MJO readings for task 3

# Wheeler and Hendon 2004: An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction

**Abstract**

* MJO along equator independent of season
* Applications of Real-time Multivariate MJO (RMM) series to monitor MJO investigated, e.g. through relationship with onset dates of monsoons in Australia and India – normally occur on enhanced phase of MJO and rarely on suppressed.

**Intro**

* MJO empirical prediciton skillful up to 20 days.
* Paper describes development of index for MJO monitoring at the BOM.
* Empirical Orthogonal Functions (EOF) representation of MJO is OLR (long-wave radiation, 850-hPa and 200-hPa zonal wind).

**Method main point**

* Baroclinic, convectively driven circulation in equatorial plane of MJO captured using OLR and zonal winds in upper and lower troposphere.

**Applications to synoptic weather**

* RMM index developed with motivation of application of potential use in statistical prediction of associated MJO weather effects
* Aspects of MJO's associated weather effects:
* Monsoon onsets
* Probabilities of extreme weekly rainfall’

**Motivation**

* Study motivated by need to monitor and predict MJO in real time.

# <http://envam1.env.uea.ac.uk/mjo.html>

**Introduction to MJO**

* Intraseasonal time scale, month-to-month variability
* 30-60 day oscillation
* Important to forecast accurately as it affects weather and climate!

**MJO rainfall cycle**

* MJO features E-ward propagation of rainfall over ‘warm pool’ region from Indian Ocean to Western Pacific.
* The RMM index by Wheeler and Hendon (see above) is now accepted standard definition – 8 phases
* Each phase is 1/8 full cycle
* Phases for each cycle
* P1 – Enhanced rainfall develops over Western Indian Ocean
* P2-3 – Enhanced rainfall moves slowly eastward over Indian Ocean
* P4 – Enhanced rainfall reaches MC
* P6-8 – Enhanced rainfall propagates Eastward further over Western Pacific, eventually dying out in Central Pacific
* Behind region of enhanced rainfall is a region of suppressed rainfall
* E.g. MJO P6 enhanced over Western Pacific, suppressed Indian Ocean
* P2 – Enhanced over Indian Ocean, suppressed in W Pacific (opposite)

**Calculating MJO and rainfall**

* CMAP – low resolution coarse satellite measurement
* TRMM – higher resolution satellite measurement

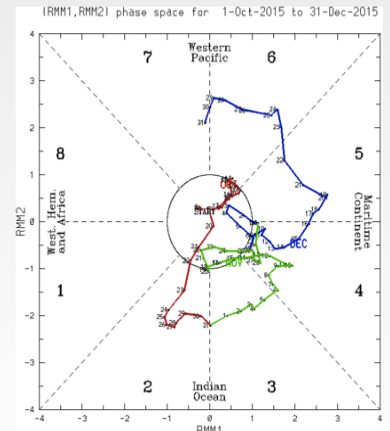
**MJO tropical dynamics**

* In addition to strongly modulating rainfall in tropics, MJO has a clear cycle with sea-level pressure
* Negative pressure anomalies (low) = enhanced rainfall – associated with Kelvin Wave and Rossby Wave anomalies (Kelvin – Rossby)
* Positive = suppressed
* Affects monsoon onset in tropics

**MJO oceans – warm SST = high rainfall, cool SST = low rainfall**

# <http://www.bom.gov.au/climate/mjo/#tabs=Average-conditions> - MJO phase defined Australia

* MJO phase 4-5 enhanced convection also in Australia
* More OLR = drier, less OLR = more convection

Here is a 2015 OND example – further away from circle means stronger MJO in that phase. So here, the blue line shows a strong phase 4-5 for convection!

# Birch et. al 2016 Fig 11

* Coastal definition within 120km of coast land!
* Sea breeze strongest in enhanced rainfall phase – 5!