Bett

GUT FEELING: *Farmers are relying on instinct rather than unreliable weather forecasts; (inset) weather forecasting is a highly technical science. Photos: Photolibrary*

STORY: JAMES NICHOLSON

More accurate weather forecasts will help people who rely on them.

er weather ahead

You would think the Bureau of Meteorology would be every farmer's best friend. For more than a hundred years, Australia's agricultural sector has relied, to a greater or lesser extent, on essential information from the national weather forecaster.

The weather, and more to the point weather forecasting, plays a critical role in the strategic decision-making processes that drive Australia's $47.5 billion agriculture industry.

Indeed, the bureau attracts a staggering nine billion hits a year to its website, and accounts for more than 45 per cent of all Australian government web traffic.

But the current reality is that the friendship is being stretched in places. Frustrated by what too often turn out to be erroneous forecasts, farmers are asking serious questions of the bureau and its capacity to deliver skilful, accurate seasonal predictions that can feed into key land-management decisions. A 2007 report based on data compiled by the bureau and the Department of Agriculture, Fisheries and Forestry

Photo: Jupiterimages

found that 76 per cent of farmers considered forecasting not to be reliable, and 73 per cent considered it not to be accurate.

As the South Australian Farmers Federation told the House of Representatives Industry, Science and Innovation Committee earlier this year, "The lack of accuracy of the current modelling methods and long-term predictions makes them a less than useful tool for agricultural farming systems within South Australia.

"Agriculture has long called for the accurate long-range climate forecasting to improve decision making and risk management on-farm but now question if we are pursuing the 'holy grail'."

The complex and highly technical science behind weather forecasting, and the innovation that drives continual improvement in forecasting accuracy, are central to decision-making across the economy, from the farming sector to water resource management, the mining, construction, tourism and aviation industries, as well as emergency response management.

Alert to the far-reaching and potentially disastrous implications across multiple industry sectors of inadequate weather prediction systems, the Minister for Innovation, Industry, Science and Research, Senator Kim Carr, requested the committee to inquire into long-term meteorological forecasting in Australia.

The committee, chaired by Maria Vamvakinou (Member for Calwell, Vic), was asked to report on the efficacy of current climate modelling methods and techniques, and long-term meteorological prediction systems, as well as innovation in long-term forecasting methods and technology. It was also invited to examine the impact of accurate measurement of inter-season climate variability on decision-making, potential applications for emergency response to natural disasters, and systems and research in use overseas that could have application in Australia.

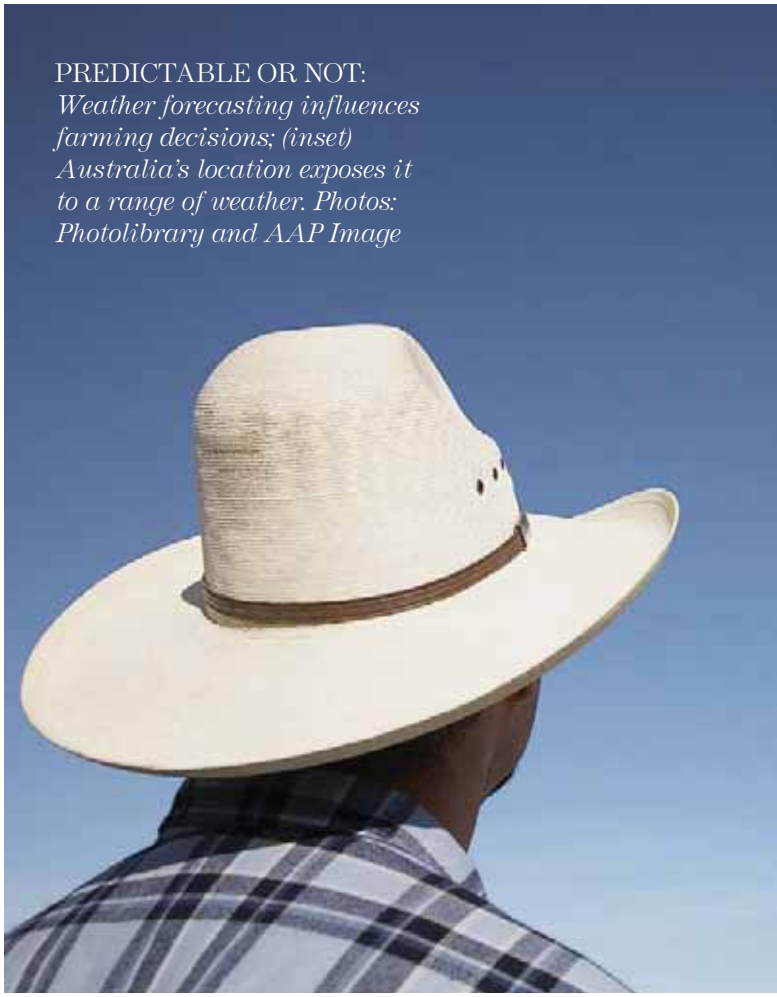
"Weather plays a huge part in the lives of all Australians," Ms Vamvakinou said. "Even simple daily activities are determined by the weather, and having access to accurate weather forecasting is essential.

"In particular, accurate long-term forecasting is essential for many of our industry sectors, for example our agricultural industry. Without accurate long-term forecasting, the planting of crops reliant on seasonal rains is a risky business."

The committee has heard evidence from farmers groups, state government departments, several individual scientists and some federal government agencies including the Department of Agriculture, Fisheries and Forestry, Land and Water Australia and CSIRO. It also heard from the Bureau of Meteorology, which bears legislated responsibility for the collection of meteorological data and the forecasting of weather and the state of the atmosphere. That responsibility includes the issuing of warnings for severe weather associated with events likely to endanger life and property.

The bureau supports ongoing research in weather forecasting principally though its partnership with CSIRO in the operation of the Centre for Australian Weather and Climate Research (CAWCR). This unincorporated joint venture brings together relevant research and development expertise from both partners.

In its submission to the inquiry, the Bureau of Meteorology noted the importance of meteorological forecasting and climate modelling to Australia's economic, environmental and social well-being and prosperity.

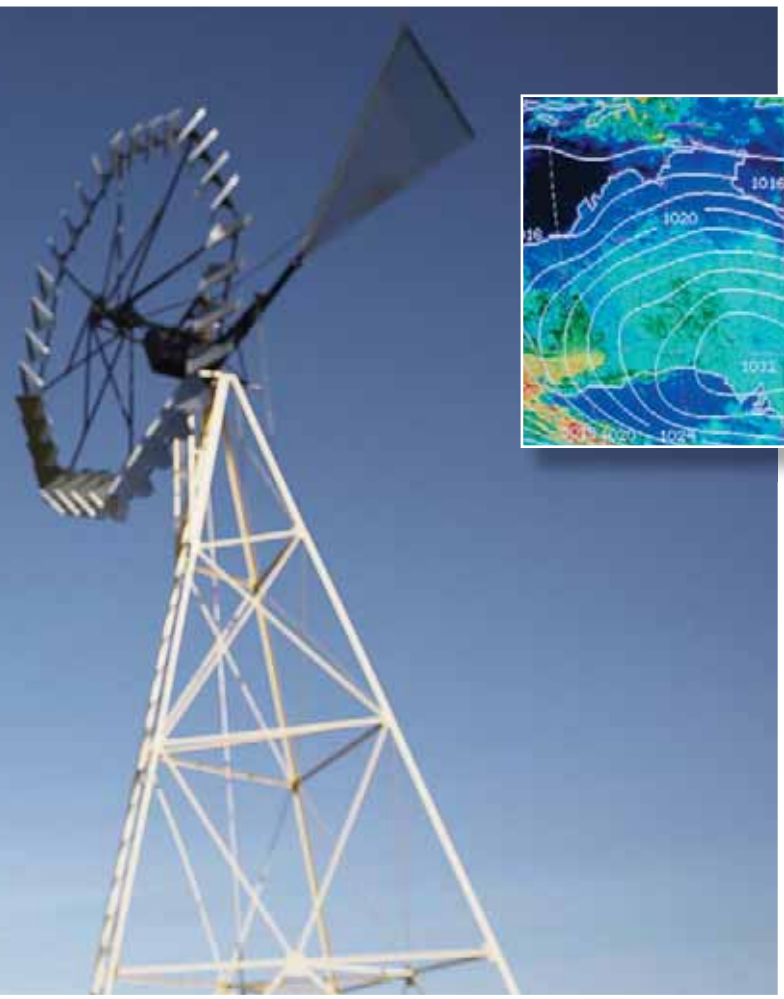


PREDICTABLE OR NOT: *Weather forecasting influences farming decisions; (inset) Australia's location exposes it to a range of weather. Photos: Photolibrary and AAP Image*

"Scientists widely acknowledge that historical climate records are no longer adequate predictors of future climate."

"Australia's location and size exposes it to a range of weather extremes such as heatwaves, bushfires, cyclones, floods and storms. Predictions of weather and climate at time-scales from hours to days and across seasons can influence decisions that range from emergency management procedures and systems through to when or whether to plant particular crops," the bureau said.

At the heart of the investigation into the adequacy and accuracy of current long-term forecasting methods is the reality that seasonal weather forecasters find themselves caught in a hiatus between a traditional method of forecasting, which has become outdated and ineffective, and a new method which is yet to be properly developed.



Forecasters have traditionally based their predictions on statistics gathered over time. Essentially, they collect observations about past or present conditions that influence weather, and use those observations to predict meteorological conditions into the future. The flaw with this 'statistical method' is that it assumes previous weather and climate patterns will be reliable indicators as to what might be expected in the future.

Climate change, however, has rendered this method almost useless, as the bureau's acting chief climatologist Michael Coughlan told the committee.

"By characterising the climate of the past and understanding again where you are now, you can go back to that record and extract similar occurrences of conditions like we have now," Dr Coughlan said. "If one can find those similar conditions in the past they can use that history of how the climate evolved from those conditions to forecast conditions.

"The problem we are experiencing now is we are seeing a very unstable climate regime or, to use the statistical term, non-stationary climate…. In other words we are experiencing climatic conditions that are not well represented in the past. That then compromises our statistically based forecast."

CSIRO told the inquiry the existing seasonal forecasts for Australia have "reached the summit of their ability", while the Department of Agriculture, Fisheries and Forestry described the inaccuracy of current long-term meteorological forecasting as one of the great barriers to its wider adoption for decision-making among farmers.

The science of prediction

The Bureau of Meteorology refers to long-term meteorological forecasting as "seasonal forecasting", and defines it as forecasting weather "from one to several months in advance".

Seasonal forecasting is distinct from short-term weather forecasting (hours to several days ahead), and from climate-scale projections, which examine changes in climate on time-scales from years to centuries.

Both weather forecasting and seasonal forecasting involve the collection of empirical observations about past and present weather conditions, which then form the basis for making a forecast of the future weather.

Seasonal forecasting provides an assessment of the likely weather conditions averaged throughout a coming season, such as whether it is going to be drier or wetter than normal, hotter or colder.

Like most types of predictions, seasonal weather forecasting is uncertain because it involves making a prediction about future events within a complex system. Scientists are trying to work out how to improve the accuracy of forecasts by researching ways of using sophisticated computer models and laws of physics to make their predictions.

According to CSIRO scientist Peter McIntosh, it is the ocean that is the key to the longer time scale of the whole climate system, upon which seasonal forecasts are based.

"The important thing is the sub-surface ocean temperature," Dr McIntosh said. "That is the whole basis of seasonal forecasting: knowing that the ocean controls the long time-scale and knowing something about the subsurface temperatures of the ocean."

Understanding of the ocean is enhanced by an international network of 3,300 'argo floats', small robotic probes which are seeded planet-wide about 500 km apart and which float well below the surface, recording important information about the ocean.

Nevertheless, the task of interpreting these complex data and translating them into seasonal weather forecasts remains a thankless one – a reality which the Bureau of Meteorology points to with four short unattributed lines on its website:

"Many critics, no defenders
Weather folk have two regrets
When they hit no one remembers
When they miss no one forgets!"

"Current long-term meteorological forecasts are primarily based on averages taken from historical climate data," the department's submission said. "In light of the international scientific consensus that human activity is increasing atmospheric carbon emissions and enhancing global warming, scientists widely acknowledge that historical climate records are no longer adequate predictors of future climate."

The alternative, emerging forecasting method into which research and development investment is increasingly being directed is what scientists term 'dynamical modelling'. Here, forecasters model current conditions using the equations of motion and laws of physics to predict future conditions.

The transition from statistical forecasting to dynamical modelling has not yet eventuated, either internationally or at home. But, according to the Centre for Australian Weather and Climate Research's deputy director Thomas Keenan, the latter technique has the capacity to provide a much more comprehensive data set and brings the hope of being able to deliver far more accurate predictions.

"In a statistical relationship you may focus just on temperature or rainfall, but in these physically based models you can actually look at the soil moisture, the temperature, the winds, the rain and have a much more comprehensive description," Dr Keenan said. "That enables a much larger product set or information source to be available, apart from improving the overall predictive skill that is obtained through these types of techniques."

The committee has heard that research is underway to replace the all-but obsolete statistical forecasting methodology with the more current dynamic system upon which farmers and other users could better rely. CAWCR has been developing successive versions of a dynamic modelling system for seasonal forecasting called POAMA (Predictive Ocean Atmosphere Model for Australia). The model has been used to undertake experimental forecasts of sea surface conditions in the Indian Ocean, which is believed to be an important driver of climate variability for Australia. According to the Bureau of Meteorology, indications are that POAMA is better equipped than current statistical approaches to provide long-term forecasts.

The key for farmers is to know how much faith to pin on weather forecasts and to understand how best to use the information.

The other major project to promise improved seasonal forecasting is ACCESS (Australian Community Climate and Earth System Simulator) which is expected to deliver improvements in the simulation of El Nino, the Indian Ocean variability, local weather phenomena and tropical processes.

Notwithstanding this early promise, Land and Water Australia's 'managing climate variability' program coordinator, Colin Creighton, told the committee how the research agenda could be progressed more quickly.

"Obviously, more investment is needed," Mr Creighton said. "We really do not have enough money for what we need to do. Whether it is for emergency services or agriculture or whether it is urban water authorities, it does not matter. Everyone is looking for better forecasts with more certainty and longer lead times.

"Obviously, we need international collaboration. We can not do it alone. While I talk about an Australian system, we are really talking about a global system. There is some good work going on in Europe and India and so on. We must recognise that this is long-term research. You do not get the results in three years. It might take five years.

"Last but not least, as you will probably hear from others, we need a new supercomputer every five or 10 years. That is the reality of where we are going in much of this science."

BETTER FORECASTING: *Scientists are using systems, modelling and measuring for improved weather forecasting. Photos: CSIRO*

The broad benefit of improved seasonal forecasting and its influence on decision-making was articulated in several of the submissions, and by witnesses who appeared in person.

CSIRO listed a number of examples of how different sectors used forecasting to inform specific decisions. They include irrigation and cropping decisions affecting the use of irrigation water; dry-land cropping decisions affecting sowing dates, the area, variety and fertiliser application; emergency services decisions affecting planning for likely extreme events; and tourism decisions affecting the planning capacity and services according to seasonal weather.

"Reliable seasonal forecasting has considerable potential to deliver tangible benefits for forward planning and business operations in agriculture and water resources, and other industry and government sectors and the broader community," CSIRO noted. "Some benefit already exists but would be enhanced through improved seasonal forecasting, clarification and education about how to interpret and apply forecasts appropriately, and therefore increased user-confidence about what seasonal forecasts do and don't offer."

While the implications of accurate forecasting extend well beyond the agriculture sector, it was the submissions representing farming interests, such as that made by the Department of Agriculture, which most urgently stressed the importance of accuracy for strategic decision-making.

"Better information about Australia's potential future climate is central to decision-making for individual enterprises and for policy planning," the department noted in its submission. "Understanding climate variability at seasonal timescales, and having relevant long-term meteorological forecasting tools, will greatly assist risk management strategies at an enterprise level."

The key for farmers is to know how much faith to pin on weather forecasts and to understand how best to use the information, according to Peter McIntosh, a principal research scientist at CSIRO.

"The information has to be part of an overall risk management system," Dr McIntosh said. "They cannot take just that information and just decide to either plant or not plant on the basis of that forecast. They might plant less area or they might delay planting or, if it was a dry year, they might plant a different variety that matures earlier—those sorts of decisions.

"They might decide to put less fertiliser on at the start, if the forecast was bad, and delay it to top dressing and wait to see if they got rainfall. There is a number of ways you can use the forecast information that is not black and white. The pay-off is in the long run. In any one year a forecast could be wrong and a farmer could come unstuck. That is why I think they should not follow the forecast only. They have to take a whole bunch of other things into consideration and just make slight changes based on the forecast."

And while some have described the attainment of accurate seasonal forecasting capability as the 'holy grail', others have a real hope that the research being undertaken through CAWCR will soon deliver dynamical seasonal forecasts that are substantially more accurate than what is currently available.

For the struggling farmers and others who rely on accurate long-term forecasting, those improvements can't come fast enough.•

For more information on the inquiry into long-term meteorological forecasting, visit www.aph.gov.au/isi or email isi.reps@aph.gov.au or phone (02) 6277 4594.