Using Self-Organising Maps to Examine the Rainfall Decline in the South-west of Western Australia

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1. Rainfall decline in the south-west

The south west of Western Australia has experienced a long-term decline in early winter rainfall. The decline has not been entirely smooth, with a step-drop towards consistently drier conditions occurring around the mid 1970s. This extended period without very wet winters has had major implications for the south-west, with a reduction in the water available for industrial, agricultural and domestic needs.

The cause(s) of the rainfall decline in south-west Western Australia are not thoroughly understood. A better understanding of the factors influencing the early winter rainfall decline will aid the policy decisions needed to manage south-west Western Australia's water needs into the future. Determining whether the winter rainfall decline is the result of either a decrease in the number of troughs affecting the area, an increase in the number of high pressure systems, a general shift in the type of synoptic systems bringing rain to the region, reduced rainfall totals falling from systems, or a combination of some or all of these factors, will offer clues to the future extent and duration of the rainfall decline.

2. Climatology of synoptic systems affecting the south-west

As part of the Indian Ocean Climate Initiative, methods to develop an understanding of how the synoptic systems have changed over the south-west, and what this change suggests for the rainfall decline, have been explored. One approach to help understand the changes in the synoptic systems before and after the mid 1970s is to produce a climatology of synoptic types and assess how the frequency of these types has changed. Historically there has been a great deal of interest in classifying synoptic types, and there have been many techniques used for clustering like situations into types. A modern method, based on artificial neural networks, is the Self-Organising Map (SOM).

There are a number of options when developing the SOM, including the size of the array of types, and the size of the spatial domain of the data. A domain ranging from 90 to 130˚E and 15 to 50˚S was found to capture the variability associated with systems affecting rainfall in the south-west. NCEP/NCAR reanalyses for June and July mean sea-level pressure (MSLP) were used to develop a SOM of 5x7 types. There has been a decrease in the frequency of types associated with anomalously wet conditions since the mid 1970s and an increase in dry types. Rainfall in the south-west is also known to be linked with upper level features, and the inclusion of data from higher levels in the development of the SOM will form the basis of further work.