Australian rainfall and the MJO

By Lexie Donald

The Madden Julian Oscillation (MJO) is a tropical atmospheric anomaly, which develops in the Indian Ocean and travels east through the tropics. With a timescale ranging from about 30 to 60 days, there are six to 12 MJO events per year.

In its active phase, the MJO is associated with increased convective activity. While the MJO has been known to exist for a long while, its effects had been considered to be confined to the tropics. But there was some anecdotal evidence that its influence extended further afield.

So a project team led by the Queensland DPI in collaboration with the Bureau of meteorology and the University of Southern Queensland is currently investigating how the MJO affects our weather and how MJO information could be used to improve forecasting accuracy.

The project investigates the geographical extent and timing of the influence of the MJO on rainfall in Australia. An index (the RMM index) developed by the Australian Bureau of Meteorology Research Centre (BMRC) was used in the statistical analysis.

This index defines eight different phases for the MJO, beginning with Phase 1 off the Indian Ocean coast of Africa, through to Phase 8 in the Pacific before it fades out (see Figure 1).

WATCHING THE MJO WAVE

The MJO can be considered as a pulse or a wave which travels from Phase 1 to Phase 8 every 30 to 60 days — it used to be called the 40 day wave.

As the wave passes, there is an obvious increase in convective activity — storms, cyclones or monsoons — in the tropics. But the effects in other latitudes are not as obvious.

We compared the position (phase) of the MJO with rainfall records at several hundred sites around Australia. If the mean daily rainfall at a location was significantly higher than normal, it was considered to be enhanced — shown as a blue dot on the maps. If the daily rainfall was significantly lower than average, it was considered to be suppressed — shown as a red dot.

We found that the MJO does indeed have a significant impact on rainfall in Australia. And the effect reaches far beyond the tropics — as far south as Tasmania.

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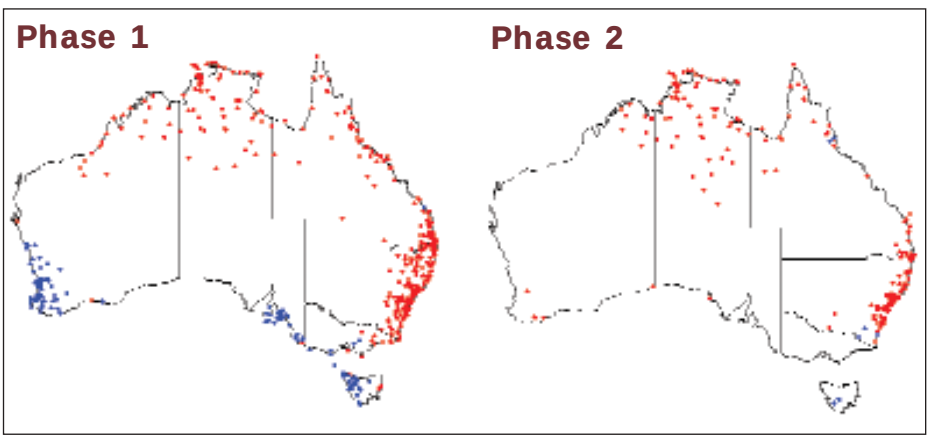
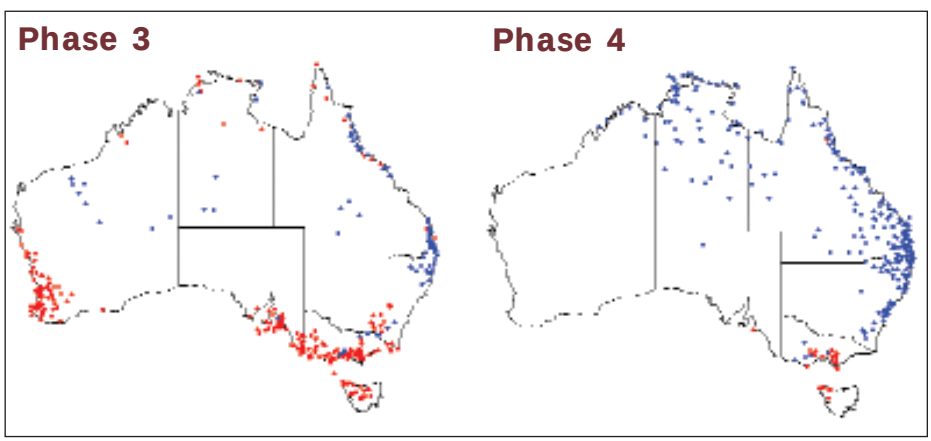
FIGURE 1: The RMM Index allows us to divide the evolution of the MJO into 8 phases, each corresponding with the geographical location of the active phase of the MJO

Phase 1 includes signals both from the initiation of an MJO event in the western Indian Ocean basin, and the breakdown of MJO events in the mid-Pacific Ocean



Suppression is experienced across the continent during phases 1 and 2, but with some rainfall to be expected along the south western coasts (Western Australia, South Australia, Victoria and Tasmania).



During MJO phase 3, south western coastal areas may experience rainfall suppression. The north eastern coastal areas (Queensland) experience an enhanced probability of rainfall, which increases to include the NT, Queensland and eastern NSW in MJO phase 4.

The precise physical reasons for the connection between MJO events and Australian rainfall have not yet been established.

A website is being designed to present the maps shown in this article, and to assist users with MJO observations and predictions. An application is before Land and Water Australia for further funding to clarify the correlations between rain and the MJO, and to investigate any link between temperature and other synoptic factors, and the MJO.

Synoptic factors need to be taken into account when applying MJO information to forecast precipitation. Future work may include development of a forecasting system that is capable of combining synoptic weather predictions.

It seems that the MJO requires a suitable synoptic situation to produce its potential influence on our rainfall. Combining MJO information with medium range forecasting models could produce much more accurate forecasts.

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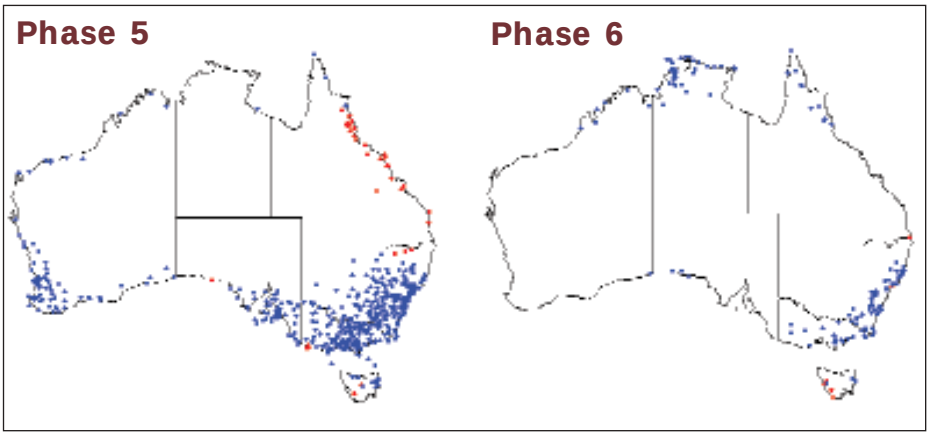
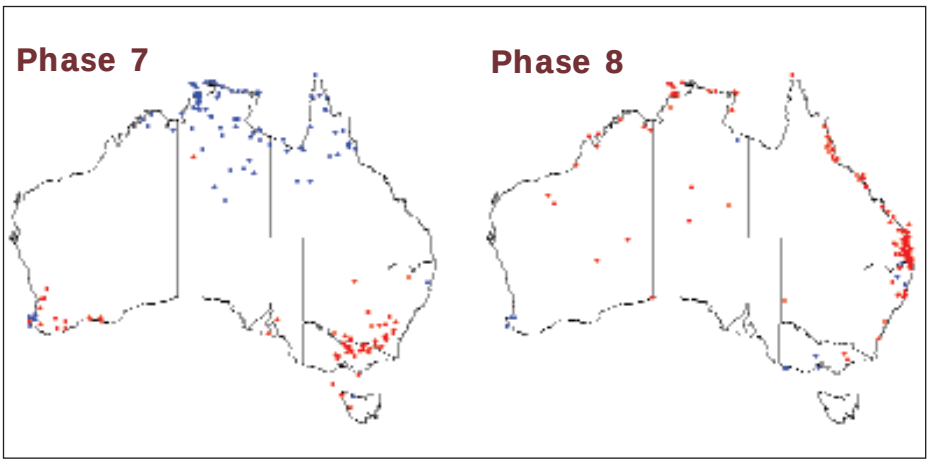
Especially with reference to the maps, it is important to understand that the results are from research in progress, which has not been externally peer reviewed (an important scientific process).



By phase 5 the eastern coast of Queensland is experiencing suppression associated post MJO-passage, while the enhanced rainfall area has reached southern Australia, which is refined to the extreme north and south of the continent by phase 6.



Phase 7 sees suppression throughout the south, with a very scattered enhancement pattern over the north of Australia. The impact appears to be breaking up by phase 8, with a scattered rainfall suppression effect across the continent.

THE MJO AT WORK

The passage of the MJO seems to have coincided with some good rain events over the past summer. The satellite photo shows the situation in early February, with the MJO in Phase 4 and cloud associated with a significant rain event in Queensland and northern NSW. (February 2, 2004. Satellite Pic courtesy of Dundee Receiving Station.