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The southern oscillation index and southern Australia

Paul Carberry

Advisory Officer Climatology, Extensive Industries Development, Tamworth

David George

Former Climate Workshop Facilitator

David Buckley

Former Climate Workshop Facilitator

When grazing and cropping conditions deteriorate, rural businesses become increasingly nervous. At times like these we wish we had a crystal ball. We begin reading forecasts and looking at the southern oscillation index (SOI) in the search for answers. But how accurate is the SOI, and does it really have a place in farm management in southern Australia?

What is the SOI?

The SOI measures the difference in air pressure between Darwin and Tahiti and is calculated daily. The difference is compared with the long-term normal difference, and is expressed as a number, which ranges from about –30 to +30. The daily figures are aggregated into a rolling 30-day average, and if the majority of the year has an SOI in the positive range, that year is said to be 'SOI positive'.

The SOI gives an indication of what is happening with the atmospheric circulation across the Pacific. When the SOI is positive, the trade winds typically blow strongly across the warm western Pacific Ocean and pick up plenty of moisture; this can then lead to rain over eastern Australia. In years with a positive SOI the rainfall is commonly above average. When the SOI is negative the trade winds are usually weakened, and the rainfall in eastern Australia will often be below average.

Unfortunately this indicator does not tell the whole picture; although the general relationships between SOI and rain are useful, there are many variables.

Is the SOI relevant in southern Australia?

While some of the rain that falls in southern Australia (southern WA, SA, Vic. and Tas.) arises not in the western Pacific, but from rain-bearing clouds that come from the southern oceans, or (occasionally) from north-west cloud bands arising in the tropical Indian Ocean, much of the moisture resulting in winter and spring rainfall comes from the equatorial Pacific. The SOI has a strong correlation during this winter spring period.

As a general rule, as you move progressively westwards across the Australian continent the correlation between the SOI and rainfall becomes weaker.

What is 'correlation'?

In mathematical terms, a 'correlation' is a measure of the linkage between two events.

If an event always occurs as a result of another event, then it has a correlation of one. If two events are completely random relative to each other they have a correlation of zero.

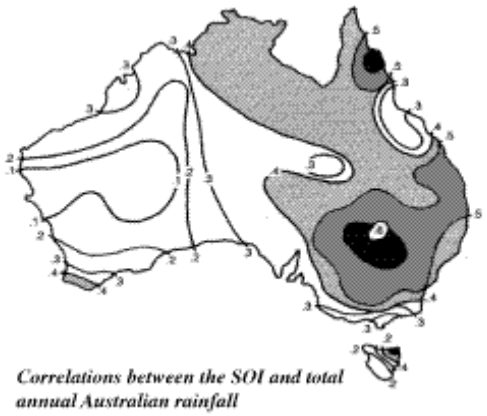

Figure 1.Correlations between the SOI and total annual rainfall for Australia.

Note the large variations, even on a broad scale. There are also local effects that may make your property have a different correlation, and, importantly, the correlations change from season to season through the year. If you want to use the SOI, you will need to find out the relationship between it and the rainfall at your place at important times of the year.

Correlations of less than 0.4 are usually considered to be very poor predictive tools. They are, however, better than tossing a coin, and as most farmers are in for the long haul the SOI may be useful over a longer period despite low correlations.

If you are in an area with a correlation of under 0.4, then less than 16% (0.4^2) of the variation in the rainfall can be explained by the SOI. For an area with a correlation of 0.2, only 4% (0.2^2) of the variation can be explained. As you can see, this is not particularly useful as a predictive tool.

Using the SOI can add a little to other predictive tools such as weather maps and forecasts, even if the correlations are not fabulous. In areas with low correlations (less than 0.4), it is important to temper the predictions of the SOI with the realisation that it is not particularly accurate in your particular district.

How do I use the SOI?

Having a financial and physical set-up that can cope with the inherent variability of the Australian climate is as important as having any predictive tool.

Like familiar biological systems, the weather is not static. This means that the SOI is also continuously changing and fluctuating. These small random changes are known as 'noise'. In order to try to eliminate some of this noise, the index is calculated using a moving 30-day average. However, the more noise you screen out, the more chance there is of missing real changes. For this reason it is a balancing act. To try to account for some of this noise but still see any changes, it is important to look at the trends in the SOI as well as the actual figures.

Fortunately, larger changes in the SOI will occur and will persist when associated with major changes in ocean temperatures. If the SOI becomes negative in autumn, this will not be significant in itself, but if it remains strongly negative into winter and spring and, at the same time, the ocean temperatures in the western Pacific are cooling, the change is likely to be highly significant. Similarly, a small negative value such as –3 is not as significant as –20.

Probably the easiest and best way to use the SOI is by looking at seasonal climate outlooks (where experts have analysed and considered the situation and published the chances of having a range of seasonal results) or by using a computer program called Australian Rainman®. The program comes with all the available records for your district and allows you to produce probabilities for which way the upcoming season could go, based on your district and its particular relationship to the SOI. The program also allows you to do a lot of other analyses of the climate in your district. You can even feed in your farm's own records.

When is the SOI most accurate?

As a rule, the spring, summer and winter SOI figures have a better relationship to the upcoming season than the autumn SOI.

Although your property may be in a region with a low annual correlation, the correlations for a particular season are likely to be stronger. For example, while your annual correlation may only be 0.4, the correlation between the winter SOI and spring rainfall may be 0.6. For this reason, you would give the SOI the most weight for decision making in winter, and very little weight for decisions at other times.

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Diagram courtesy Queensland Department of Primary Industries.

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