CliMag

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The key to better seasonal forecasts: Is it a multi-model approach?

by Sarah Cole

What will be the key that gives forecasting models the next step up in accuracy? This is a recurring question for climate experts.

Source: Tom Dixon, Econnect Communication

Wool and cropping producers John Ive, Joe Keynes and Bill Yates listen to forecasting presentations at the recent MCV Climate Champion program workshop.

As the experts tease out the relatively new science of 'dynamical' modelling—using physics to model interactions between atmosphere, water and the land for forecasts instead of statistical records—they are converging on the idea of using multiple models to generate one forecast.

This 'consensus' method may be the next vital step in improving seasonal forecasts, and scientists from major research providers such as the Bureau of Meteorology, CSIRO and universities are considering bringing together multiple models from different sources.

Consensus forecasting (also called multi-model forecasting) uses the models which perform best at different times of the year for each region to generate more accurate seasonal forecasts.

Forecasts can be improved by using modern statistics to adjust the outputs of dynamical models. CSIRO researchers have trialled this process for frost predictions; it can also be done for other weather indicators, such as rainfall.

POAMA, the Bureau's Predictive Ocean Atmosphere Model for Australia, is an example of bringing together a number of model runs to produce a forecast 'in-house'.

Choosing the right models

Dr Mark Howden from CSIRO's Climate Adaptation Flagship says forecasters can work out which models to use based on how well a model performs: 'We know when they have skill and not.'

If people know the conditions under which a model is less accurate, they can then make better decisions', says Dr Howden, 'we can produce error bars on the forecasts and people can do their own evaluations.'

Professor Roger Stone, from the International Centre for Applied Climate Science (University of Southern Queensland), has analysed the skill/accuracy of six years of forecasts to determine which models are most useful and when.

His analysis shows that forecasting for eastern and northern Australia is most accurate when El Niño - Southern Oscillation (ENSO) has a strong signal—when the climate is clearly in El Niño or La Niña conditions, such as in 2010, 2011 and 2012. The dynamical POAMA model also appears to predict southern and western Australia's climate quite well in ENSO years. [continued on page 2]

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MANAGING CLIMATE VARIABILITY R & D PROGRAM

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'Years with strong ENSO signals are easier to predict. Weak years have no signal, and middle years are a challenge, as was the case in 2013', Professor Stone says.

'But we shouldn't throw away statistical models. They are useful at quantifying rainfall three to six months ahead—that to me is the value.'

Moving forward

'The idea to bring together a number of models from different sources is a great opportunity to deliver better outcomes using the latest science and techniques', says Simon Winter, Science Manager of the Managing Climate Variability program (MCV).

A priority that emerged from the MCV Climate Champion program workshop in Canberra in March is the ongoing need to improve climate forecasting.

Mr Winter says, 'Whether the models we use are dynamical or statistical is a moot point right now—we need to understand how our researchers' knowledge can be combined to go forward.'

The next thing to work out, he says, is what Australia's approach will look like. MCV will meet with the Bureau and CSIRO to look at the potential for collaboration.

The Centre for Australian Weather and Climate Research (CAWCR) is an example of how those agencies have worked and are working together.

Dr Oscar Alves, from CAWCR, is keen to collaborate with other agencies on this effort to increase the accuracy of seasonal forecasting. 'There are fewer errors in forecasts when you combine models', he says.

Potential partners in the collaboration are very aware of the confidence that users currently have in forecasts, and the importance of maintaining that.

It is critical that the multi-model approach is well supported by:

- consistent and reliable data streams so that each forecast is based on the correct models, and has a guaranteed level of skill
- stable forecasts of past events ('hindcasts') to recalibrate forecasts when models are updated
- supercomputing power
- operational support for the forecast
- information for users about how the forecast is 'made'
- continued integration into decision-making apps.

Simon Winter says that MCV's next task is to facilitate a process that brings the relevant research organisations together to scope out a collaborative project that examines how to improve climate forecasting for agriculture.

'It's still big picture', Mr Winter says. 'We're looking for guidance from the researchers, but it's clear that we need a collaborative approach and an agreed methodology to give users improved forecasts.'

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Source: Tom Dixon, Econnect Communication

The clouds in this photo taken last year in Longreach didn't end up bringing rain for MCV Climate Champion alumnus James Hegarty. He says seasonal forecasts are generally 'pretty good', but rainfall from storms is 'patchier than ever'.

Simon Winter, Science Manager of the MCV program, says it's clear that we need a collaborative approach.


Source: Tom Dixon, Econnect Communication

Climate tools that manage for drought

by Tom Dixon

Growers and graziers across Queensland and New South Wales are experiencing one of their driest years on record, with temperature and rainfall records being broken across the region. Australia's highly variable climate means that droughts are not uncommon, but they are still devastating and can be financially disastrous. Could using climate tools help reduce the impacts?

James Walker, a grazier from Longreach, western Queensland, was heavily exposed to the drought. Facing strategic decisions based on what he knew about the upcoming weather, he sold cattle early in 2012 and replaced them with wool-cutting sheep.

Since attending a workshop in the 2012 MCV Climate Champion program meeting in Birchip, Victoria, James has been a keen user of the Predictive Ocean Atmosphere Model for Australia (POAMA)—the Bureau of Meteorology's physics-based, and official, seasonal forecast model.

POAMA predictions for the 2012–13 summer helped him to make his critical decision.

'In western Queensland, rainfall patterns are sporadic. In 2012, POAMA was in a neutral pattern for our region, with no strong conviction either way for rainfall', says James.

'With no more rain, we could have run out of feed, grass and water very quickly.'

Given that conditions were already so dry on the ground, and with POAMA's odds not pushing for the above-normal rainfall needed to alleviate conditions, he decided to destock his farm and sell one of his properties.

'The decision was an educated gamble. It paid off and averted huge capital losses', says James. 'I had confidence in the system because it's dynamical forecasting, not historical modelling. It wasn't the only thing that I used to form a view, but they're the sort of indicators I use to make a decision.

'We did end up getting some rain, but most of this region and most of north-western Queensland didn't', he says.

'A lot of cattle were sold or agisted because of the lack of grass. The market was flooded, and we avoided the loss in capital within our livestock enterprise', says James.

'The more information I can get on rainfall patterns and forecasts, the better I can manage my business.

Source: Tom Dixon, Econnect Communication

James Walker on his property in Longreach, western Queensland.

'The climate has always been variable, and we're already managing for it. In terms of managing climate change, it'll be a progressive process over many years', he says.

James' case study is published on the Climate Kelpie website.

Using multiple tools

Bureau research, partly funded by MCV, has been focusing on improving services for agriculture for many years.

New POAMA seasonal outlook information includes monthly, and potentially shorter, rainfall outlooks. These will be delivered through a new interface, which includes drill-down information to give greater context to local forecasts. The Bureau's market research shows that different users access information in different ways, and therefore the Bureau is ensuring that information is delivered more clearly and in a better form for decision-making.

Aside from POAMA, several other products are being tailored to assist agricultural decisions. Streamflow forecasts and a pilot heatwave service are available on the Bureau's website, while a 'wet season onset' service for northern Australia is being trialled for release. Research is also looking at the possibility of multi-week forecasts for extreme events.

MetEye—a new tool for short-term weather forecasts and information

MetEye™, released in 2014, shows maps of current weather observations as well as the official forecasts produced by the Bureau. MetEye™ helps you view real-time weather observations and seven-day forecast information.

MetEye™ allows you to:

- view real-time temperature, rainfall, radar images, cloud cover and wind speed for one location
- easily search for your local weather data
- save your favourite locations
- drag and zoom to any area in Australia
- combine the latest weather and forecast weather on one map (e.g. rain radar, cloud, temperature, rainfall, wind, waves etc.)
- display more detail for each day of the week in tabular displays.

The Bureau is interested in feedback from farmers who are using its information to manage production, including seasonal prediction models, and welcomes comments on every aspect of this project.

The Bureau hopes that such feedback will help improve the information it provides, and that by working closely with growers and graziers it can ensure they receive exactly the information they need.

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Project updates

The following table lists our current projects.

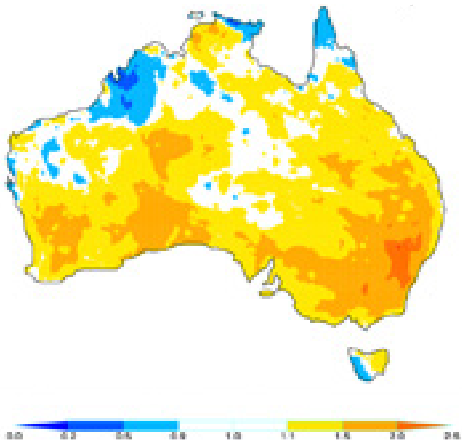
Project title	Time	Summary of research objectives	Progress to date	Research contact
POAMA seasonal forecast value	2014–16	Incorporate seasonal forecasts based on Predictive Ocean Atmosphere Model for Australia (POAMA) in decision-making.	The project aims to establish confidence in the value of POAMA-based seasonal forecasts for decision-making within Australia's cotton, wheat and grazing industries. Enhancing the ability to incorporate probabilistic seasonal forecast information into agricultural business practice will increase long-term (5–20 years) business value and inform risk management.	**Dr Peter McIntosh** CSIRO Marine and Atmospheric Research Peter.Mcintosh@csiro.au 03 6232 5390
Australian CliMate app development	2014–16	Latest improvements of the Australian CliMate app: a climate risk management tool readily accessible for farmers to query weather data.	This project will update and enhance the Australian CliMate app to enable access to a wider set of weather-based information tools for agricultural decision-makers. Accessible on any computer or Apple mobile device, CliMate will continue to improve the ability of farmers to analyse risk and uncertainty in Australia's variable climate. Improvements will include the addition of POAMA seasonal forecasting, a potential yield calculator, a drought analysis and alert tool, and a trend analysis tool.	**Dr David Freebairn** david.freebairn@gmail.com 0408 876 904
Improve skill for regional rainfall and temperature	2013–16	Generate more skilful multi-week seasonal forecasts of the Australian climate at regional scales.	This project will assess the degree to which POAMA-3 climate forecasting is an improvement on POAMA-2. The project will document climate drivers—Indian Ocean Dipole and El Niño - Southern Oscillation—and regional Australian climate skill in POAMA and UK Met Office models; make a set of model improvements ready for the operational version of POAMA-3; and conduct a set of forecasts of past events ('hindcasts') to evaluate the impact of improvements on Australian regional forecasting. Improved forecasting will deliver more useful information for the better management of regional agricultural activity, such as time of sowing and fertilising, and food security.	**Dr Harry Hendon** Bureau of Meteorology H.Hendon@bom.gov.au 03 9669 4120
Can advances in weather forecasts reduce emissions from nitrogen fertiliser?	2013–16	Investigate the potential of recent advances in dynamic weather forecasts and models to cost-effectively reduce nitrous oxide (N_2O) emissions.	Research has highlighted three drivers of N_2O emissions under Australian conditions: nitrogen inputs, soil labile carbon and soil moisture. This project complements recent and current research by exploring the potential for dynamic weather model forecasts to minimise N_2O emissions from soil moisture when fertiliser is applied. The project will assess how different fertiliser uses can mitigate N_2O emissions under forecast scenarios. Using these models to inform farming practice will help create the kind of smart farming systems necessary for mitigation and adaptation.	**Dr Clemens Scheer** Queensland University of Technology clemens.scheer@qut.edu.au 07 3138 7636
Multi-week climate outlook products for Australia (Phase 2) Continuation of previous MCV research	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.	Phase 1 of this project produced prototype tools for multi-week forecasting (the period between 7 days and 3 months) using raw experimental data produced by POAMA-1.5. The products were trialled on MCV Climate Champion participants. Phase 2 will continue to improve the prototype tools and develop the web interface.	**Dr Andrew Watkins** Bureau of Meteorology A.Watkins@bom.gov.au 03 9669 4360
Predictions of heat extremes on the multi-week timescale Continuation of previous MCV research	2012–14	Investigate the ability, or skill, of POAMA for making predictions of extreme heat events for forecast timescales of less than one month.	This project started by exploring the large-scale climate drivers—specifically, the El Niño - Southern Oscillation (ENSO), the Madden-Julian Oscillation, the Southern Annular Mode and atmospheric blocking events—that lead to episodes of extreme heat over Australia. Researchers are now examining POAMA's ability to capture and predict these drivers, as well as the link between the drivers and extreme heat. For example, in terms of ENSO, the probability of having an extremely hot week is increased across much of southern Australia in spring months during El Niño events, and POAMA is able to capture this fairly well. This work will increase understanding of extreme heat events.	**Dr Debbie Hudson** Bureau of Meteorology D.Hudson@bom.gov.au 03 9669 4796

Project title	Time	Summary of research objectives	Progress to date	Research contact
Northern Australian monsoon prediction Completed	2011 –13	To develop a wet season onset prediction strategy, using dynamical models of prediction such as POAMA.	Test the potential (mechanism and limits) of the latest version of POAMA (POAMA-2) to predict northern Australian wet season rainfall. The project identified that POAMA-2 is unable to replicate the observed trend to wetter conditions (and earlier wet season onset dates) in north-western Australia.	**Matt Wheeler** Bureau of Meteorology M.Wheeler@bom.gov.au 03 9669 4068
Investigate teleconnections between climate drivers and regional climate, and model representations of these links Work completed, report being finalised	2010 –13	Improve Australia's dynamical forecasting by investigating the connection between rain-bearing weather systems and remote climate drivers, including El Niño - Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), Madden-Julian Oscillation, subtropical ridge and Southern Annular Mode.	Equatorial convection has a significant effect on weather systems in mid-latitudes. Rossby waves spread energy eastwards and polewards to alter the strength of mid-latitude weather systems and therefore rainfall. Analysis indicates that both ENSO and the IOD influence southern Australian weather in winter and spring via Rossby waves originating in the Indian Ocean. The mechanism appears to be more complicated than previously understood. POAMA's representation of this teleconnection pathway appears to be shifted to the east, which may help explain why skill is decreased in south-east Australia.	**Dr Peter McIntosh** CSIRO Marine and Atmospheric Research Peter.Mcintosh@csiro.au 03 6232 5390
Understanding frost risk in a variable and changing climate Completed	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.	Spatial analysis of frost trends—such as minimum temperatures, numbers of frosts, cold-wave duration and frost-season length—has been completed. The proportion of events above the long-term 90th percentile has been finalised. Major synoptic drivers of frost have been analysed. A statistical model of frost frequency has been developed for the region of strongest change frequency and occurrence (i.e. southern New South Wales and northern Victoria). VineLOGIC has been benchmarked for 4 grape-growing locations in the Yarra Valley. The effect of climate change on budburst (the emergence of new leaves at the start of growing season) has been assessed for 4 main grape varieties grown in this region.	**Dr Steven Crimp** CSIRO Steven.Crimp@csiro.au 02 6242 1649
Improving forecast accuracy through improved ocean initialisation Completed	2010 –13	Improve predictions of conditions in the Indian Ocean and, ultimately, predictions of regional climate for western, southern and eastern Australia.	POAMA uses sophisticated assimilation techniques to ingest oceanic observations to initialise model forecasts and create analysis estimates of the ocean state at each point in time. We included new ocean observations (sea surface temperature and altimeter) and accounted for ocean–atmosphere coupling. We have evaluated improvements in the forecasts of the Indian Ocean Dipole (IOD) and regional climate. So far, two new enhancements (coupled assimilation and direct assimilation of sea surface temperature data) will likely improve the initialisation of Indian Ocean model forecasts. Including altimeter data did not improve IOD predictions and will not be pursued. A new comprehensive 32-year ocean reanalysis is incorporating both improvements. Forecasts of past events ('hindcasts') using the POAMA-2 model are being performed to assess the impact on the skill of IOD forecasts. These improvements will then be incorporated into the new POAMA-3 system.	**Dr Oscar Alves** Centre for Australian Weather and Climate Research O.Alves@bom.gov.au 03 9669 4835
Assessing and managing heat stress in cereals Completed	2008 –13	Investigate the meteorology and climatology of spring heat events on the southern grains wheat belt.	In this final stage of the project, researchers examined the likelihood of heat events at different locations and at various crop growth stages to estimate the likely damage in the current and future climates. An experiment was conducted to further understand the interaction between heat and moisture stress. The project also developed a risk management package for growers.	**Dr Peter Hayman** South Australian Research and Development Institute peter.hayman@sa.gov.au 08 8303 9729

Researchers blazing a trail on extreme heat predictions

by Alison Binney

Australian climate scientists are leading the research worldwide into understanding what drives periods of extreme heat over Australia.



This map shows the expected chance of having an extremely hot week (a decile-10 event) during spring months under El Niño conditions. Scientists communicate the odds of having extreme heat as a ratio of the chance in an average year. The darker orange colours indicate that the odds of having extreme heat are nearly doubled over regions of southern and eastern Australia during El Niño.

Source: Bureau of Meteorology

Over the past two years, scientists have identified the gaps in scientific literature for understanding heatwaves across Australia as well as improved forecast modelling capabilities for warning of 'unusual upcoming heat events'.

'Our work contributes significantly to the growing area of research that is filling the gap between weather forecasts and seasonal outlooks', says Dr Debbie Hudson from the Bureau of Meteorology.

'Being able to predict the risk of heat extremes two to four weeks into the future, and on a seasonal timescale, is still in its infancy worldwide.'

Dr Hudson, who is heading the research on behalf of the Managing Climate Variability (MCV) program, says advance warning of heat extremes allows grain, grape, rice, horticulture and other irrigation farmers to manage irrigation demand.

'Having accurate forecasts on timescales beyond one week and up to a season will assist farmers in the development of better risk management strategies', Dr Hudson says.

Mixed irrigation farmer Jennie Hawkins, from Finley in southern New South Wales, says such advance warnings will mean 'more efficient and more specific management practices'.

'Increasing the accuracy of forecasts in the two to three weeks before an extreme event gives us better lead times to plan our contingencies.

'This information can even be important for the temporary water markets. The more accurate the forecast is, the less volatility in the marketplace—in terms of both price and availability of water', Jennie says.

The work into extreme heat predictions is part of the MCV's ongoing research into climate forecasting across Australia for the agricultural industry.

Source: Econnect Communication

Knowing two to three weeks in advance when heat will be extreme gives farmers good lead-times to plan for contingencies.

A major component of the research into heat extremes is to understand how various climate drivers influence extreme heat events.

The climate drivers of most interest to the researchers are the El Niño - Southern Oscillation (ENSO), the Indian Ocean Dipole, the Southern Annular Mode, the Madden-Julian Oscillation (MJO), persistent high pressures over the Tasman Sea and atmospheric blocking.

'We now know that the chance of having an extremely hot week nearly doubles in much of southern Australia during spring months when we have El Niño conditions', reports Dr Hudson.

El Niño conditions are associated with extensive warming of the sea surface in the central and eastern tropical Pacific, whereas La Niña is associated with extensive cooling of the sea surface in the central and eastern tropical Pacific.

Dr Hudson also says that certain phases of the MJO can have a big impact on the chance of having heat extremes, even over south-eastern Australia. The MJO is a large-scale, slow-moving band of increased cloudiness that travels eastwards around the globe along the equator, 'pulsing' roughly every 30 to 60 days.

Over the next year, the researchers will be developing and refining experimental forecast products from the Predictive Ocean Atmosphere Model for Australia that warn of upcoming extreme heat events.

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Improving regional forecasts for rainfall and temperature

by Mary O'Callaghan

If Australia's farmers are to embrace multi-week seasonal climate forecasts, predictions at the regional scale need to be closer to the mark. A new three-year research project aims to do just that.

A skilful forecast with a lead-time of weeks or months is on every Australian farmer's wish list. It can instil confidence in farming decisions such as whether to buy or sell stock to match pasture growth; whether to crop or not crop; whether to fallow or seed; whether to sow dry or wait for rain.

Such decisions should be made within a multi-decision-making framework—this is central to climate risk management —but skilful long-range forecasts can have tangible benefits for Australian agriculture.

POAMA (the Predictive Ocean Atmospheric Model for Australia) is the Bureau of Meteorology's state-of-the-art, dynamical (physics-based) climate model used for long-range forecasting, from multi-week to seasonal and longer. Although POAMA-2 can provide good forecasts of the El Niño -Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), which are the primary drivers of predictable variations in rainfall and temperature across Australia, the POAMA-2 system does not give enough detail of the impacts of ENSO and the IOD at the regional scale demanded by agriculture (Figure 1).

In a new three-year Managing Climate Variability–funded research project, a team from the Centre for Australian Weather and Climate Research (CAWCR), led by Dr Harry Hendon, is working to improve POAMA's forecast skill for rainfall and temperature for all regions across Australia, on multi-week to seasonal timescales.

The new POAMA-3 forecast system will be based on the ACCESS coupled model, which is Australia's national modelling framework for weather and climate change projections. The ACCESS model was developed by CAWCR in collaboration with the UK Met Office and the Geophysical Fluid Dynamics Laboratory in the USA, and is a major progression from the modelling capability of POAMA-2.

'One of the ways to improve POAMA's ability to simulate key drivers of regional climate variability and their local impacts', explains Dr Hendon, 'is to increase the spatial resolution.'

'Increases in resolution will lead to forecasts with more regional detail', he says.

'POAMA-2 has a resolution of 250 kilometres. For POAMA-3 we are considering 75 to 150 kilometres. As an example, at a 150-kilometre grid Tasmania will be represented, but at a 75-kilometre grid we will be able to differentiate between the climate of eastern and western Tasmania.'

Increased resolution will also improve how the tropics are represented in the model, and how the tropics impact the climate in parts of Australia outside the tropics. But, Dr Hendon cautions, forecast skill will only be improved at the regional scale if there is predictability at that scale, that is, if the large-scale drivers manifest differently in different regions.

Dr Hendon will also be evaluating technical upgrades provided by the UK Met Office to improve the representation of tropical intra-seasonal variability, to see if they improve POAMA's regional predictive skill.

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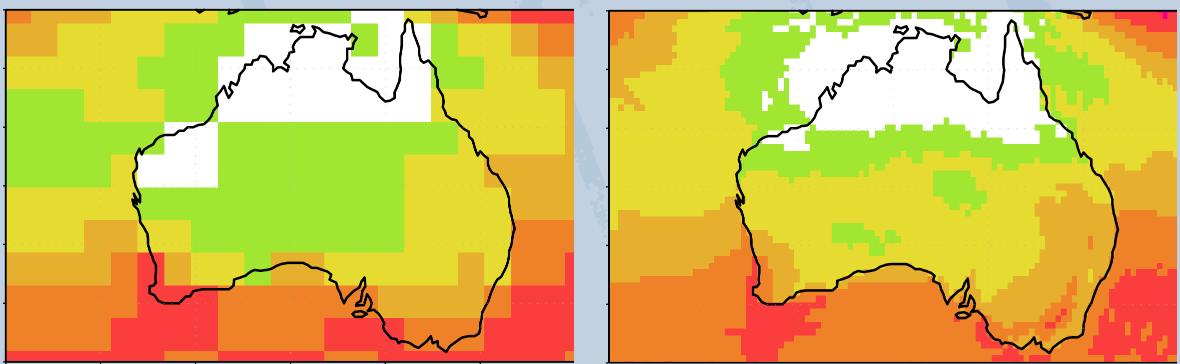

(a) 250-kilometre resolution (b) 55-kilometre resolution

Figure provided courtesy of Dr. M. Latif.

Source: Bureau of Meteorology

Figure 1. Increasing the resolution of the POAMA system will mean that forecasts will be much more specific to a region. This example shows the simulated mean winter rainfall (mm/day) for 1982–2009.

Figure 1 (a) is at a resolution of 250 kilometres which is about the resolution of POAMA-2. Figure 1 (b) is at a resolution of 55 kilometres which is what researchers are aiming to produce from POAMA-3. With higher resolution, we can see critical aspects of the mean rainfall, such as the maximum rainfall tracking along the Great Dividing Range and Goyder's Line in South Australia.

From heat stress to frost risk

A summary of some of the recent research into Australia's climate

by Elisabeth Berry

The Managing Climate Variability (MCV) program exists to help natural resource managers and primary producers 'manage' both the risks and opportunities associated with Australia's variable and changing climate.

Last year saw the successful completion of several MCV-funded research projects working towards this goal.

Improving weather predictions using POAMA

At the core of some of the MCV-funded projects is the enhancement of POAMA—the Predictive Ocean Atmosphere Model for Australia—which is the Bureau of Meteorology's most advanced forecasting approach for improving confidence in seasonal forecasts.

Matt Wheeler, senior research scientist for the Bureau, tested the potential of POAMA to predict northern Australian wet season rainfall. The aim of the work—carried out between 2011 and 2013—was to develop a prediction strategy for the onset of the wet season.

POAMA's skill was found to be relatively high at simulating the climate variability associated with the El Niño - Southern Oscillation and onset dates of the wet season. However, it was unable to reproduce the observed trend to wetter conditions (and earlier wet season onset dates) in north-western Australia.

Another Bureau project, conducted in partnership with CSIRO, also used POAMA-2 to assess predictions of sea surface temperatures in the Indian Ocean. Between 2010 and 2013, Dr Oscar Alves, the Bureau's Seasonal Prediction Systems team leader, looked at ways to improve the regional climate predictions of western, southern and eastern Australia, and incorporated these into the yet-to-be-released POAMA-3 system.

Assessing heat stress in cereals

Dr Peter Hayman, principal scientist from the South Australian Research and Development Institute (SARDI), sought to understand the impact of heat stress on grain in Australian conditions.

The 2008–13 project, a partnership between SARDI and the University of Adelaide, investigated the meteorology and climatology of spring heat events and the effect on the southern grains wheat belt.

The project examined the likelihood of heat events at different locations and at various stages of crop growth to estimate the likely damage in current and future climates.

The outcome was a risk management package presented to grain growers at a series of workshops.

Understanding the risk of frost in a variable and changing climate

A team of scientists at CSIRO, led by senior research scientist Dr Steven Crimp, has identified trends in the occurrence of frost across southern Australia.

Frost occurrence is linked to a long-term southerly shift in position and intensity of the high-pressure band typically located over central Australia in spring.

The CSIRO project improved understanding of the climate drivers responsible for change in both the frequency and occurrence of spring frosts across southern New South Wales and northern Victoria. Researchers also gained knowledge on how the risk of frost has changed in the past and may change in the future, and what this means for Australia's cereal production, as well as for the wine and grain industries.

For more information about new or completed MCV research projects, please contact Simon Winter, Science Manager for the program, on 02 6281 5257 or via email.

Multi-week forecast maps on the way

A new multi-week forecasting tool for rainfall is set to transform seasonal outlook information

by Robbie Mitchell

An exciting new tool will be available on the Bureau of Meteorology website later this year—a tool that will help bridge the gap between seven-day weather forecasts and three-month seasonal outlooks.

It will initially comprise an interactive map of Australia, which will allow users to access region-specific information on:

- seasonal and monthly rainfall and temperature forecasts
- the probability of receiving more rainfall and higher temperatures than average
- the probability of receiving the amount of rainfall needed.

'This tool has the technology to deliver outlooks for fortnightly information', says Dr Andrew Watkins, manager of Climate Prediction Services at the Bureau's National Climate Centre.

'It includes monthly rainfall and temperature forecast information, which is currently only available on the experimental POAMA website.'

'These forecasts will allow farmers to plan more accurately for rainfall events that are forecast to happen over the next 12 weeks, not just over the full season.'

By using information from Australia's coupled ocean and atmosphere seasonal forecast model—the Predictive Ocean Atmosphere Model for Australia or POAMA—the new tool is seen as an important first step in providing farmers with a truly seamless (days through to months) prediction service.

Aside from delivering the multi-week rainfall forecast map, Dr Watkins says the project will have a 'lasting legacy' in terms of the way the Bureau communicates weather and climate forecasts to the public.

'A major objective of this project has been to improve the way we communicate data to the public', says Dr Watkins. 'We can have the best model in the world, but if we don't communicate its outlook in a way people can use and understand, then it loses value.'

'The map will give people a more visual and user-friendly experience. This will allow farmers to quickly interpret and use the forecasts in their own context and, hopefully, improve their ability to plan ahead.'

Another important objective of the project has been to make forecast information as locally relevant as possible.

'Farmers are always after regionally relevant information to help make their decisions as precise as possible', says Dr Watkins. 'This has been difficult in the past because the technology was too slow to allow us to do this. We're now taking advantage of new technologies that allow faster access to more data.'

'We plan on using what we have developed and learnt during this project to develop similar multi-week forecasts for a range of other variables important for agriculture', says Dr Watkins. 'There is also preliminary work looking at creating a tool to communicate forecasts for extremes such as floods, frosts and heatwaves. Such a tool would give people a better heads up for these dramatic and sudden events.'

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What is POAMA?

The Predictive Ocean Atmosphere Model for Australia (POAMA) is Australia's coupled ocean and atmosphere seasonal forecast model. Scientists at the Centre for Australian Weather and Climate Research developed the model. The centre is a collaboration of the Bureau of Meteorology and CSIRO. POAMA has been shown to be more accurate than previous statistical seasonal forecast models, and is particularly useful at forecasting Pacific Ocean temperatures, which are a key input of long-term Australian forecasts. Seasonal climate outlooks and El Niño - Southern Oscillation information is available on the Bureau of Meteorology website —for rainfall and a climate model summary.

Weather forecasts may help reduce greenhouse gas emissions from nitrogen fertiliser

by Elisabeth Berry

Agriculture is responsible for up to 30 per cent of human-caused greenhouse gas emissions.

Nitrous oxide (N_2O) is of particular concern for the industry because it has a global warming potential nearly 300 times that of carbon dioxide. More than half of Australia's N_2O emissions come from in-crop applied fertiliser.

Under Australian conditions, N_2O emissions tend to be greatest when soils are warm and waterlogged and in paddocks with high carbon and nitrate content. Adding nitrogen fertiliser to the soil before heavy rainfall is a recipe for increasing N_2O emissions.

But can recent advances in dynamical weather forecasting be a cost-effective way to reduce N_2O emissions from nitrogen fertiliser?

This is the question now being asked by a team of researchers at the Queensland University of Technology (QUT), as part of the Managing Climate Variability (MCV) program's ongoing research into climate forecasting for the Australian agricultural industry.

The QUT project is a partnership between the South Australian Research and Development Institute, the Bureau of Meteorology, and the Charles Sturt University campus at Orange.

'Recent advances in the science, availability and communication of weekly and multi-week weather forecasts have unrealised potential in managing nitrogen fertiliser', says QUT's Dr Clemens Scheer, who is heading the research project.

This unrealised potential, he explains, lies in 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', he says. This becomes complicated, however, as farmers in dryland and regularly irrigated areas welcome the rain after top-dressing crops and pasture with fertiliser.

'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 will not only have economic benefits by maximising plant uptake, but will also minimise N_2O emissions as well as other losses through denitrification, deep drainage and run-off.

The MCV project aims to develop a framework to study nitrogen fertiliser use in Australian farming systems and determine how weather and climate forecasts can be used to make better decisions.

The project will use a combination of climate simulation modelling and decision analysis. It will then apply the framework to case studies across the grains, dairy and sugar industries, and evaluate the framework's impact on farm productivity and N_2O emissions.

'It's all part of developing the information-rich, smart farming systems that are vital in the process of mitigating and adapting to climate change', Dr Scheer says. 'We will then be able to assess if using weather forecasts for nitrogen fertiliser decisions can also be the basis for an offset methodology for N_2O abatement under the federal government's Carbon Farming Initiative.'

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One of the measuring chambers used by the researchers to measure N_2O emissions in the field

Source: Dr Clemens Scheer

App update to provide access

to drought and crop-yield analysis

by Elisabeth Berry

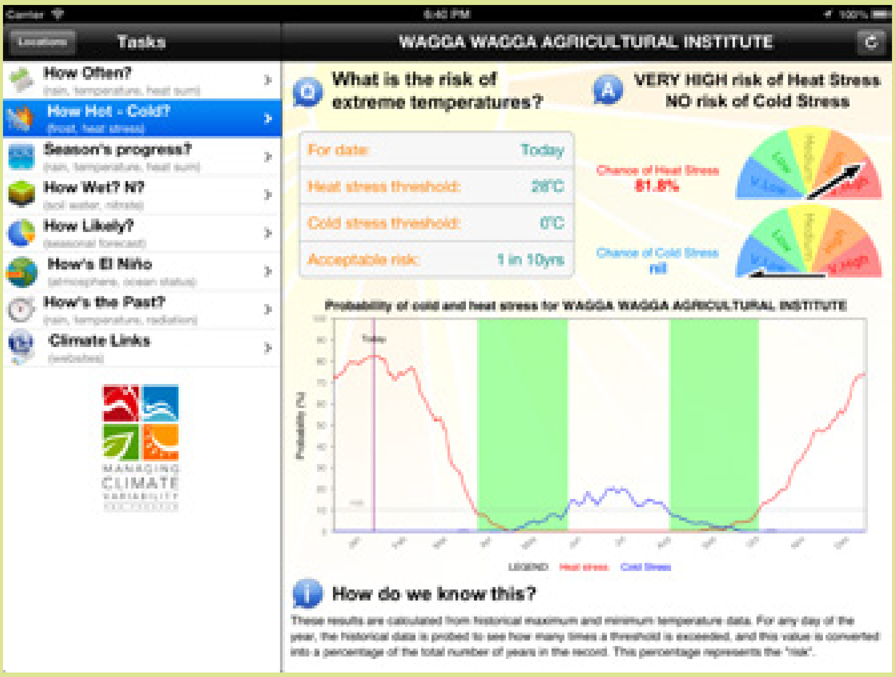
Users of the Australian CliMate app will soon be able to better understand drought conditions.

The free app, developed for the Managing Climate Variability (MCV) program and accessible on any computer or smartphone device, is being updated to enable a wider set of weather-based information tools for growers.

Updates to CliMate—to be released progressively over the next two years—will contain analyses on the status of drought events brought on by the El Niño - Southern Oscillation climate driver. Farmers will also be able to access information on the top 10 historical droughts for a particular location and the duration of those droughts.

The updated app will have additional tools to track estimated crop yields based on a season's progress and to explore possible trends in climate. Its functions may also be enhanced by the addition of the Predictive Ocean Atmosphere Model for Australia, the Bureau of Meteorology's most advanced seasonal forecasting approach to improving confidence in seasonal forecasts.

'The new developments will continue to target the next generation of Australian farmers', says Dr Freebairn, MCV project leader, who co-developed the app.



The app helps farmers make sense of past climate statistics and forecasts for their location.

'It's all about improving the ability of farmers to analyse risk and uncertainty in our variable climate.'

First released in 2013, CliMate is a suite of climate analysis tools designed for decision-makers whose business relies on the weather. It was developed by MCV to replace a number of ageing but useful tools, with a single, more accessible source of climate information for smartphone-savvy growers.

CliMate has allowed users to quickly 'interrogate' the last 65 years of weather statistics, forecasts and climate probabilities for their specific location. It has also enabled them to explore many 'what if' situations; to ask questions about rainfall, temperature and radiation, as well as heat sums, soil water and soil nitrate changes.

The seven key tools already existing on CliMate are: 'How often?', 'How hot/cold?', 'Season's progress?', 'How wet? N?', 'How likely?', 'How's El Niño?', and 'How's the past?'.

Over the past 12 months, these tools have been downloaded 15 000 times, with 70 000 requests made for climate data from the SILO database, hosted by the Science Delivery Division of the Queensland Department of Science, Information Technology, Innovation and the Arts.

The app was initially road-tested by farmers participating in the MCV Climate Champion program and leading grain growers via the Grains Research & Development Corporation's regional panels. An evaluation of user experiences will be similarly incorporated into the new MCV-funded project to guide its future development.

CliMate can be downloaded on any computer from the CliMate website, or by searching for 'Australian climate' in the Apple App store.

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Onwards and upwards for Managing Climate Variability

by Simon Winter

Welcome to the new digital edition of CLIMAG.

The move to a digital magazine is just one of our exciting new developments in this next phase of the Managing Climate Variability (MCV) program.

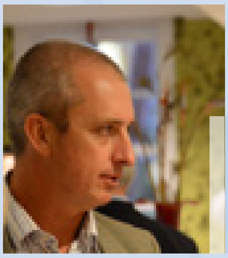
Our new projects (highlighted throughout this edition) focus on four themes:

1. **Improved climate forecasting for agriculture –** working with the major climate research groups to improve the skill of climate forecast models and an increased focus on issues such as extreme events.
2. **Improved climate services for farmers –** looking at how the climate forecasting information is packaged and delivered to agriculture, such as through the Bureau of Meteorology's Water and the Land site.
3. **Improved risk management for farmers –** addressing how climate forecasting data is incorporated into a farmer's decision-making processes to help mitigate climate risks. MCV previously delivered the CliMate mobile app as part of this theme's work.
4. **Improved climate communication and knowledge management** – continuing to support the MCV Climate Champion program, the Climate Kelpie website and this publication, CLIMAG.

These projects are building on 22 years of investment in climate research and development for Australian agriculture.

A key priority for MCV is to increase the linkages between our Climate Champions and the researchers. This will ensure that the research maintains a focus on the needs of farmers and delivers products useful to farmers.

The MCV program represents a $4.5 million investment over three years—2013/14 to 2015/16—by program partners: Grains Research and Development Corporation, Meat & Livestock Australia, Rural Industries Research and Development Corporation, Sugar Research Australia and Cotton Research and Development Corporation; as well as contributions for specific projects from Dairy Australia, Horticulture Australia Ltd and Australian Wool Innovation.



Simon Winter, Science Manager for the Managing Climate Variability program

A new Science Manager

Welcome to our new Science Manager, Simon Winter.

Simon has been a researcher and research manager in the agricultural sector for more than 25 years—primarily in meat and livestock.

In addition to his new role with MCV, he manages numerous cross-sectoral programs for the Rural Industries Research and Development Corporation—which he has represented on the MCV program management committee for the past five years.

Prior to this, Simon managed Australia's animal health surveillance programs, was engaged in agricultural research as a university lecturer, and was a team leader in the development of the Meat Standards Australia grading scheme.

Simon's strength lies in delivering practical outcomes that advance the agricultural sector.

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GRDC Grains Research & Development Corporation

mla MEAT & LIVESTOCK AUSTRALIA

Australian Government

Cotton Research and Development Corporation

Rural Industries Research and Development Corporation

Sugar Research and Development Corporation

Managing Climate Variability is a collaborative program between the Grains, Cotton, Rural Industries and Sugar Research and Development Corporations; and Meat & Livestock Australia.

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For more information on Managing Climate Variability, visit www.managingclimate.gov.au

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