A guide for farmers in using seasonal forecasts in South Eastern Australia

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

AGRICULTURE VICTORIA

- case studies of growers
- our key climate drivers
- wetter vs drier patterns explained
- the latest insights and tips

A guide for farmers in using seasonal forecasts in South Eastern Australia
Case studies of growers and other useful information on using seasonal climate forecasts in South Eastern Australia.
A joint initiative of the GRDC/Agriculture Victoria 'Using seasonal forecast information and tools to manage risk and increase profitability in the Southern Region' project.
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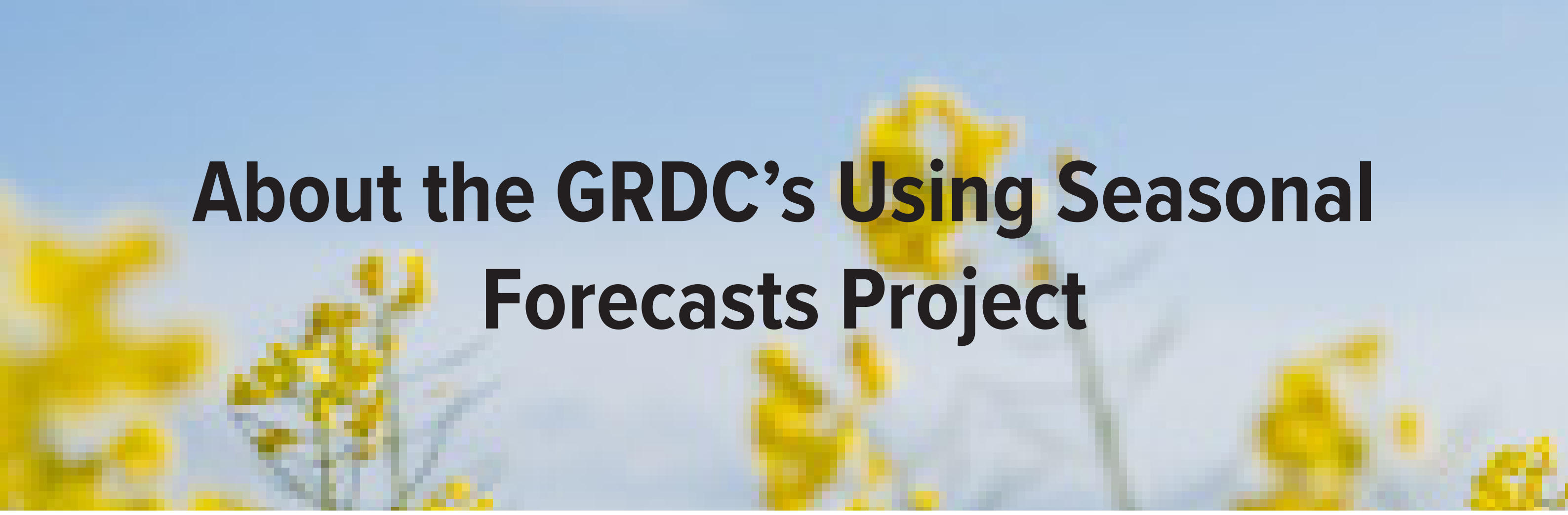

About the GRDC's Using Seasonal Forecasts Project

Recognising the importance of year to year climate variability as a major source of risk to grain grower profitability, the GRDC are investing in the *Using seasonal forecast information and tools to manage risk and increase profitability in the Southern Region project*. This applied project is working with the South Eastern Australian grains industry to improve how we communicate and use imperfect, through improving, seasonal climate forecast information.

GRDC Grower Relations Manager - South, Randall Wilksch, says "Many growers and their advisers are aware of seasonal climate forecasts but are unsure how to best use the information in decision making. We want to address this challenge by encouraging the most effective use and uptake of the latest climate information to improve profit and risk management for our grain growers."

The project has three main components:

1

Extending 'The Break' suite of seasonal forecast products to cover the whole GRDC southern region. This includes climate outlook newsletters, videos and webinars for each of South Australia, Victorian, Tasmanian and southern New South Wales growers.

2

Working closely with over 20 advisors from South Australia, Victoria and Tasmania through workshops and follow-up discussions to explore if and how seasonal climate forecasts can be better incorporated into the management of grain farms.

3

Creation of this publication of case studies and advice for GRDC Southern region growers and advisors on making the best use of seasonal forecast information to better target crop inputs, manage risk and increase profitability.

Seasonal climate forecasts (SCF) can play an important role in the farm decision making process, especially in years that sit outside the 'average'. Examples of where and when seasonal forecasts can be particularly useful to grain growers are outlined in the articles and case studies that follow.

This information presented in this booklet draws on the knowledge and experiences of grain farmers, advisors and researchers around how and when seasonal forecasts can aid you in making decisions about your farm enterprise. The project is being led by Graeme Anderson and Dale Grey from Agriculture Victoria. In addition to overall project management, they lead the extension of the successful '*The Break*' suite of communication products across the Southern region.

For more project details visit; www.forecasts4profit.com.au.

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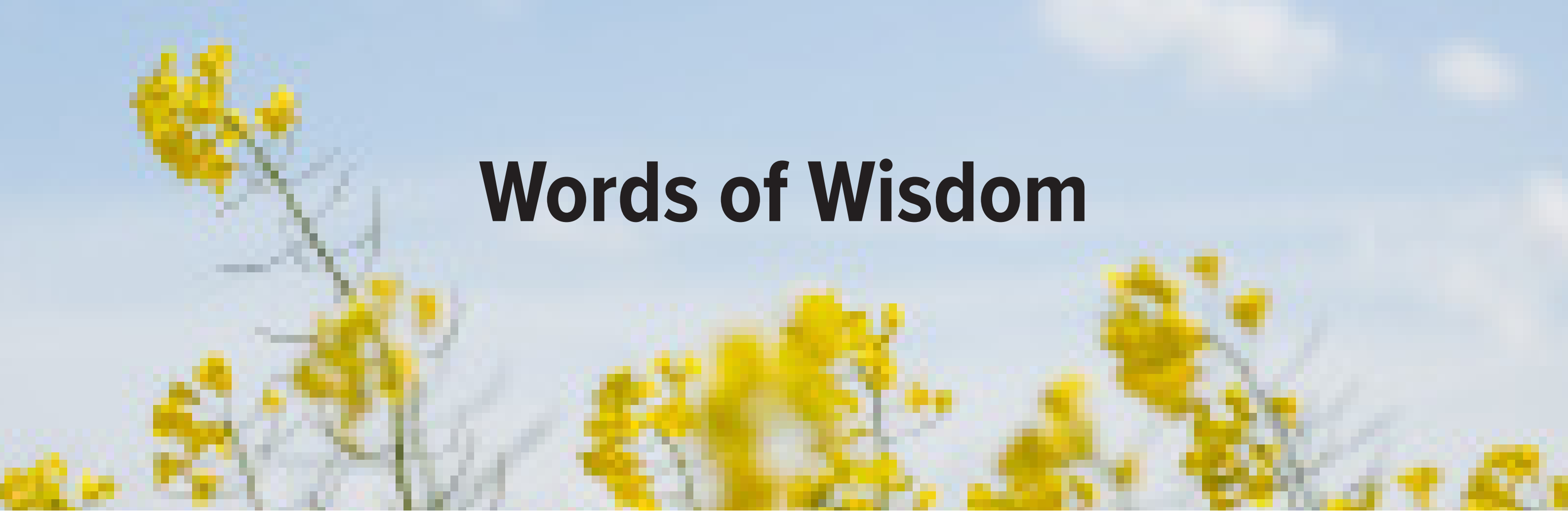


Words of Wisdom

Key messages about using Seasonal Forecasts; a selection of quotes overheard by Graeme Anderson

“Make decisions on what’s knowable first. After that forecasts are a useful ten percenter”

“Just like forecasts for markets, the economy, prices – seasonal forecasts can’t predict the future. But, used carefully with background commentary from a trusted source – forecasts can help you map out your scenarios”

“All options are possible at any time, but some seasons a pattern can change the odds of what’s more likely”

“Beware the language of forecasters. ‘Neutral’ doesn’t mean average rainfall, it means that there’s a third chance of receiving either average, drier or wetter”

“A 70 per cent chance of wetter than normal is the same as 30 per cent chance of drier – so be careful you understand the probabilities and the language of any forecast”

“Seasonal forecasts tend to be worth paying more attention to in those years when a key climate driver is in an active phase”

“Best to squint your eyes when looking at a seasonal forecast maps.....it’s the ‘vibe’ you’re looking for, such as is there more or less moisture floating about this year”

“The commentary that sits behind the forecast is the key bit - it’s about the background conditions”

“All forecasts are wrong, but some are useful!”

“Forecasts tend to make more sense when you know about the key climate drivers that were behind your district’s big dry and wet periods”

“Climate change will turn up one month and one season at a time, so seasonal forecasting just becomes more important”

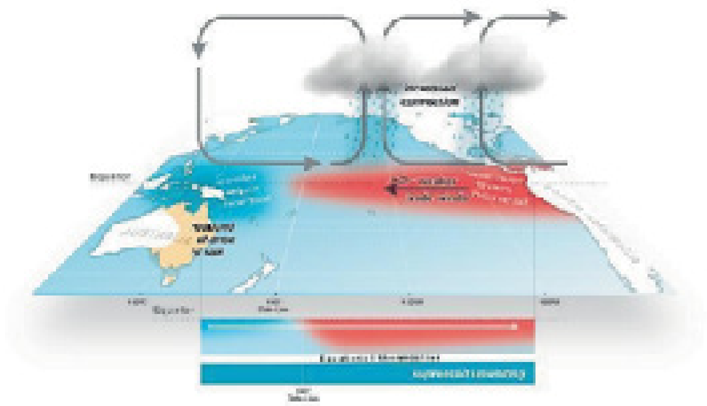
“Seasonal forecasts might only be of value or have a stronger signal every second or third year”

“All models have value – best to get a few opinions to get the overall vibe”

“If they do a hundred climate model runs for the next 3 months, when 80 runs are drier and 20 runs wetter, that’s where the 80 per cent chance of drier than median figure comes from”

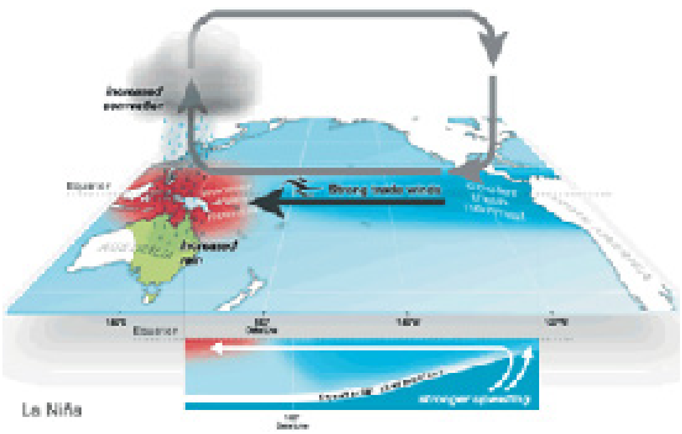
Climate drivers that affect

ENSO – (El Niño Southern Oscillation) refers to sources of rain bearing moisture that comes from the tropical Pacific Ocean. Historically El Niño years send us less moisture, increasing the chance of drier springs. La Niña years (like 2010) send us more moisture and eastern Australia tends to have increased chances of average or wetter springs. Farmers can track what ENSO is up to see what the outlook is for each spring – June-August is a good time to look at how things are set up for spring rainfall. The SOI (Southern Oscillation Index) is a measure of the pressure difference between Darwin and Tahiti. In El Niño years, the pressure is higher over the Darwin/Australia region and lower at Tahiti in the Pacific (SOI negative), which is not helpful for the flow of tropical moisture towards Australia. Recent events/seasons include El Niño (2015, 2009, 2006, 2002, 1997, 1994) and La Niña (2011, 2010, 2007, 2000, 1999, 1998).



During the El Niño phase warm waters head towards South America and trade winds are weakened. This results in less atmospheric moisture available for rain in Australia. In the past, El Niño years have been correlated with an increased chance of drier springs.

Images: Courtesy of BoM



Historically, La Niña years deliver more moisture to Australia, because warm waters gather closer to our north coast.

Combined with increasing trade winds this provides more moisture in the atmosphere and directs it towards eastern Australia. In the past, La Niña years have been correlated with an increased chance of wetter springs.

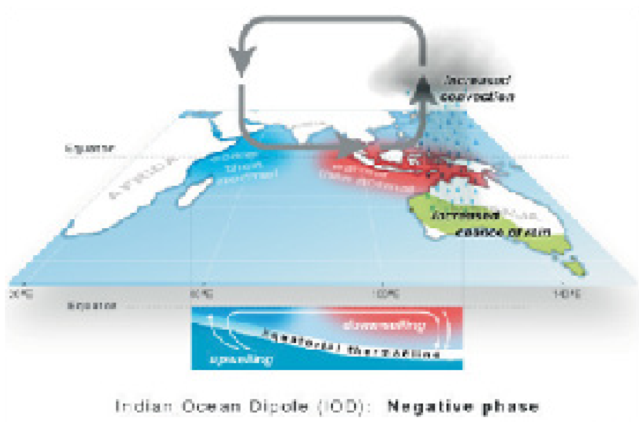
Images: Courtesy of BoM

South Eastern Australia

IOD – (Indian Ocean Dipole) refers to the supportive role played by the Indian Ocean and northwest cloud-bands and triggers coming from the tropical Indian Ocean region off the coast of northwest Australia. For much of the South East region, spring rainfall shows a strong correlation with drier years when IOD is in the drier phase (positive IOD). Wetter springs are more likely during negative IOD phases, when extra moisture flows and rainfall triggers get sent down to us via northwest cloud bands which drop out their moisture when they hit our cold air down south. Recent events/seasons include IOD positive/drier (2019, 2015, 2012, 2011, 2006, 2004, 1997, 1994) and IOD negative/wetter (2016, 2010, 1992).

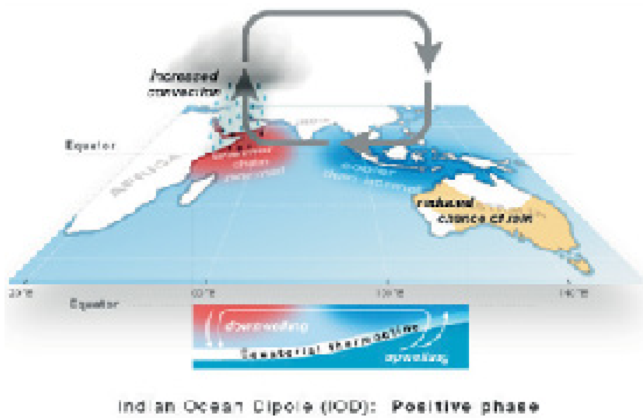
When the Indian Ocean is warmer in the east than it is in the west, we have a negative IOD event. This means that more moisture is available closer to Australia and can be delivered to SE Australia through northwest cloud bands.

Typically, negative IOD events have been associated with wetter seasons in SE Australia.



Images: Courtesy of BoM

A positive IOD occurs when the Indian Ocean is warmer in the west (near the coast of Kenya) than it is in the east (near Sumatra). This reduces tropical moisture availability for SE Australia and can make for a drier winter/spring.



Images: Courtesy of BoM

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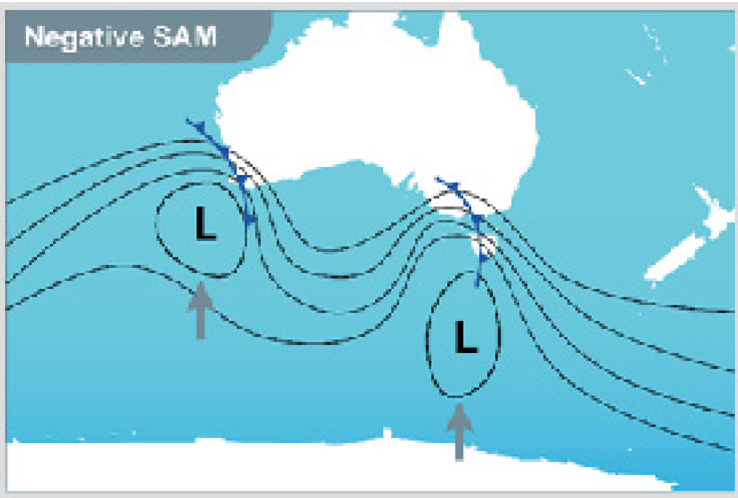
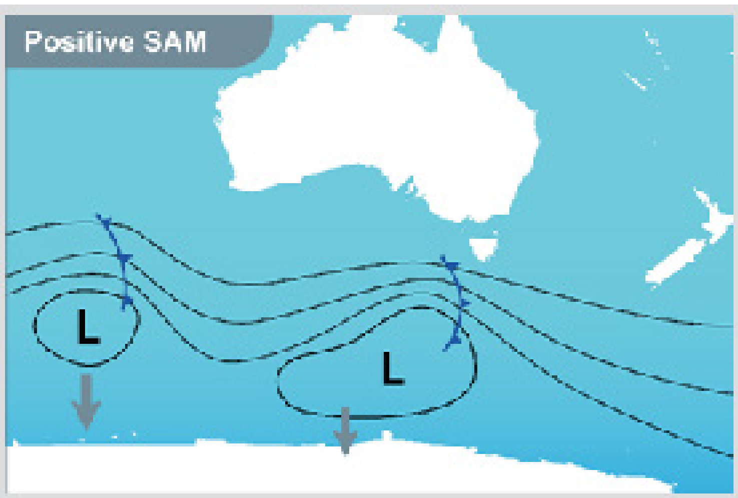
Climate drivers that affect

SAM – (Southern Annular Mode) refers to belts of westerly winds that circulate around the Southern Ocean and can influence the strength of frontal activity and rain triggers that get to the South East region. More regular or stronger fronts lead to wetter winters. When SAM is in a positive phase, fronts sit a lot further poleward, which can lead to drier winters. However, in summer the same SAM positive phase can assist with summer rainfall events along eastern parts of Victoria and southern NSW. In recent decades SAM has spent more time further south which partly explains reduced winter rainfall in parts of South East region.



Images: Agriculture Victoria

When the westerly wind belt expands, more (or stronger) fronts can come closer to southern Australia. Negative SAM increases the likelihood of above average winter rainfall in SE Australia.

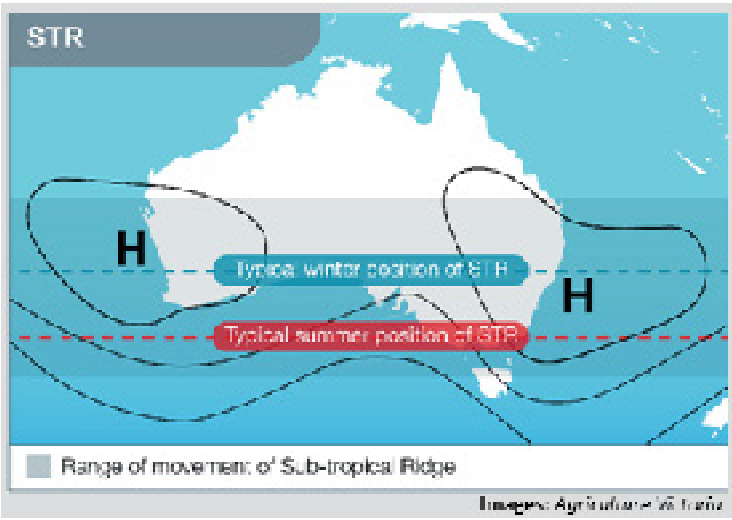


Images: Agriculture Victoria

When the belt of westerly winds contracts around Antarctica less (or weaker) rain producing fronts move across southern Australia. This is called the positive SAM phase and decreases the chance of rainfall (from fronts) during winter.

South Eastern Australia

STR – (Sub-Tropical Ridge) is a natural high-pressure belt that sits across southern parts of Australia and can influence the location and strength of high-pressure systems. Farmers know that seasons with stronger or more frequent blocking high pressure systems over southeast Australia don't tend to produce the regular rainfall that we would like. In recent decades the pressure pattern during the growing season has been measured as being a bit stronger, which meteorologists blame for the less reliable autumns rains in parts of southeast Australia. It also sets up the weather pattern that can bring cold/dry air from near Antarctica over parts of our region which can increase the incidence of frosts.



Typically, in winter the STR moves north, allowing fronts to pass over southern Australia. In summer, the STR typically moves south, blocking the passage of fronts which is part of the reason why SE Australia experiences rain bearing cold fronts during winter. The strength of the high-pressure systems also affect rainfall. Higher pressure means less rainfall.

Did you know that:

The wet spring and end to 2010 was wetter due to both ENSO (strong La Niña) and IOD (negative IOD = wetter) sending more moisture down this way.

The 2006 drought was the result of a combination of ENSO (El Niño - drier) and IOD (positive IOD = drier). The bigger droughts often occur when both are in their dry phase.

The 2015 dry spring was also the result of ENSO (El Niño - drier) and positive IOD (drier) teaming up again at their drier end of the scale.

The wetter 2016 winter spring was thanks to a negative phase (negative IOD = wetter) of the Indian Ocean Dipole, which helped herd extra moisture to the South East region via northwest cloud bands.

CASE STUDY ONE

Farming by numbers allows for variability in forecasting

AUTHOR
Rachael Oxborrow

Property: Springfield

Owners: Hugh, Merrily, Neville and Margaret Keam

Location: Lah, Victoria

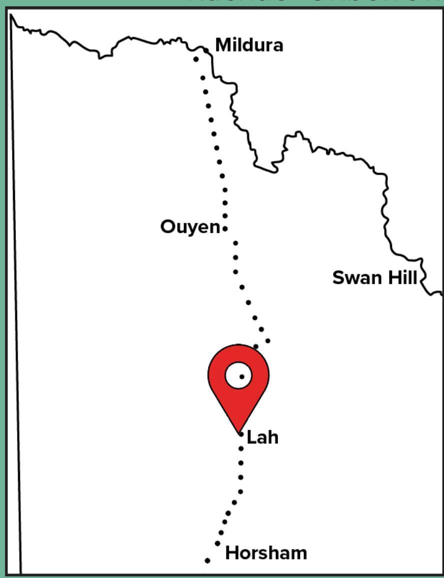
Farm Size: 2000 hectares

Enterprises: cropping and sheep

Average Annual Rainfall: 325 mm

Soil Types: sandy Loam, Clay Loam

Typical Crops Grown: wheat, barley, beans and lentils.



The mechanical engineer in Hugh Keam has adapted to the variables that make up the world of farming, prompting him to create his own yield calculator and consult seasonal forecasts to guide his decision making.

Hugh's 10 years in the automotive industry wired him for numbers and spreadsheets and after returning to the family farm in 2006 he has been taking every opportunity to research and seek further knowledge to better his operation.

"I see so much benefit in research and the most demoralising thing for me when I came home to farming is there's no set responses when it comes to farming," he said.

"In engineering 2+2=4 all the time but with farming it seems like your neighbour can do one thing and you can do another thing and you can both end up with the same result.

"That has been challenging for me."

To combat the variability, Hugh has been adapting his own spreadsheet which adapts the crop simulation software Yield Prophet ® and the wider French and Shultz research to include details specific to his operation and previous season's results. This approach allows Hugh to consult seasonal forecasting services such as Agriculture Victoria's The Break to simulate possible scenarios for the season.

"When it comes to trying to put an equation around what you should end up with when you put a crop in the ground, there's too many variables and to this day I still find it frustrating that I can't predict accurately what I'm going to get," he said.

"I follow Dale Grey's The Fast Break with a lot of interest, the Bureau of Meteorology's Water and the Land information, the Norwegian Government's weather site and Elders weather.

"I find these tools help validate my decisions and they are generally fast and reliable, if any weather forecast can be reliable."

"In engineering 2+2=4 all the time but with farming it seems like your neighbour can do one thing and you can another thing and you can both end up with the same result."

Hugh farms with his wife Merrily and parents Neville and Margaret near Lah in Victoria. They crop 2000 hectares with a rotation of wheat, barley and either lentils or beans, while also running 360 ewes.

"Sheep are a great avenue for profit, particularly with prices the way they have been, and it has saved us in tough years," he said.

"Having livestock also allows us not to be scared of using a crop for hay, particularly if it is a tough and dry season, as we know we have stock to cover its use if we can't on-sell it."

The Keam's property hosts an Agriculture Victoria trial using moisture probes up to one metre below the surface, giving the family a unique insight into their retained soil moisture and crop water use. Hugh also conducts annual soil tests on all planned cereal paddocks, with one deep nitrogen test included in the mix to keep on top of nutrition trends across the property.

"When spreading urea, I'll often put in test strips to see if I've got the nitrogen rate right," he said.

"I usually have a double rate and an 'untreated' strip.

"This serves as a good visual test throughout the year, but the main results are in the yield."

Hugh said 2019's dry seasonal forecasts had prompted some of his neighbours to cut back on their cropping area, but his knowledge of retained summer rainfall thanks to the soil moisture probes had given him some confidence.

"From my point of view, the forecasted El Niño can be a dry or a wet version of the climate cycle and this year we've put the same amount of crops in," he said.

"We're playing with canola as our risky crop as we have summer rains to fall back on, but if you didn't you might consider pulses instead.

"We've had our fourth best start in 15 years and while I know from our first-year home on the farm in 2006 things can go south quickly, I work hard to be across the capabilities and limitations of our farming system."

Insights into Seasonal Forecasting

An interview with Dale Grey, Seasonal Risk Agronomist (Agriculture Victoria)

Q. What makes you more confident about a Seasonal Forecast? What are the signals you look out for?

The first thing to consider is the time of the year. I'm never very confident about using longer term forecasts during autumn because that's where the predictability barrier is, but I certainly start to become more confident in forecasts when we get into winter; the July forecast for August-October is when I have greatest confidence in forecasts. I don't place much confidence in summer forecasts. Exceptions to these times can occur when fully functioning climate drivers occur very early or late in the season.

Secondly, if the models are predicting wetter or drier, are they also predicting a reason why this might be happening such as a major climate driver like El Niño or La Niña or a signal from the Indian Ocean Dipole? In other words, is there a known physical reason as to what might be causing a drier or wetter forecast.

Thirdly, is there actually evidence of indicators such as ocean or cloud changes month by month, that you can see 'things' are actually happening or changing in the direction of the forecast? A seasonal forecast is one thing but if you can see evidence that a forecast is starting to play out, then that can be a situation where you can have more confidence in that forecast.

Q. What's neutral mean?

Neutral doesn't mean average. Frustratingly, there are two uses of the term 'neutral' - if referring to a 'neutral' ocean, that infers that the ocean is behaving in its historically 'average' or 'normal' state (i.e. not in an El Niño or IOD positive state).

However, when we refer to a 'neutral' forecast it's tempting to think that neutral means average but that's not the case. Neutral means anything is possible. For example, models may be run 100 times and from all these model outputs a neutral forecast says that one third of the models are indicating a drier forecast, one third came out average and one third came out with a wetter forecast. In other words, there is no strong signal in any direction pointing wetter, average or drier– that's the official term for the meaning of a 'neutral' forecast. Neutral means plan for anything.

Q. Do you have a favourite seasonal forecast model or prefer to scan them all to check the vibe?

Because I've been looking at seasonal forecast models for the last 11 years, I do have my favourites that have won my 'Brownlow' count over the years. They are usually the European Centre for Medium-Range Weather Forecasts (ECMWF), the Bureau of Meteorology (BoM) and the UK Met office models that have been the best performers over the last 10 years. But in saying that they have all, at times, performed poorly so I don't have rose coloured glasses on when I'm looking at any of the models.

Q. Do some of the models perform better at predicting say, IOD or ENSO than others?

Yes. ECMWF model is generally a bit better for predicting what's happening with the Indian Ocean Dipole. Some models are better at ENSO whilst others are better at predicting both. However, my experience suggests that you'd be mad to put all your eggs in one basket and just look at the one model because that could be the year that that particular model doesn't perform well or pick anything. For example, if six models are forecasting drier and your one 'favoured' model contradicts these six then you wouldn't stick with that one model just because it is usually the more reliable one. Better to consider the overall 'vibe'. That's why I provide an analysis of a range of models in The Fast Break indicating what the range of models are predicting. When you can see half or more of the models swinging a certain way then that tells me something.

Q. If a forecast says we have 50 per cent chance of above or below average rainfall – does that mean we are most likely to get average?

No. It's all about probability. If a model says a 50 per cent chance of above average (median) rainfall then there is a matching percentage of getting the opposite of that, i.e. 50 per cent chance of getting below average rainfall. It's frustrating because there are no absolutes in climate modelling, or any future prediction for that matter. It's all about probabilities.

Some useful links for that rainy day:

Where's the rain expected for the next 7 days? www.bom.gov.au/jsp/watl/rainfall/

The next 7 days (model forecast) – just hit the play button and see what the next week might play out www.bom.gov.au/australia/charts/viewer/index.shtml

BoM product showing how much soil moisture is about www.bom.gov.au/water/landscape/

The BoM seasonal outlooks, which now have a monthly video snapshot as well as 1 to 4 months outlooks for rainfall and temperatures www.bom.gov.au/climate/ahead/

CliMate app – useful tool to look up your nearest local long-term rainfall station data and then ask questions like "How often we do we get autumn breaks with 50 mm over 2 weeks in March-May? www.climateapp.net.au/

CASE STUDY TWO

Seasonal tools frame big-picture vision

AUTHOR
Clarisa Collis

Northern Victorian grower Wayne Thomas was busy loading wheaten and vetch hay onto trucks dusted with brittle soil in the dry heat when GroundCover visited his family's 1540-hectare property at Youanmite, about 25 kilometres south-west of Yarrawonga.

Triggering this on-farm activity was the forecast for a soaking the following day, heralding a brief reprieve from the prolonged dry conditions during the 2018 growing season on the Thomas family's farm.

Wayne's risk management response to protect high-value hay from potential weather damage highlights the influence of increasingly sophisticated seasonal forecasting in helping to shield cropping operations from a changing climate and variable seasonal conditions.

However, seasonal forecasting is one of many tools the second-generation grower uses to frame a big-picture vision of the climatic and seasonal landscape that guides his approach to risk management across cereal, oilseed and legume crops grown for grain and hay.

"Each tool only assists with part of the overall picture, so we use a suite of tools to build the most accurate picture of our farm business risk profile," he says.

For Wayne, these tools fit into the past, present and future of the farm's cropping program: wheat, canola, oats, vetch and faba beans. They range from first-hand seasonal experience and paddock records to up-to-date soil moisture and weather data collected on-farm to seasonal and climatic forecasts, and a web-based decision support tool.

For example, he analyses data collected by a deep soil moisture probe and weather station installed on his property by Agriculture Victoria to help determine the yield potential of crops based on plant-available subsoil moisture and on-farm weather conditions.

From a fixed paddock location, the weather station records climatic information, such as in-crop temperature and received rainfall, while sensors in the capacitance probe record subsoil moisture at 10-centimetre increments from a depth of 30cm to one metre in the soil profile.

In the dry 2018 growing season, Wayne used data sourced from both the weather station and moisture probe on his property to help inform a key decision in farm business management - the decision to cut some wheat, canola, oats and vetch for hay instead of harvesting these crops for grain.

“Each tool only assists with part of the overall picture, so we use a suite of tools to build the most accurate picture of our farm business risk profile.”

Owners:
Wayne and Terese Thomas

Location:
Youanmite, Victoria

Farm Size:
1540 hectares, 1500 hectares cropping

Average Annual Rainfall:
450 mm

Soil Types:
sandy loam over clay

Soil pH:
5 to 6

Typical Crops Grown:
wheat, canola, oats, vetch, faba beans

He says the weather station showed paddock temperatures, which plummeted from minus 1.3 to 6.2°C between 1am and 7am on 29 August, caused severe stem frost that saw cereal and oilseed crops “frozen in time”.

“We’d never experienced frost like that before - in the past we’ve only had partial stem frost.

“Some of our wheat and oats didn’t grow another centimetre,” Wayne says.

The arrested crop development was reflected in the probe data that showed his frost-damaged wheat had stopped drawing moisture from the subsoil, suggesting it had stopped growing.

This frost impact on the Thomas family’s farm was also observed by Agriculture Victoria seasonal risk agronomist Dale Boyd who manages a Victoria-wide network of probes and weather stations on growers’ properties and releases commentary based on the data collected.

Wayne’s inspection and monitoring of crops showed the severe frost damage was not limited to 350 hectares of wheat. It caused major damage to most of the farm’s 600ha of canola and 250ha of oats as well.

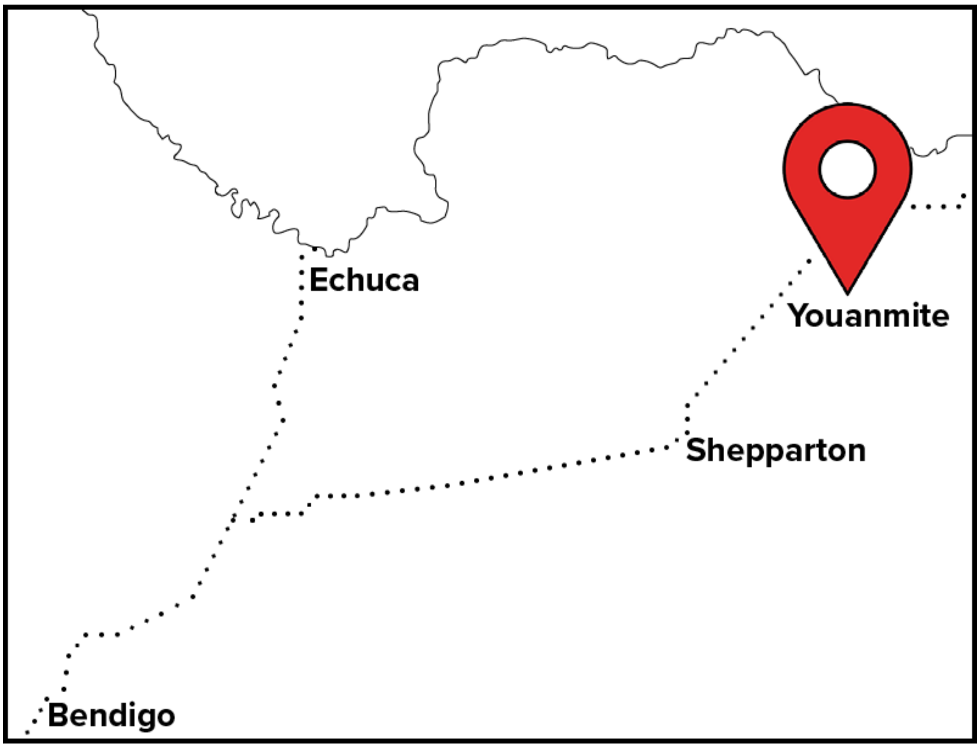
But he says lessons learnt from frost damage in past cropping seasons, plus in-crop examination, confirmed losses were less severe where crops were sown into legume stubbles.

This he attributes to the increased plant-available soil moisture following legume crops compared with cereals, and the dry conditions known to exacerbate frost-damage.

Apart from frost losses, other considerations that influenced Wayne’s decision to cut about two thirds of his crops for hay were short and long-term seasonal and climate forecasts, released by Agriculture Victoria.

To this end, he relies on seasonal forecast commentary, The Break, produced by Agriculture Victoria seasonal risk agronomist Dale Grey. The Break provides a range of seasonal forecast summary newsletters, comparing forecast models, including Bureau of Meteorology (BoM) models, and soil moisture data for three to six months.

For instance, the short and long-term outlook in early September for continuing dry conditions saw Wayne cut some wheat and vetch for hay, even though it escaped



frost damage, to help “salvage profitability” from these moisture-stressed crops.

“Based on past experience, paddock data and seasonal forecasting, we know how much moisture crops need to fill grain.

“If there’s no moisture left in the soil profile and the seasonal outlook is hot and dry in September, it’s often safer to cut at-risk crops for hay than hang out for rain,” he says.

Chasing the “most profitable, low risk” management option, he adds that forecast information is carefully measured against the backdrop of long-term yield averages and crop dry matter cuts that ranged from 1.7 to 2.5 tonnes/ha last year.

Wayne also fine tunes his crop area and inputs to match predicted seasonal conditions.

For instance, where seasonal climate models forecast low decile conditions, in which rainfall is ranked for each calendar year, and the probe on his property shows depleted subsoil moisture, Wayne might replace part of his wheat or canola area with less thirsty vetch or oaten hay enterprises.

“We don’t dramatically change our area planted to different crops in a dry season, but we may pull 100ha of wheat or canola from our program,” Wayne says.
And he might adjust his nitrogen fertiliser application rates based on seasonal and climatic predictions of a dry season as well.

For example, in a high rainfall season, Wayne usually applies 30 to 50 kilograms of nitrogen/ha to help maximise grain productivity and profitability where cereals, with high yield potential, are sown into legume stubbles.

However, in the low rainfall 2018 growing season, no nitrogen fertiliser was applied to the farm’s stubble-sown cereals – a move that saw him secure better gross margins from parched crops, showing low yield potential.

Wayne’s seasonal risk management toolbox also comprises the web-based decision support tool, Yield Prophet®, used to estimate crop yield potential based on predicted rainfall and soil core testing, plus BOM Indian Ocean Dipole outlooks known to influence on-farm rainfall.

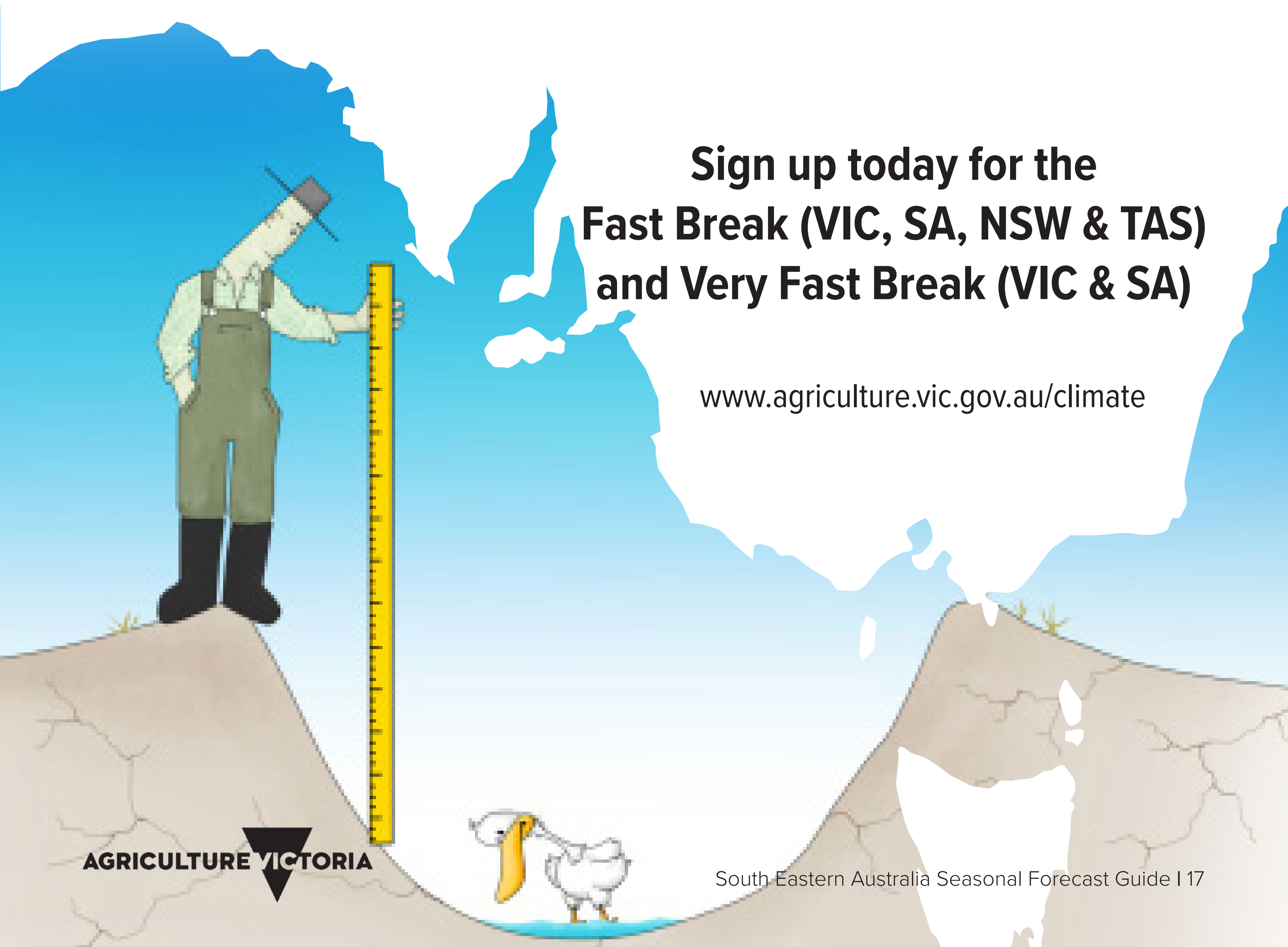
Caution in Autumn - Autumn predictability barrier

Farmers are always keener for more accurate seasonal forecasts in Autumn. However, The Break team suggest some caution should be exercised in Autumn as it is often a time of lower forecast model skill and outlook confidence.

With exception of perhaps late May 2015, in most Autumns the Pacific and Indian Oceans have not usually showed their hand enough to let us know what direction they might go for the growing season.

Also an Autumn break can be triggered by one or two individual weather events, rather than a recurring pattern (which seasonal models are better at picking up). In Autumn it's always best to go with the known known's, such as stored soil moisture, feed and water stores, and if it hasn't rained by X I will do Y to base the majority of your decisions on.

It is a bit like the football season, your team may not look like finals hopefuls at the start of the season, but by about June or July we have a better idea of our teams form and if they will make finals or not.



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Interpreting seasonal forecasts

There are many different models with many different styles of outputs, following are examples of the most common types and how to interpret them.

Good models are never run in isolation, the best models are run multiple times to show the possibilities inherent in the chaotic climatic system. Figure 1 shows the output of the Bureau of Meteorology's (BoM) ACCESS-S model predicting Sea Surface Temperature (SST) anomalies for the NINO3.4 region (a large area of the central Equatorial Pacific Ocean). The graph shows the historic temperature to the left (black line) and the model predictions to the right (light grey lines). There are 99 different predictions in grey, each called an ensemble member that make up the ensemble plume (the collection of all the grey lines). The green line and dots make up the ensemble mean which is the average of all the 99 ensemble members. This is the average prediction of the model, but the spread of the grey lines shows that there is great variation in the prediction around the average. After starting the model, the individual predictions nearly always spread out becoming more uncertain over time. Sometimes plumes are more tightly bunched providing greater certainty, sometimes they start spreading greatly.

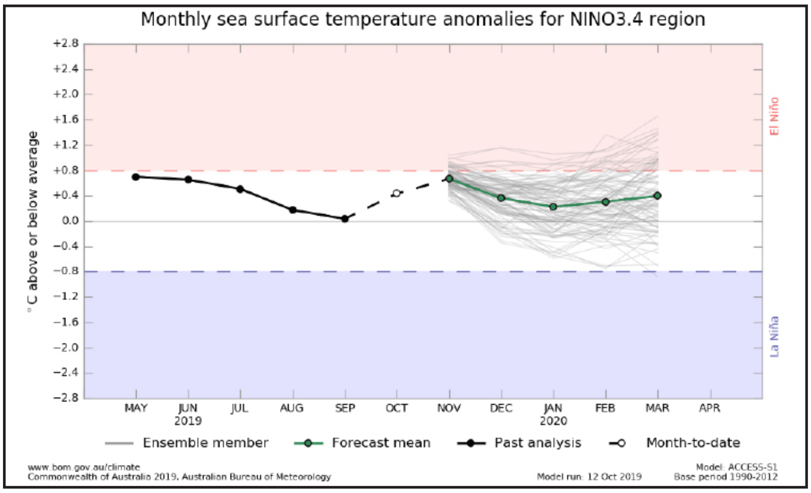


Figure 1. Monthly sea surface temperature anomalies for NINO3.4 region. Source: BoM.

The plume of results exists for any parameter the model is predicting for and rainfall is no different. For the BoM's ACCESS-S model 99 predictions of rainfall are generated for every location. When presenting model predictions for rainfall, climate researchers use a range of different images. The one we are most familiar with is the percentage chance of being above or below median shown in figure 2. By ranking all 99 ensemble members in all locations, the BoM than compares the outputs to the median (the middle value but usually close to the average). For an area to be shaded brown, less than 40 per cent of the ensemble members were greater than average, it also means the opposite that 60 per cent of the ensemble members were less than average. The map does not emphatically state that somewhere is going to be wet or dry, just the probability of it being wetter or drier based on the 99 ensemble members. If its shaded white the chances of being wetter or drier than the average are about the same; there were just as many wet ensemble members as there were dry ensemble members. This can best be interpreted as "plan for any possibility". This type of percentage chance forecast is called "probabilistic".

AUTHOR
Dale Grey

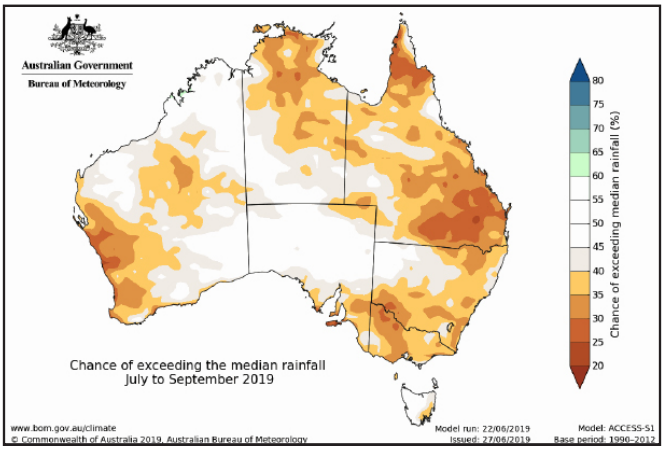


Figure 2. July to September 2019 chance of exceeding the median rainfall map. Source: BOM.

Another way of showing the range of climate outcomes is to use what's called a tercile map (tercile means three). Instead of comparing to the median or average, this compares the ensemble members to the lowest third, middle third or the wettest third of the record. The APEC Climate Center (APCC) map in figure 3 shows greater numbers of predictions in the lowest third of records in brown, more average or middle third forecasts in grey and wetter third forecasts in green. The white colour represents the areas where the ensemble members fell out in the classical climatological pattern of a third dry, third average or a third wetter.

The white is also best interpreted as "plan for any possibility" or all outcomes have a 33.3 per cent chance of occurring. Looking at Victoria, this map shows that 40-50 per cent of the ensemble members fall into a driest third of records prediction in the north. Southern areas had a slightly higher probability of 50-60 per cent. In my experience, the way the models are leaning is of more value than getting caught up in the percentage strength of the prediction. In the last 12 years many dry seasons have occurred when the models were only just sniffing drier in the wind.

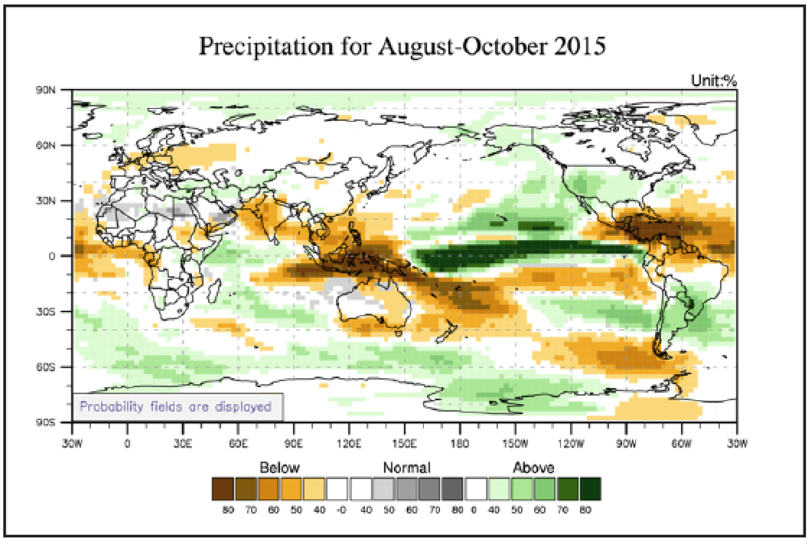


Figure 3. July to September 2019 chance of which tercile rainfall map. Source: APCC.

The final method of displaying predictions is to simply map the ensemble mean. Average out all the ensemble members for a particular grid point on the map and compare the rainfall to normal. This is called a "deterministic" forecast and is presented in an anomaly format. Rainfall is predicted to be either close to normal, or varying degrees of drier or wetter than normal. Figure 4 shows a prediction from the National Centers for Environmental Prediction (NCEP) showing an ensemble mean forecast, the scale is in mm/day. The mustard yellow colour shows a large area of SE Australia that is likely to receive 45-90 mm less than normal for the July to September period. Once again, it's important not to get hung up on how wet or dry the forecast is, just whether on average the model is predicting a shift in rainfall compared to normal.

I like forecasts that give you both deterministic and probabilistic outputs. They both tell you slightly different information, one in terms of dumbed down absolutes, but the other in terms of chances of occurrence.

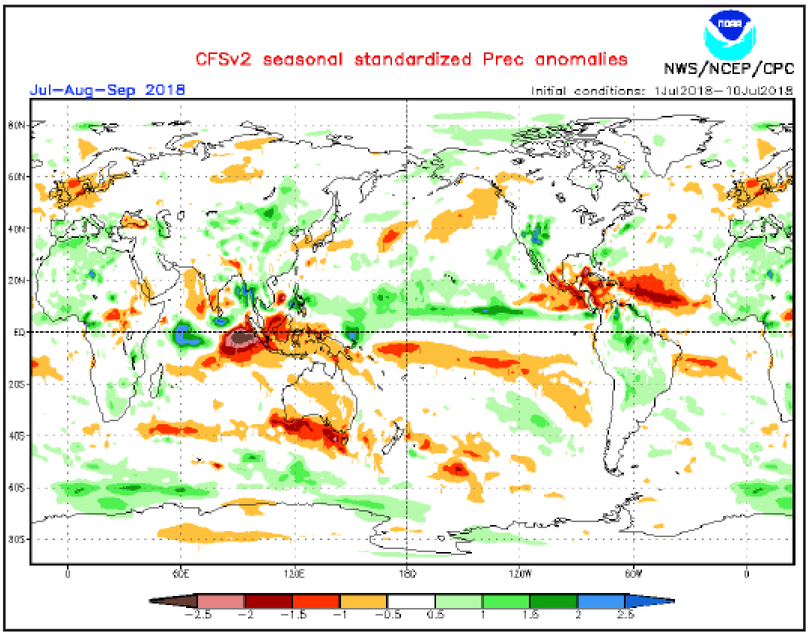
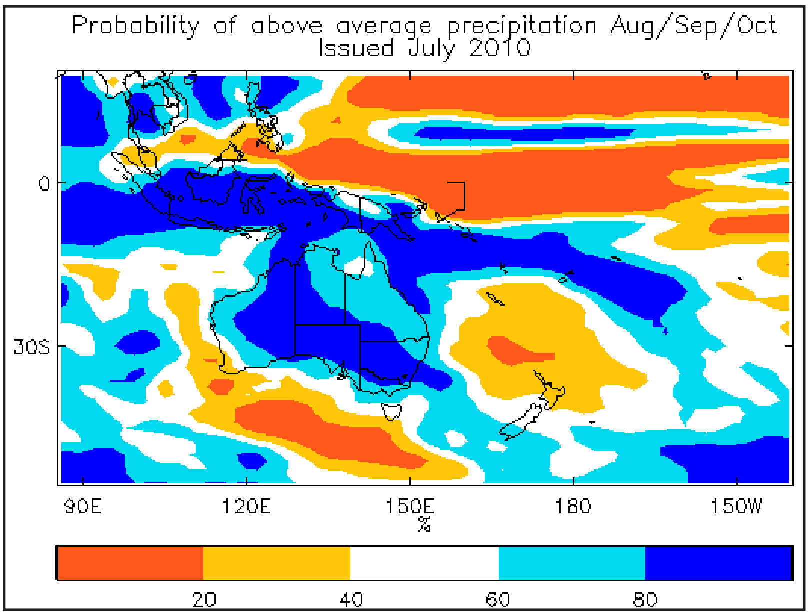


Figure 4. July to September 2018 rainfall anomaly prediction map. Source: NCEP.



For balance, here are some historic forecasts showing some wetter predictions for comparison.

Figure 5. Sept-Nov 2010 Probability of above average rainfall. Source: UK Met Office.

This map shows most of Australia was predicted to have a greater than 80 per cent chance of the rainfall being above average.

Figure 6. Sept-Nov 2016 probability of wetter/normal/drier tercile rainfall. Source: National Oceanic and Atmospheric Administration (NOAA) North American Multi Model Ensemble.

This map shows much of Australia having 40-60 per cent chances of rainfall to be in the wettest tercile.

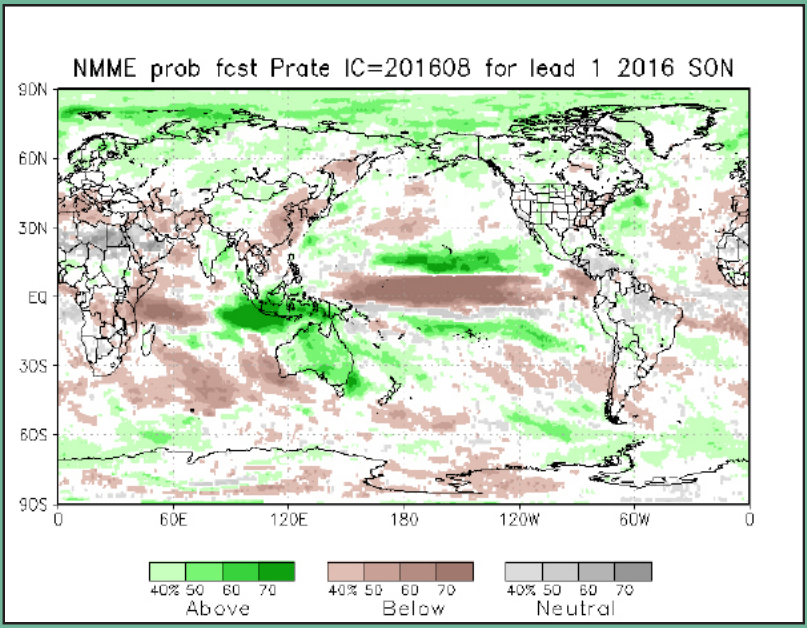
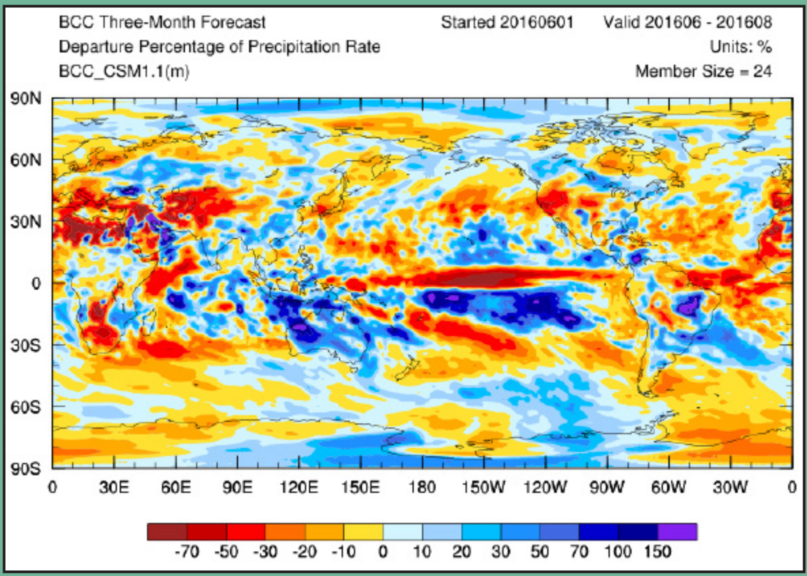


Figure 7. June-August 2016 rainfall percentage anomaly prediction map. Source: Beijing Climate Centre.

This map shows a deterministic forecast predicting it likely to be wetter than average over much of Australia.



AGRICULTURE VICTORIA

CASE STUDY THREE

Range of forecasting tools useful for variability

AUTHOR
Rachael Oxborrow

Owners: Jeff, Jenny, Andrew, Dale, Mark and Libby Baldock

Location: Kimba, South Australia

Farm Size: 7000 hectares

Livestock: 2700 breeding ewes

Enterprises: cropping and sheep

Average Annual Rainfall: 330 mm

Soil Types: red clay, loam and sand

Typical Crops Grown: wheat, barley, oats, canola, lupins, peas, vetch and medic pasture

Andrew Baldock knows the canola at his family's property needs to be in the ground before the opening season rains and he uses seasonal forecasting to help guide their dry sowing decisions.

"Where we are, if we don't have a pretty good profile of moisture, we will need good opening rains to sow canola as it just needs that early vigour to get well established," he said.

"If canola isn't in by the middle of May, then it's not going in.

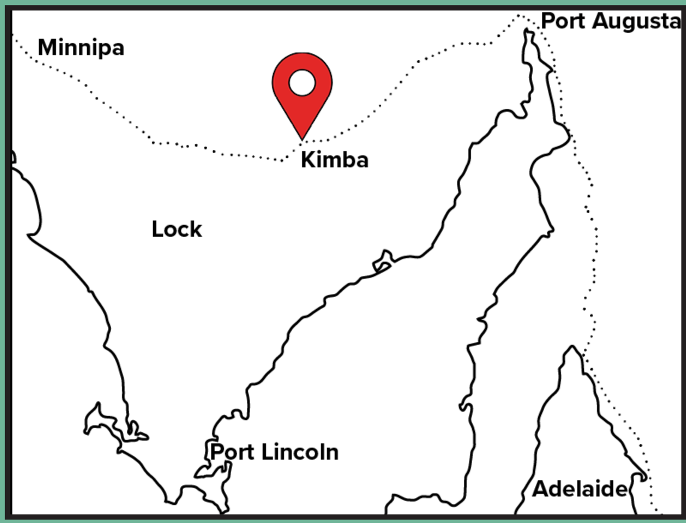
"It's a decision based on the seasonal outlook, stored soil moisture, paddock history and gut feel."

In the past, the Baldocks have held off seeding until the end of April knowing yields won't suffer, but Andrew acknowledges if rain comes too late into May or even June and they haven't started seeding there's going to be quality issues.

"That might be when we would make the call to sow wheat dry, get it in the ground and manage weeds in our rotation instead of waiting for rain and a first knockdown," he said.

"In terms of fertiliser, both short-term and seasonal forecasts give us greater confidence on application timing."

The Baldocks are fourth-generation farmers at Kimba where they run a mixed farming operation of 2700 breeding ewes and crop around 5500ha. They manage a rotation of wheat, barley, oats, canola, lupins, peas, vetch and medic pasture. Andrew farms with his father Jeff, brother Mark and brother in law Nathan.



"If you start seeing patterns where a lot of forecasters are predicting the same outcome you feel like you have more of a chance of that scenario occurring."

Andrew manages the cropping and grain marketing side of the operation and consults forecasts out to seven days to guide day-to-day work around factors such as wind and rain for opportunity to spread fertiliser or spray. Seasonal forecasts such as Agriculture Victoria's The Fast Break and the quarterly Bureau of Meteorology forecasts can guide planting timing and the crop rotation mix, as well as urea applications heading into spring and harvest.

"It really is worth looking at a range of seasonal forecasters to allow for variability," Andrew said.

"If you start seeing patterns where a lot of forecasters are predicting the same outcome you feel like you have more of a chance of that scenario occurring."

Andrew also believes experience play an important part in making decisions on what a forecast is predicting and the likelihood of what will happen.

"I'm a fairly young farmer really and haven't had a great deal of experience, so I'm taking notice of the forecasts and how they affect us. I'm also considering how different moisture levels in the soil affect us over time," he said.

"This should help us to make better decisions going forward.

"We also like to look at the historical accuracy of the forecasts on the Bureau of Meteorology website to guide us and give us confidence.

"If we're getting a 50 per cent chance of higher than average rainfall with only 50 per cent historical accuracy, it's pretty hard to make much of that, but if you're getting 70 per cent chance of higher or lower rainfall with 60-70 per cent historical accuracy you feel it's more likely to happen."

As knowledge of the property's specific soil water holding capacity and the industry's knowledge of water requirements of crops throughout the years improves, Andrew said the family was gaining confidence in consulting seasonal forecasts for in-season guidance.

In season 2019, the Baldocks are observing wheat at 2-4 leaf stages and barley starting to tiller in mid-June. Andrew said the barley will require much more rain in the coming months than the wheat will to succeed and this will be in the back of his mind while making operational decisions.

"The nitrogen application side of farming and having the confidence to apply it in-season is a huge decision for everyone and we know from research this contributes significantly to the yield gap," he said.

"The ability to be more efficient with our nitrogen application through timing and confidence would be made easier with more reliable forecasting.

"Sometimes you just can't get the confidence to apply nitrogen and we've hesitated in the past despite a good long-term forecast and it has proved quite costly.

"You're balancing the scenarios of whether that large rainfall event could happen and potentially cause leaching or whether caution is the right move and the rain doesn't happen."

CASE STUDY FOUR

Consensus informs strategic step-change

AUTHOR
Clarisa Collis

Kate Burke, managing director and farm business strategist with the Echuca-based consultancy, Think Agri, says 'data consensus' is fundamental to the core principles of strategy she advocates for lifting crop productivity and profitability.

Dr Burke, who has 29 years of grains industry experience, including 12 years agronomy consulting in the Wimmera and Mallee regions, says data consensus is gleaned from an increasingly sophisticated suite of seasonal and climate risk management tools.

It is then used to inform the critical thinking and decision-making processes at each stage of the strategy she recommends to help growers optimise farm business management.

Her strategy comprises three main steps:

1

Assessment of the farm business's position at a particular point in time – relative to historical records, spanning seasonal, climatic and on-farm data – to provide a comparative benchmark.

2

Consideration of three 'possible futures' for the farm business, including estimates of yield potential for all three situations, such as below average, average and above average rainfall. Appraisal of the likelihood of these possible futures based on historical records, as well as up-to-date on-farm data and short and long-term forecasts.

3

Identification of management options for the three possible futures, and consideration of their implications – financially and logistically – as part of an overall action plan.

She advises farm business operators to repeat this staged approach, at least monthly, and before making major management decisions, drawing on data trends or patterns that emerge from analysing a range of seasonal and climate risk management tools.

"Consensus or agreement in the data obtained from a variety of sources is more persuasive than data from a single source," Dr Burke says.

She looks to the subscription-based seasonal forecast commentary, The Break, and seasonal forecast summary newsletters, comparing a range of predictive models, released by Agriculture Victoria seasonal risk agronomist Dale Grey.

Her toolkit also contains deep soil moisture probe data and commentary released by Agriculture Victoria seasonal risk agronomist Dale Boyd who manages a Victoria-wide network of probes on growers' properties.

The Bureau of Meteorology (BOM) is another trusted source of data, with its local and state seasonal forecasts, Indian Ocean Dipole monitoring, and Australian weather watch radar and wind forecasts.

Plus, she suggests growers examine the findings of on-farm soil core sampling and web-based decision support tools, such as Yield Prophet® to estimate crop yield potential based on predicted rainfall and soil testing. Dr Burke also refers to analytical, modelling and simulation tools, such as the CliMate decision-making aid, the French-Schultz model and the Agricultural Production Systems sIMulator (APSIM).

"The beauty of the Agriculture Victoria tools is that they provide a 'form guide' of data from different sources that allow growers to see whether there is consensus in the seasonal and climate forecasts at a glance," she says.

"Data from the on-farm network of deep soil moisture probes is also useful in helping to gauge crop yield potential based on the soil moisture profile across different cropping areas."

"Together, these tools can assist growers to play the season on its merits."

2016 example

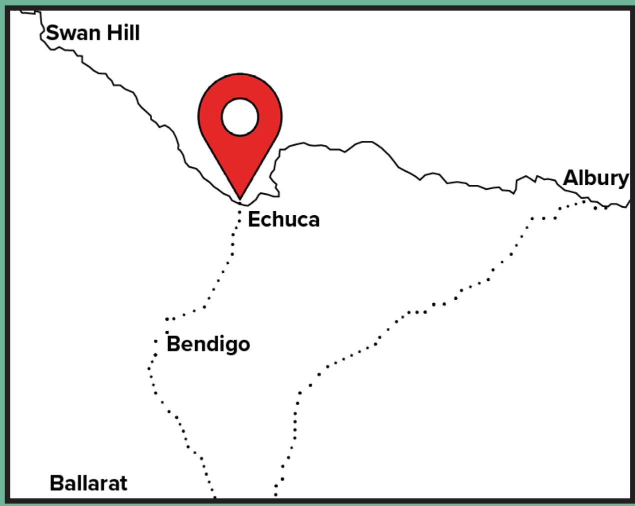
She says the 2016 season, for example, highlighted the improved crop productivity and profitability that can be achieved where growers used a variety of tools to better estimate yield potential.

"In that season, some growers in northern Victoria underestimated their dryland wheat yield potential at about four tonnes per hectare, mostly based on gut feel and average figures.

"But growers who used a range of tools, such as seasonal and climate outlooks and deep soil moisture data, to more accurately estimate yield potential at up to nine tonnes per hectare were able to better match their inputs to this yield potential.

"Budgeting for that higher yield potential, saw some growers spend an extra $150 per hectare on urea to feed the crop, which in many cases, saw them harvest an extra 5t/ha, returning about $1000 per hectare in extra income."

Of the many tools she uses, Dr Burke says BOM



forecasts, particularly Indian Ocean Dipole (IOD) and El Niño–Southern Oscillation (ENSO) climate indicators, distributed by Agriculture Victoria, have a significant influence on critical thinking as part of crop management.

More specifically, indicators suggesting a positive IOD phase and an El Niño phase, which tend to result in below average rainfall and warmer than average temperatures across southern Australia, may provide a trigger for reducing a farm's canola cropping area.

Predictions for positive IOD and El Niño phases, associated with dry, warm conditions, might also see growers plan to cut crops for hay instead of harvesting them for grain, she says.

Whereas forecasts suggesting a negative IOD phase and a La Niña phase, indicative of above average winter and spring rainfall, and colder than average temperatures, might prompt southern growers to consider applying more nitrogen to feed higher crop yield potential.

"Under these conditions, growers may also think about reducing the farm's cereal hay area," she says. "Wet springs usually cause hay quality issues and the abundance of pasture hay in wet conditions tends to reduce cereal hay prices."

However, Dr Burke emphasises the importance of assessing these climate predictions against the backdrop of a suite of risk management tools to provide an overarching perspective of the season, geared to better inform a strategic approach to farm business management.

Forecasts4Profit website

The Forecasts4Profit website has been produced as part of the GRDC ‘Using Seasonal Forecasts’ extension project, a collaboration between the Grains Research Development Corporation (GRDC), Agriculture Victoria, South Australian Research and Development Institute (SARDI) and Federation University.

The Forecasts4Profit web resource provides a single location to find:

- The latest versions of The Break seasonal updates
- Farmer case studies sharing how they are using seasonal forecast information
- Handy links, tools and forecast model sites accessed by The Break team
- The Very Fast Break flashback highlights - an entertaining way to test your climate knowledge.

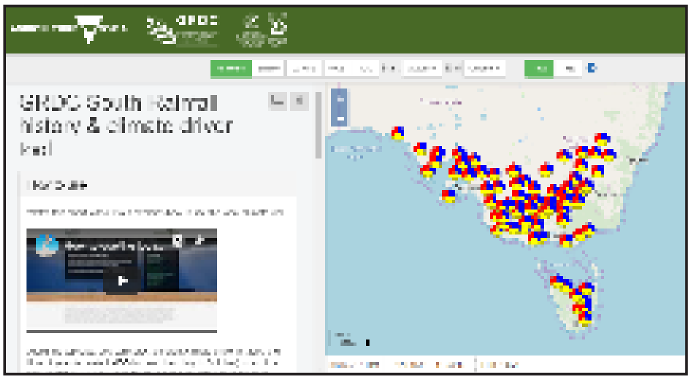
You can access the site and the Local Climate Tool explained below at www.forecasts4profit.com.au.

Local Climate Tool

The Local Climate Tool allows you to assess the effect of El Niño, La Niña and positive and negative IOD on rainfall in your area.

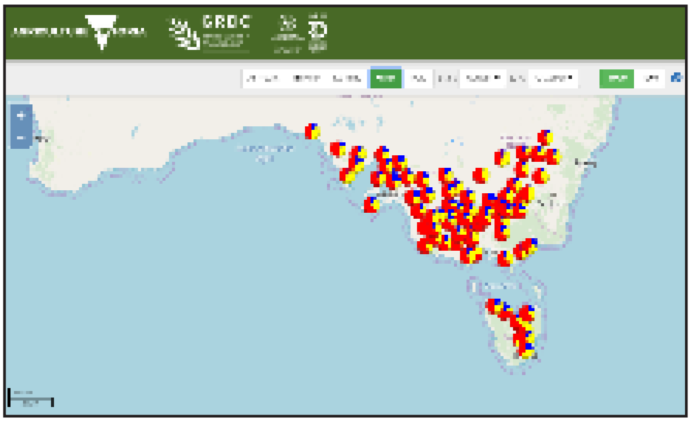
The Local Climate Tool has been produced as part of the GRDC ‘Using Seasonal Forecasts’ extension project, a collaboration between the GRDC, Agriculture Victoria, SARDI and Federation University.

The page you arrive at when entering the site has all the locations you can interrogate using the tool.



You will also see an information panel and blue circles (with ‘?’ in them) next to objects. These two options provide you more information and can help you understand what the tool is saying.

Across the header you can see each of the climate drivers (El Niño, La Niña, positive IOD and negative IOD) and the months of the year as different selection buttons.



Once you select a climate driver, in this case positive IOD which has been an active climate driver in 2019, the pie charts on the map change to represent the rainfall totals in positive IOD years.

You can also select the months in which you want to interrogate, we have selected August to October because for broadacre cropping this is a crucial time for rain in the low to medium rainfall zones but depending on your industry and system you can change the months to suit.

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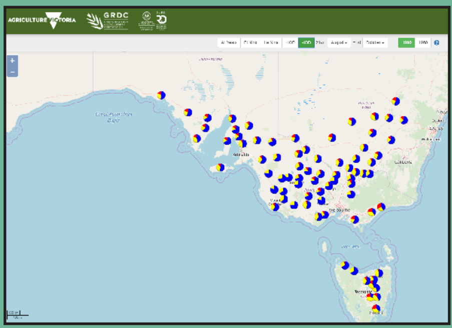
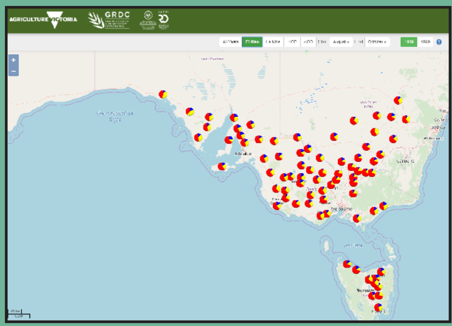
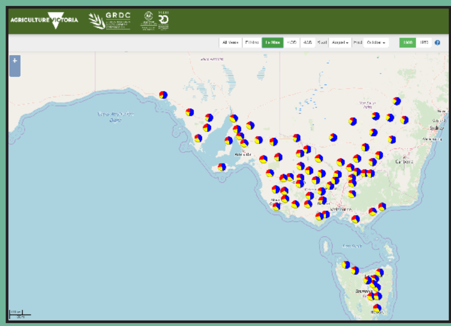
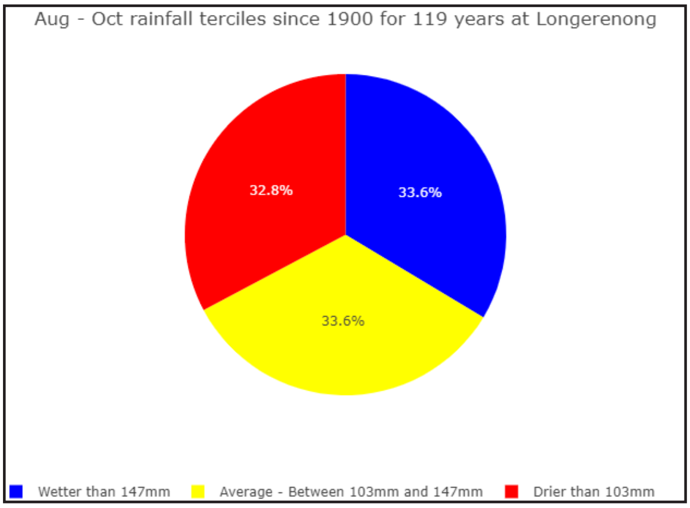
As you select the different climate drivers the pie charts change.







For each location you can drill down further enabling you interrogate the location closest to you.

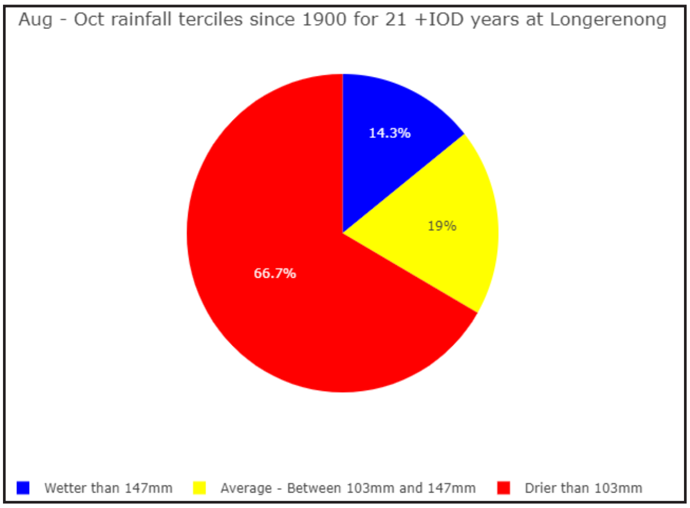


When all years are selected the pie graph, commonly referred to as a chocolate wheel, the different options (wetter, average and drier) will have approximately the same likelihood of occurring.

The chocolate wheels were the brainchild of SARDI research Peter Hayman, to communicate the probabilities of season forecasts.

As the chocolate wheel breaks the distribution into three, wetter, average and drier, it becomes what is known as a tercile distribution.

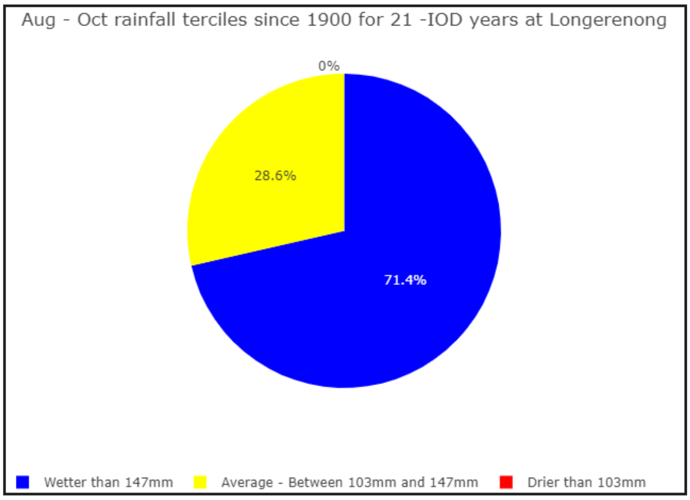
The boundaries between wetter, average and drier is determined by the historical rainfall totals experienced at the location and are therefore different for each location.



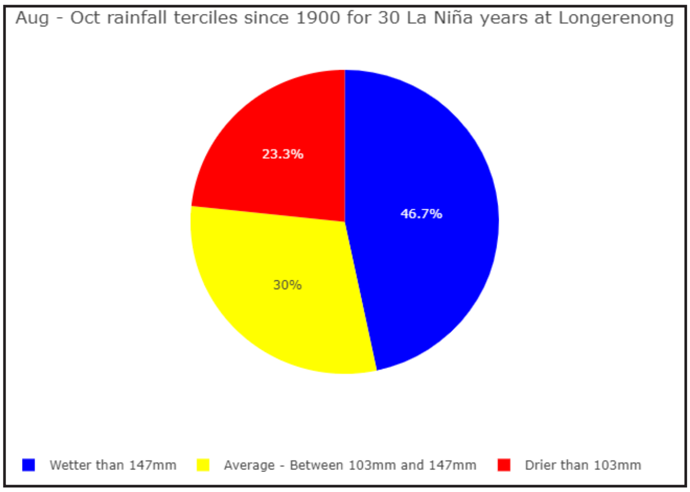
When you select a climate driver, you can see that the probabilities for wetter, average and drier change.

Here you can see the pie chart for positive IOD years at Longerenong looking at August to October rainfall.

We can see that there have been 21 positive IOD years in the last 120 years, of these 66.7 per cent have been drier than 103 mm for the August to October period. While a high percentage of positive IOD years have been drier, the wheel shows that there have been years when conditions have been average and wetter for the August to October period at Longerenong.

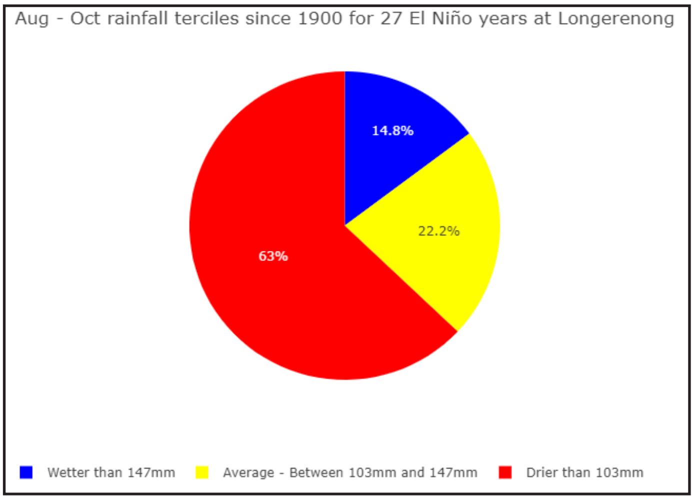


The other phase of the IOD is the negative IOD. When you select the negative IOD pie chart you can see that most years have been wetter than 147 mm, 28.6 per cent have been between 103-147 mm and no years in the last 21 negative IOD years has the rainfall for August to October been less than 103 mm.



The El Niño Southern Oscillation (ENSO) is the other climate driver that has a major impact on Australia. The wet phase of ENSO is known as La Niña.

Here we can see that in the past 30 La Niña years for Longerenong 46.7 per cent have been wetter than 147 mm, 30 per cent have been between 103-147 mm and 23.3 per cent have been drier than 103 mm.



The drier phase of ENSO is known as El Niño, when we look at the pie chart for Longerenong we can see that the majority, 63 per cent, of the past 27 El Niño years have been drier than 103 mm.

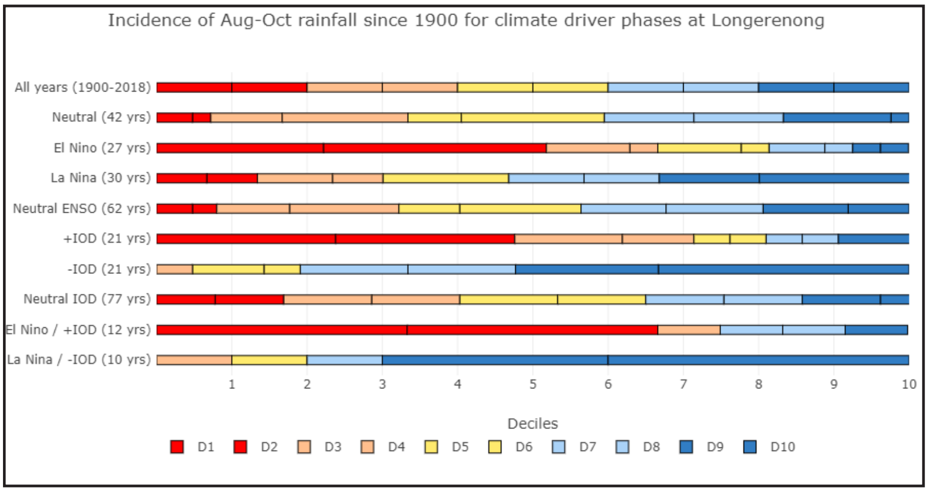
While the pie chart breaks the climate driver years into terciles (three; wetter, average and drier), this figure breaks them into deciles (ten equal sections), again based on the historical rainfall figures for the location.

These are commonly referred to as chocolate bars and are the brainchild of SARDI researcher Peter Hayman.

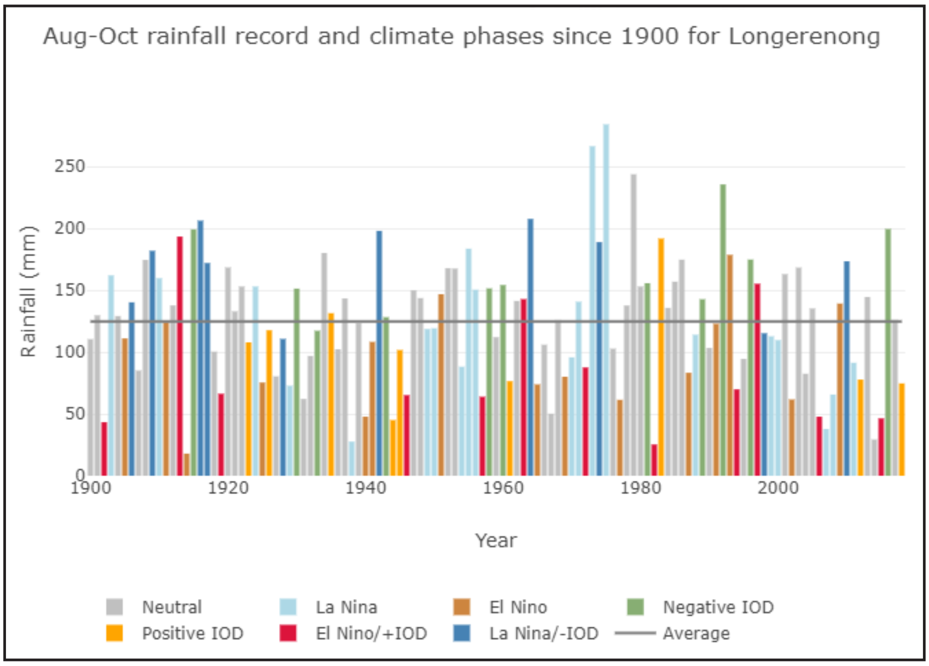
You can see that the first bar which takes the data from all years, has equal splits into ten even sections, this represents climatology.

But when you look at a certain climate driver the deciles increase or decrease in size. If you look at the positive IOD, deciles one and two (red), increase in size, and we lose decile ten completely.

To get the most out of this graph it is best to interact with it online, as you can then hover over the different decile lines to get the percentage numbers.



In this bar graph the years have been colour coded to which climate driver was active in that year, this enables you to see how different climate drivers have affected your location at different times and there is no clear pattern.



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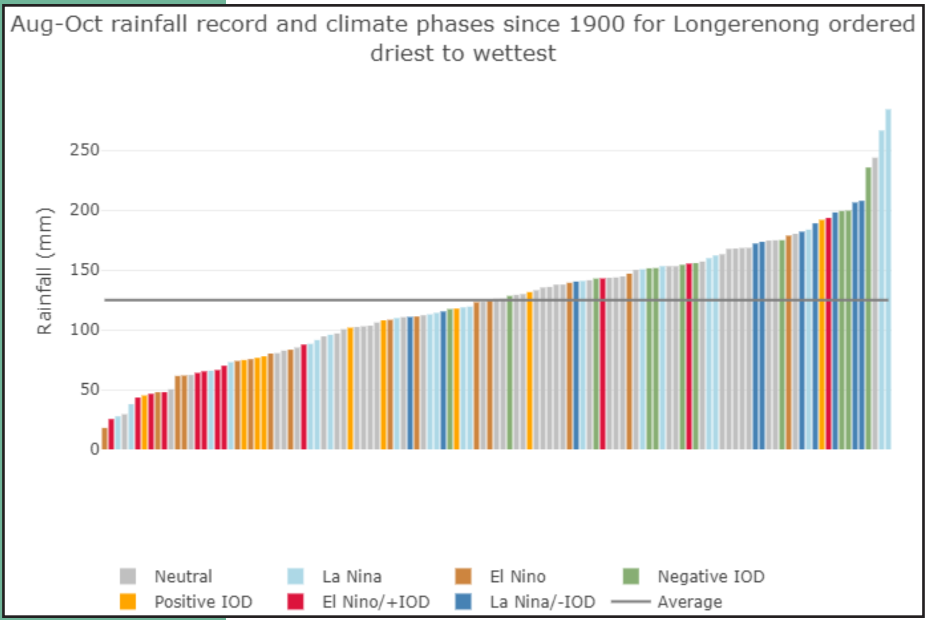
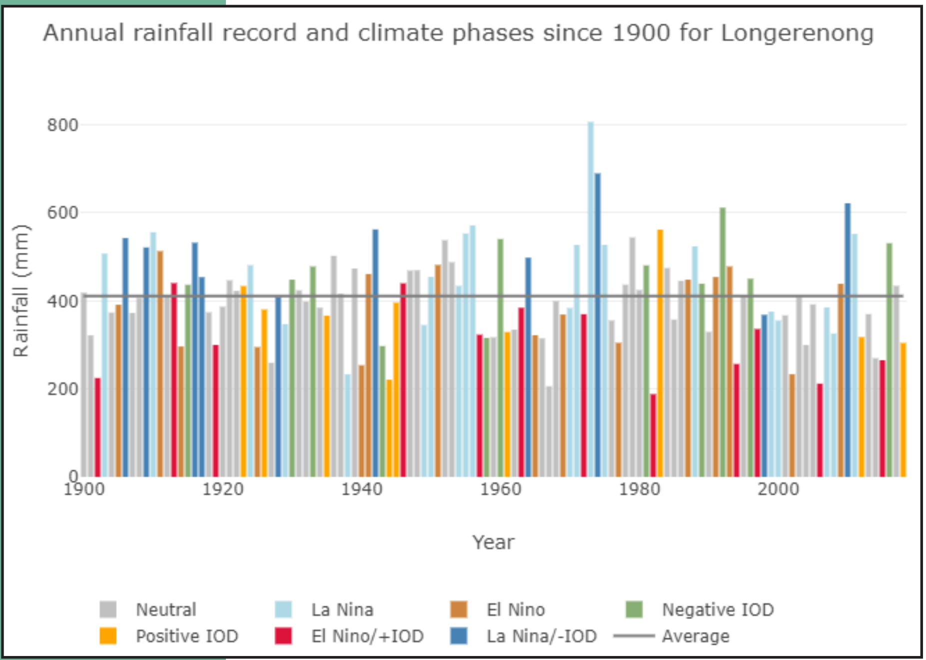
This bar graph is a variation on the graph before, with the same data, but arranged from the driest to wettest August to October for Longerenong. This is in the style of Darren Ray from Bureau of Meteorology (BoM).



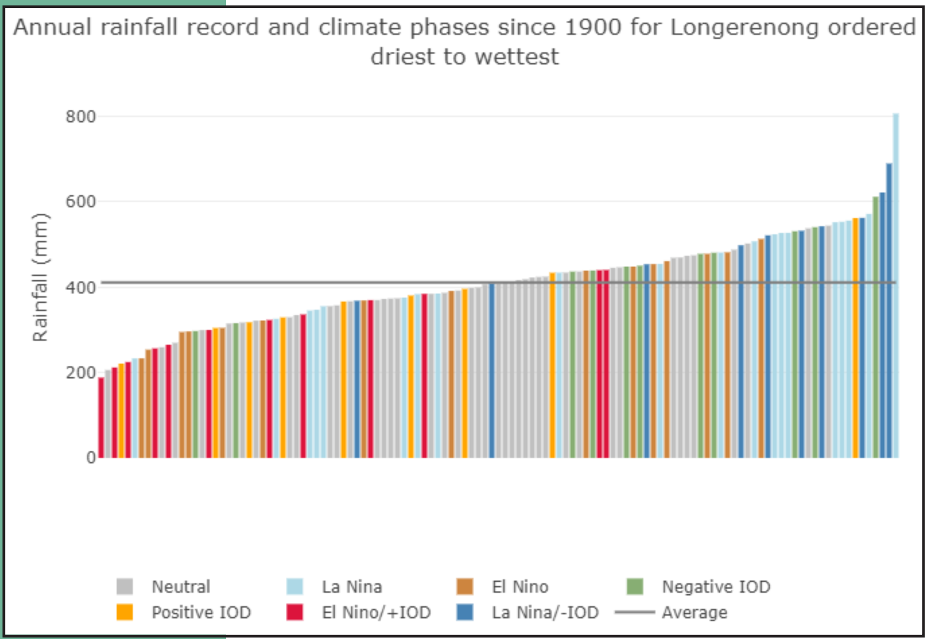
Here you can see that for Longerenong there is a higher proportion of blue and green years to the right of the graph, and red and yellow years to the left of the graph.

But it also shows that there are some blue and green years that have fallen in drier years and vice versa. This is because climate driver effects don't always play by the rule book, occasionally they are the opposite of what you would expect.

This graph is the same coloured bar graph as above but draws in the annual rainfall not just the August to October totals.



This graph is also the same as the sorted bar graph above but is drawing in the annual rainfall not just the August to October totals.



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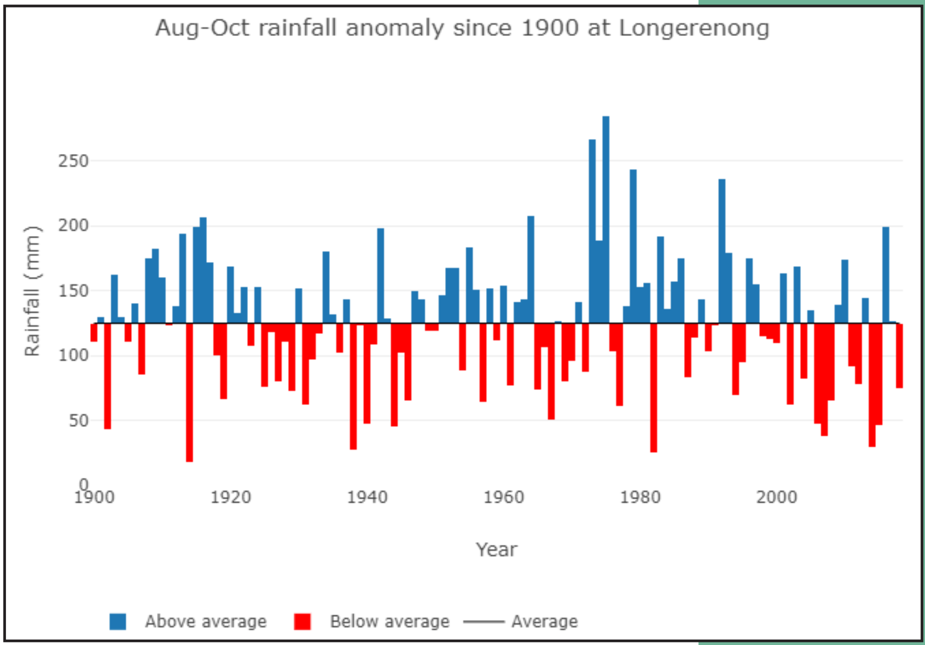
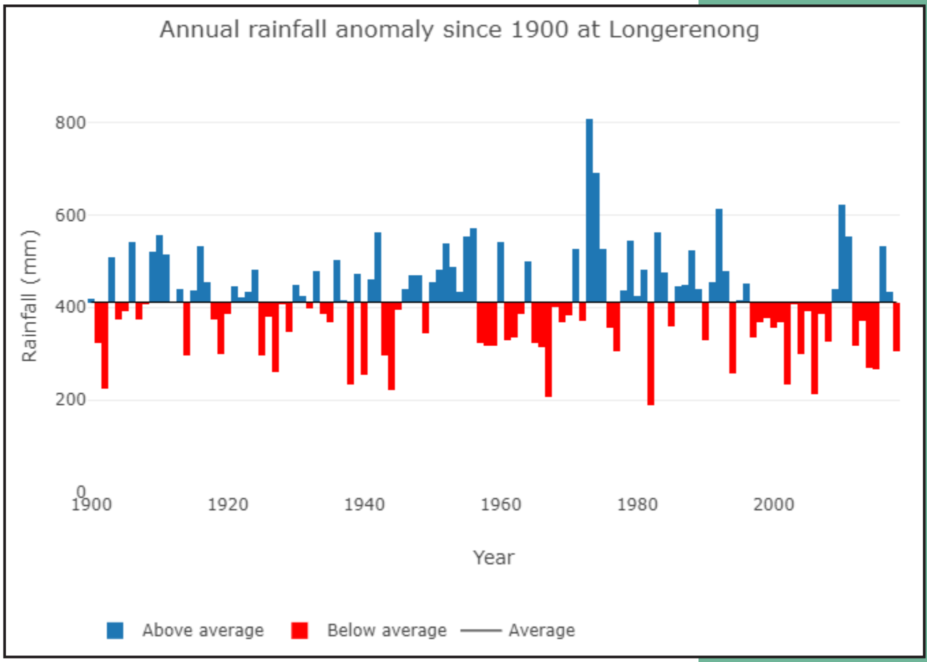


This figure and the one below allows you to look at the rainfall totals for each year, for the time period set (in this case August to October) compared to the long-term average. The red bars indicate totals below the average, while blue bars indicate rainfall above the average.



This graph is the same depiction as above, except that it shows annual rainfall instead.

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Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Aug-Oct
1913	3	71	49	16	31	11	22	49	89	56	21	23	440	194
1983	6	6	80	40	61	23	68	66	72	54	65	22	562	192
1997	32	15	5	3	56	19	12	38	85	32	36	4	336	155
1963	60	0	19	2	45	45	40	56	59	29	0	5	364	143
1935	10	9	30	32	18	47	56	53	57	22	13	21	357	132
1926	4	5	7	51	60	49	54	49	31	30	3	10	360	110
1923	8	2	0	0	69	101	89	32	34	42	17	39	434	108
1945	22	109	1	1	21	71	36	59	19	23	20	14	396	102
1972	54	61	4	42	30	15	47	57	13	10	29	1	370	80
2012	9	4	35	12	40	60	51	31	35	13	11	17	318	78
1961	0	20	20	59	16	30	43	16	32	28	26	39	329	77
2018	12	4	7	7	43	30	30	43	7	25	27	66	304	75
1994	28	27	2	5	24	58	23	16	14	40	18	1	257	70
1919	2	65	25	4	57	19	32	20	31	15	4	27	300	66
1946	55	80	49	9	30	45	71	26	17	23	13	21	440	65
1957	4	122	21	11	20	33	20	20	6	38	20	9	323	64
2006	32	2	6	42	25	17	26	16	31	2	8	6	212	48
2015	78	10	3	17	25	45	19	11	31	5	15	8	255	46
1944	11	9	1	36	39	2	27	1	8	36	11	40	221	45
1902	6	5	32	0	11	37	6	21	10	13	4	80	225	43
1982	31	11	25	19	26	22	14	6	13	6	4	4	188	25

The Local Climate Tool also isolates the monthly rainfall totals for the years that experience a certain climate driver.

To the left we have the 21 years of the positive IOD split into monthly rainfall, the annual total and the total for the months selected (August to October).

The August to October data is colour code to align with where it sits within the tercile pie graph (chocolate wheel), wetter, average or drier, as described at the beginning of this article.

This allows you to see that while some years have resulted in very poor August to October rainfall in a positive IOD phase, there are years that have had reasonable falls. While probability says there is less likely to be wetter years, some of the drier years may still be acceptable in your industry and/or system.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Aug-Oct
1992	22	21	25	39	79	40	14	76	80	80	62	74	612	236
1964	0	9	2	38	14	47	81	48	77	83	65	15	498	208
1916	32	4	0	15	14	85	53	77	80	50	55	58	532	206
2016	42	26	24	8	63	42	66	46	110	44	17	43	531	200
1915	14	0	0	31	34	100	44	65	111	23	11	2	437	199
1912	24	17	9	43	101	47	38	73	67	58	55	21	552	198
1974	116	38	39	122	88	17	66	54	60	75	7	8	690	189
1909	25	11	42	37	60	77	52	132	21	29	22	15	522	182
1996	16	27	23	17	11	97	66	70	84	21	9	10	450	175
2010	15	46	63	44	33	22	52	77	47	50	46	130	622	174
1917	15	49	20	15	57	28	69	39	64	69	14	14	454	172
1901	30	9	4	6	59	95	100	93	21	42	16	5	481	156
1960	23	35	43	50	87	30	32	53	83	18	70	17	541	154
1958	8	10	7	4	41	8	58	72	27	53	23	1	316	152
1900	0	30	0	26	20	5	48	50	27	75	32	135	448	151
1989	4	14	28	31	73	62	55	54	41	48	24	8	439	143
1906	2	34	52	6	82	87	57	43	47	51	70	12	543	140
1943	15	32	5	23	15	36	31	53	51	25	6	5	297	120
1933	52	0	17	37	75	32	34	35	58	25	45	69	478	117
1998	17	21	4	63	19	43	44	16	40	60	30	13	368	115
1928	53	82	38	21	20	49	33	6	43	62	0	3	409	111

This table shows 21 negative IOD years broken down into monthly rainfall amounts, with total annual and August to October rainfall. Sorted from most rainfall for the August to October period to the least. Colour coding indicates if the 21 years fall into the wetter and average category.

This table shows the 27 El Niño years.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Aug-Oct
1913	3	71	49	18	31	11	22	48	89	56	21	23	440	194
1993	66	9	13	2	25	21	73	49	82	48	46	45	478	179
1997	32	15	5	3	56	18	12	38	85	32	36	4	336	155
1951	14	68	13	29	51	60	46	51	11	85	15	39	402	147
1963	83	0	19	2	45	45	43	56	59	25	0	5	384	143
2009	0	1	13	19	52	83	56	47	71	22	64	32	409	139
1911	3	128	33	12	63	53	39	19	93	12	1	57	513	124
1991	45	9	13	15	7	153	52	62	58	3	20	17	454	123
1905	26	14	1	52	39	77	54	18	32	62	14	4	391	111
1941	121	9	45	27	10	47	61	17	62	30	25	8	461	108
1972	54	61	4	42	30	15	47	57	13	18	29	1	370	88
1987	38	49	14	13	75	56	41	22	10	52	11	67	448	83
1969	13	46	51	17	50	8	58	40	27	12	24	23	369	80
1925	11	15	6	14	79	38	28	22	48	6	26	3	296	75
1965	1	0	5	12	54	22	57	58	11	5	37	60	322	74
1994	20	27	2	5	24	58	23	16	14	40	10	1	257	70
1919	2	66	25	4	67	19	32	20	31	15	4	27	300	66
1946	55	80	40	9	30	45	71	26	17	23	13	21	440	65
1957	4	122	21	11	20	33	20	20	6	38	20	9	323	64
2002	11	9	13	16	21	25	25	18	31	13	32	21	233	62
1977	17	22	20	14	49	52	19	22	15	25	30	11	305	61
2006	32	2	6	42	25	17	26	16	31	2	8	6	212	48
1940	7	3	2	65	28	9	30	13	19	16	37	24	254	48
2015	70	10	3	17	25	45	19	11	31	5	15	8	265	46
1982	6	5	32	0	11	37	6	21	10	13	4	80	225	43
1902	34	14	20	19	26	22	14	6	13	6	4	4	188	25
1914	10	21	10	56	24	19	19	9	5	4	52	67	296	18

There have been 30 La Niña years which you can interrogate.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Aug-Oct
1975	32	1	30	15	45	13	58	34	74	177	28	20	527	284
1973	48	150	18	35	107	61	75	76	55	136	24	10	807	267
1964	0	9	2	38	14	47	81	48	77	83	85	15	408	208
1916	52	4	0	15	14	85	53	77	80	50	88	58	537	206
1942	24	17	9	40	101	47	30	73	67	50	60	21	502	190
1974	118	38	30	122	88	17	86	54	60	75	7	8	680	189
1955	1	62	25	16	51	121	49	106	32	45	31	10	550	184
1909	25	11	42	37	80	77	52	132	21	29	22	15	522	182
2010	15	16	63	44	33	22	52	77	47	50	40	130	622	174
1917	16	40	20	15	57	28	60	30	64	63	14	14	454	172
1983	5	13	58	88	45	43	49	41	78	44	85	27	507	167
1910	9	1	90	5	62	72	91	44	90	26	47	12	506	160
1924	12	75	38	7	16	41	12	47	53	53	125	2	481	153
1956	11	0	80	60	110	63	51	48	46	56	24	6	572	151
1971	22	22	17	102	51	48	34	44	52	45	65	24	527	141
1906	2	34	52	6	82	87	57	40	47	51	70	12	540	140
1950	0	77	62	21	94	16	42	30	50	39	16	13	465	119
1918	10	68	12	2	33	14	36	9	44	65	51	2	345	118
1998	17	21	4	63	19	43	44	16	40	60	30	13	368	115
1988	36	23	37	3	135	76	40	28	65	23	24	30	524	114
1989	8	24	31	0	45	26	20	57	17	39	35	67	376	113
1928	53	82	38	21	20	49	33	6	43	62	0	3	409	111
2000	2	91	8	41	27	17	49	26	52	32	23	19	386	110
1970	22	2	24	65	27	28	18	51	25	20	61	39	384	96
2011	160	68	71	15	23	18	52	44	13	35	53	48	582	91
1954	51	0	6	105	16	29	37	35	16	37	47	54	434	88
1929	28	27	41	18	26	41	25	27	17	28	8	71	347	73
2008	45	0	7	0	39	33	40	32	27	7	10	69	326	66
2007	71	26	6	66	65	7	38	13	18	7	46	23	385	38
1938	35	16	1	24	13	49	48	11	12	5	19	8	253	28

Due to the complexity of the website it is best if you access it via a desktop computer or tablet. The screen size on a smart phone does reduce the amount of information you can view at any one time making it difficult to read some of the graphs and tables.

CASE STUDY FIVE

Seasonal forecasts helping to reduce risk

AUTHOR
Rachael Oxborrow

Heeding the signals coming from seasonal forecast information has saved Yorke Peninsula grower Tony Andrews from large areas of potentially failed crop in 2018.

A dry start plus a drier outlook for the season before he began sowing prompted Tony to reduce the area he committed to field peas in his 800-hectare program. He reduced his pea plantings from 243ha to 174ha and filled the gap with barley. This was despite knowing he was planting barley in a paddock with a high weed burden that would require more management and spray applications over summer. The decision has proved a wise one.

"It has been a very disappointing year for peas and in the end I was harvesting for seed and cost recovery," he said. "Barley has been the opposite and we've had average yields and good quality with some malting grade coming through." "If I had put the other paddock into peas, I would have had a cleaner paddock now for next year but at the same time I would have had to reap another near failure." "I've definitely made more money out of the changes I made this year by listening to the forecast information."

In-season rainfall has been less than half the historical average for 2017 and 2018 at the Nalyappa property and risk reduction has been a priority to ensure the farm remains profitable. Over time Tony and his wife Michele have grown in confidence in adjusting their plans based on forecast outlooks as they have experienced seasons and conditions consistent with the forecasts.

Tony says he now plans to be flexible where possible knowing it could prevent disappointing seasons. He says a dry forecast would usually prompt him to "lean" towards hardy varieties and maximise his barley plantings, while a wet forecast could allow him to favour field peas and chase potential higher returns.

"I'm always planning my cropping program for an average to above average season, but when I see dry forecasts come through I usually alter my plans," he said.

"This year they were dead right and the fact that I've had success with following forecasts helps me trust it as a source of advice in the future."

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Property:
Tea Tree Glen

Owners:
Tony and Michele Andrews

Location:
Nalyappa, South Australia

Farm Size:
800 hectares

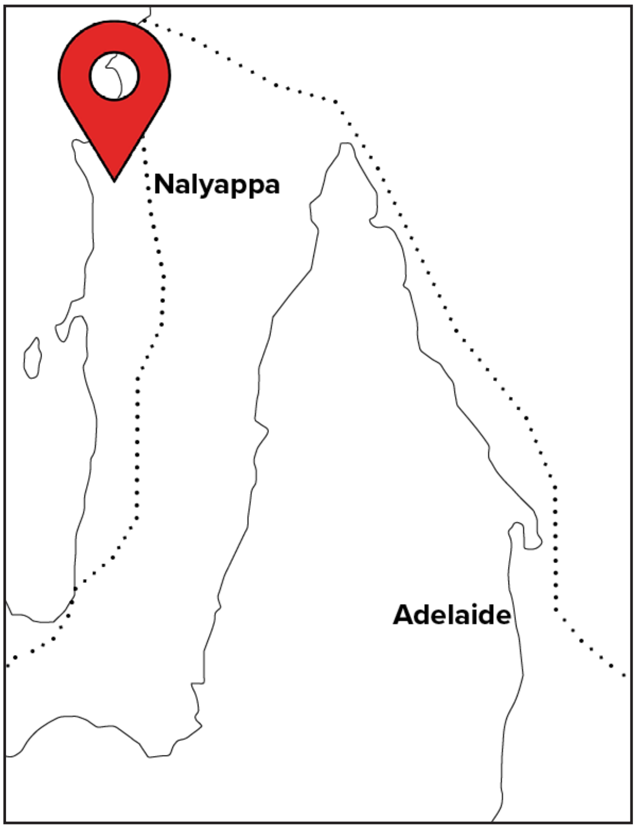
Average Annual Rainfall:
400 mm

Soil Types:
red clay to sandy loam

Typical Crops Grown:
wheat, barley, canola, lentils, oaten hay and field pea hay

"I've definitely made more money out of the changes I made this year by listening to the forecast information."

Tony and Michele have been monitoring seasonal forecasts for around four years and have welcomed the expansion of GRDC investment with Agriculture Victoria to extend the subscription-based forecast service The Break to South Australia.



"Even with some good experience with my decisions around seasonal forecasts, I'm always mindful of what is actually happening in the short term and the decades of cropping experience in my family. I think more and more people are using seasonal forecasting as a part of their cropping operation. While some may take it more seriously than others, we know farming can be a gamble and anything that reduces our risk is definitely worth my time," says Tony.

Decisions around spraying and fertiliser application also involve seasonal forecasting consultation for Tony, who says spring is a key time for cost management if a drier period is more likely based on forecasts. He monitors evidence of disease or pest damage and is usually inclined to spray less often or not at all if problems are within threshold levels in a dry period.

"If the forecast indicates favourable spring conditions and you see the peas podding up nicely, they're worth the extra fungicide and insecticide," Tony says. "I've always held the view with peas and chickpeas especially that you don't waste too much money on fertiliser with them, but you definitely focus on fungicide and insecticide as that will do more good in spring. In a wet year you will often observe more bugs in your crops but in a dry year there is usually much less pest activity. This means in a dry year you can monitor activity and potentially spray less often and save on repeat applications."

CASE STUDY SIX

Bending with the seasons in Mallee country

Property: Merriwa Pastoral Company

Owners:
Bronwyn and Geoff Hunt, Karen, Bill and John Fenton

Location:
Normanville, Victoria

Farm Size:
1484 hectares, 1436 hectares cropping

Enterprises: cropping and sheep

Average Annual Rainfall:
342 mm

Soil Types:
duplex, clay loam over clay

Soil pH:
8 to 8.5

Typical Crops Grown:
wheat, barley, canola, lentils, oaten hay and field pea hay

AUTHOR
Clarisa Collis

Facing seasonal and climatic variability with resilience and adaptability, one Mallee farming couple 'bend' their approach to crop management based on increasingly sophisticated seasonal forecasting and soil moisture data in north-west Victoria.

There, in this semi-arid region, Normanville growers Bronwyn and Geoff Hunt sharpen their farm business acumen using seasonal knowledge, tools and information drawn from the past, present and future of their 1484 ha property.

As such, the Hunts look to lessons learnt from past cropping seasons and paddock history; up-to-date data collected by a deep soil moisture probe and weather station installed on their property; and information from short and long-term seasonal forecasts. They also look to the findings of on-farm soil core sampling and a web-based decision support tool - Yield Prophet® - that estimates crop yield potential based on predicted rainfall and their soil core test results.

Using this suite of tools, the Hunts say they 'lean' rather than 'confidently step' towards management tactics to help shield their grains operation from a changing climate and variable seasonal conditions, including shifting, and sometimes harsh, weather patterns.

To this end, they routinely measure seasonal forecast information against on-farm soil moisture and nutrient information as part of an overarching strategy that aims to match crop inputs to growing season conditions and ultimately, maximise farm business profitability.

Turning to 'reliable sources', they refer to subscription-based seasonal forecast commentary, The Break, produced by Agriculture Victoria seasonal risk agronomist, Dale Grey. The Break provides a range of seasonal forecast summary newsletters, comparing forecast models and soil moisture data for three to six months. They also rely on deep soil moisture probe data and commentary released by Agriculture Victoria seasonal risk agronomist Dale Boyd who manages a Victoria-wide network of probes on growers' properties.

The Bureau of Meteorology (BoM) is another trusted source for the Hunts, particularly in terms of its local and state seasonal forecasts, Indian Ocean Dipole and Southern Oscillation Index monitoring, Australian weather watch radar and wind forecasts.

Tracking their strategy through the southern growing season, the couple say: "If the seasonal outlook for April and May indicates there is a 70 per cent possibility of drier than average conditions, we might change our farm management approach at the paddock level."

“With climate change, rainfall is moving out of the growing season so we receive more summer rainfall and less spring rainfall now.”

However, these seasonal outlook predictions are also carefully considered against the farm backdrop of soil moisture and nutrient availability. For example, when data from their soil core sampling and deep soil moisture probe shows subsoil moisture is depleted, the Hunts may opt to reduce the farm’s canola cropping area. However, when the data shows that the soil moisture profile is at least half full, they may decide to increase the farm area planted to this thirsty, deep-rooted oilseed, known to forage for moisture a metre beneath the soil surface. Soil moisture information is also used to identify their wettest paddocks on which they sow canola.

In contrast to this seasonally-flexible approach to their canola country, the farm area sown to wheat and barley remains fixed because these hardier cereals have proven relatively adaptable to variable seasonal conditions.

Sowing Time

To help minimise the unpredictable longer-term risk of heat shock later in the growing season, the Hunts now early sow their wheat, lentils and canola in April, instead of May, and their barley in May, instead of June. Such an approach can increase the unpredictable risk of frost damage, though the Hunts see this as less of a risk than heat shock.

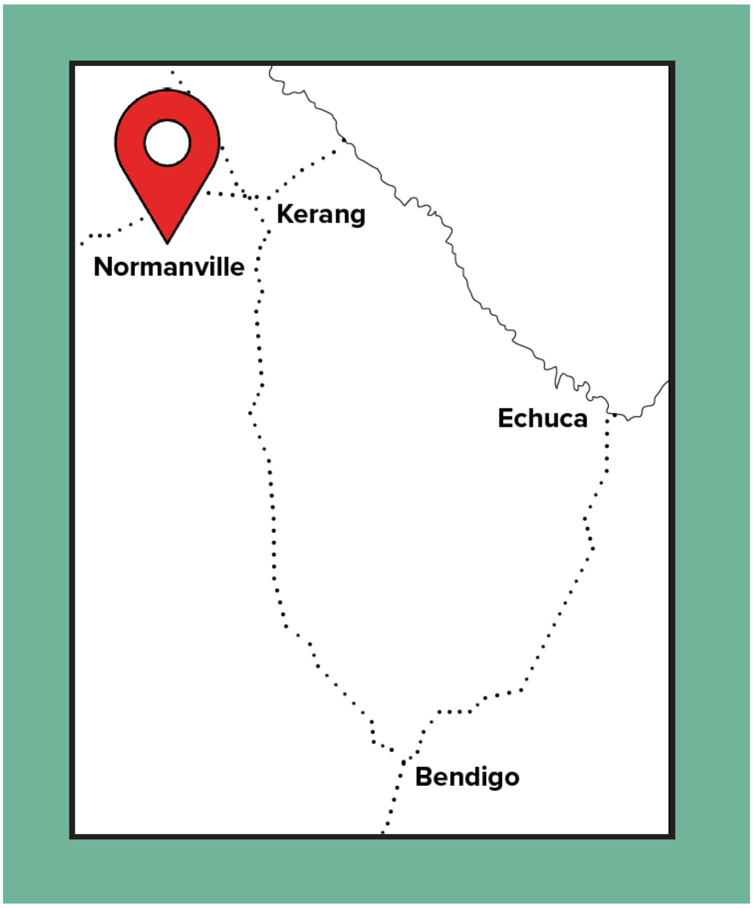
“We sow earlier to help minimise losses from heat shock, particularly during the sensitive flowering phase, and to help avoid the effect of hot weather towards the end of the season. We can’t avoid both these seasonal challenges, but we can manage risk for them.”

An added benefit of earlier sowing is that it helps to buffer their grains operation from shifting weather patterns in a changing climate – a development reflected in seasonal forecasts, historical rainfall data and their own farm records.

“With climate change, rainfall is moving out of the growing season, so we receive more summer rainfall and less spring rainfall now. Some late-sown Mallee crops were not harvested as a consequence of the dry conditions in the 2018 growing season.”

Moisture Measurement

The Hunts say their management decisions early in the growing season, especially those at sowing, are mainly informed by soil core sampling. They collect six soil cores from each paddock, at increments of zero to 10 centimetres (cm); 10 to 40cm; 40 to 70cm; and 70cm to one metre in the soil profile. These soil core test results, collected in March just before April-sowing, are then entered into the Yield Prophet® decision-support tool and reality checked against measurements from the deep soil moisture probe.



Accompanied by a weather station, sensors in the capacitance probe record subsoil moisture from a fixed location on their property at 10cm increments from a depth of 30cm to one metre in the soil profile. The data, which can be accessed by other growers, is then sent via the mobile phone network to a server for storage, analysis and interpretation using graphing software.

The Hunts prefer their early-season crop management decisions to be guided by known soil moisture parameters because there is a limit to how much they can rely on seasonal forecasts due to the spatial variability of rainfall that fluctuates from farm-to-farm and district-to-district.

"For instance, we received 22 millimetres (mm) of rain on our farm, while the neighbouring property received just 10 mm from the same weather event. The BoM's local weather watch radar and Agriculture Victoria information sources have highlighted, quite dramatically, how patchy the rainfall is in this area." Nevertheless, they describe seasonal forecasts as an "important, but approximate guide" that increasingly influence their farm business management decisions as the growing season progresses. For example, acknowledging moisture and nitrogen as their main yield-drivers, they consult seasonal forecasts, in conjunction with Yield Prophet®, soil core testing and probe measurements to help inform their approach to crop nutrition later in the growing season. To minimise the potential for applied nitrogen losses in a "risky production area", the Hunts generally apply nitrogen fertiliser to cereals as late as possible, just before the end of tillering in late July or early August.

During the prolonged dry conditions in 2018, the Hunts decided not to apply any extra nitrogen to their cropping program; a decision, partly based on the outlook for drier than average conditions that saw them secure better gross margins from moisture-stressed grain and hay enterprises. In contrast, during the 2017 season, they applied about 100 kilograms of urea per hectare to cereals to optimise the productivity and profitability of that year's bumper crops.

The Hunts also closely monitor the BoM's Indian Ocean Dipole (IOD) outlook because they have found these climate phases, typically starting in May or June, have a strong influence on their farm's growing season rainfall. More specifically, a negative IOD phase tends to result in above average rainfall in winter and spring, which provides a cue for the Hunts to consider applying more nitrogen just before the end of tillering. BoM wind forecast maps indicating wind direction and average speed, are one more tool the Hunts use to help guide their herbicide, insecticide and fungicide spraying operations.

The availability of Agriculture Victoria's seasonal forecasting tools and information, previously limited to growers in Victoria, are now being extended to growers across the southern grains region in South Australia and Tasmania as part of a new GRDC-invested research project.

Insights into soil moisture monitoring

An interview with Dale Boyd, Seasonal Risk Agronomist (Agriculture Victoria)

When a well-respected knowledge source was no longer accessible, a group of farmers found themselves in a pickle. They had thought their agronomist was a genius given his knowledge of soil moisture and how this aided their decision making. This was one of the catalysts for Agriculture Victoria Seasonal Risk Agronomist, Dale Boyd, to initiate a successful pilot of introducing soil moisture probes used for irrigation into dryland paddocks, that was 10 years ago.

“At the time soil moisture probes in the broadacre grains industry were placed in the paddock after sowing and removed prior to harvest, collecting data during the season,” Dale said. A removable probe system may not allow you to know when your soil’s water bucket is full or empty. Advantanges with a permanent sub surface probe with long term data collection was identified.

Dale believes the network has provided greater insight in:

- greater understanding of the effect of out of season rainfall
- the benefits of summer weed control, knowing your soil moisture base for crop rotations and options
- identifying the connection of deep soil moisture to in season rainfall
- the impacts of hay versus grain and the benefits that soil moisture left can provide for the next season
- the economics behind hay versus grain.

For people considering purchasing a soil moisture probe there are a few things that you need to know and can do to get the most out of the system, Dale explained.

“Determine if there is an existing soil moisture probe network in your location. Existing networks can provide you with insight into any local issues that you should consider with your soil moisture probe, but also enable localised networks to expand and strengthen,” Dale says.

There are many different networks across Victoria, South Australia and New South Wales, Dale is currently unaware of any in Tasmania positioned in an unirrigated site, but is keen to hear from anyone in Tasmania that does have one. Many of these networks have been set up by grower groups, Landcare networks and agronomy firms.

“Determining the location of your soil moisture probe is critical. Preferably the location can provide you with a farm reference point, it is your average performing area with your most common soil type. This will mean you can then extrapolate the information for the other parts of the farm,” Dale said.

Dale explained you also need an area that is not influenced or affected by trees or is a high or low-lying area. Having the ability to situate the telemetry hardware component of your soil moisture probe system on a fence line will mean you are less likely to damage it with a vehicle and it also doesn’t increase your weed burden by sowing around it.

Preferably the soil moisture probe would be accompanied by a rain gauge, to help understand the data.

“A cost to these systems is the ongoing telemetry fees, be that 3G or 4G, Bluetooth, WiFi or LoraWan, and the online interface where you are able to visualise your information,” Dale said.

The Agriculture Victoria network is a 3G and 4G system, which have been successful for this system, but it will solely depend on your area, probe, cost and connectivity.

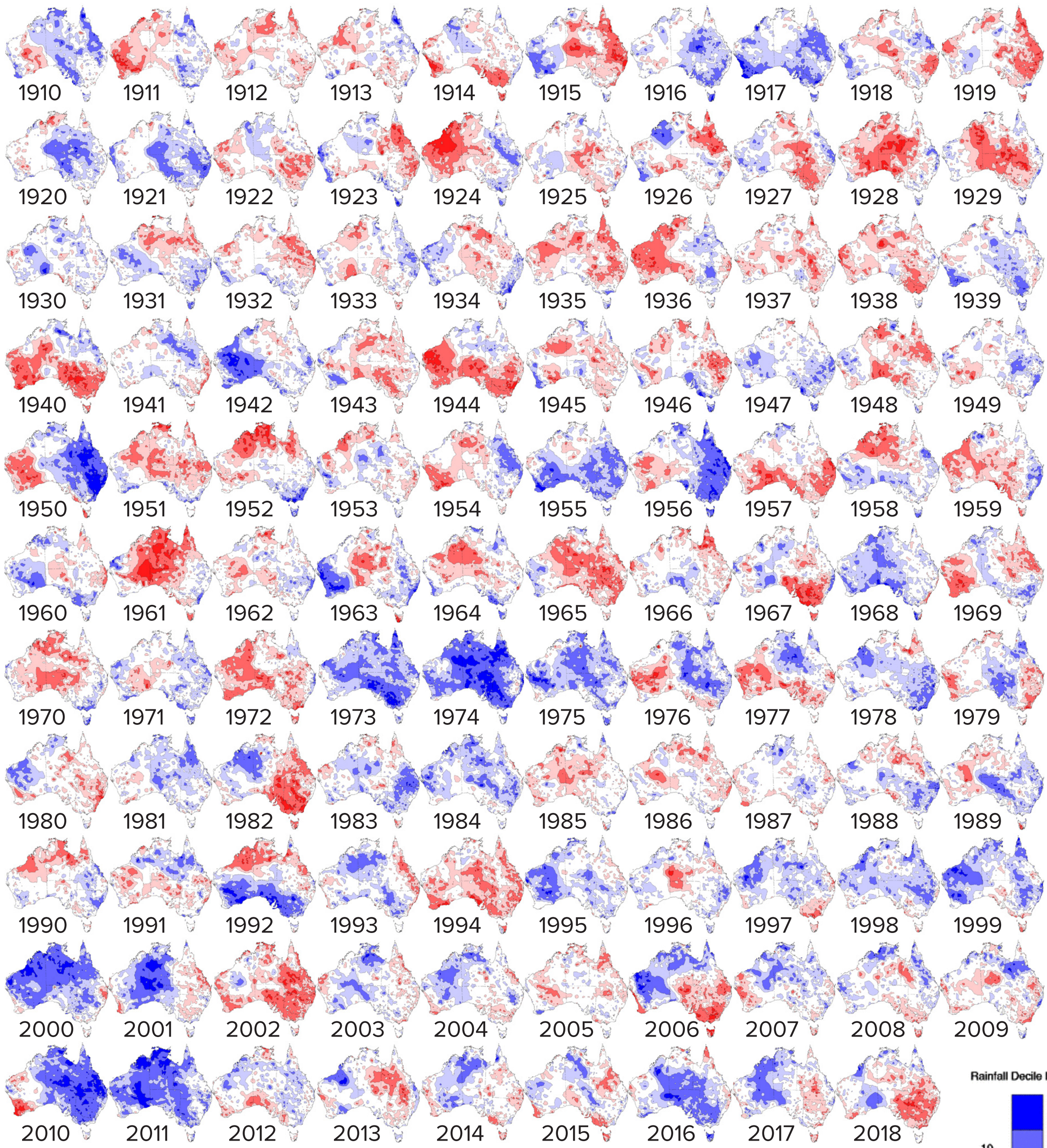
There are different types of probes, the Agriculture Victoria network is made up of capacitance probe 80 cm long, with sensors every 10 cm. They are positioned deep in the soil to a depth of 30 cm, therefore measuring from 30 cm down to 100 cm. Dale’s recommendation is that deep soil moisture is the critical information, so don’t give yourself gaps in information by having less sensors or sensors further apart.

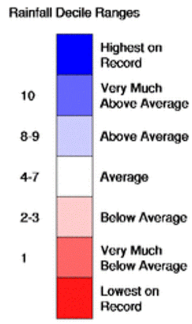
Dale recommends at least 80 cm probe, but in some soil types where root growth goes beyond a metre, consider a longer probe.

“The ultimate end goal from the Agriculture Victoria network is to have grains industry farmers with knowledge of their soils and water holding ability so that in the future, whether it be by moisture probes, spatial imagery, models or whatever form of monitoring seasonal conditions they use, they will have knowledge of per cent full or available mm when asked how the season is going.”

Dale Boyd; dale.boyd@agriculture.vic.gov.au

Annual rainfall deciles 1910 to 2018





Data provided by the Bureau of Meteorology. Maps show the annual (1 January to 31 December) rainfall deciles.

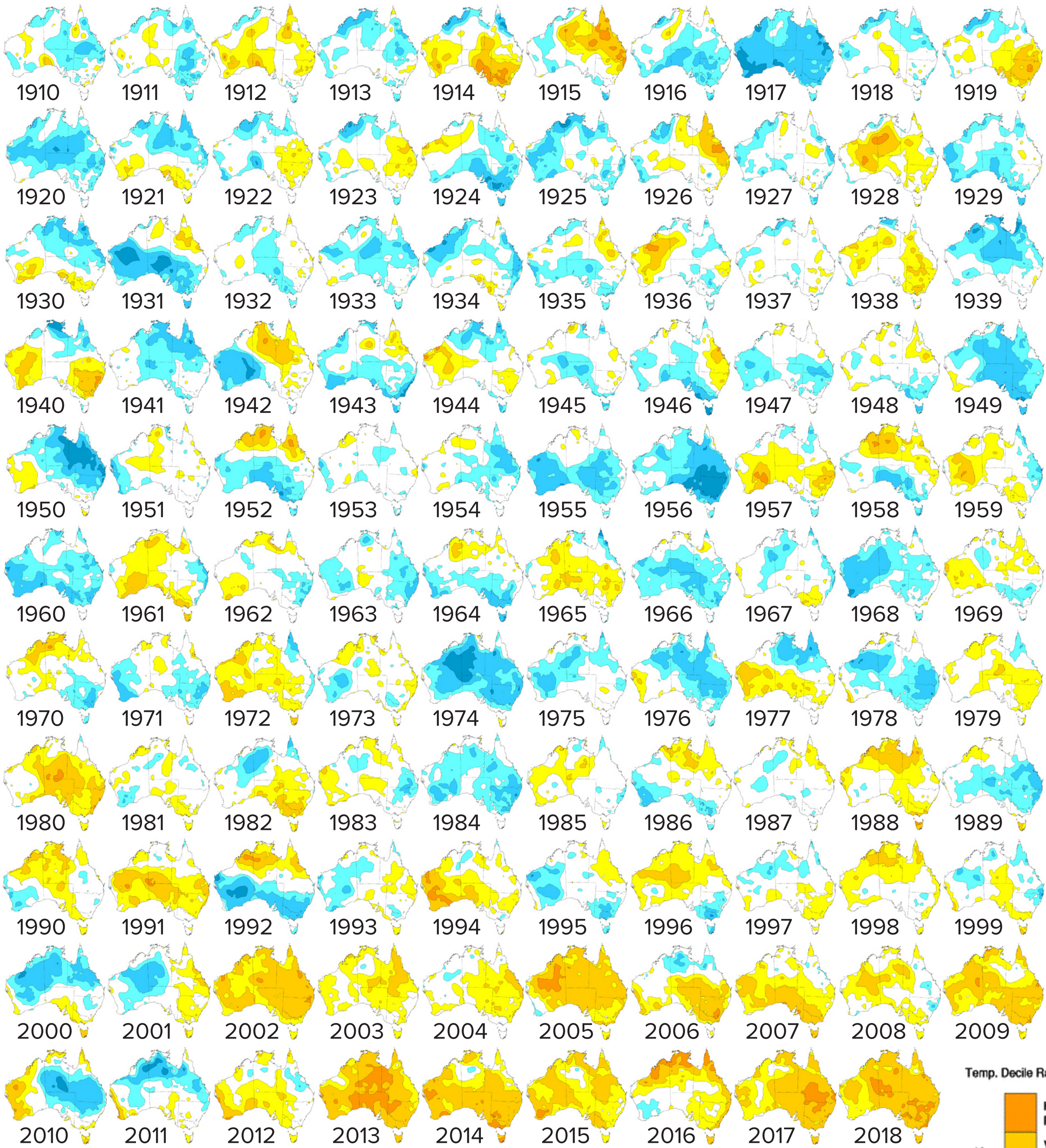
The grids show the rainfall values across Australia in the form of two-dimensional array data.

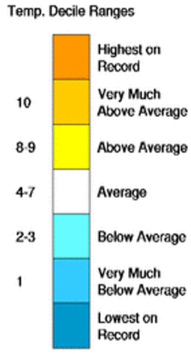
The analyses (grids) are computer generated using a sophisticated analysis technique. It incorporates an optimised Barnes successive correction technique that applies a weighted averaging process to the station data. Topographical information is included by the use of rainfall ratio (actual rainfall divided by monthly average) in the analysis process.
On the maps each grid-point represents an approximately square area with sides of about five kilometres (0.05 degrees).
The size of the grids is limited by the data density across Australia.
This grid-point analysis technique provides an objective average for each grid square and enables useful estimates in data-sparse areas such as central Australia. However, in data-rich areas such as southeast Australia or in regions with strong gradients, 'data smoothing' will occur resulting in grid-point values that may differ slightly from the exact rainfall amount measured at the contributing stations.

The observational (station) data on which the analyses were based have an associated accuracy of the order of 0.01 degrees (approximately 1km) or better.

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Annual maximum temperature deciles 1910 to 2018





Data provided by the Bureau of Meteorology. Maps show the annual (1 January to 31 December) maximum temperature deciles.

The grids show the temperature values across Australia in the form of two-dimensional array data.

The analyses (grids) are computer generated using a sophisticated analysis technique. It incorporates an optimised Barnes successive correction technique that applies a weighted averaging process to the station data. Topographical information is included by the use of temperature ratio (actual temperature divided by monthly average) in the analysis process.
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AGRICULTURE VICTORIA

CASE STUDY SEVEN

Forecast knowledge is power in the low rainfall zone

Property:
Wootoona

Owners:
Bernard, Susan and Ben Carn

Location:
Quorn and Umberatana Station, South Australia

Farm Size:
12,000 hectares (1000 hectares arable) and 57,000 hectares

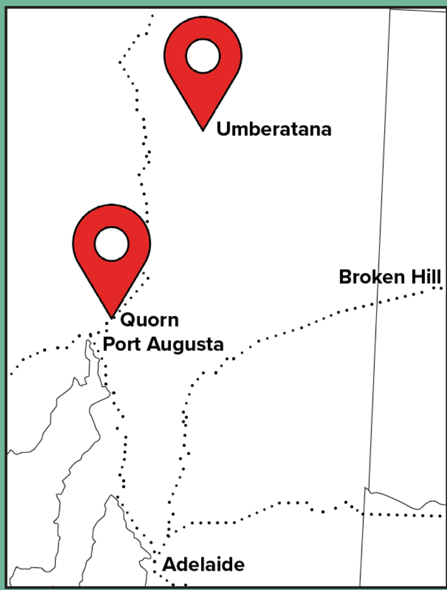
Livestock:
7000 merino sheep and 80 cattle

Average Annual Rainfall:
220 mm to 300 mm

Soil Type:
red clay

Typical crops grown:
wheat and barley

AUTHOR
Clarisa Collis



Destocking, reducing cropping area and opportunity summer planting after considering seasonal forecast advice are measures the Carn family have taken to reduce financial risk over the past decade. They farm in marginal country just south of Quorn in South Australia and seasonal forecast information is just one of the decision-making tools they need to plan their seasons.

Susan, husband Bernard and son Ben run 12,000 hectares in the Flinders Ranges at Quorn and they also manage a further 57,000ha in the North-east pastoral area on Umberatana Station. At present they run around 7000 merino sheep, 80 cattle and crop wheat and barley.

“I see so much value in listening to seasonal forecasts to help guide our decisions and quite often the changes we make on advice from those forecasts deliver the best outcome,” Susan says.

“In 2018 we were three quarters of the way through what we had planned to plant and stopped.

“I sat down and had a look at the dry winter/spring forecast and thought no, I’m really not liking this, particularly as we didn’t have much subsoil moisture.” Susan says she made the suggestion to her husband to stop seeding and it has turned out to be the right call.

“We didn’t harvest anything this year (2018), it was all fed to our sheep ages ago,” she says. “After seeing the forecast, the writing was on the wall. “I also questioned how many sheep we had and whether it was sustainable to keep this many.”

As the season progressed and the seasonal forecasts were shown to be accurate, the Carns significantly destocked both their Quorn and Umberatana properties and have lambs in their feedlot.

Susan says she has seen rainfall patterns change significantly over the past few decades and this has prompted them to trial certain measures to protect their income, stock and land against dry year forecasts. This includes putting sheep lick feeders in most grazing paddocks, using available barley on hand to supplement ewes and introducing lambs to grain to prevent over-grazing.

“That’s really made a difference in our lambing percentage and our ewes are looking so much better,” she says. “This normally works really well, but this year has been horrible, and we’ve used all our barley and didn’t grow any new seed, so we’ve had to buy in a lot of seed to keep us going.”

"I see so much value in listening to seasonal forecasts to help guide our decisions and quite often changes we make on advice from those forecasts deliver the best outcome."

Susan says consulting seasonal forecasting as a part of farm planning requires an attitude of flexibility and willingness to trial various options. Susan's interest in weather forecasts and climate outlooks started when she noticed their seasons were changing and wanted to understand what was happening. She has participated in several South Australia Research and Development Institute (SARDI) climate-risk courses, became a Climate Champion Program participant and takes note of Agriculture Victoria's Fast Break service which expanded to South Australia and Tasmania in 2018.

"In an ideal world I would know in March or April what is happening for the cropping season but that is usually the most unreliable time for seasonal forecasting," Susan says. "My husband and son's idea is you need to plant at least something and take the chance for it to pay off, but I am much more cautious."

Summer planting in response to a wet summer forecast is something the Carns have also explored and this has previously given them summer feed for livestock that lasted well into autumn. Susan says this measure has the potential to help in the future and is an example of being flexible in response to forecast information.

"One year we got two inches in early summer and I'd heard that someone had tried putting in a barley crop in summer and it actually paid off," she says. "This is a great option if we don't have a lot of feed. Bernard had just finished harvest and then he started sowing in a paddock by the main road in November. I'm sure people wondered what on earth we were doing, but it turned out to be a good move."

The Carns also time their sheep breeding for lambing to occur when there is the best feed available. "I like to know around the end of October what's going to happen as far ahead as I can," Susan says. "This guides us as to when we put our rams in. A forecast with a lot of summer rain would suit an earlier lambing in autumn, but a dry summer forecast would suit a late autumn or winter lambing to try for more feed to be available in wetter months."

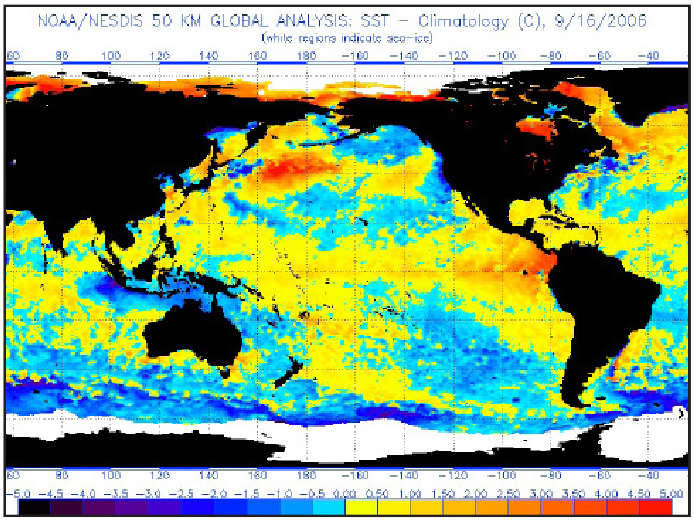
Why forecasters look closely at Sea Surface

COMPARE THE PAIR!

AUTHOR Graeme Anderson

The winter-spring seasonal rainfall variability in southeast Australia is strongly influenced by Sea Surface Temperatures (SST), especially along the equator and to the north of Australia. To see the contrast, below is the 2006 dry pattern (El Niño plus positive IOD) and the 2010 wet pattern (La Niña plus negative IOD).

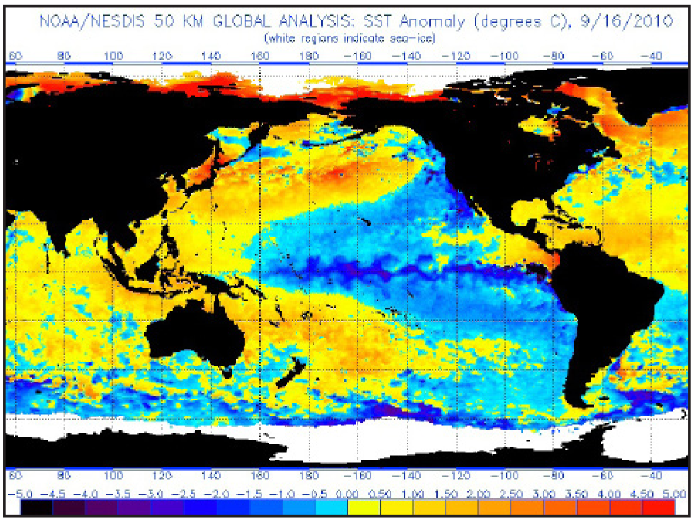
Spring 2006 SST Anomaly



Cooler (blue) SST's to the north of Australia are usually associated with less cloud and moisture in our region.

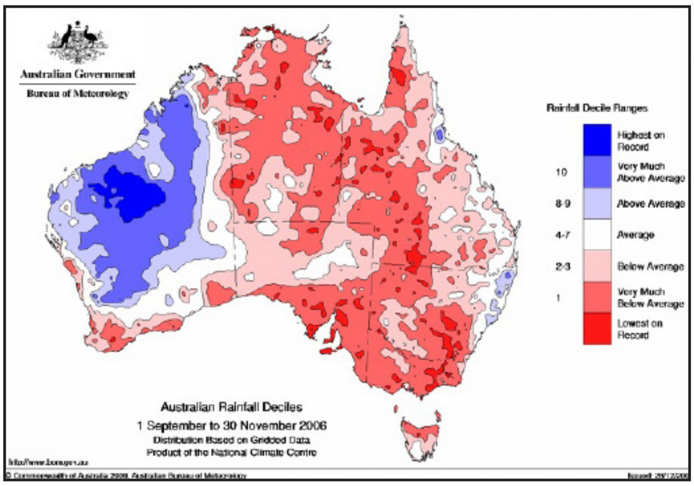
Source: NOAA, www.ospo.noaa.gov/Products/ocean/sst/anomaly

Spring 2010 SST Anomaly

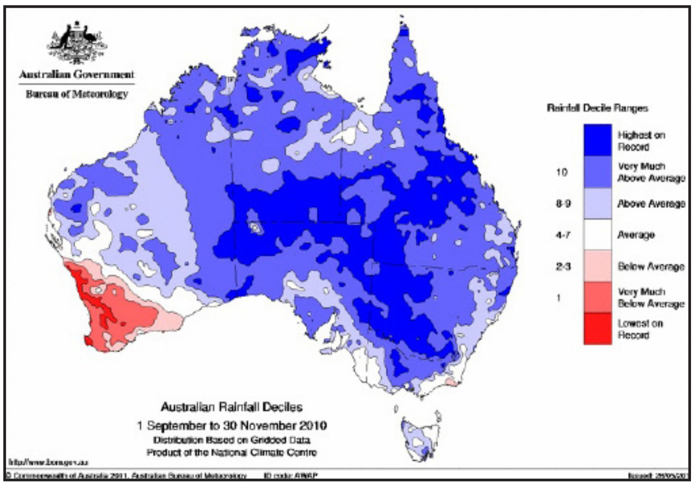


Warmer (orange) SST's to the north of Australia are usually associated with cloud and moisture in our region.

Source: NOAA, www.ospo.noaa.gov/Products/ocean/sst/anomaly



Rainfall decile spring 2006. Source: BoM



Rainfall decile spring 2010. Source: BoM

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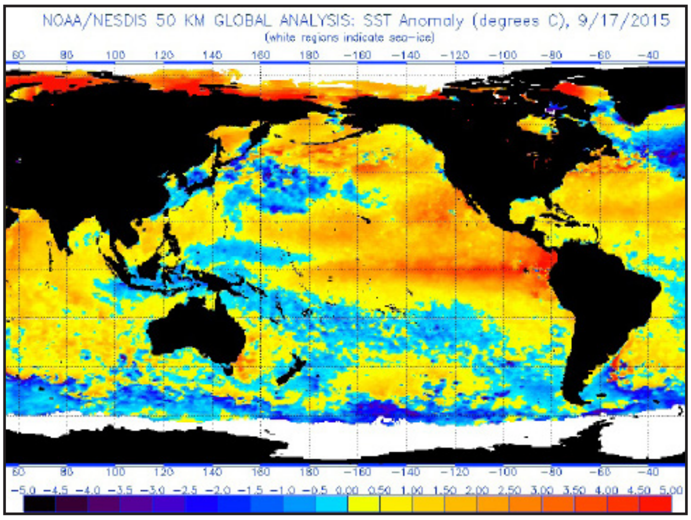
Temperatures - a dry versus wet pattern

COMPARE THIS PAIR TOO!

Another example for recent spring seasonal rainfall variability in southeast Australia being influenced by Sea Surface Temperatures (SST), especially along the equator and to the north of Australia. To see the contrast, below is the 2015 drier pattern (El Niño plus positive IOD) and the 2016 wetter pattern (negative IOD) with much warmer waters to the northwest of Australia.

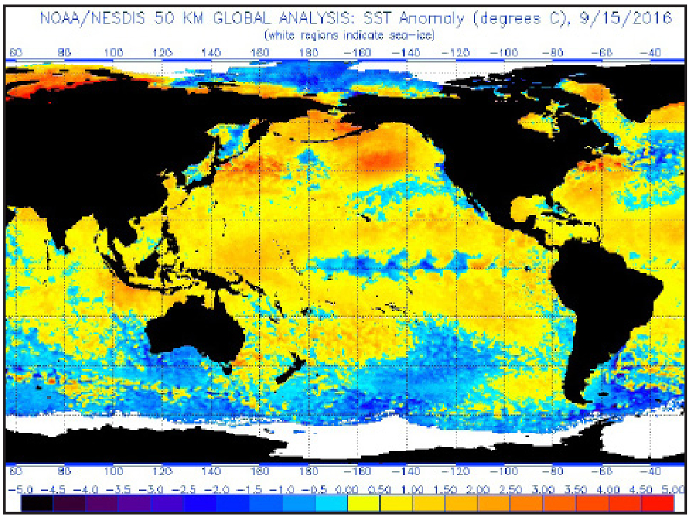
Spring 2015 SST Anomaly



Cooler (blue) SST's to the north of Australia are usually associated with less cloud and moisture in our region.

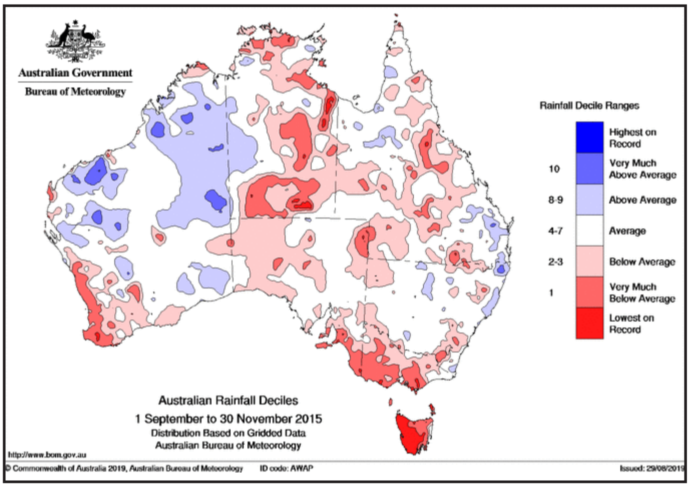
Source: NOAA, www.ospo.noaa.gov/Products/ocean/sst/anomaly

Spring 2016 SST Anomaly

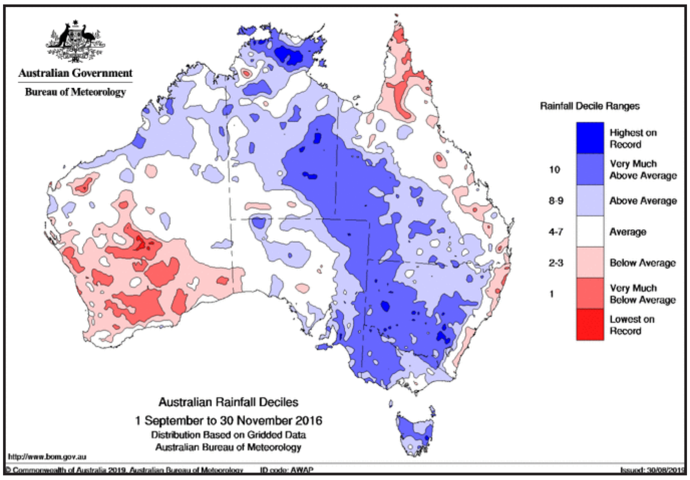


Warmer (orange) SST's to the north of Australia are usually associated with cloud and moisture in our region.

Source: NOAA, www.ospo.noaa.gov/Products/ocean/sst/anomaly



Rainfall decile spring 2015. Source: BoM



Rainfall decile spring 2016. Source: BoM

Forecast consulting makes for educated farming decisions

AUTHOR
Rachael Oxborrow

Consulting the weather forecast is almost a daily occurrence for Port Lincoln grower Mark Modra, who utilises short term and seasonal forecasts to make educated decisions about crop selection, fertiliser application and livestock numbers.

Mark is a regular subscriber to forecasting services, both Australian and international, to educate himself on current and future weather conditions that could impact his operation. He uses these services and knowledge of factors such as existing soil moisture, crop rotation history and soil testing results to guide his decisions.

"Weather forecasting is very important for us as farmers and if it could guarantee accuracy, it could save the agricultural industry millions of dollars but also generate many more," he said.

"Environmentally there would be large gains in terms of wind erosion, nitrate leaching of putting urea on knowing that it's not going to get washed through the system."

However, due to the risk of inaccuracy, Mark exercises an element of discretion around making significant decisions based on seasonal forecasting alone.

"I am more cautious and conservative with my decisions than I have been in the past," he said.

"To address the risk of season-to-season decisions, I've been creating a farming system that has an organic-based nitrogen focus using clovers and legumes.

"If I get a wet year, I've got slow releasing nitrogen from having legumes in the rotation that don't leach or leave you in deficit. In a dry year that organic nitrogen is consequently not released saving the crop from burning off and then leaving excess nitrogen for the following season."

Mark said this approach has allowed him to be less concerned with the timing of in-season nitrogen application and frequency, which can present issues in terms of leaching, timing and crop yield potential in wet years. The southern Eyre Peninsula grower farms with his wife Tamara, their four children, and his parents Sylvia and Theo.

"In Australia, we spend millions on weather forecasting and yet we still get it so wrong," Mark said.

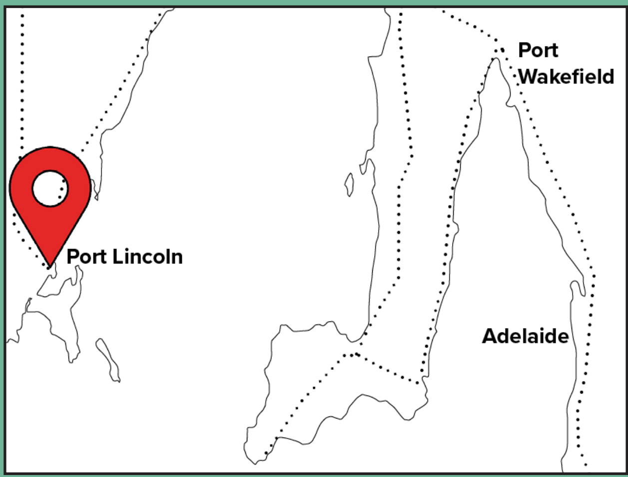
"Four-day forecasts are good; seven days are rubbery and after that, flipping a coin seems to be as accurate as the forecast models. Having said this, the Bureau [of Meteorology] do a good job and the forecasting accuracy has improved in recent years.

"There is a fine balance between knowing what the weather and seasonal forecasting is saying, but also being aware of the probability of different outcomes."

"We as farmers have improved our ability to manage the extremes; things like retaining stubble, early sowing, and using feedlots for sheep have enabled us to survive and even prosper in years where we would previously have gone backwards.

"To try and protect myself from the risk of seasonal variability I'm always looking at what farming systems I can employ that will cover the extremes that would hurt my farming operation the most.

“Weather forecasting is very important for us as farmers and if it could guarantee accuracy, it could save the agricultural industry millions of dollars but also generate many more.”



Property:
Seaero

Owners:
Mark, Tamara, Sylvia and Theo Modra

Location:
Port Lincoln, South Australia

Farm Size:
1800 hectares

Average Annual Rainfall:
400-500 mm

Soil Types:
variability - form red brown earth to lime over buckshot gravels

Enterprises:
cropping and sheep

Typical Crops Grown:
canola, wheat, barley, lupins, beans and lentils

“At the back of my mind I’m always aware that the end of the season is really what gives you your return.

“This year, things are looking really good, but I’ve got to be careful I don’t put too much nitrogen in my system.

“If the rain stops short in August my crops could be too big and I’ll have all this biomass with nothing to finish it off.”

The Modra family began its long history in farming by running sheep on Thistle Island, off the coast of Port Lincoln. They sold this operation in the 1980s and moved to a continuous cropping system on the mainland. In the early 2000s they reintroduced sheep into their system. Mark now manages 1800 hectares of cropping which features a canola, barley, wheat and legume rotation and a flock of 1600 Merino ewes and crossbred lambs.

“Sheep provide income diversity and play an important role in creating a resilient farming system,” he said. “This year I followed the seasonal forecast of a late break and sold sheep, but it turns out I shouldn’t have as the break was early and now I have plenty of area for grazing but not enough numbers to take advantage of the opportunity.

“If I had an accurate forecast, we could have kept more sheep on farm and the business could have profited $70,000 just in this one example.”

Mark said the seasonal forecast can also impact decisions on where he will plant certain crops across their operation.

“I have a number of blocks over a distance of 70 kilometres and if it is going to be a dry season for example, I will grow less canola on my northern blocks and I will grow lupins on my southern blocks, but if it is predicted to be wet I would swap that around,” he said.

CASE STUDY NINE

Seasonal tools fine-tune investment

AUTHOR
Clarisa Collis

For Greg Toomey from Landmark Elmore, the art of risk management is a delicate balance that sees him continually fine-tune farm business decisions to match variable and changing seasonal and climatic conditions.

Drawing on 30 years of agronomy experience, including 19 years as an Elmore district agronomist in northern Victoria, Mr Toomey aims to lift gross margins while shielding cropping operations from shifting, sometimes harsh, weather patterns.

With profitability front-of-mind, he uses experience and trusted sources of information to guide “clever investment” in cropping inputs that help optimise gains in bumper years and minimise losses in challenging years.

Informing this approach to crop investment, Mr Toomey refers to an increasingly sophisticated suite of seasonal and climate risk management tools developed by Agriculture Victoria.

The suite comprises subscription-based seasonal forecast commentary, The Break, which is produced by Agriculture Victoria seasonal risk agronomist Dale Grey. The Break provides a range of seasonal forecast summary newsletters, comparing forecast models and soil moisture data for three to six months.

Mr Toomey examines deep soil moisture probe data and commentary released by Agriculture Victoria seasonal risk agronomist Dale Boyd, who manages a Victoria-wide network of probes on growers’ properties.

He also refers to Bureau of Meteorology (BOM) data, particularly in terms of its local and state seasonal forecasts, Indian Ocean Dipole and Southern Oscillation Index monitoring, Australian weather watch radar and wind forecasts.

Exploring how he wields these tools for northern Victorian growers, Mr Toomey uses soil moisture probe data as a “reference point to help extrapolate plant available moisture across a cropping district”.

Accompanied by a weather station, sensors in the capacitance probes record subsoil moisture from a fixed location on farms at 10-centimetre increments from a depth of 30cm to one metre in the soil profile. The data, which can be accessed by agronomists and other growers, is then sent via the mobile phone network to a server for storage, analysis and interpretation using graphing software.

Mr Toomey says trends in the soil moisture data gleaned from the on-farm probes are used to “tweak” the percentage mix of crops grown in rotation.

For example, information from the probe network that ‘suggests subsoil moisture is depleted often provides a cue to reduce the farm area planted to canola.

The farm area planted to this deep-rooted oilseed crop, known to access moisture at depth in the soil, is generally replaced with relatively drought-tolerant barley or oaten hay crops, he says.

Mr Toomey says the probe network has also delivered unexpected, and influential, new perspectives on crop water-use.

In the wet 2016 season in the Elmore district, for instance, the on-farm probes indicated the soil moisture profile was full in early October but, by the end of that month, crops had used more than 80 per cent of this moisture reserve, he says.

As a consequence of this finding, Mr Toomey now more conservatively estimates crop yield potential in spring which, in turn, means applying less nitrogen fertiliser and reduced expenditure on crop nutrition.

He also measures seasonal forecasts, mainly in winter and spring, against soil moisture data as part of an overarching strategy that aims to match crop inputs to growing season conditions and ultimately maximise farm business profitability.

Seasonal forecasts are studied against the backdrop of BOM forecasts, particularly Indian Ocean Dipole (IOD) and El Niño–Southern Oscillation (ENSO) climate indicators distributed by Agriculture Victoria, he says.

For instance, he might apply more nitrogen to feed higher yield potential where climate forecasts suggest negative IOD and La Niña phases, which are indicative of above-average winter and spring rainfall, and colder-than-average temperatures.

A forecast for wet, disease-prone conditions can also influence the timing of, and planned expenditure on, fungicide applications, he says.

Whereas predictions of positive IOD and El Niño phases associated with dry, warm conditions, might provide a trigger for cutting crops for hay.

Putting the potential profitability of this management decision into context, he says that in many situations, cutting northern Victorian crops for hay secured an extra $500 per hectare compared with harvesting them for grain in the dry 2018 season.

CASE STUDY TEN

A MIX OF TOOLS TO MAKE THE BEST OF THE GOOD YEARS AND RIDE OUT THE TOUGH ONES

AUTHOR
Barry Mudge

Barry and his wife, Kristina, operate a 1600 Ha mixed farming property in the Upper North of South Australia. Rainfall is highly variable, but the annual averages is around 330 mm (220 mm growing season). Barry considers the variability in rainfall an asset which needs to be managed to maximise profitability over the range of seasons.

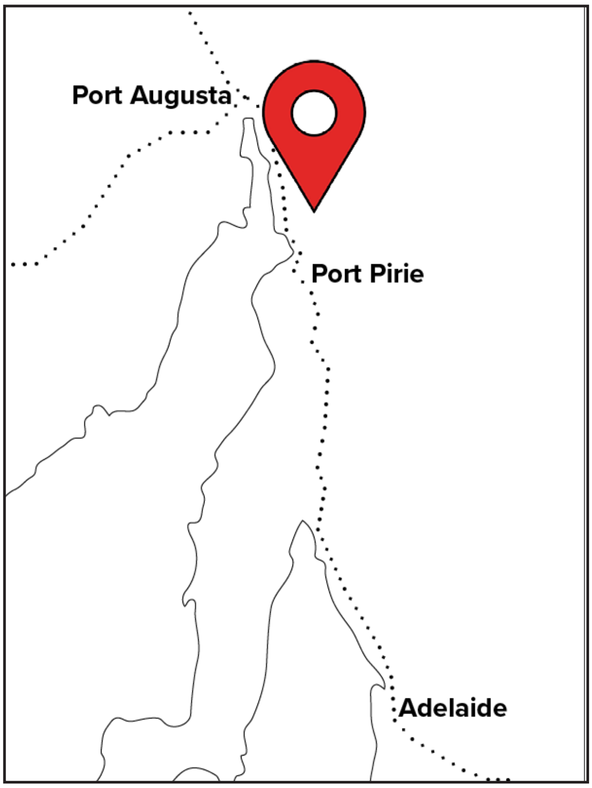
"The facts are that in these low rainfall environments, we can either be farming in some of the most productive country in the state, or some of the worst, depending on how the season turns out. The challenge is to maximise the benefits of the good years and just learn to ride out the poorer seasons."

So, the focus needs to be on good agronomy and maximising water use efficiency. At the same time, Barry believes that seasonal forecasts have a role to play, but he remains cautious about putting too much emphasis on them. He has used seasonal forecasts in various ways over a lot of years but points to the need to be realistic in what they are telling us.

"We are very fortunate in Australia to have comprehensive climate records dating back at least 100 years. This provides us with an excellent starting point in understanding what the variability of our seasons looks like - all a seasonal outlook forecast does is potentially alter the probabilities of the various outcomes occurring. And, unfortunately, history shows that the reliability of seasonal forecasts is not particularly high."

A key time of the year for decision making is when crops are established; usually in late April or early May. Several years ago, Barry developed a simple index to provide guidance on expectations for the season which was then used to guide planting intentions. While seasonal forecast information was included in the index, it remained a relatively minor influence. "Generally, the information that we know about the season, such as stored soil water, crop establishment opportunities and other agronomic factors remain more critical to the decision than a forecast whose reliability is marginal at best."

If seasonal forecasts are going to be considered, Barry considers that we firstly should focus on the level of skill sitting behind the forecast. And this can obviously vary both at different times of the year and between different years. "I get annoyed when I see a forecast that hasn't got at least some reference to skill, or past reliability. As an example, anyone can forecast the winner of the Mel-



"Used cleverly, seasonal climate forecasts may sometimes enable us to be at least more comfortable with the many climate sensitive decisions that we need to make in the course of our farming careers."

Property:
Sandalwood

Owners:
Barry and Kristina Mudge

Location:
Upper North of South Australia

Farm Size:
1600 hectares (1200 hectares cropping)

Average Annual Rainfall:
330 mm

Soil Types:
loamy mallee, stoney red-brown earths and desert loams

Soil pH:
6.8 to 8

Typical Crops Grown:
wheat, barley, lentils and vetch pasture

bourne Cup, but history shows that not many people actually get it right".

While Barry believes his planting index was useful in getting an early feel for the season, he has been disappointed with the reliability of the early season forecasts. "From my observations, rarely do we get any useful information in our district from seasonal forecasts prior to June. This is a great pity as this could be incredibly valuable. But as we progress into winter and spring, we can get some years where there are clear indications of trends. This might only occur, perhaps 50 per cent of the time but it can prove useful in adjusting fertiliser levels or planning fungicide applications".

Barry's main message when using seasonal outlook forecast information is to make sure that any influence they may have on decision making is soundly based. "Too often we tend to allow forecasts to subjectively invade our sub-conscious and affect our decision making. A little bit of analysis of the range of possibilities and how a seasonal outlook forecast could change these is usually a worthwhile exercise".

An example of this occurred in 2018. Towards the end of his sowing program, Barry had the choice between continuing to plant lentils (seen as relatively risky in his low rainfall environment) or planting vetch for grazing (seen as less risky). Some analysis showed that it was only in very dry years would the vetch be the better proposition and a seasonal forecast would need to be showing extreme dryness with a high level of underlying skill to support the argument to plant vetch.

Given the uncertainties inherent in the climate, Barry considers it unlikely that reliability of seasonal forecasts will ever reach the stage when they become the "Holy Grail". "We accept that we farm in a highly unreliable and climatically variable region. Seasonal outlook forecasts will not change this. But used cleverly, they may sometimes enable us to be at least more comfortable with the many climate sensitive decisions that we need to make in the course of our farming careers".

The 'Using Seasonal Forecasts' project is brought to you by GRDC and partners.