Advances in Weather Forecasting

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What are the steps involved in producing a weather forecast?

(a) **Collection** of meteorological information

(b) **Processing** of this information

(c) **Preparation** of the forecast

(d) **Distribution** of this forecast

(All this must be done in a time frame that enables step (d) to be actioned before the forecast period begins.)

Advances in each of these four steps have been considerable over the last decade, and are resulting in more accurate and readily available information to assist with decision making in rural affairs.

We will now look briefly at some of the progress in each area.

(a) Collection of meteorological information:

This involves such activities as the regular taking of weather readings on the ground with temperature, wind speed and direction, humidity, barometric pressure, cloud amount and height, rainfall etc. being recorded by weather observers around the countryside. Also recorded are weather observations at sea and from aircraft.

In recent times there has been a move towards automatic weather stations that can provide data continuously, rather than relying on human collection of information at fixed times. The next generation of meteorological satellites will also be able to collect "fields" of information by scanning on different wavelengths such as infra-red and microwave. As well as providing pictorial information on cloud patterns, these satellites will provide data on upper winds and temperatures, surface pressures and sea states.

This type of information will be particularly valuable because it will be in the form of continuous fields, rather than the point-to point sampling currently in use.

(b) Processing of the information:

The weather information collected is today processed far more quickly than it was twenty years ago.

The old methodology involved manually recording observations, plotting the data on weather charts by hand, and then storing the information in archives so that climatological perspectives could be constructed. This process was time consuming and labour intensive, as well as requiring large storage spaces for all the records. Now the messages are transmitted electronically, charts are plotted and analysed by machine, and much of the data also stored electronically. This results in a considerable time saving , which then becomes available to the forecaster as increased "thinking time" for the actual preparation of the forecast. Also the electronic storage provides a significant saving in space, and a vastly improved access system to Bureau records, with a much faster response now possible to any request for climatological information.

(c) Preparation of the forecast

This area has seen a total revolution in the last 2 decades or so. The main agents of this change have been twofold;

(1) Satellite photography

(2) Mathematical simulations of weather

Discussing satellites first, photography from meteorological satellites began in 1961 with TIROS 1 (Television/ infra red observational satellite). In the following 30 years, meteorological satellites have been progressively refined and now provide indispensable information to the forecaster on an hourly basis.

The two basic types of meteorological satellite are polar orbiting and geostationary. The polar orbiting satellite operates at a comparatively low altitude (~800/1500km), and is sun-synchronous; this means that it progresses across the Earth at the same speed as the day/night line. Because of the low altitude, detailed photographs are possible showing quite small scale meteorological motions.

The geostationary meteorological satellite orbits at a much higher altitude (~36,500km), and is geo-stationary, which means that it remains over the same place on the Earth's surface at all times. The advantage of this system is that photographs may be taken at regular intervals and a "movie loop" constructed, showing the movement of cloud over the region in question, and this enables a far clearer weather picture to be built up.

Both types of satellite scan on the visible and infra red wavelengths, the latter so that images can be collected on the "night side" of the Earth.

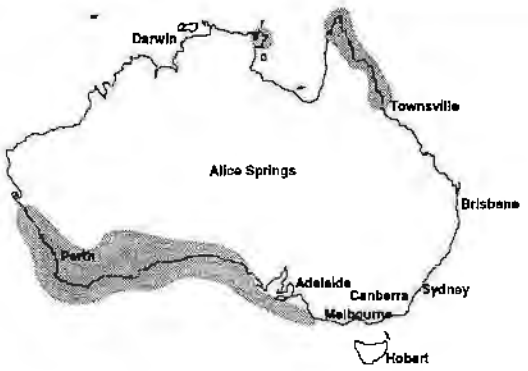
Mathematical weather simulations have also been a major area of progress recently. With increasingly sophisticated mathematical "models" of the Earth's atmosphere now available and constantly being refined, together with the huge calculating power available from modern supercomputers, these models are now becoming the basis for day to day forecasting.

One model giving very good results is the Australian GASP (Global Assimilation and Prognosis) system which produces forecast charts now out to a week ahead, with both forecast pressure systems and rainfall being depicted. (See fig(1))

Routine forecasting out to a week ahead with "useable" accuracy should be achievable over the next 2 to 3 years.

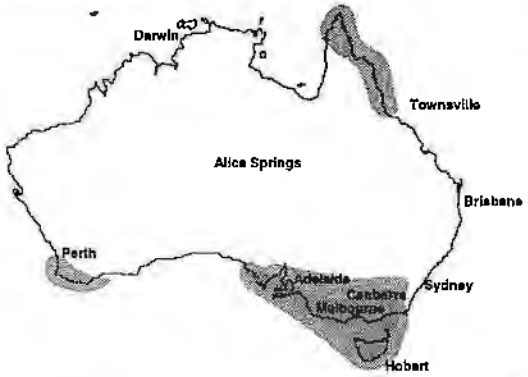
Bureau of Meteorology

Special Services Unit



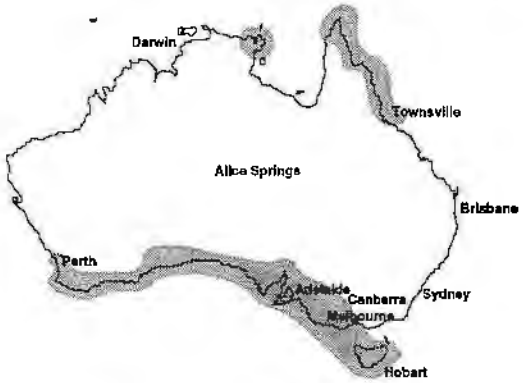
Probability of rainfall in the 24 hours to 10 pm Tuesday

Chance → Likely → Highly Likely



Probability of rainfall in the 24 hours to 10pm Thursday

Chance → Likely → Highly Likely



Probability of rainfall in the 24 hours to 10pm Wednesday

Chance → Likely → Highly Likely

Probability of rainfall in the 24 hours to 10pm Friday

Chance → Likely → Highly Likely

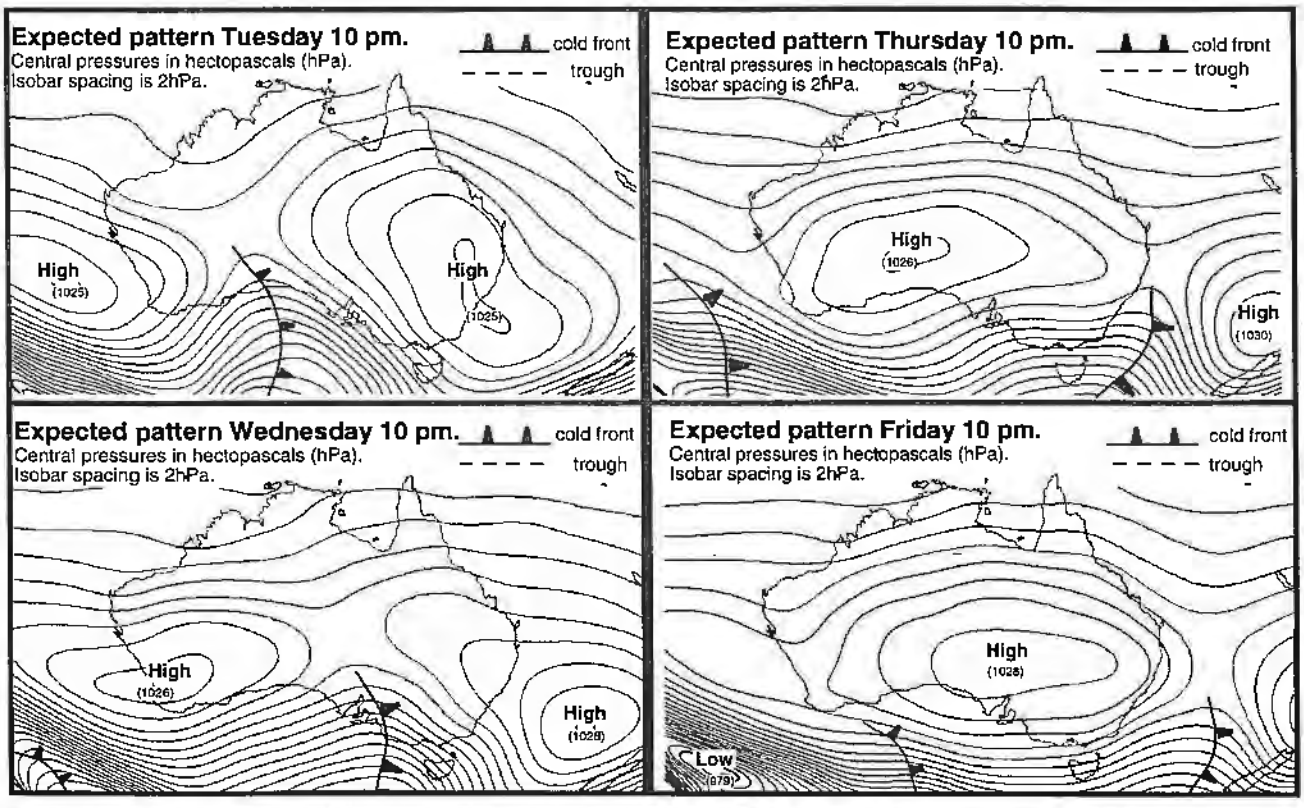


FIGURE (1)

(d) Distribution of the forecast

Up until quite recent times, the Bureau relied almost entirely on the print and electronic media for forecast distribution. Whilst necessary at the time, there were problems with this system.

For instance rural weather is not seen as a major priority in many metropolitan daily newspapers, and as a result, usually only minimal space is allowed for presentation of the district forecasts. This in turn, means only room for very basic forecast information, with further outlooks sometimes limited to only two or three words.

As far as the electronic media is concerned, convenience is a factor. Many farmers organise their day to be home to watch the nightly weather presentation at the end of the news segment. This of course, can be inconvenient, and a more flexible distribution system is desirable.

These twin problems of lack of forecast detail and fixed transmission times have been addressed in the Bureau's "Farmweather" service, of which "Cottonfields" is an example. This is distributed via the Telecom Infofax system, and can be accessed by any farmer with a fax machine.

After requesting "Cottonfields" on his/her fax machine, a farmer receives three sheets;

(1) A detailed forecast for the local area

(2) A "weathergraphics" page, showing expected pressure patterns and rainfall out to four days ahead, based on the Bureau's mathematical GASP model.

(3) A recent satellite photograph.

This detailed information is updated every weekday, and is available to the farmer whenever required. "Farmweather" is an example of a direct "from the Bureau to the Farmer" distribution system, which can be extended in the future by the use of computer bulletin boards.

Because the fax machine allows independent and personalised distribution of weather information, I believe it will be comparable to the satellite and mathematical computer simulation in the revolutionising of meteorology towards the end of the twentieth century.