

Using Weather Forecasts for Improved Water Use

1. Background

Weather prediction has been gradually improving over the last decade or so, with several factors contributing to the improvement.

The two main contributors have been the advent, refining and increased frequency of satellite photography, and secondly the improvement in the mathematical simulation of the atmosphere's motion.

Both these improvements have been incorporated into the Bureau of Meteorology's "Cottonfields" service, which routinely presents up to date satellite photographs and output from numerical weather models as part of the service.

"Cottonfields" is accessed through a fax machine interface by polling a regularly updated data bank, and during the period when the cotton is in the ground, up to 1500 calls a week are received.

One of the main intentions of the service is to enable growers to improve their water management strategies, and to assist in this, rainfall predictions out to 4 days ahead are issued.

This is done in three ways:

- (a) In graphic form showing areas around Australia where rain is considered likely. This is a combination of output from a computer model, as well as input from Regional forecasting staff.
- (b) In text form as an expert opinion from a meteorologist, with actual rainfall amounts predicted.
- (c) In probability form, showing the chance of rain as a percentage likelihood.

Accurate rainfall predictions can produce considerable savings, both environmentally and in real dollar terms.

For instance, if the rainfall prediction indicates useful falls developing three days ahead, then growers can hold off on irrigation, with significant water savings resulting.

Growers can also postpone spraying operations if rain is expected. If spray is applied and rain follows soon after, a re-application may be necessary which is expensive and undesirable from an environmental standpoint.

The "Cottonfields" service attempts to be of assistance in this area and has been well received by the industry, with two separate user surveys confirming that savings have resulted in the areas of water and spray management.

The Bureau now has over two years of forecasts available, enabling a forecast verification survey to be undertaken.

The results of this survey, which compare rainfall predictions with what actually followed, show that there is now significant skill in predicting rain out to four days ahead.

2. Methodology

The "Cottonfields" service provides rainfall probability predictions out to 4 days ahead, but in an overall form for the cotton growing area, and is not location specific.

In this verification scheme, all available forecasts were processed for each location to see if the overall figures issued in "Cottonfields" represented good value for the location in question.

The locations reviewed were Tamworth, Bourke, Gunnedah, Moree, Wee Waa and St. George.

Forecast probabilities were broken up into percentage bands and compared with actual rainfall that followed.

For example, it was shown that at Moree, a 30% chance of rain was forecast 116 times out of 830 forecasts. Rain was actually recorded on 36% of these 116 days, indicating a slight underforecasting of rain.

The following is a summary of the verification:

Station: Tamworth (970 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	14%
20%	33%
30%	32%
40%	42%
50%	79%
60%	75%

Generally the rainfall was under predicted, particularly at the high probability end of the spectrum. Best forecast accuracy was around the 30 to 40% levels.

Station: Bourke (873 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	6%
20%	16%
30%	28%
40%	42%
50%	71%
60%	60%

Was one of the best performers. However the 50% prediction was a substantial under-forecasting of the actual rain to follow.

Station: Moree (830 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	8%
20%	32%
30%	36%
40%	53%
50%	100%
60%	82%

This represents a consistent under-forecasting of rainfall, although by only small amounts at the lower end of the forecast spectrum. However there is a clear message that we must forecast higher probabilities in areas currently in the 40 to 60% forecast range.

Station: Gunnedah (895 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	8%
20%	31%
30%	40%
40%	45%
50%	92%
60%	100%

The Gunnedah results are similar to those of Moree- showing an under-forecasting of rain, particularly in the upper ends of the spectrum.

Station: Wee Waa (824 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	7%
20%	14%
30%	28%
40%	25%
50%	43%
60%	64%

Wee Waa was interesting because it showed the reverse trend of over-forecasting rain in all levels apart from the 60% band.

Station: St.George (1016 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	6%
20%	24%
30%	29%
40%	36%
50%	43%
60%	92%

The trend here was mixed, but substantial under forecasting was noted for the 60% band.

Station: All stations (6224 forecasts verified)

Forecast probability	Percentage of occasions on which rain occurred
10%	9%
20%	26%
30%	33%
40%	42%
50%	69%
60%	81%

The overall figures were quite impressive up to 40%, but under-forecasting was apparent in the 50 and 60% bands.

In this analysis, all forecasts on days 1 to 4 ahead have been included together. It will obviously be useful to obtain some idea of how accuracy varies as we move out in time and compare each forecast day individually. This analysis could not be completed in time for the conference, but will be provided to the industry in the near future.

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