CliMag

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$1.8 million grant

to improve critical forecasts for farmers

Funding success reaffirms importance of seasonal forecasting timescales

Climate has been reaffirmed as one of the most important drivers of agricultural production in Australia, following the announcement of $1.8 million funding for a farmer-focused seasonal forecasting project.

In early May, the Australian Government confirmed support of the three-year project, which brings together Managing Climate Variability (MCV) partners and others, led by the Rural Industries Research and Development Corporation (RIRDC).

'The bid's success recognises the fact that seasonal forecasting is arguably the most important climate forecast time frame for farmers', says Simon Winter, MCV's Science Manager.

The project will bridge the gap between seasonal climate forecasts and on-farm business decisions to help farmers improve productivity and profitability.

'We know that this project will deliver benefits to farmers in the form of improved forecasts, and in understanding how best to use them', says Simon.

Round one of the Department of Agriculture's $100 million Rural Research and Development for Profit program called for projects that would focus on achieving 'tangible benefits' for primary industries.

The seasonal forecasting project incorporates key practical outcomes to reduce climate risks to farmers, including skilling up farmers to minimise their losses in the poorest seasons and make the best of the good seasons.

RIRDC's Managing Director, Craig Burns, emphasises that equipping farmers with a better understanding of climate variability and how to use forecasts in business decision-making is an effective and proven way of addressing drought.

The funding comes at a critical time in relation to seasonal forecasting: 'It's allowing us to progress work that will build on recent advances in seasonal forecasting, and help upskill farmers to manage their businesses in a variable climate', Simon says.

Project partners will focus on the following aspects to improve on-farm decision-making:

- identify what information different farming sectors need about seasonal climate risks, what type of decisions farmers are making, and where these decisions are happening
- work directly with farmers to create tools, case studies and training to improve farmers' understanding and use of existing seasonal forecasts
- improve the capability of Australia's foremost seasonal prediction system (previously the Predictive Ocean Atmosphere Model for Australia), by analysing and reducing its main errors.

Photo: Econnect Communication

Nothing is more important to Gillian Taylor (centre) than ground cover. Find out how she is combining seasonal rainfall outlooks with on-ground feed triggers to create a holistic, planned, rotational grazing plan at Bowna in New South Wales's South West Slopes.

In this issue

MANAGING CLIMATE VARIABILITY R & D PROGRAM

Discussions from the annual national workshop of the Managing Climate Variability Climate Champion program, Wagga Wagga, March 2015.

An ongoing dialogue:

Making decisions in spite of uncertain forecasts

By Sarah Cole

Queensland Country Life surveyed readers at the start of March about making on-farm decisions and relying on weather forecasts.

Forty-one per cent of those who responded said that the forecasts weren't accurate enough. Almost a third of respondents acknowledged that the forecasts are 'the best tool available'. The remainder said they use forecasts, sometimes, if they fit with what they have already observed.

This challenge—working with uncertainty when decisions need to made about whether to move stock, sow seeds or irrigate crops—is farming's 'bread and butter', but is by no means easy.

Bridging the gap from science to applied decisions is something the national Managing Climate Variability program (MCV) has been tackling since 1992.

'Farmer comments highlight that there is still a gap between climate research and the agricultural industry, and that more work needs to be done in how forecasts are interpreted and used for decision-making', according to Simon Winter, Science Manager for MCV.

The annual national workshop for the program, held in Wagga Wagga in March, brought farmers and climate specialists together to talk about how to better interpret forecasts and translate the data into decisions that will sustain Australia's agricultural economy.

Farming's unexpected advantage in the complex language of probability

'Farmers and climate scientists need to keep having more conversations about the language used in forecasting probabilities', says Dr Peter Hayman.

As a principal scientist in climate applications at the South Australian Research and Development Institute, Dr Hayman has experienced a career's worth of discussion between both of those groups.

He's fascinated with how language can contribute to our understanding of probabilities—because it's such a crucial element of using weather and climate information.

Unfortunately, we can't leave the complicated language of probability out of communicating about weather, Dr Hayman says.

But he believes the farming community has one huge advantage: its common use of deciles.

'Most farmers and agronomists understand the concept of deciles very well', says Dr Hayman. 'They're a really effective way to talk about risk, and farmers are way ahead of a lot of people in using them.'

'There's a lot of information even in saying, "It's a decile-3 season." Farmers already know that seven out of ten of those types of seasons will be wetter, but they know that three out of ten will be drier.'

It's clear that Dr Hayman acknowledges the challenge of decision-making in spite of complex and uncertain information.

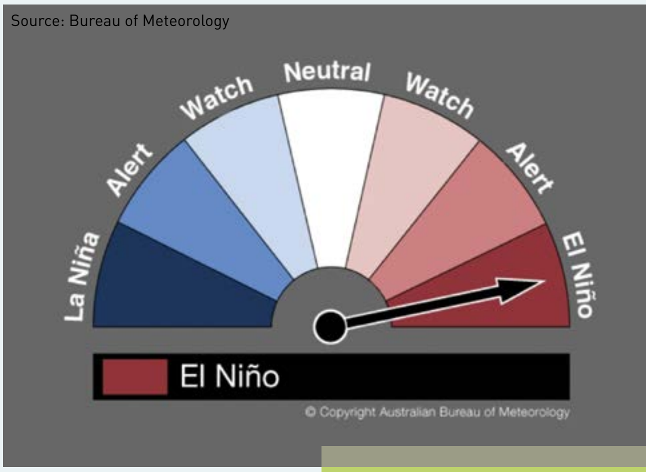
'The forecasts are too good to ignore, but not good enough to completely rely on. Even though there are uncertainties, we do have more information than if we were guessing by chance.'

The key, he believes, is to use those forecasts to *adjust* risk-management strategies, not to plan for a single outcome and abandon the risk-management strategies.

At the MCV workshop, Dr Hayman demonstrated with a raffle-wheel. Spinning the wheel, he explained that our knowledge about climate has increased a lot—that is, getting the pattern of outcomes closer to what happens in the real world—but uncertainty means we randomly land on just one outcome on the wheel, whether that's wet, dry or in the middle.

Dr Hayman is also a fan of the Bureau of Meteorology's ENSO Tracker dial: 'You don't need tips from other people, because the dial shows you the consensus of many different models and climatologists', he says. 'And it has really clear rules about when it changes between *watch* and *alert*.'

Source: Bureau of Meteorology



The ENSO Tracker swings between seven categories, and is updated fortnightly.

Discussions from the annual national workshop of the Managing Climate Variability Climate Champion program, Wagga Wagga, March 2015.

Test what you know about El Niño and La Niña

- **El Niño doesn't guarantee a drought, but it certainly increases the chance.** Of the 26 El Niños since 1900, 17 led to widespread drought. We can also experience droughts during non–El Niño periods.
- The **strength of an El Niño doesn't indicate the strength of its impact;** 1997 and 1982 were both strong El Niño years with very different rainfall impacts. This is not true for La Niña events, where stronger events often have a stronger rainfall impact.
- The **chance of El Niño, La Niña or neutral in any one year isn't one-third of each**. In any 10-year period, you might expect about two El Niño years, two La Niña years, and about six neutral years.
- A *watch* status on the ENSO dial means **at least double the normal risk** of an El Niño/La Niña occurring. An *alert* status is **roughly triple the normal risk**.
- Check out the Bureau's El Niño explainer (PDF 1.5 MB).

'Producers have more control over climate risk than they think'

'Our Wangaratta (Victoria) cattle and sheep business was really challenged by the failed springs of 2006 and 2007. We were not proactive enough in our management', says Dr Jason Trompf.

Dr Trompf is no stranger to difficult climatic conditions. So much so, he helped create a *More lambs, more often* workshop with a team of climate and agriculture specialists, to share his experiences with other farmers.

He presents the workshop with John Young from Western Australia, a *Lifetime Wool* researcher who models and analyses farming systems. They ran the workshop for the MCV's Climate Champion participants in Wagga Wagga.

The Bureau's Agata Imielska explains the ENSO phenomenon to MCV Climate Champion participants at Wagga Wagga.

Photo: Econnect Communication

Dr Trompf and John Young find that most producers believe they have little control over their profitability.

'But people do have quite a deal of control, and can have as much or more of an effect on profit than market prices do', John says, 'and they can put strategies in place to deal with variability.'

The key is to reduce risk by aiming for more consistent returns through increasing flexibility. This is the focus of the workshops.

'It's about standing back and looking at your production risk. How can you manage, day to day, an environment that could grow double the feed from one year to the next?' says Dr Trompf.

Key messages from *More lambs, more often* workshop

- Businesses can begin to cope with increasingly variable seasons by having effective decision-making and an efficient production system.
- To increase the consistency of business profits, systems need to make money in most years, not just the good ones.
- Many businesses have lots of low-hanging fruit they can work with straight away.
- Although it's challenging for producers to recognise and act on a deteriorating season, poor seasons happen incrementally.
- Businesses need to be flexible to cope with unexpected conditions, but hand in hand with that flexibility is the ability to respond quickly. Pre-planned strategies and trigger points encourage timely responses.
- Dr Trompf and John Young recommend a clear exit strategy—a plan for how you will manage, for instance, stocking rates under deteriorating seasonal conditions, or a late break or failed spring. It needs to outline your tactics, dates for action, what you'll do and who is responsible.

Discussions from the annual national workshop of the Managing Climate Variability Climate Champion program, Wagga Wagga, March 2015.

At the MCV national workshop, three Climate Champion farmers gave climate scientists and farmers firsthand accounts of their on-farm decision-making processes.

Combining seasonal rainfall outlooks with on-ground feed triggers

Nothing is more important to Gillian and David Taylor than ground cover.

The grazing plan for their 990-hectare cattle property at Bowna (in New South Wales's South West Slopes) covers the next five to six months of pasture between pasture-growing and non-growing seasons (roughly November to April).

In October, the Taylors evaluate the feed available in their paddocks: if forecasts predict below-average rain until April, they make a decision on stock numbers for the upcoming season.

Combining information from forecasts for rain for the next three to six months, local knowledge, and current and rested paddock conditions, they create a holistic, rotational grazing plan.

Gillian says, 'Because medium- and long-term forecasting is not very reliable in southern New South Wales, I rely on carefully watching the feed in my paddocks, and constantly readjust my plans for stock numbers.'

'If I find stock are moving through paddocks faster than I planned, I know something is going wrong, and I will replan or sell off livestock.'

Gillian says this constant monitoring prevents a state of crisis for feed, instead of supplementary feeding without machinery to manage the feeding: 'Our trigger is the grass in front of us. If we get good rain, we can always buy stock in.'

'Last year in August, we'd had a great season and good rains, so we brought in 300 heifers and kept them until November', Gillian says.

'We were thinking of keeping them until December to get better prices, but we could see forecasts for a dry summer and potential of an El Niño.

'They wouldn't have put on any weight, and put pressure on our plan and livestock water.'

In hindsight, Gillian says they could have probably kept the cattle on longer but that she was happy with her early call.

Gillian's grazing plan outlines the paddocks that all her stock will move through from November to April.

A neutral ENSO status does not necessarily mean 'average' conditions

'In our area, even a full soil-profile of moisture in mid-winter won't be sufficient to get us through spring', says Andrew Carmichael.

Andrew produces wheat, barley and field peas at Coolamon, half an hour north-west of Wagga Wagga.

This means that spring forecasts are the most important ones for Andrew and his agronomic clients, and it is important that they're reliable.

'But, unfortunately, spring forecasts are really difficult to pin down here. We get to July and August, and need to make decisions about how far to push our crops', he says.

Andrew finds that the most difficult climate outlooks to plan from are those which are neutral—between El Niño and La Niña conditions. Over the last three years, for example, the area experienced very dry springs while in neutral conditions.

Because neutral ENSO conditions don't necessarily predict or indicate 'average' rainfall, decision-making in those times can be difficult, and Andrew says those are 'what really impacts our profitability'.

Andrew is very happy using five-day Bureau forecasts to plan his nitrogen applications, spraying and contracting operations a week ahead.

'The short-term forecasts have been very good for wind speed and direction, temperature and rainfall. They have improved a lot, and the way it's presented on the website is much easier to use, too.'

Discussions from the annual national workshop of the Managing Climate Variability Climate Champion program, Wagga Wagga, March 2015.

At the MCV national workshop, three Climate Champion farmers gave climate scientists and farmers firsthand accounts of their on-farm decision-making processes.

Photo: Econnect Communication.

David Cattanach, irrigated cropper at Coleambally, talks to MCV Climate Champion farmers who do not irrigate on-farm.

Seasonal forecasts critical for water budgets in low-rainfall Coleambally

Cropping near the irrigated, low-rainfall area of Coleambally (south-west New South Wales) means realistic water budgets are critical for David Cattanach.

'Over the past 10 years, I have become more interested in forecasts of likely weather through the growing season because of limitations on our irrigation allocations', says David.

Although no precious irrigation water runs off David's farm—any excess is pumped straight back into his dam—getting a crop through to harvest is still tricky.

The area receives between 50 and 500 millimetres of rainfall a year but, increasingly, it does not come in the growing season, so is much less effective for producing crops.

'Thirty years ago, for a winter crop, we wouldn't even have to irrigate twice', says David. 'But because a larger portion of our rainfall is falling outside the growing season, we now have to irrigate four or five times.'

In addition to David's work since 2010 as an MCV Climate Champion farmer, he has been assisting a CSIRO team to test other methods of generating seasonal climate forecasts for his local town of Griffith.

David finds the Indian Ocean Dipole a more reliable guide to seasonal climate in his area at planting time (April–June) than Pacific Ocean indices.

Farmer feedback crucial to improving how Bureau forecasts are communicated

In the past two years, the Bureau has made some major upgrades to integrate ocean and atmosphere physical modelling (called 'dynamical modelling') into its climate outlooks.

That means that the climate outlooks have significantly improved in accuracy, says Agata Imielska, a senior climatologist with the Bureau.

But the process doesn't stop, says Agata. 'We commonly hear from the community that they want the perfect weather or climate forecast —and of course that's what everyone would want.'

The other part, the Bureau knows, is making the information accessible and easily understandable.

Feedback through MCV from rural research and development corporations, and representative farmers in the Climate Champion program, has been critical in how best to present forecasts and outlooks.

'The feedback really shapes the way our products and services are developed, because the forecasts are there to support [on-farm] decision-making', says Agata. 'The way the Bureau's website looks has been strongly driven by feedback that we have received from farmers.'

The Bureau is keen to help people understand what climate outlooks can and can't say: 'It's about understanding the limitations and how you can then best use the outlooks', says Agata.

Current Bureau tools pull together information from different models, with adjustments by climatologists:

- ENSO Tracker: updated fortnightly, the official status of the El Niño–Southern Oscillation. It has a visual dial showing its status, plus text that explains what's happening.
- ENSO Wrap-Up: monthly information about the state of the Pacific and Indian Ocean.
- Climate outlooks: monthly and seasonal, for rainfall and temperature. There's also a video which explains each month's information.
- Other climate outlooks for streamflow, tropical cyclones and climate models.

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Read case studies of Gillian Taylor, Andrew Carmichael and David Cattanach online

Using seasonal forecasts:

How long before farmers see a pay-off?

By Robbie Mitchell

A study has found that wheat farmers in south-west Western Australia could increase their gross margins by about $67 per hectare on clay soils.

Led by Senthold Asseng (CSIRO) and funded by the Managing Climate Variability program, the 2012 project examined returns on farms between 1980 and 2006.

The increase was achieved by adjusting the amount of nitrogen applied at the start of the season based on the seasonal forecast prediction from the Bureau of Meteorology—an excellent result in a region where the seasonal forecast has 70 per cent skill at predicting above- or below-median rainfall.

Can the same result be achieved in other regions and for other commodities?

This is what Peter McIntosh intends to find out using three case studies: cotton and wheat in New South Wales, and grazing in northern Australia.

'The project aims to establish confidence in the value of using seasonal forecasts for decision-making within Australia's cotton, wheat and grazing industries', says Peter.

'Preliminary results from sites in the eastern Australian wheatbelt suggest an average forecast value of about $50 per hectare with a pay-off time of between three and eight years.'

Photo: Peter McIntosh

Peter McIntosh explaining seasonal rainfall variability in Australia to Dr Caroline Ummenhofer (formerly a UNSW climate researcher, now at Woods Hole Oceanographic Institute in the US) and Dr Michael Poole (formerly a CSIRO climate researcher, now retired and an Honorary Research Fellow).

Because seasonal forecasts can only indicate shifts in the probability of rainfall in the growing season—for example, one year might have a 75 per cent chance of below-median rainfall—it takes a number of years for farmers to be reasonably certain of good long-term returns.

A skilful forecast biases the odds in a farmer's favour in the long term, and the longer a farmer uses a forecast, the more certain they can be of a long-term pay-off.

Peter has come up with a way to calculate this pay-off time for two scenarios:

1. where the climate in each year is independent from the other years
2. where the climate in neighbouring years may have some connection.

'Good returns can usually be achieved by simply applying fertiliser in all years, but the risk is relatively high compared to current practice', says Peter.

'Alternatively, a farmer can selectively apply fertiliser only in years forecast to be wet, with similar good returns but with a minimal increase in risk.'

If successful, this project is a first step that could lead to substantially increased use of seasonal forecasts and significant long-term increases in farm income, with the potential to offset some of the negative effects from climate change and to improve environmental outcomes.

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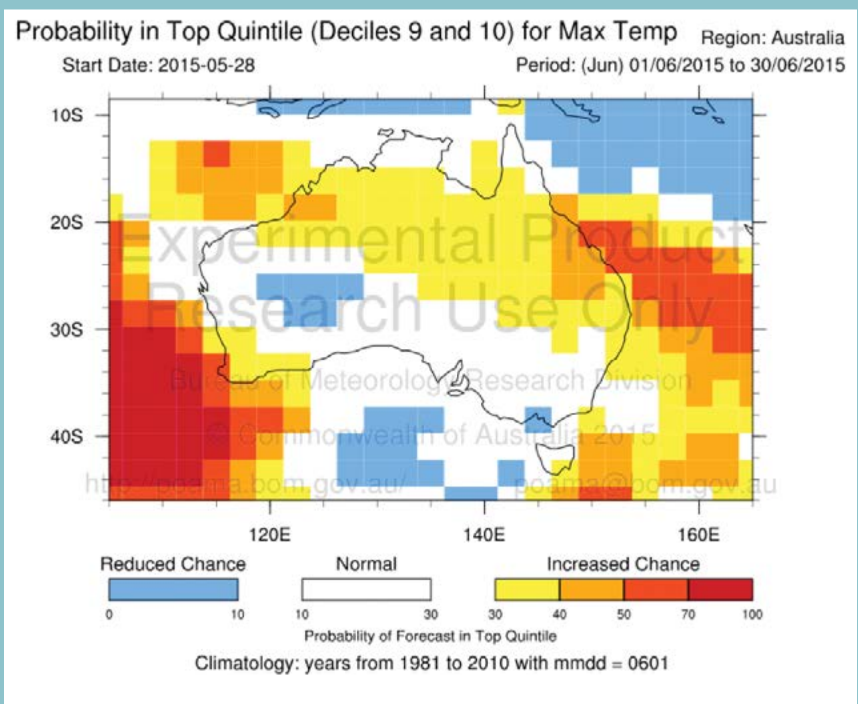
Extreme heat: New forecast tools available for testing

Identifying periods of extreme heat, and their severity, are critical for most agricultural industries in Australia: from stock to cropping to horticulture, and more.

As climate modelling evolves in Australia, forecasting extreme heat is about to get a much-needed boost.

The Bureau of Meteorology is testing five new experimental tools from their experimental seasonal prediction system.

The suite of tools focuses on forecasting extreme heat in upcoming weeks, fortnights, months and seasons.



An example experimental product: the chance that the maximum air temperature for the upcoming month (June 2015) will be in decile 9 or 10 of usual events between 1981 to 2010.

The tools are a result of a project led by Dr Debbie Hudson (Bureau of Meteorology) since its inception in 2011.

The first step was to understand how large-scale climate drivers can lead to episodes of extreme heat over Australia. Researchers wanted to understand how well the seasonal prediction system could capture the relationships between climate drivers and extreme heat that Australia has experienced in the past.

Next, the researchers directly compared the forecasts for extreme heat with what happened.The final step was to develop the experimental forecast products.

The products are still in testing, and people who would like to trial them for research purposes can apply for access online.

5 new tools for forecasting extreme heat

- **Extreme heat days forecast for Australia**: the number of hot days within the upcoming months or season, and chance of having more than the usual number of hot days. (A 'hot day' means the maximum temperature is over 90 per cent of historical observations for time of year and region.)
- **Extreme temperature forecasts**: the chance that the upcoming weeks, fortnights, months or season will be in the top decile (10 per cent, or decile 10) or top quintile (20 per cent, or decile 9 or 10) of usual events.
- **Rainfall and temperature histograms**: daily rainfall or temperature over a selected period of time, for whichever region you select.
- **Heatwave forecast for Australia**: the chance and location of low-intensity, severe and extreme heatwaves for any time up to one month out. (A 'heatwave' is three or more days of high maximum and minimum temperatures.)
- **Subtropical ridge high over Tasman Sea index forecasts**: the state of the subtropical ridge over the Tasman Sea, which has a strong influence on the chance of extreme heat over southern Australia.

Contact Dr Debbie Hudson,
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Apply to test the experimental heat-extreme products at: http://poama.bom.gov.au/

Multi-week forecasts

may help with applying nitrogen, reducing emissions

By Robbie Mitchell

Photo: Dr Clemens Sheer

Photo: Dr Clemens Sheer

Can advances in weather forecasting help farmers reduce losses and emissions from nitrogen fertiliser?

Managing the use of nitrogen fertiliser is a balancing act between knowing the right product, the right rate, the right time and the right place to apply it, says Michael Waring, a sugarcane grower in Ingham, Queensland.

'Most farmers will tell you that it's a difficult and costly task getting all those things right', says Michael. 'It's made somewhat more difficult up here in Far North Queensland by the big rains we get.'

Rainfall helps wash nitrogen fertiliser into the soil, reducing the chance of it being lost as ammonia gas (a process called volatilisation). But adding nitrogen fertiliser to the soil before heavy rainfall is a recipe for loss as a different gas—nitrous oxide.

Nitrous oxide is of particular concern for agriculture because it has a global warming potential nearly 300 times that of carbon dioxide. More than half of Australia's nitrous oxide emissions come from fertilisers applied to crops and pastures.

During years of higher-than-average rainfall, Michael says he loses nitrogen three ways: through denitrification, leaching as it moves with soil water below the root zone and being washed away in surface water.

The latter is something that the sugarcane industry is under growing pressure to remedy, because of the effect it is having on the Great Barrier Reef.

'Because fertiliser is the second-highest cost in producing sugar cane, after harvesting, losing nitrogen from our soils is critical. So we're always keen to know how we can improve the way we apply it to reduce our losses.'

Working with farmers

Michael is one of five farmers across Australia who are working with researchers on case studies to determine whether recent advances in dynamical weather forecasting can be a cost-effective way to reduce nitrous oxide emissions from nitrogen fertiliser.

'Recent advances in the science, availability and communication of weekly and multi-week weather forecasts have unrealised potential in managing nitrogen fertiliser', says Dr Clemens Scheer, a senior research scientist at Queensland University of Technology, who leads the research project.

This unrealised potential, he explains, lies in the more efficient use of nitrogen fertiliser.

'Farmers have long been advised, as part of best management practice, to avoid applying nitrogen fertiliser on moist soils before heavy rain', says Dr Scheer.

However, this becomes complicated because farmers in dryland and regularly irrigated areas welcome the rain after applying a second round of fertiliser (top-dressing) to crops and pasture.

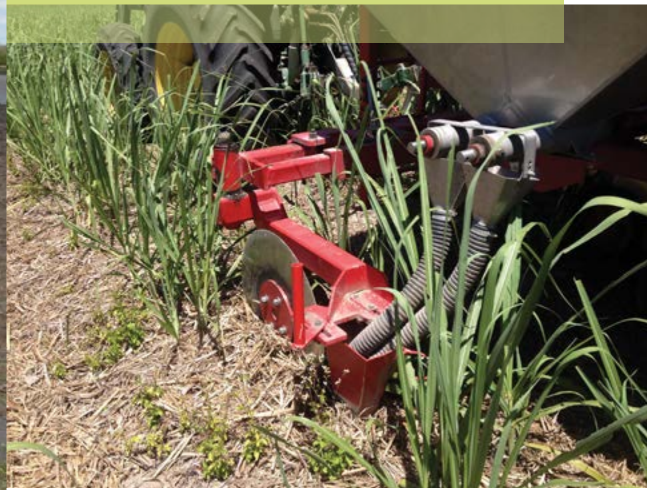
'The fertiliser industry is promoting the four Rs: right product, right rate, right time and right place', Dr Scheer says.

'Our project is focusing on using weather forecasts as a guide to help farmers make these decisions. We are using forecasts to adjust the timing and, in some cases, the rate of fertiliser application.'

Researchers have found that a more efficient use of nitrogen fertiliser has economic and environmental benefits.

Below: Waterlogging greatly increases nitrogen losses from soils, via denitrification.

Michael applies fertiliser 75 millimetres below the soil surface, between rows, to reduce the risk of volatilisation and run-off.



The three-year project is a partnership between Queensland University of Technology, South Australian Research and Development Institute, the Bureau of Meteorology, and Charles Sturt University.

The group is working with farmers and farmer groups representing the grain, sugar and dairy industries in New South Wales, Queensland and South Australia at five sites which provide a range of climatic conditions and soil characteristics.

Making multi-week forecasts more accessible

Central to the project have been multi-week forecasts produced by the Bureau of Meteorology's seasonal prediction system (previously the Predictive Ocean Atmosphere Model for Australia)—a state-of-the-art, dynamical (physics-based) climate model.

Multi-week forecasts allow farmers to plan more accurately for rainfall events that are forecast to happen over the next 12 weeks.

'The real advances from this project have come from working with the Bureau and its information-technology people, who have repurposed seasonal prediction system data to fit the format required for crop and pasture modelling tools such as APSIM and DairyMod', says Dr Peter Hayman, principal scientist in climate applications from the South Australian Research and Development Institute.

Using these modelling tools, Dr Hayman and his colleague Bronya Alexander are researching different scenarios. They're looking to determine the economic and environmental benefits of using forecasts to apply nitrogen at different rates and times across different farming systems.

'The grains, dairy and sugar industries have their own guidelines in place for managing nitrogen, so we are trying to work within these rules and guidelines without creating something new', he says.

'That's why it was important that we were able to link the seasonal prediction system's forecast data to APSIM and DairyMod, because these are tools that researchers and advisers who are working with farmers know and understand.'

Dr Hayman says now that the seasonal prediction system data has been repurposed, it will not only help them work with farmers, but will help future researchers, advisors and farmers to use the data for their own predictive and management purposes.

Building on current knowledge

In terms of the case studies with farmers, Dr Scheer says an important facet will be to understand current interactions between climate and nitrogen in the grains, dairy and sugar industries and how this research can build on best practices and tools.

'The project will not produce a specific tool which farmers can physically use to make their fertiliser decisions; however, the result could provide the basis of such a tool in a future project, if the concept is proven to work', says Dr Scheer.

'At the moment, it's a proof of concept project, meaning we want to prove that dynamical weather forecasting can be effectively used to adjust the timing and rate of fertiliser application in a cost-effective way to reduce nitrous oxide emissions.

'The economic factor is a key to the success of this research and whether its outcomes will be adopted by, and advantageous for, farmers.'

Back in Ingham, Michael is enthusiastic to work with Dr Scheer and Dr Hayman to prove the concept: 'Anything that can help you better predict the future is helpful when making decisions, so I'm looking forward to seeing if multi-week forecasts can reduce our nitrogen losses.'

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Project updates

The following table lists our current projects.

Project title	Time	Summary of research objectives	Progress to date	Research contact
Can advances in weather forecasts reduce emissions from nitrogen fertiliser?	2013–16	Investigate the potential of recent advances in dynamical weather forecasts and models to cost-effectively reduce nitrous oxide emissions	Researchers have worked with the Bureau of Meteorology to adapt multi-week weather forecasting data from its seasonal prediction model for simulation programs APSIM and DairyMod. The researchers used these programs to model how different rates of nitrogen fertiliser affect wheat, sorghum, sugar and pasture production under different weather scenarios. They also assessed the impact on nitrous oxide emissions from soil. The information can show the nitrogen-use efficiency and the economic return for each dollar invested in nitrogen fertiliser. So far, the models show that a multi-week forecast can aid in applying nitrogen more efficiently. Researchers are now in the final phase of the project, and will run simulation experiments for 5 case-study farms to explore the potential of dynamical weather forecasts across different industries.	**Dr Clemens Scheer** Queensland University of Technology clemens.scheer@qut.edu.au 07 3138 7636
Value of seasonal forecasts in decision-making	2014–16	Incorporate seasonal forecasts based on dynamical seasonal prediction models in decision-making on-farm	The project aims to establish confidence in the value of forecasts based on seasonal prediction models for decision-making within Australia's cotton, wheat and grazing industries. Seasonal forecasts are based on probabilities, and may take a number of years to produce good returns for farmers. Ways to calculate this pay-off time have been developed based on two assumptions: first, that climate in each year is independent from the other years; and secondly, that neighbouring years may have some connection. A set of risk metrics has been developed to help assess the trade-off between value and risk when making decisions in the wheat industry. Preliminary results from sites in eastern Australia suggest an average forecast value of about $50 per hectare, with a pay-off time of between 3 and 8 years.	**Dr Peter McIntosh** CSIRO peter.mcintosh@csiro.au 03 6232 5390
Multi-week climate outlook products for Australia (Phase 2)	2012–14	Produce a set of web-based tools for a multi-week rainfall forecasting service, and make the tools available on the Bureau's Water and the Land website	For the first time in 25 years of seasonal forecasting at the Bureau, new time periods (monthly forecasts) were added to the climate forecasting services, giving producers greater assistance with planning and timing on-farm decisions. Phase 1 of the project produced prototype tools for multi-week forecasting (the period between 7 days and 3 months) using raw experimental data produced by the Bureau's seasonal prediction model. These products were trialled with MCV Climate Champion program participants. Phase 2 continued to improve the prototype tools and developed a 1-month and 2-month outlook for rainfall, and maximum and minimum temperatures. These outlooks are now published on the Bureau's climat These forecasts will enable farmers to better plan their operations and manage climate risks, and will assist the Bureau in releasing fortnightly outlook services in the future.	**Dr Andrew Watkins** Bureau of Meteorology A.Watkins@bom.gov.au 03 9669 4360
Predictions of heat extremes on the multi-week timescale	2012–14	Investigate the ability, or skill, of the Bureau's seasonal prediction model for making predictions of extreme heat events for forecast timescales of less than 1 month	Research has shown that there is significant potential to extend traditional weather forecast warnings for extreme heat events to include longer timescales. Researchers now have an improved understanding of the climate drivers that lead to extreme heat. A number of experimental forecast products were developed as part of the project. These products, and the researchers' acquired knowledge, will be invaluable for realising the ultimate vision of forecasts of extreme heat for farmers.	**Dr Debbie Hudson** Bureau of Meteorology D.Hudson@bom.gov.au 03 9669 4796

What cost improved seasonal forecasts for agriculture?

By Simon Winter,
Science Manager for the Managing Climate Variability program

Simon Winter takes a look at efforts to understand the benefits from improved seasonal forecasting

Climate is the primary driver of agricultural production. This is particularly relevant in Australia, as we have the most variable climate of any inhabited country. Climate is also, by far, the most discussed topic among farmers.

Why it is so talked about?

I suggest there are three reasons:
1. It is so difficult to predict.
2. The predictions are so easily misinterpreted.
3. It is so fundamentally linked to agricultural production; arguably, more than any other issue.

The accuracy of three- to ten-day weather forecasts has greatly improved over the past 30 years. Seven-day forecasts are more accurate now than a three-day forecast was in the early 1980s.

Forecast skill has been steadily increasing, and skill for the northern and southern hemispheres became more closely aligned around 1999–2000. This is mainly due to more readily available satellite data.

However, the advances in seasonal forecasting have not been as great. This is mainly due to the focus being on shorter term weather forecasts and the much longer term 10-year (decadal) and multi-decadal climate change forecasts. Also, seasonal forecasts have varying relevance to other sectors, compared to agriculture.

Assessing the value of improved seasonal forecasting

A report by the Centre for International Economics—commissioned by MCV in 2014—assessed the value of improved seasonal forecasting for agriculture along with 11 other industry sectors.

No studies have previously estimated the impact of climate on agricultural production in Australia.

The report concludes that the potential annual benefits from improved forecasting for agriculture alone could accumulate to $1.5 billion. With even more climate variability expected under climate change, the Centre expects that value to increase.

It also estimates that the potential value of improved seasonal climate forecasts for Australia's agricultural sector is much greater than for other sectors in the economy.

The combined value of potential annual benefits for other sectors could accumulate to $388 million (see Table 1).

[continued on page 12]

Table 1. Climate sensitivity and the value of improved forecasts

Sector	Average GVA 2002-03 to 2011-12	Contribution to GDP (average 2002-03 to 2011-12)	Equivalent U.S. sectoral 70-year climate sensitivity	Estimated annual value of improved seasonal forecasts
	$m	per cent	per cent	$m (per cent of the climate sensitivity)
Agriculture	21 429	1.88	12.1	1567 (45 per cent)
Health care (and social assistance)	61 879	5.43	3.3	--
Construction	79 851	7.00	4.7	192 (4.6 per cent)
Electricity	16 556	1.45	7.0	2.3 (0.2 per cent)
Coal mining	20 852	1.83	14.4	68 (2.0 per cent)
Offshore oil and gas (90 per cent of oil and gas extraction)	20 363	1.79	14.4	93 (2.8 per cent)
Retail trade	50 696	4.44	2.3	--
Transport (road and air)	22 824	2.00	3.5	5 (0.5 per cent)
Water (water supply and waste services)	10 550	0.92	7.0	28 (3.3 per cent)
Emergency services (public administration and safety)	55 920	4.90	3.3	--
Financial and insurance services	104 079	9.13	8.1	--
Tourism [a]	23 761	1.91	3.3	--

[a] Tourism figures are from the Tourism Satellite Account and are based on a 10 year average of 2001-02 to 2010-11

Note: The sensitivity of US sectors to climate has been used here as an initial indicator of the degree of climate sensitivity, however, the climate sensitivity of US and Australian sectors are likely to differ due to the climate conditions faced and the nature of the sectors. These figures should be interpreted considering these caveats. See chapter 3 for further discussion.

GVA = gross value added, the sectoral equivalent of gross domestic product (GDP); All values are given in Australian dollars at 2012 prices.

Source: ABS 2012a; ABS 2011; Lazo et al. 2011