On-Farm Water Management and the Madden-Julian Oscillation

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Abstract

The Madden Julian Oscillation (MJO) is a tropical atmospheric phenomenon, which, develops over the Indian Ocean and travels eastward through the tropics. With a timescale ranging from 30 to 60 days, the MJO has a frequency of 6 to 12 events per year. The active phase of an MJO event is associated with increased tropical convective activity. Following active convection is a region characterised by westerly wind bursts. Statistical evidence (Kolmogorov-Smirnov distance) confirms that the tropical passage of the MJO correlates with periods of enhanced and suppressed rainfall states in higher latitudes. In this paper we show the impact of the passage of the MJO on the timing and amount of rainfall, with respect the Real-Time Multivariate MJO (RMM) Index. We also examine the potential for on-farm risk management made possible due to the temporal scale of the MJO, which bridges the gap between synoptic weather forecasting and current seasonal climate forecasting.

Key Words

Madden-Julian Oscillation, climate, intra-seasonal forecasting.

Introduction

The Madden Julian Oscillation is a tropical atmospheric perturbation. It is initiated over the western Indian Ocean as an active convective regime that moves east at around 5-10 m/s. Convection is dried out around the mid Pacific Ocean, after the MJO has attained speeds of up to 15 m/s and the influence on eastern hemisphere rainfall has deteriorated. It then has an average periodicity of around 40days. The MJO has a temporal scale of 40 days on average . The Real Time Multivariate MJO Index (Wheeler and Hendon, 2004) is an objective method of determining the location and relative strength of MJO convection, and divides the passage of the convective regime into 8 phases. Using the RMM Index as an MJO proxy we have linked the equatorial passage with the timing of rainfall in Australia (Donald et al, 2006). Having established causative patterns of rainfall enhancement and suppression we investigated the magnitude of these rainfall anomalies.

The temporal scale of the MJO sits at the interface of weather and climate forecasting, when many rural tactical decisions are made. The timing of ground preparation, planting, spraying, irrigation and harvesting can all be influenced by in-crop rainfall events. Forecasting of enhanced and suppressed rainfall events using MJO information is an alternative for agribusinesses to fine tune their tactical action plans. Farmers can access this MJO information at http://www.apsru.gov.au/mjo/index.asp

Methods

Methods for determining patterns of rainfall enhancement and suppression were described in Donald et al,(2006), with data up to and including July 2006. Rainfall anomalies were determined by calculating median rainfall for point or grid data, and determination of the mm/ RMM Index Phase rainfall anomaly.

Results

Maps quantify the impact of the MJO on rainfall timing and amount for a selection of Australian summer and winter RMM Phases 1-8. Such information can impact on a wide range of decisions – from

scheduling harvest operations, to pest and disease management, to cattle marketing and agistment. Use of these maps might constitute a potentially valuable tool for improved farm-scale water use efficiency, as they take account of the passage of the MJO for irrigation management. In regions that show a demonstrable MJO impact, scheduling irrigation after the expected passage of the MJO could allow strategic adjustment of the amount of irrigation applied. While the economic and environmental impacts of such tactical adjustments may differ from region to region and from season to season, use of the MJO can be considered a 'no-regret' precautionary approach.

Conclusion

The MJO impacts on the timing of rainfall in most of Australia's cropping and grain growing regions. Improved information on the intra-seasonal timing of rainfall will allow rural land and water managers to make tactical water management decisions, based on information about the probable timing and scale of rainfall events. Many water related decisions are planned beyond the time scale of synoptic forecasting (up to 10 days), but within the season. Intra-seasonal changes in pre-crop, in-crop and harvesting rainfall suppression and enhancement events require planning to adopt appropriate measures/ counter-measures. Better knowledge of MJO affected rainfall provides a means to fill the information gap between weather and climate forecasts required for such a scale of temporal planning. A Land and Water Managing Climate Variability-funded project is in the process of providing operational MJO-based forecasts as part of the services provided by the Commonwealth Bureau of Meteorology. The project uses the tropical grazing industry as a case-study to refine the information and present it in a way most suitable for rural practitioners.

References

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