rain-grown forage, a more flexible feedbase is increasingly important. We're equipping farmers with the knowledge they need to meet these challenges.'

Fleur, Sam and Elizabeth Tonge

The project team meets with farmers in spring and autumn to discuss forage options in the light of current and expected seasonal conditions. Fleur and Sam Tonge manage a 200-cow dairy farm in Casino using home-grown pasture and forage crops.

'We're convinced of the ability of climate forecasting to help our decision making in producing a regular supply of low-cost feed and maintaining our long-term profitability', says Fleur.

'We're more flexible managers now. We have a tool box of options and can determine which areas of our management we can change to optimise our production.'

With improved knowledge of soil moisture levels, local rainfall patterns and climate signals, farmers involved in the project are able to determine the best pastures and crops to plant. Most farmers in the Tonges' discussion group are now using weather sites to decide when to plant and cut for silage.

'Our group is getting used to the idea of probability-based information', says Fleur. 'We also know that nothing's absolutely certain, but we're learning that these probabilities are significant in decision making.

'An unexpected windfall from our increased knowledge is we've become more aware of the factors affecting grain pricing', adds Fleur. 'We can now forward-buy, save money and be better prepared for our dry times.'

'There is a lot to be gained from the MCV research for dairy farming', says Katrina. 'MCV research in other industries such as grain and beef are also offering findings that the dairy industry can benefit from.'

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The Wet crystal ball

Landowners in northern Australia may soon have the inside scoop on Mother Nature's plans, thanks to Managing Climate Variability and a new forecast coming out of Queensland's Department of Primary Industries and Fisheries and the Bureau of Meteorology Research Centre.

'By the end of August each year, we hope to be able to forecast when the wet season will arrive, and when the wet and dry spells will occur during the wet season', says Lexie Donald, the project officer.

'This will be very useful for graziers, who usually have to make their best guess about stocking rates, turn off, what mineral supplements to buy and how much pasture might be available.'

These are important decisions, given that northern Australia accounts for about a third of the national beef herd and is responsible for around $1.5 billion per year in exports, according to ABARE.

Photo: Andrew Campbell

Photo: Andrew Campbell

Tom Stockwell runs Sunday Creek Station in the Northern Territory and is a member of the project steering committee.

'If you know the wet season is coming soon, you'll try to get your dry season work done now', says Tom.

He says that the predictions, once they become routine, will help him with both day-to-day management and with long-term planning. For example, this year he has ordered half dry and half wet season supplements, but if he knew whether the rainfall would be reliable or patchy, he could manage his supplies better.

'And if it doesn't look like there will be an early start to the wet season, we could have Sundays off. Otherwise, we'd be working seven days a week.'

The research team is working on predicting the onset and strength of the wet season using El Niño - Southern Oscillation indicators, and the pulse of the wet season using the Madden-Julian Oscillation.

'The grazing industry is a good case study for the application of this technology', says Lexie Donald.

'The predictions will also be useful for planning in other industries—sugar, grain, construction, medicine and even tourism.'

Heavy rainfall is often correlated with outbreaks of diseases such as pneumonia, bronchitis, malaria and dengue. Medical centres would benefit from wet season predictions when making decisions about vaccines or antibiotics they might need.

'Our immediate focus is on providing information for northern Australian graziers. We're working with them to establish the best way to present the information and if we can get these seasonal predictions right, the ramifications are huge for multiple industries in Australia's tropical north.'

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Hedging your bets with derivatives

John Hamparsum

Derivatives—insurance products based on weather and climate indicators—may offer farmers an innovative advantage in crop planning, capitalising on increasingly reliable knowledge of climate variability forecasting.

Studies have shown that farm and shire crop yield and quality are strongly associated with the Southern Oscillation Index (SOI) when the SOI is examined through the core crop growing period. In the near future, it is possible that farmers will be able to trade in derivatives based on SOI values to hedge or insure against crop failures. Much like options are traded on the stock market, derivatives could be traded through stock brokers.

'The benefit of derivatives over other insurance products is that they would be paid out solely on the value of the SOI, rather than the condition or final yield of the crop', explains Dr Roger Stone from the Queensland Department of Primary Industries and Fisheries and the University of Southern Queensland.

Supported by Managing Climate Variability, Dr Stone is investigating the potential of derivatives trading using the wheat industry as a case study.

'Over a reasonable time period, the derivative system should be able to provide a buffer against El Niño type years and the potential those years have to reduce yields in areas of Australia', says Dr Stone.

'It's about spreading the risk of such events across the globe, which requires the backing of large reinsurance companies or similar types of institutions.' Reinsurance companies insure the insurance companies.

'There has been a long history of derivative trading in the energy industry. We're looking at what type of premium these derivatives would require in agriculture and who they would most benefit.'

To find out, Dr Stone is sitting at the kitchen table with growers across Australia such as John Hamparsum, a grain and cotton farmer on the Breeza Plains in New South Wales. John and his family manage 1400 hectares, of which 1000 hectares are irrigated.

'Derivatives could provide the ability for us to hedge against events both ways at critical times of the year', says John.

'How useful the product will be for farmers will depend on how the climatic event could affect us financially and how the insurance providers calculate the premiums. We're watching for these opportunities and are open to their potential.'

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Making hay while the sun shines – or not

After saving $20,000 by deciding not to cut his crop for hay despite the drought, Bill Long is more convinced than ever of the benefits of Yield Prophet®.

Bill has used Yield Prophet® for the last two years on his farm at Adrossan on the north coast of South Australia's Yorke Peninsula.

As the season broke early in Adrossan, Bill and most farmers in the region were heartened by the good rains and planted their crops as soon as they could. The good start meant crops grew well through winter. But the last significant rain fell in the middle of July, and August and September were the driest on record. By the end of September, it was clear that yields would be disappointing.

'Many of the growers in the region cut grain crops for hay when it's like this', says Bill. 'This cashes in on the good crop growth made with the early rains and offsets the risk of not getting the rain needed for a decent grain yield. But there is a trade-off. Grain fetches a higher price per tonne than hay, so if we make the wrong choice we could lose out.'

Bill's gut feel was that he might get a greater financial return if he cut one or several of his wheat crops for hay. He decided to check his intuition with Yield Prophet®.

Bill White

Even if the season finish of 2006 were to equal the driest year on record, Yield Prophet® predicted that Bill's wheat would still achieve significant grain yields. Given skyrocketing prices for wheat with the expanding national drought, Bill decided not to cut hay.

'I'm glad I followed Yield Prophet®', says Bill. 'We did get the driest year on record. The worst case scenario happened. But Yield Prophet's® prediction held true and we safely harvested the paddock.

'It's fantastic—having access to this kind of science to check against your gut feel is just invaluable. Models like Yield Prophet® can save the industry millions of dollars by making decisions more clear cut.'

Yield Prophet® is partly funded by Managing Climate Variability. It allows farmers and advisers to assess climate risk online for their own site-specific crops and paddocks.

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Managing Climate Variability - what next?

Work is underway to develop the next phase of Managing Climate Variability (MCV). The Program Management Committee is devising strategies to meet the needs of investors and clients—Australia's farmers, natural resource management practitioners, and policy makers. Central to this is a science plan that will translate investor needs into science activities. A series of task groups, including a natural resource management working group and a technical committee, will contribute to the science plan.

Natural resource management working group

The working group will help the program engage more strongly with regional bodies to better understand and meet their needs. Membership will consist of representatives of Australia's 56 regional bodies and will be geographically diverse, representing Australia's key climatic regions and natural resource issues.

The group will provide advice on the strategic needs of regional bodies, especially as they prepare to accommodate climate variability into their activities as part of Natural Heritage Trust 3. The group will also help the flow of information about climate variability and natural resource management opportunities between regional bodies and scientists.

Technical committee

The technical committee will provide a solid scientific grounding to the design of the next phase of MCV. It will comprise eight experts selected through an open call process in December. Its aim is to provide technical advice to the Program Management Committee to help set research priorities and to ensure the integrity of the project selection process and scientific findings.

If you are interested in participating in the technical committee, contact Ben Bryant. Phone: 02 6263 6030 Email: ben.bryant@lwa.gov.au

Science plan

'Formulating a science plan is essential', says Program Coordinator Colin Creighton. 'MCV must use the huge investment in climate change science in a way that is strategic and reaps maximum benefit for Australian agriculture and natural resources. We must become a sharply focused part of the global science push.'

The science plan will propose investment in five key components:

1. increased skill in seasonal forecasting
2. implications for natural resources
3. agricultural applications
4. adoption of products, tools and approaches
5. adaptation to Australia's changing climate in the timeframes of investment—eight to 10 years

For more information on the natural resource management working group and the science plan, contact
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MCV is a collaborative program between the Grains, Rural Industries and Sugar Research and Development Corporations; the Australian Government Natural Heritage Trust and Department of Agriculture, Fisheries and Forestry; Dairy Australia; Meat & Livestock Australia; and Land & Water Australia. The National Farmers' Federation and Australian Wool Innovation Limited are associate partners.

Econnect Communication provides communication support to MCV.
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