



Madden-Julian Oscillation: Recent Evolution, Current Status and Predictions

**Update prepared by
Climate Prediction Center / NCEP
March 16, 2009**



Outline

- **Overview**
- **Recent Evolution and Current Conditions**
- **MJO Index Information**
- **MJO Index Forecasts**
- **MJO Composites**



Overview

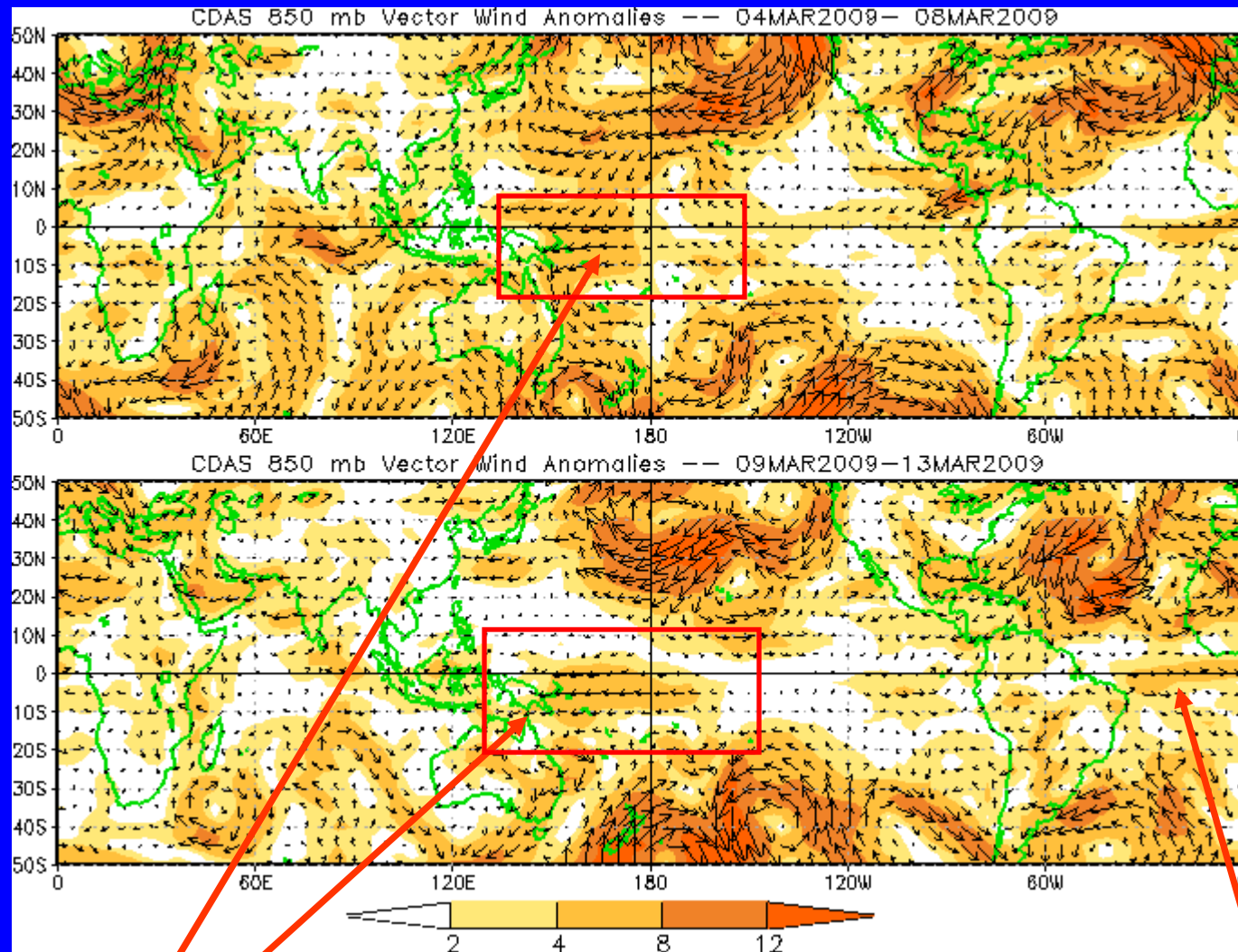
- **The MJO is incoherent.**
- **Convection remains somewhat disorganized across the Maritime Continent.**
- **The MJO is expected to remain incoherent or weak for at least the next week. Some MJO forecasts indicate a strengthening MJO signal during Week 2 but uncertainty in development is very high at this time.**
- **At the current time, the MJO is not expected to contribute significantly to impacts across the global tropics and US and the pattern of tropical convection is anticipated to be more closely related to La Nina.**

Additional potential impacts across the global tropics are available at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/ghaz.shtml>



850-hPa Vector Wind Anomalies (m s^{-1})

Note that shading denotes the magnitude of anomalous wind vectors



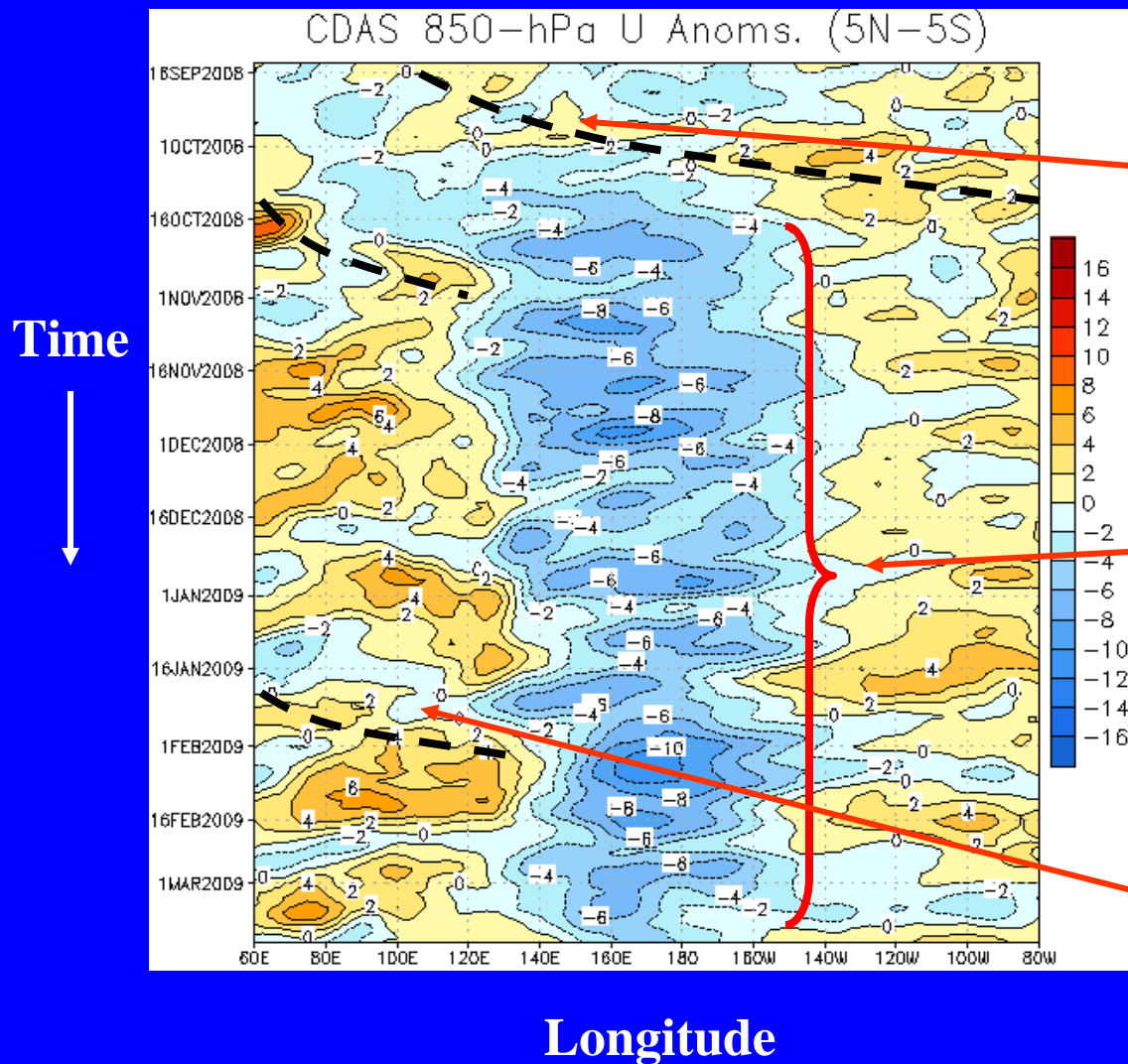
Easterly anomalies continue across the equatorial western and central Pacific but have weakened.

Westerly anomalies over the Atlantic Ocean have increased.



850-hPa Zonal Wind Anomalies (m s^{-1})

Westerly anomalies (orange/red shading) represent anomalous west-to-east flow
Easterly anomalies (blue shading) represent anomalous east-to-west flow



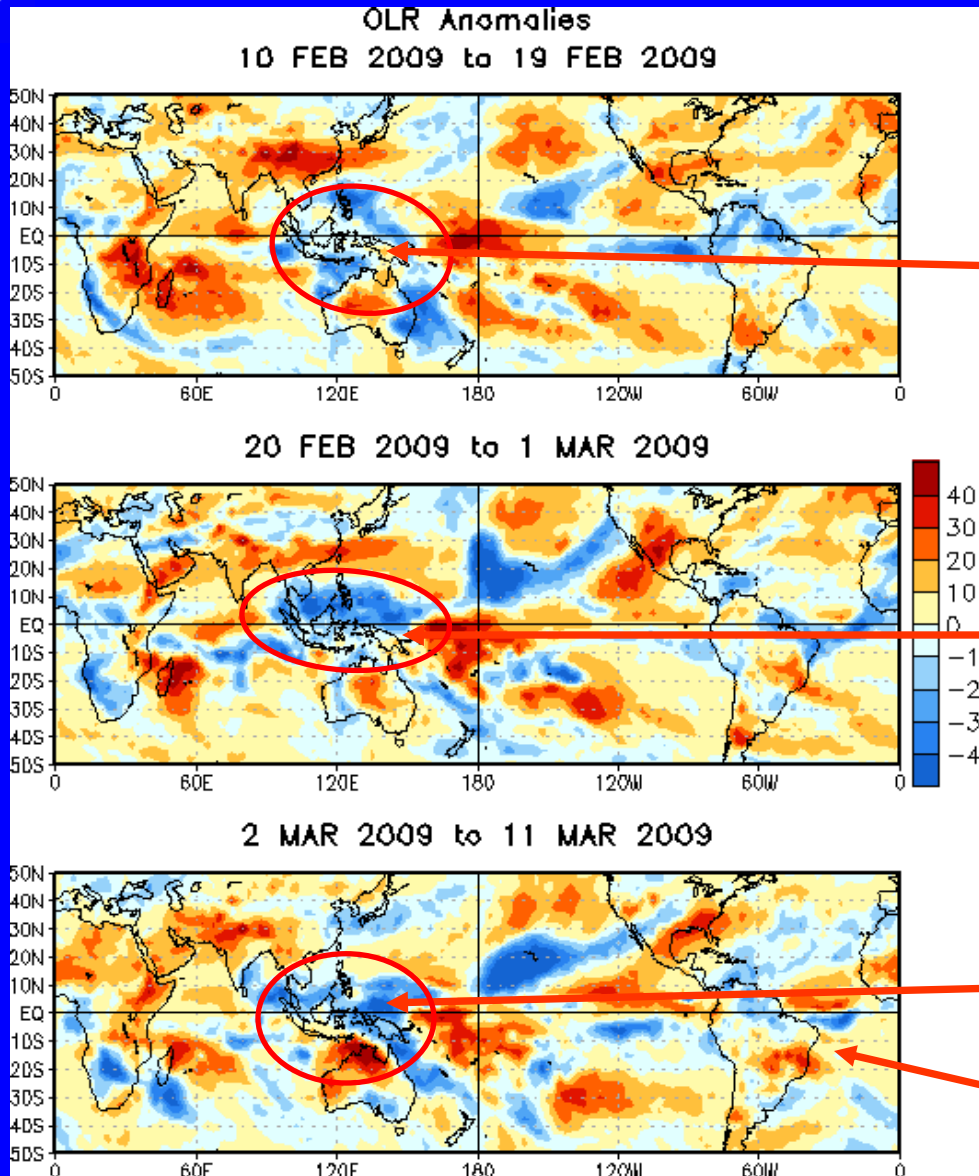
Beginning in September, anomalous westerlies associated with the MJO shifted from the Indian Ocean across the Pacific.

A persistent pattern of westerly (easterly) anomalies stretching from the Indian Ocean to the central Pacific Ocean has been in place since October with a few breaks in late December and mid-January.

The decrease in westerly anomalies in mid-January was associated with MJO activity.



OLR Anomalies: Last 30 days



Drier-than-normal conditions, positive OLR anomalies (yellow/red shading)

Wetter-than-normal conditions, negative OLR anomalies (blue shading)

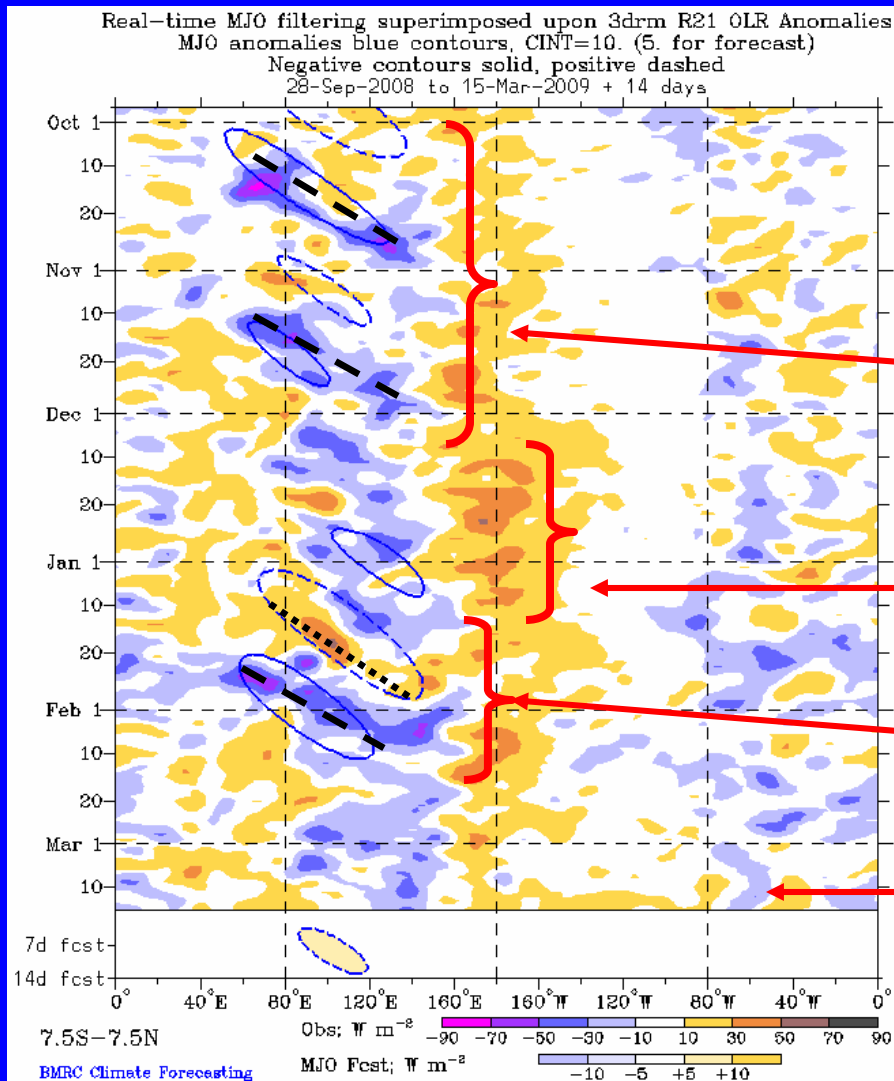
During mid-February enhanced convection was observed over the waters surrounding the Maritime Continent.

During late February, convection strengthened across the northern Maritime continent and parts of the western Pacific.

Convection has remained active during early March across the Maritime Continent while dry conditions are evident for parts of Brazil and Northern Australia.



Outgoing Longwave Radiation (OLR) Anomalies (7.5°S-7.5°N)



Drier-than-normal conditions, positive OLR anomalies (yellow/red shading)

Wetter-than-normal conditions, negative OLR anomalies (blue shading)

(Courtesy of the Bureau of Meteorology - Australia)

Moderate MJO activity was most evident from late August to mid-November as enhanced (suppressed) convection developed across the Indian Ocean and shifted eastward during the period.

In December and January, anomalous convection was generally stationary and consistent with La Nina conditions.

From mid-January to mid-February, eastward movement of suppressed (enhanced) convection is observed from the Indian Ocean to portions of Indonesia and the western Pacific.

Recently, convection has been closer to average across much of the equatorial tropics.

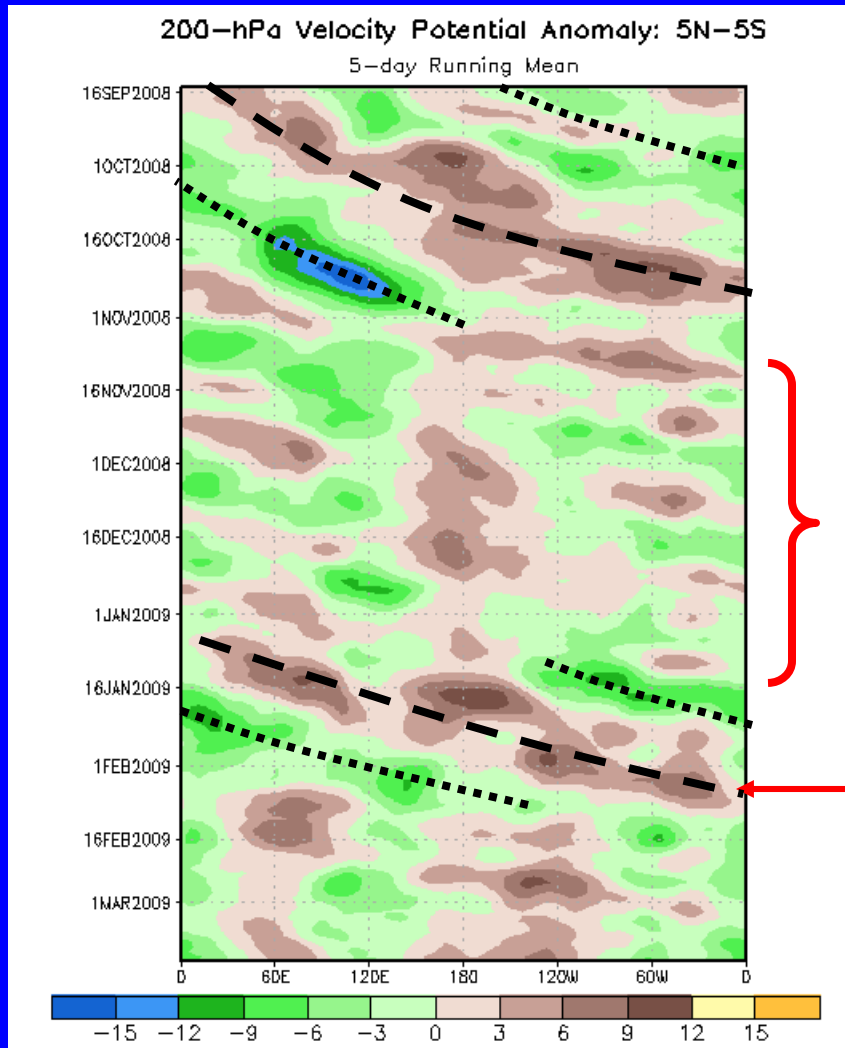


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time



Longitude

The MJO strengthened in early September and eastward propagation was observed from September through October.

From mid-November to mid-January, the subseasonal activity organized on a faster time scale and the MJO was weak or incoherent.

Velocity potential anomalies increased as the MJO strengthened and shifted eastward during January to mid-February.

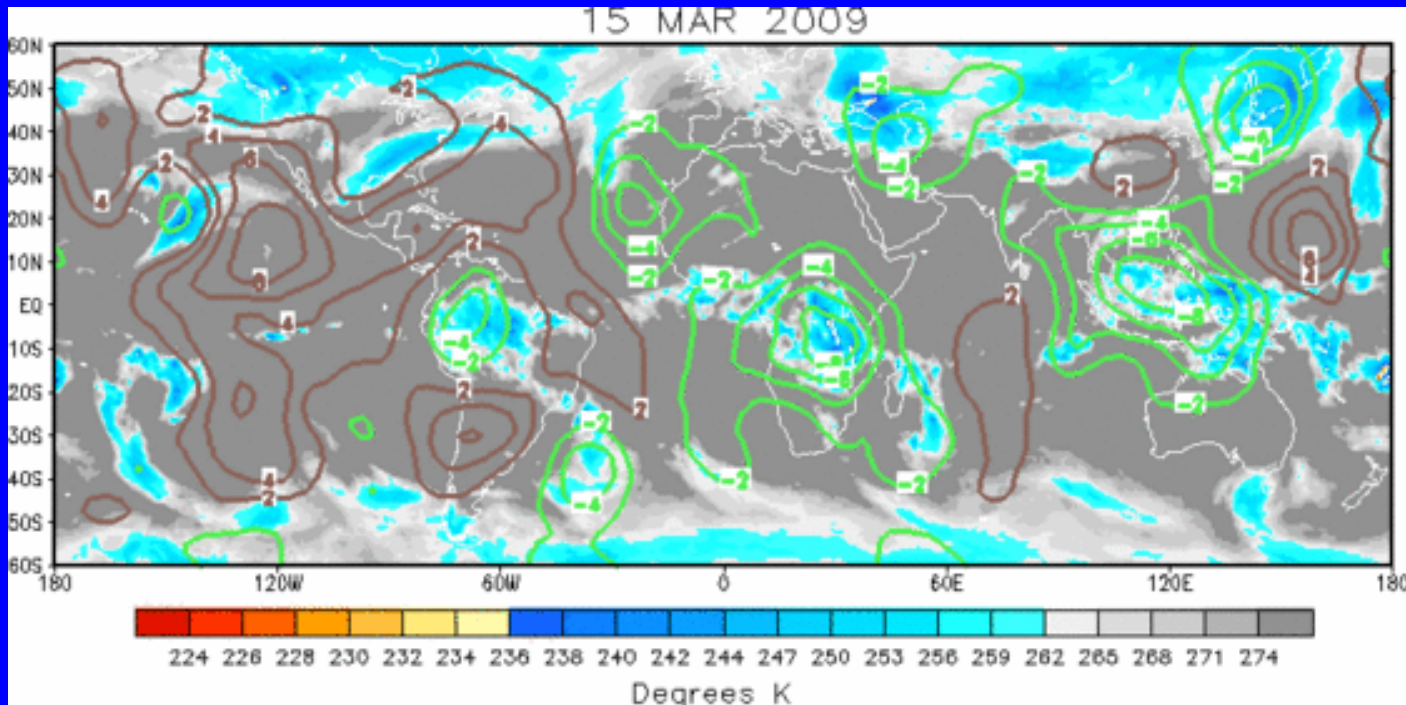
Recently, the velocity potential anomalies have become more incoherent.



IR Temperatures (K) / 200-hPa Velocity Potential Anomalies

Positive anomalies (brown contours) indicate unfavorable conditions for precipitation

Negative anomalies (green contours) indicate favorable conditions for precipitation

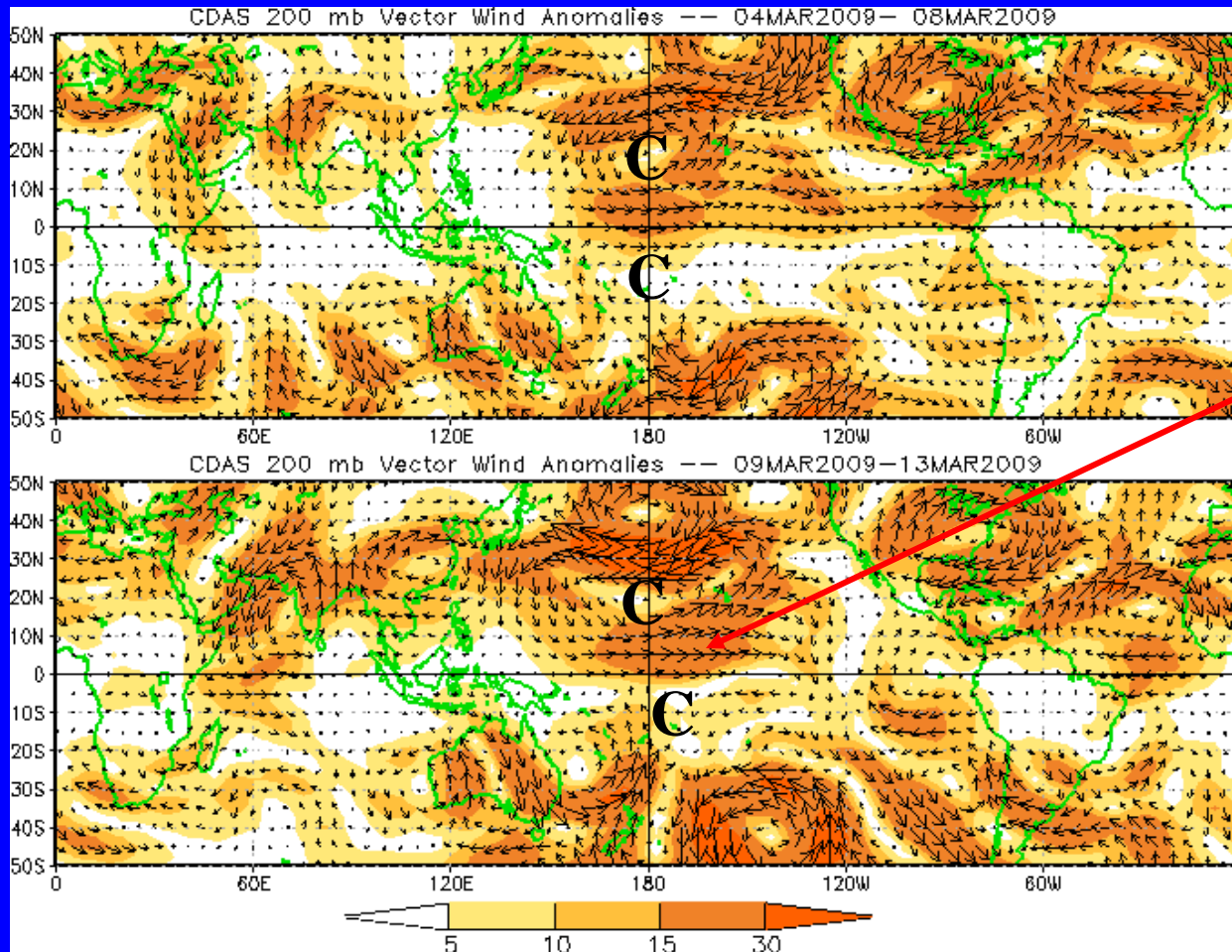


The velocity potential spatial pattern is not coherent and is dominated by more regional anomalies.



200-hPa Vector Wind Anomalies (m s^{-1})

Note that shading denotes the magnitude of anomalous wind vectors

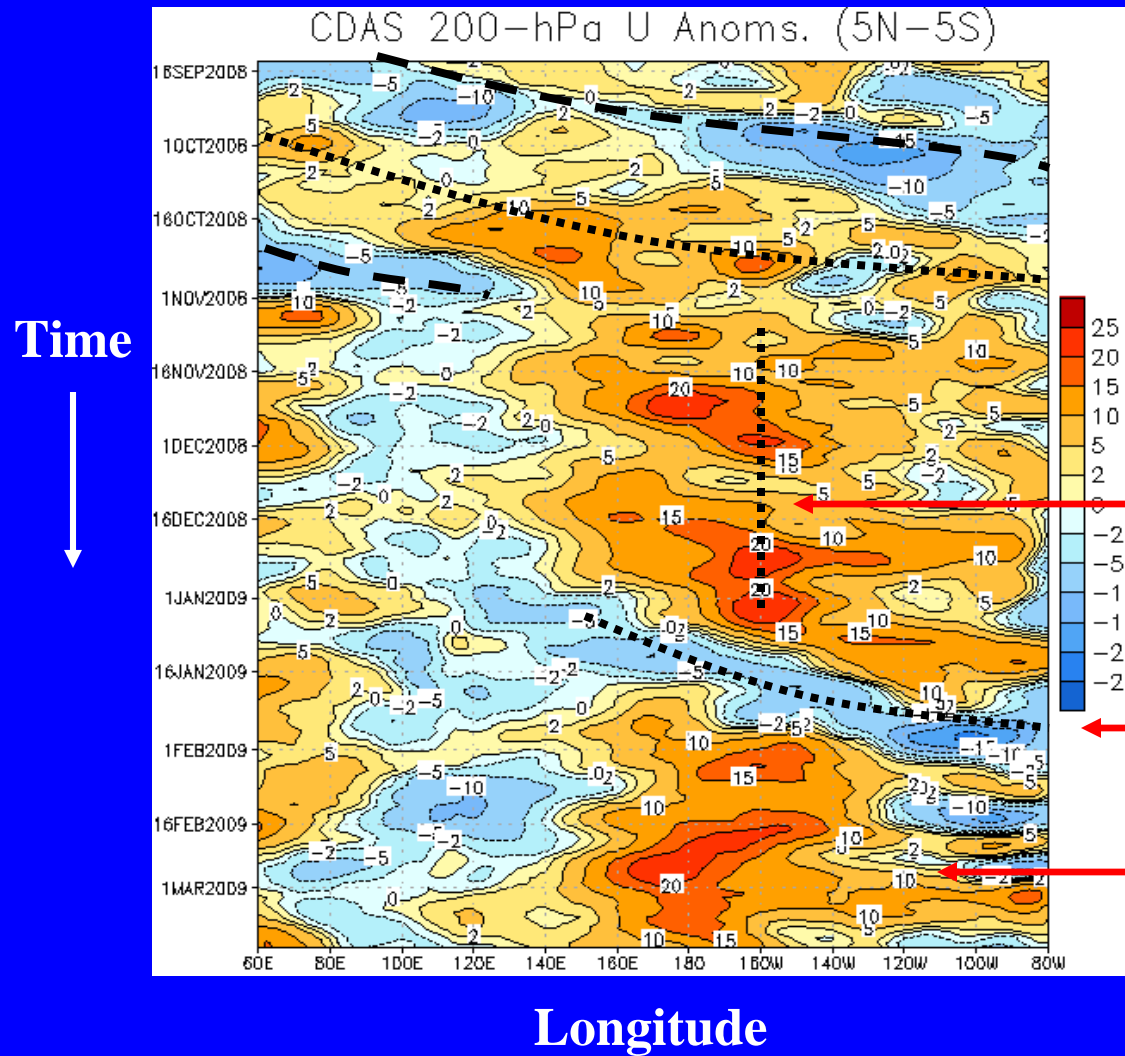


Westerly anomalies have remained nearly stationary over the equatorial central Pacific Ocean.

Cyclonic (C) circulations are evident north and south of the equator across the central Pacific.



200-hPa Zonal Wind Anomalies (m s^{-1})



Westerly anomalies (orange/red shading) represent anomalous west-to-east flow

Easterly anomalies (blue shading) represent anomalous east-to-west flow

Westerly and easterly anomalies associated with the MJO activity shifted eastward during September and October.

Westerly anomalies strengthened markedly in mid-November near the Date Line and persisted through December. These anomalies are consistent with La Nina conditions.

Eastward propagation is evident during January associated with the most recent MJO activity.

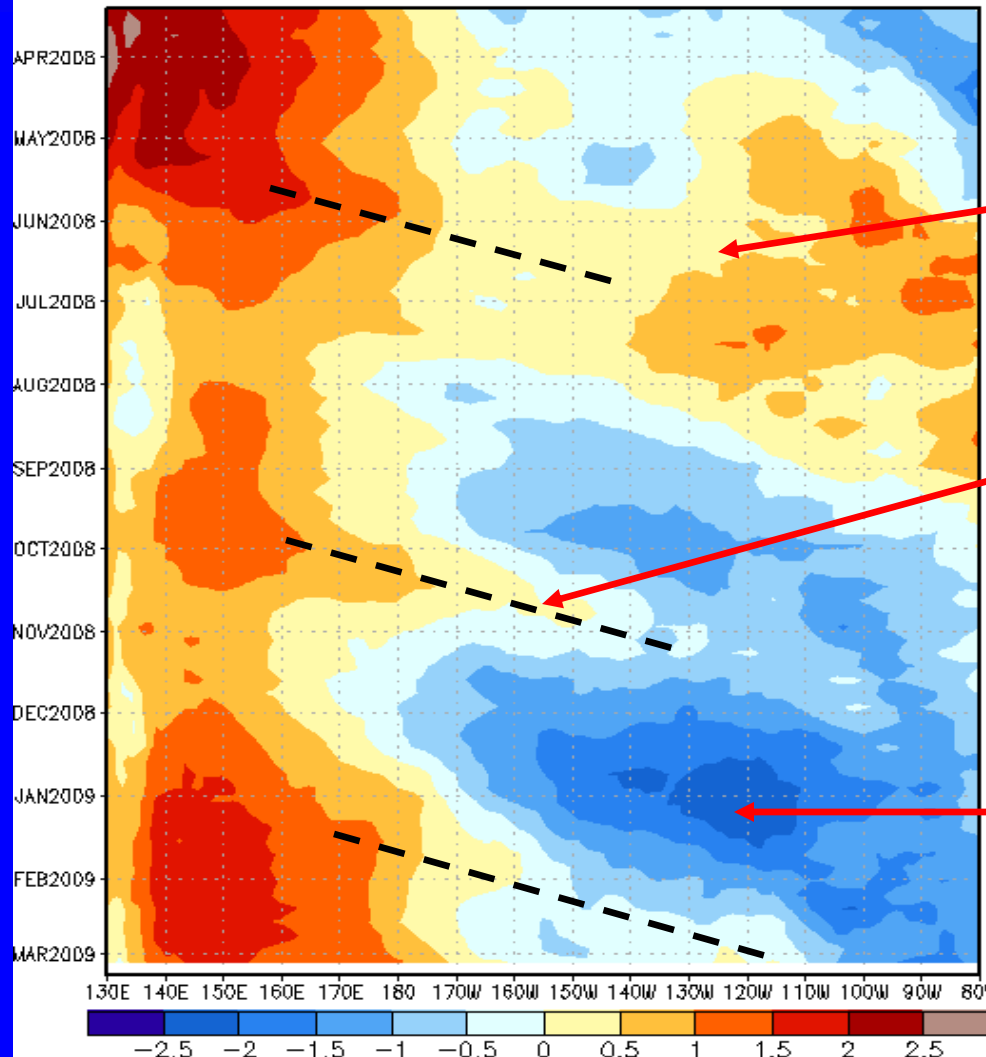
Westerly anomalies strengthened over the central Pacific during mid-February.



Weekly Heat Content Evolution in the Equatorial Pacific

EQ. Upper-Ocean Heat Anoms. (deg C)

Time
↓



During June and July 2008, positive heat content anomalies encompassed much of the Pacific basin.

During August 2008, negative anomalies started to develop east of the Date Line and have increased and expanded eastward. There was a pause in this increase during October as a Kelvin wave shifted eastward.

During November 2008 – January 2009, negative anomalies increased across the Pacific but became less negative during February.

Longitude



MJO Index -- Information

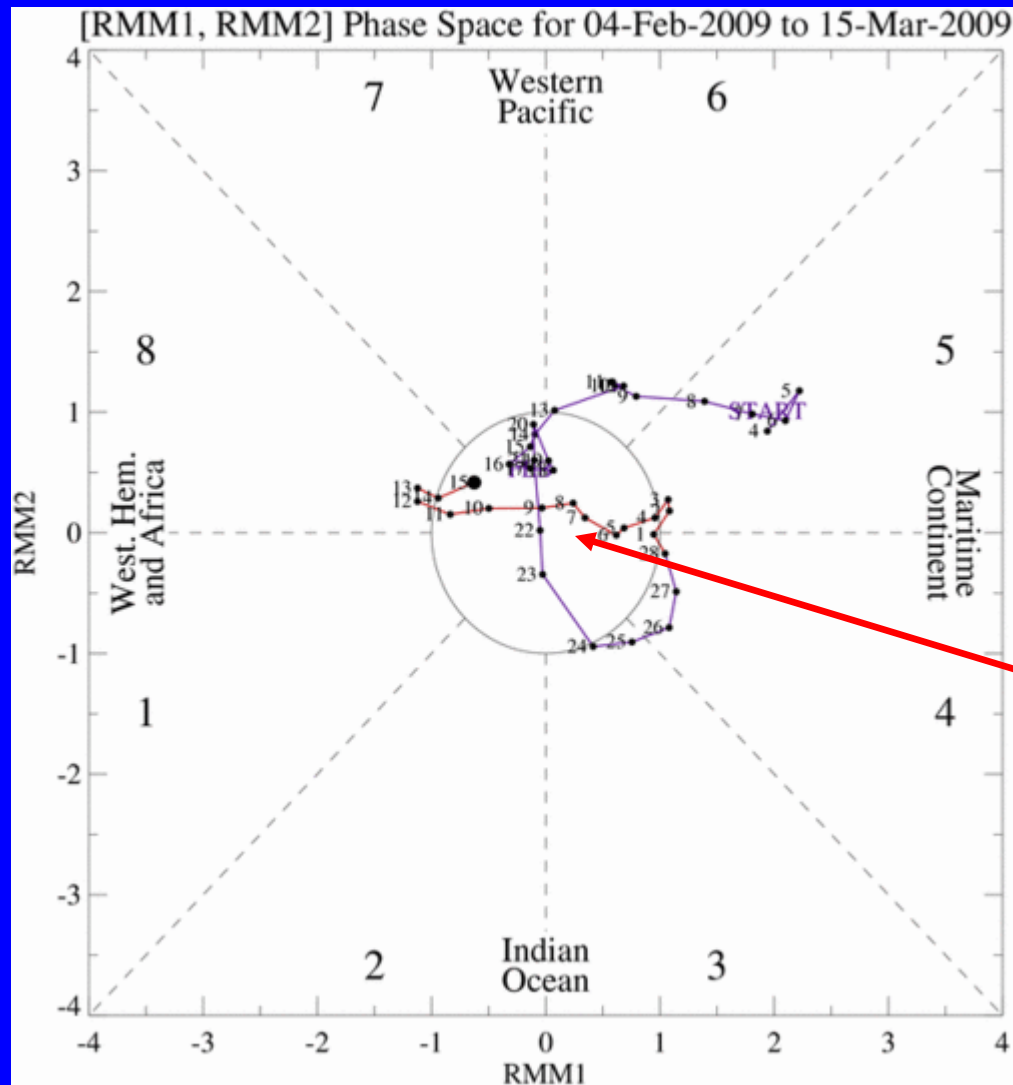
- The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).

Wheeler M. and H. Hendon, 2004: An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction, *Monthly Weather Review*, 132, 1917-1932.

- The methodology is nearly identical to that described in WH2004 but small deviations from the BMRC figure are possible at times due to differences in input data and methodology. These typically occur during weak MJO periods.
- The index is based on a combined Empirical Orthogonal Function (EOF) analysis using fields of near-equatorially-averaged 850-hPa and 200-hPa zonal wind and outgoing longwave radiation (OLR).



MJO Index -- Recent Evolution

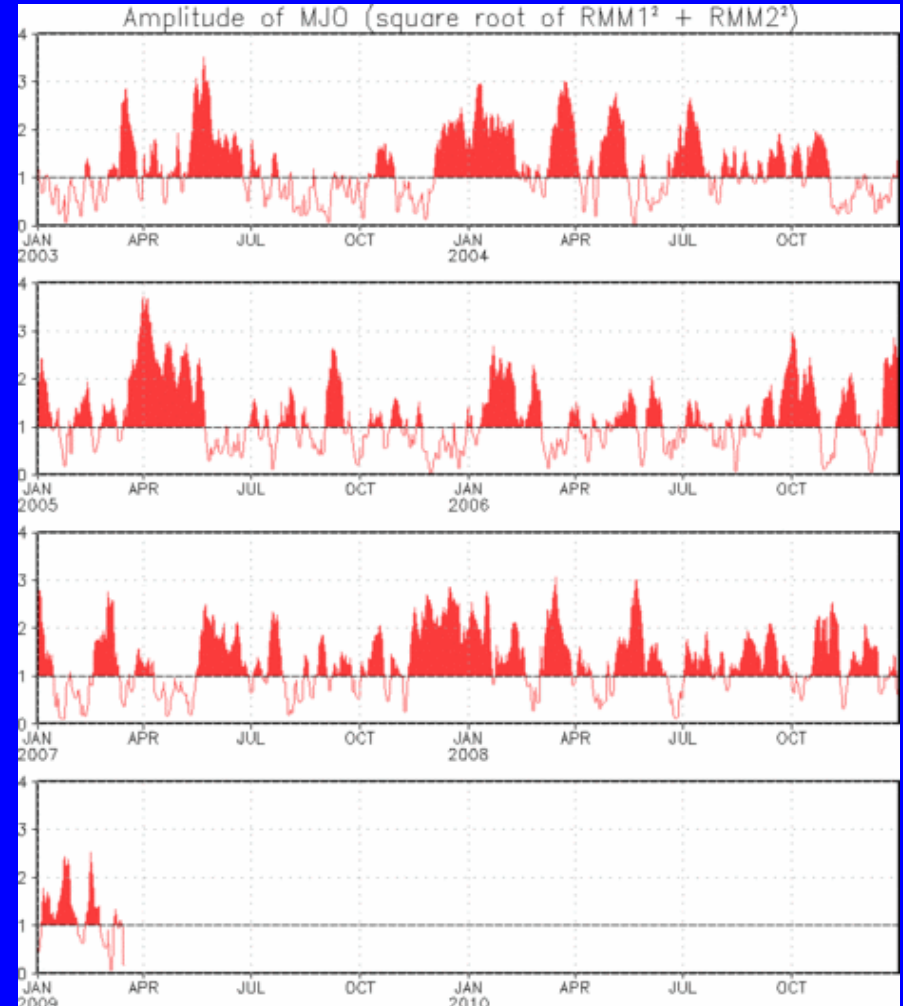
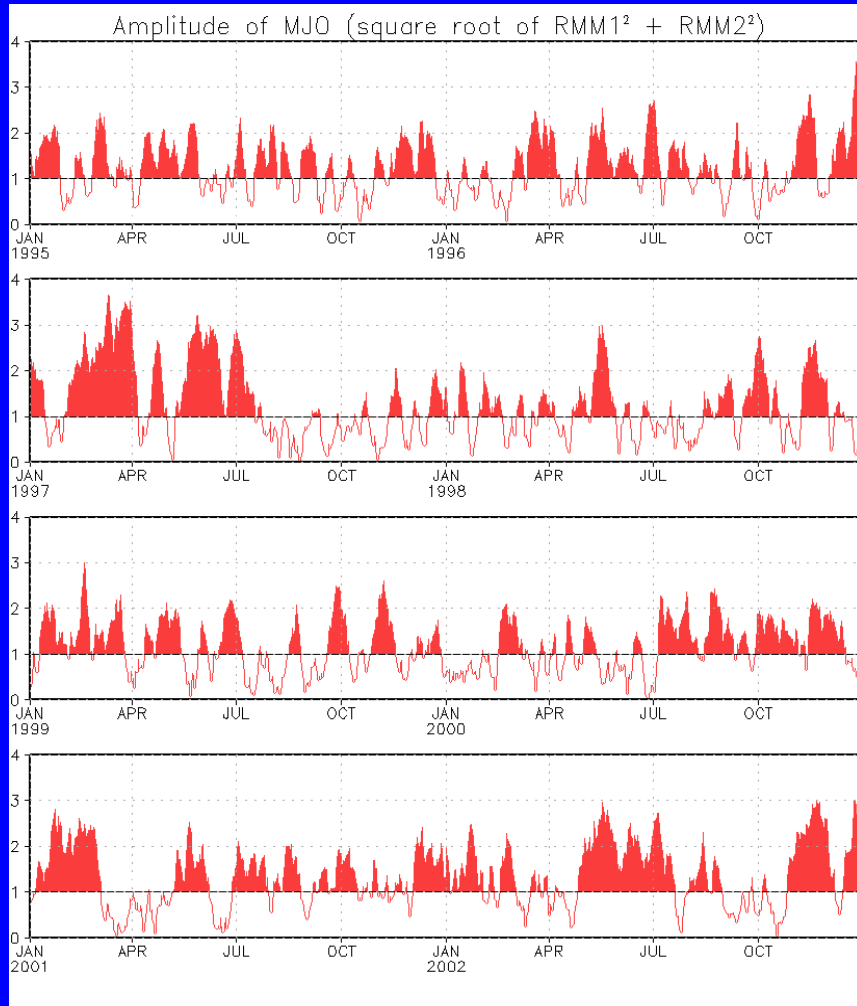


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the origin is proportional to MJO strength
- Line colors distinguish different months

The MJO index briefly increased in amplitude during late February but during March the MJO amplitude has remained weak.



MJO Index – Historical Daily Time Series



**Time series of daily MJO index amplitude from 1995 to present.
Plots put current MJO activity in historical context.**



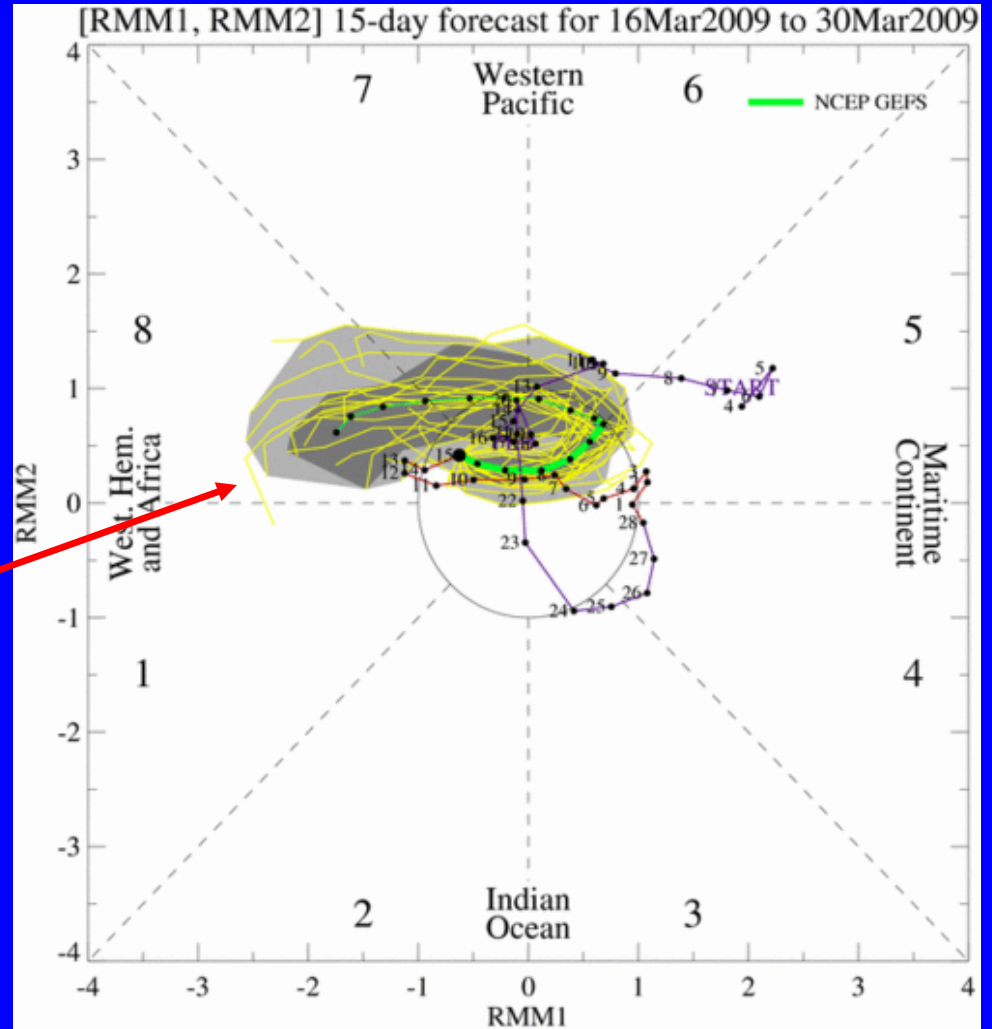
Ensemble GFS (GEFS) MJO Forecast

Yellow Lines – 20 Individual Members
Green Line – Ensemble Mean

RMM1 and RMM2 values for the most recent 40 days and forecasts from the ensemble Global Forecast System (GEFS) for the next 15 days

light gray shading: 90% of forecasts
dark gray shading: 50% of forecasts

The GEFS forecasts predict weak MJO activity during the Week 1 period. A strengthening MJO signal is forecast, however, during Week 2 and this needs to be closely monitored.

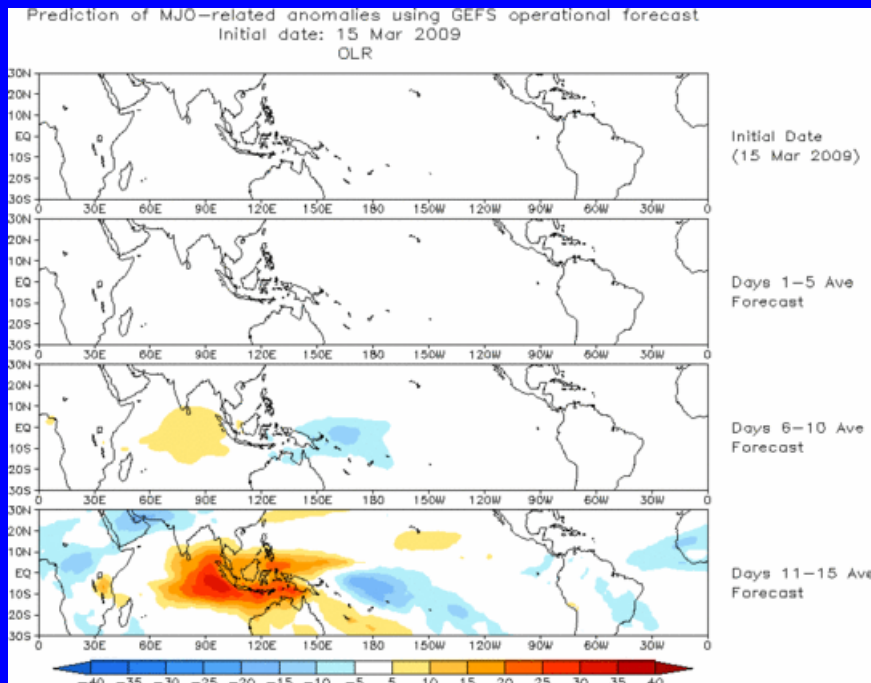




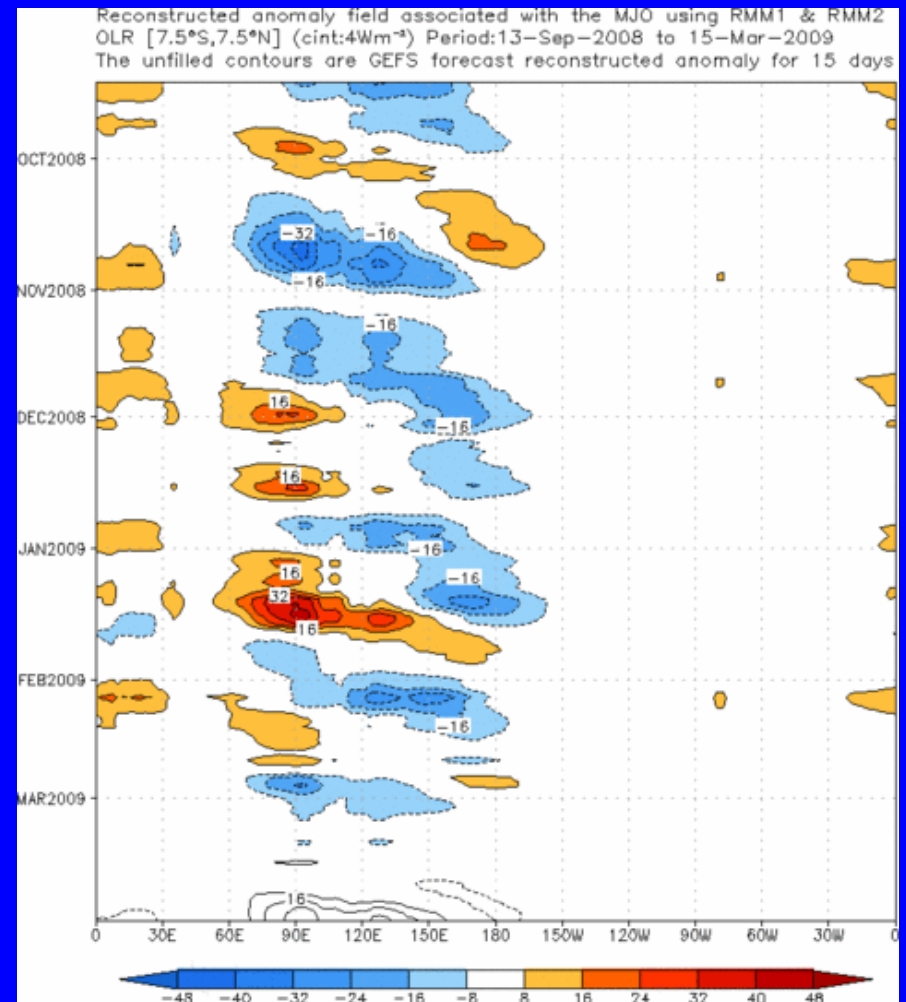
Ensemble Mean GFS MJO Forecast

Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



Time-longitude section of (7.5°S-7.5°N) OLR anomalies for the last 180 days and for the next 15 days



Weak convective anomalies are forecast for week-1.
Suppressed convection over the eastern Indian Ocean and Maritime Continent are forecast for week-2.

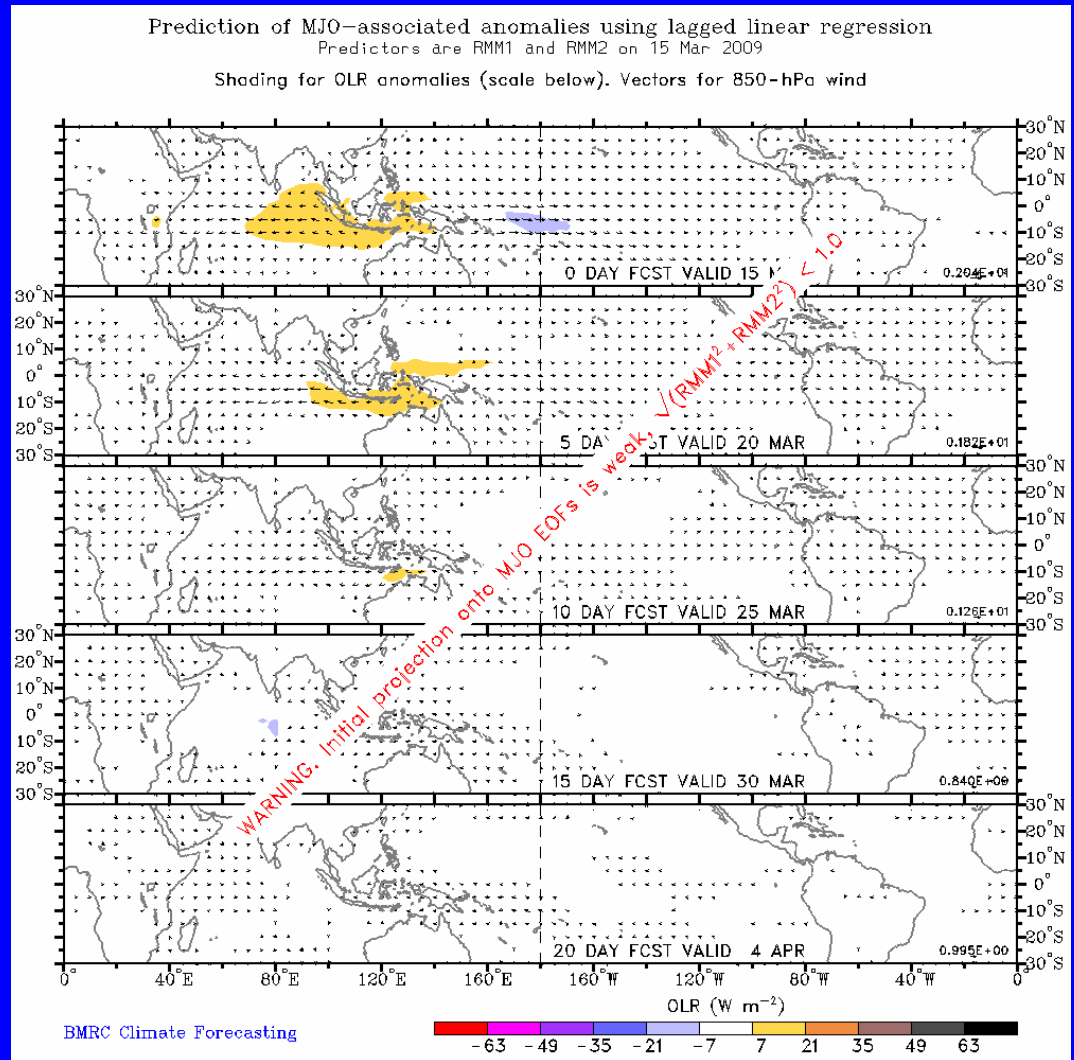


Statistical MJO Forecast

Figure below shows MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies and 850-hPa wind vectors for the next 20 days
(Courtesy of the Bureau of Meteorology Research Centre - Australia)

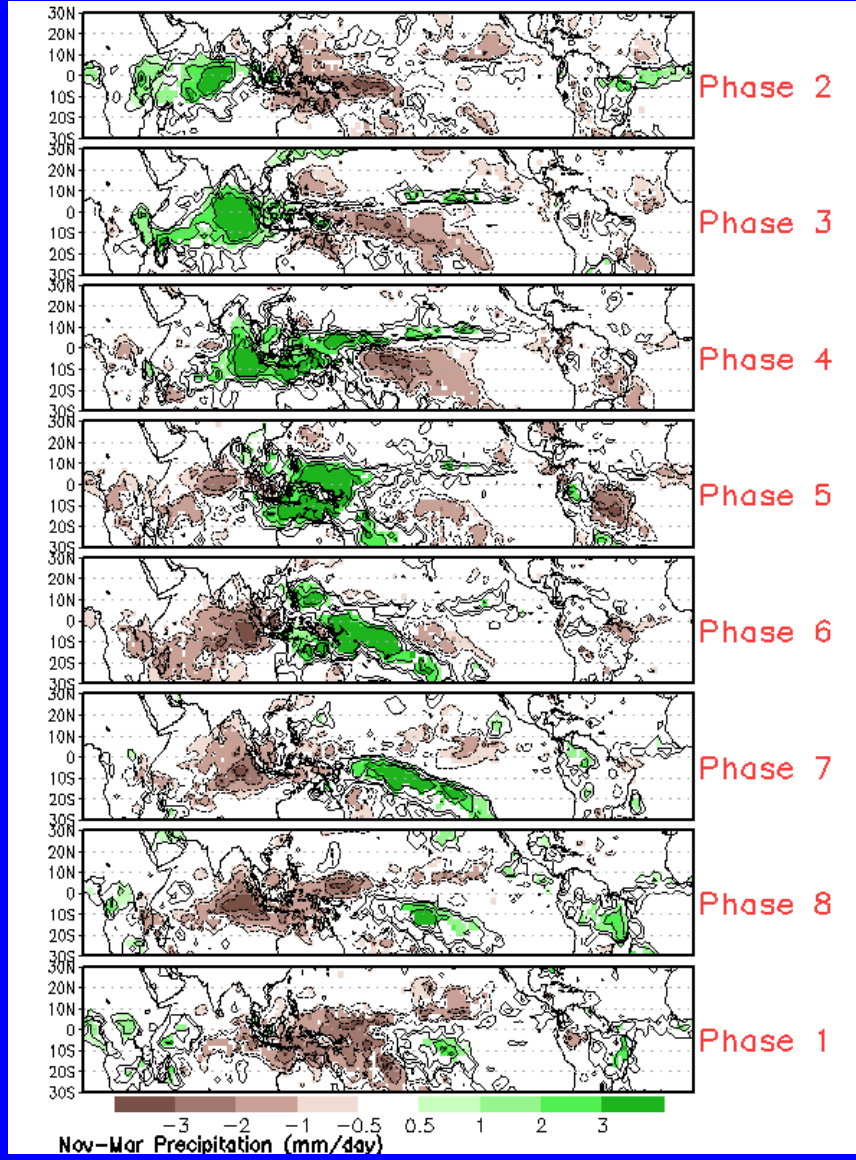
A statistical MJO forecast indicates weak MJO activity during the next 1-2 weeks.





MJO Composites – Global Tropics

Precipitation Anomalies (Nov-Mar)



850-hPa Wind Anomalies (Nov-Mar)

