BRS use of climate information to analyse drought events

Ashley Leedman, Tim Brinkley, Greg Laughlin & John Sims
Bureau of Rural Sciences

The Bureau of Rural Sciences (BRS) is a scientific agency within the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF). The Exceptional Circumstances (EC) team within BRS has two primary responsibilities. The first is to provide scientific advice to the National Rural Advisory Council (NRAC) on applications for EC assistance, submitted to the Commonwealth by State and Territory Agricultural Departments or representative bodies. We are also responsible for providing information on the impact of the drought on agricultural production to the Minister for Agriculture, Fisheries and Forestry, the policy section within DAFF and to a variety of Government and non-Government agencies. The recent drought has had a marked impact on the profile, workload and operational structure of the BRS EC team.

Since October 2002, BRS has provided assessments of 52 EC applications. The aim of these assessments is to provide advice on the rarity and severity of a 'drought event' in a particular region against a set of scientific and policy criteria. One of the most important criteria is whether a region has experienced a climatic event that would be expected to only occur once in every 20 – 25 years.

BRS uses a range of primary as well as derived climate products to analyse drought in this context. Data provided by the Bureau of Meteorology (BoM) is fundamental for this purpose.

The greatest challenge in communicating scientific information about exceptional events such as drought is the combination of being able to clearly and simply convey climatic information while also creating an understanding of the limitations inherent in this information. The remainder of this paper will discuss some of the methods BRS uses to analyse drought and also highlights the components of these analyses that most successfully conveyed climatic information. The limitations of these analyses will also be discussed.

1. Spatial and temporal analyses of rainfall data

Spatial analyses of rainfall data were used extensively to identify areas experiencing severe rainfall deficiencies (Figure 1). Figure 1 shows a rainfall percentile map of a region in southern Queensland, produced using the Rainfall Reliability Wizard. The Wizard uses monthly rainfall data provided by the BoM in ASCII grid format with a resolution of 0.25 degree of latitude-longitude across Australia. These data sets are based on approximately 4000 rainfall sites across Australia and interpolated using a Barnes successive correction technique.

This type of graphical presentation was successful in communicating drought because readers could see the extent and severity of the rainfall deficiency across a particular region. However, although successful at giving a broad impression of the rainfall deficit, graphical presentations are limited because actual rainfall can often differ significantly from the interpolated record. For example, Figure 1 shows that the area covered by site 42030 experienced a rainfall deficit somewhere between the 20th and 30th percentile, whereas rainfall data at that point taken from the SILO Patched Point Data set suggests that this site actually experienced its 4th lowest 24 month rainfall total in 113 years of records. This apparent discrepancy is associated with the need to interpolate rainfall data, when rainfall events can be very localised, and there can be errors in some individual data points which affect the analysis. However, most people who view rainfall percentile maps do not understand

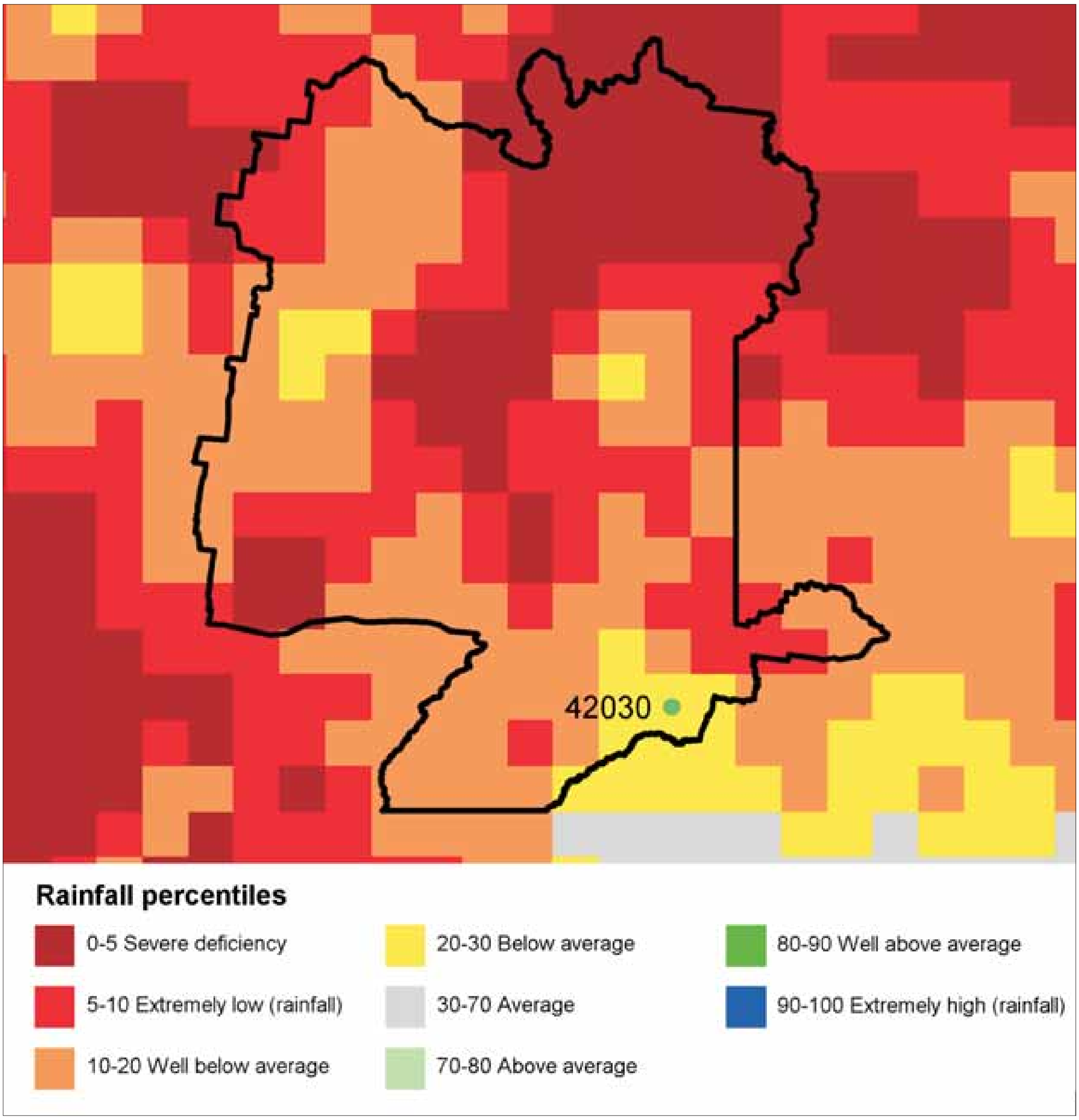

Figure 1. 24-month rainfall percentile map (January 2001 – December 2002). Produced by the Rainfall Wizard using gridded data supplied by the Bureau of Meteorology.

how the data is manipulated and the extent of the variation between simulated and real data. This lack of understanding has the potential to lead to incorrect conclusions being made about the extent of the rainfall deficiencies in particular areas.

The use of moving averages was another method used to show the extent and historical frequency of a rainfall deficiency at a particular site. Figure 2 shows a 24-month moving average graph for the site used in the above example. This type of figure had only a limited impact. One of the moving average's primary limitations is that it can only be done on periods that are multiples of 12 months. This is not a problem if the tool is used to provide context but it does limit its ability to analyse event periods. Another issue with moving averages is that the moving average line falls below the 5th percentile more frequently than once in every twenty years – i.e., there could be 10-20 similar events in the historical record. This generally causes confusion and makes interpretation difficult for people who do not fully understand how moving averages are produced.

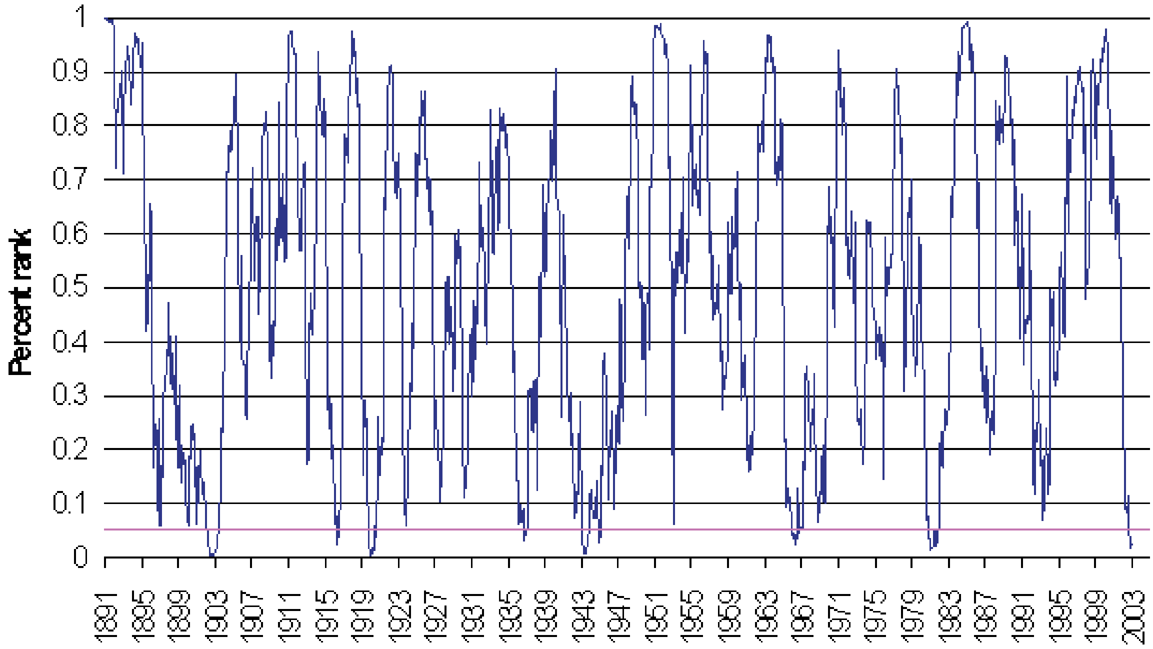

Figure 2. 24 month moving average. Produced using rainfall data from the SILO Patched Point Data Set for climate station 42030. Purple line represents the 5th percentile.

2. Climate Forecasts

The climate forecasts produced by BoM were very effective at providing an indication of how much rain might fall over the next three months (Figure 3). These maps were effective because they were simple; however - and perhaps because of their apparent simplicity - these maps have the potential to provide an unrealistic expectation that an area was definitely going to be drier or wetter over the upcoming period. This misunderstanding seemed to occur because people generally have a limited understanding of probability and how it is used in climate forecasting. Further, few people understood that the probabilities shown in the climate forecasts were limited by differing amounts of skill depending on the region and the timing of the forecast.

3. Modelling of Potential Plant Growth

The use of graphical demonstrations of plant growth was an effective way of showing the potential impact of a rainfall deficit (Figure 4). Figure 4 shows cumulative potential plant growth over three separate growing seasons for the same site as used in the above examples. In this example potential plant growth was calculated using GROWEST Plus. The plant growth curves shown are bounded by the percentile growth curves, conveying an impression of how the current season compares to all previous seasons on record. One of the primary strengths of this analysis is that it not only uses rainfall but also encompasses other climatic variables such as maximum and minimum temperature, solar radiation and evaporation.

While being an effective way to demonstrate the impact of the drought on plant growth, it is also important to understand the limitations of the GROWEST output. The limitations of the GROWEST model are that it does not account for current plant conditions and nor does it factor in such things as plant death, frost impact and management strategies. However, despite these limitations Figure 4 does show an integrated approach to using climate information that is easily understood by most people. Combining climate forecasts with the GROWEST output is the next logical step in presenting growth information.

In summary, the biggest challenge encountered in presenting information on the extent and severity of the drought was to provide clear and simple

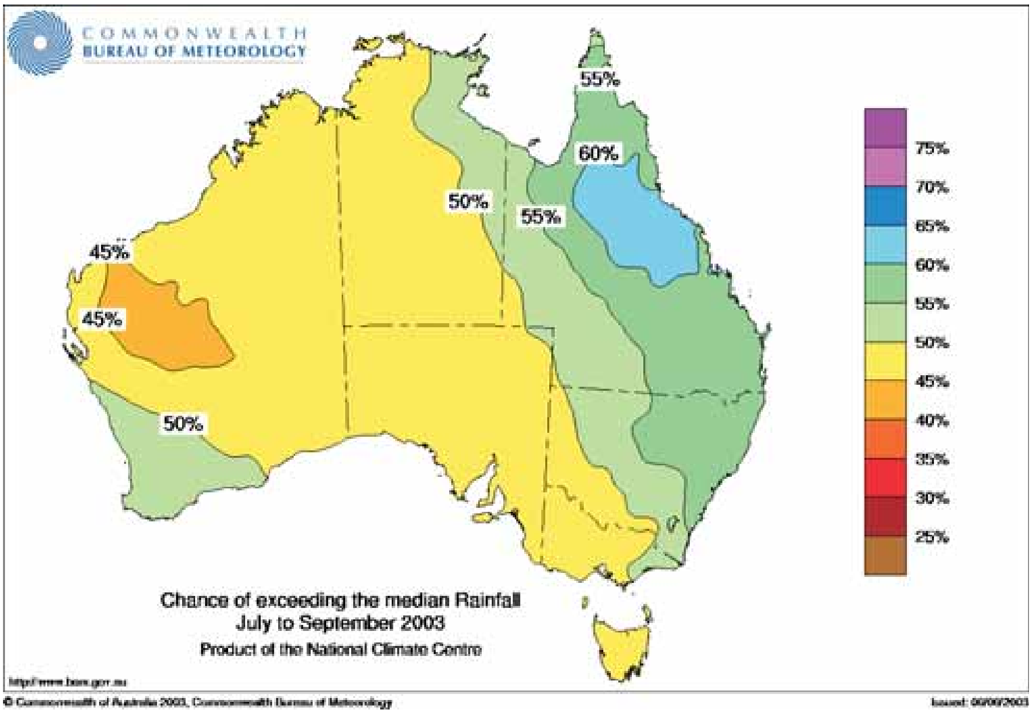

Figure 3. Sample three-month climate forecast. Produced by the Bureau of Meteorology.

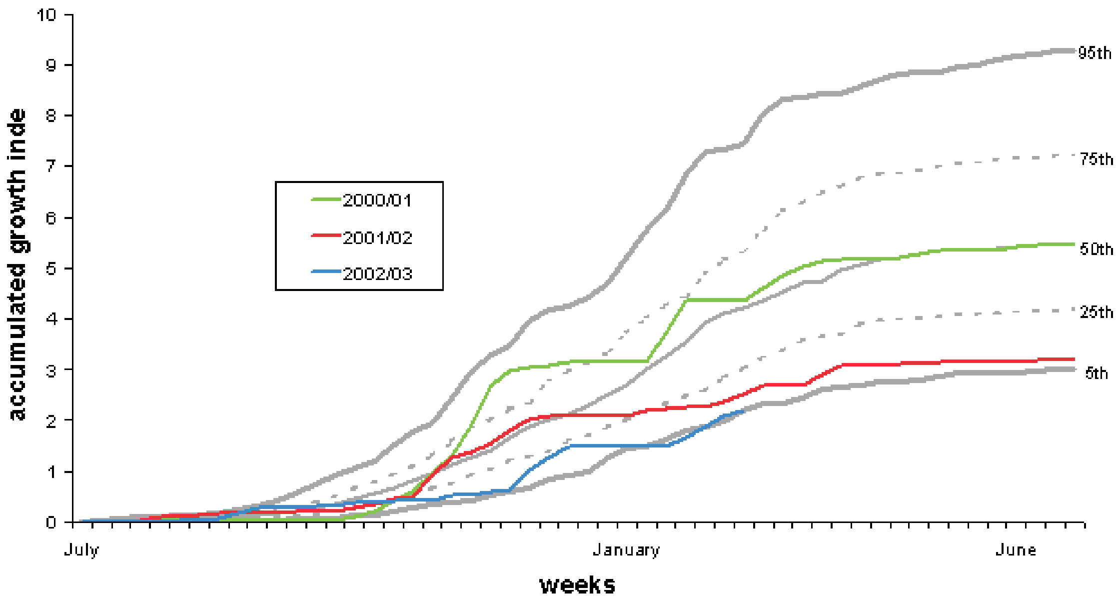

Figure 4. Potential accumulated growth index. Produced by GROWEST Plus using rainfall, temperature, evaporation and solar radiation data from the SILO Patch Point Data Set for climate station 42030. Coloured lines represent individual years and grey lines represent percentile limits for all years from 1900.

messages that included information on the limitations of the outputs produced. Without highlighting the limitations of the outputs produced, end users might misinterpret the information and form incorrect conclusions about the extent and severity of the drought in a particular region. Further, it became apparent during this drought that policy and decision makers are very focussed on the use of climate forecasts. The challenge from now on is to make these forecasts more accurate and more useful to end-users.