



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

**Update prepared by  
Climate Prediction Center / NCEP  
February 17, 2009**



# Outline

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



# Overview

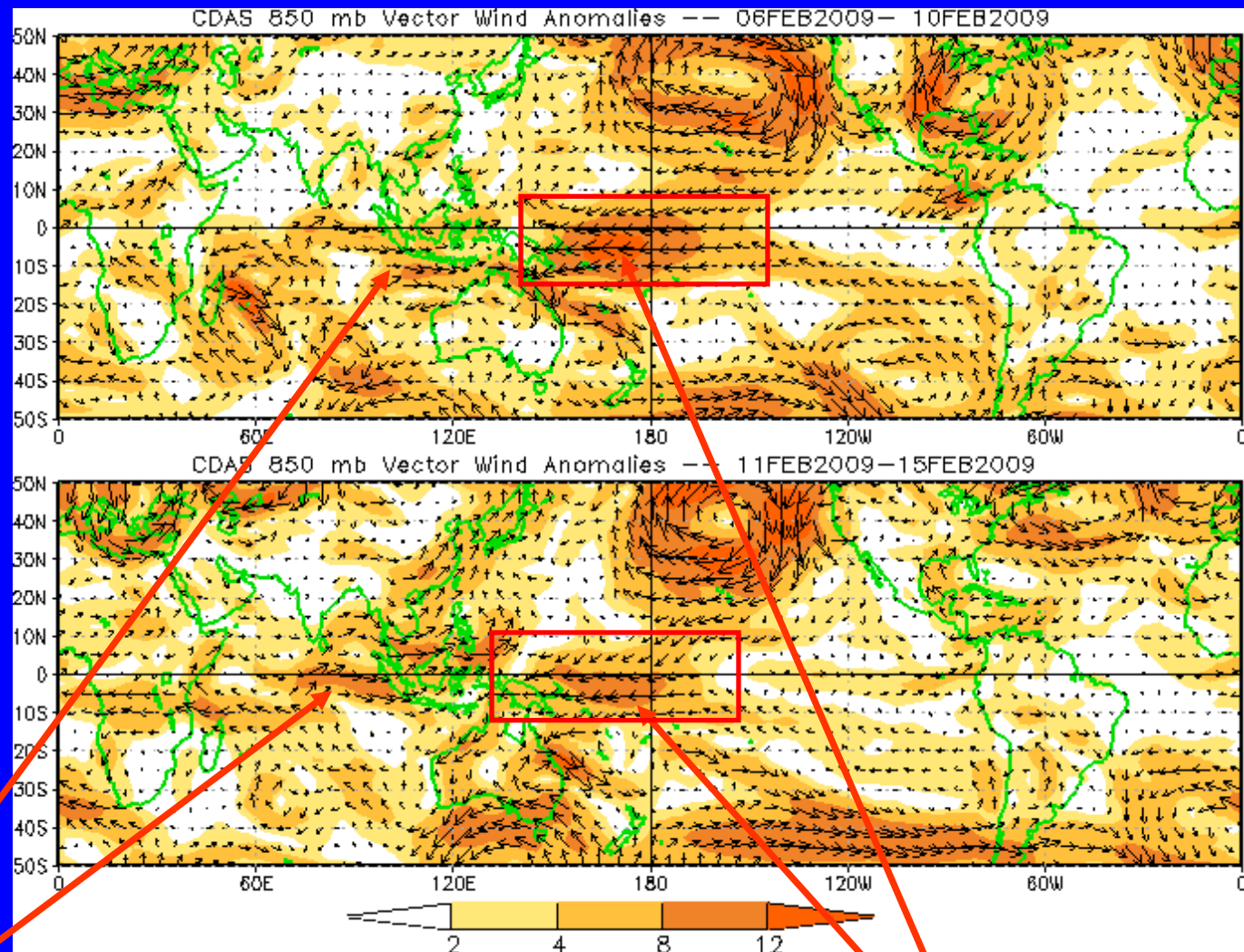
- **The MJO has further weakened.**
- **The MJO is expected to remain weak during the next 1-2 weeks.**
- **The MJO is not expected to result in any significant impacts across the global tropics and the pattern of tropical convection is anticipated to be dominated by La Nina conditions.**

**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 ( $\text{m s}^{-1}$ )

Note that shading denotes the magnitude of anomalous wind vectors



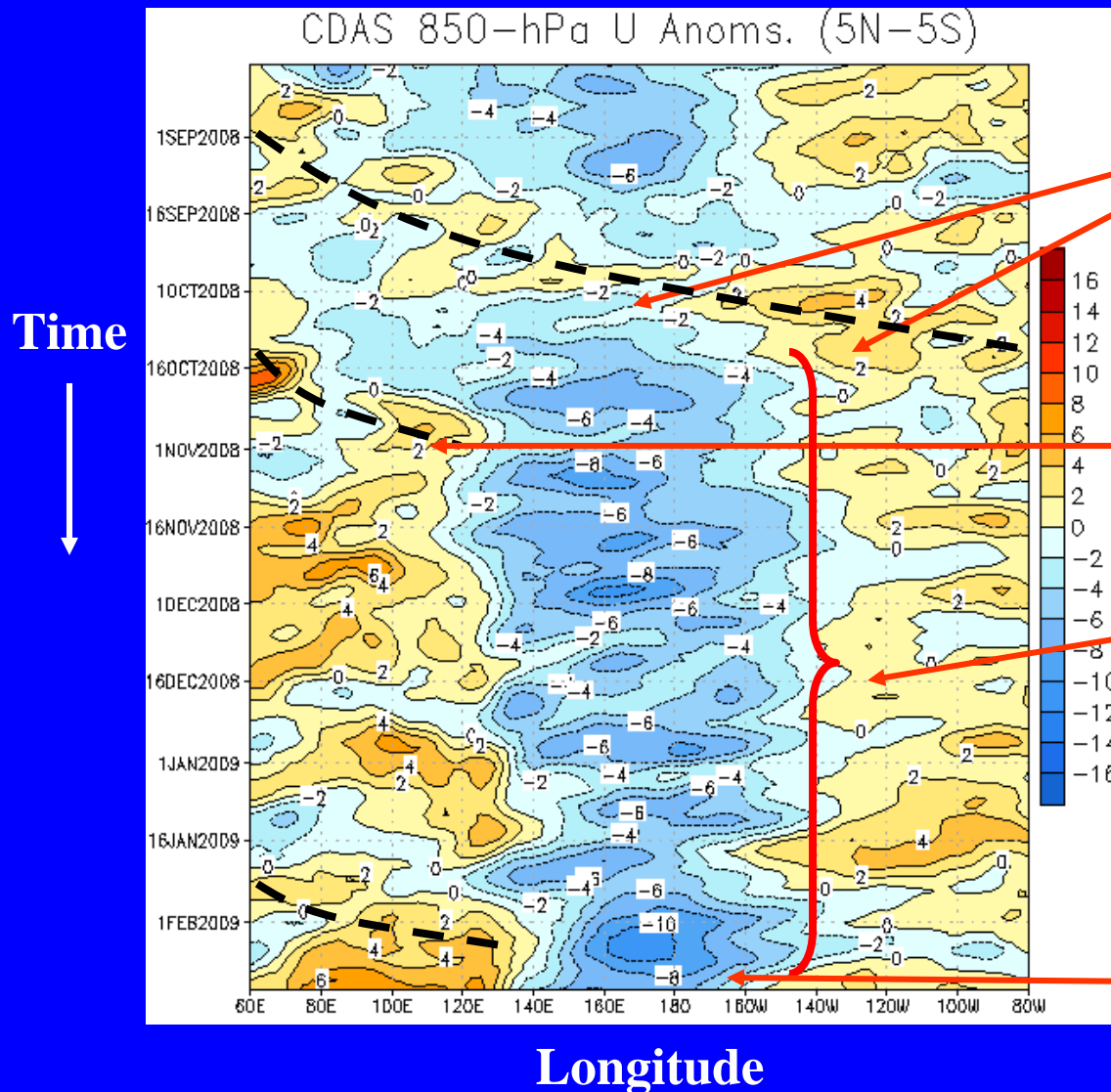
Westerly anomalies have strengthened over the equatorial Maritime Continent.

During the last five days, easterly anomalies have weakened across the equatorial western and central Pacific.



# 850-hPa Zonal Wind Anomalies ( $\text{m s}^{-1}$ )

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.

These westerly anomalies reentered the Maritime Continent during late October but eastward progress stalled.

A persistent pattern of westerly (easterly) anomalies stretching from the Indian Ocean to the central Pacific Ocean has been in place since October.

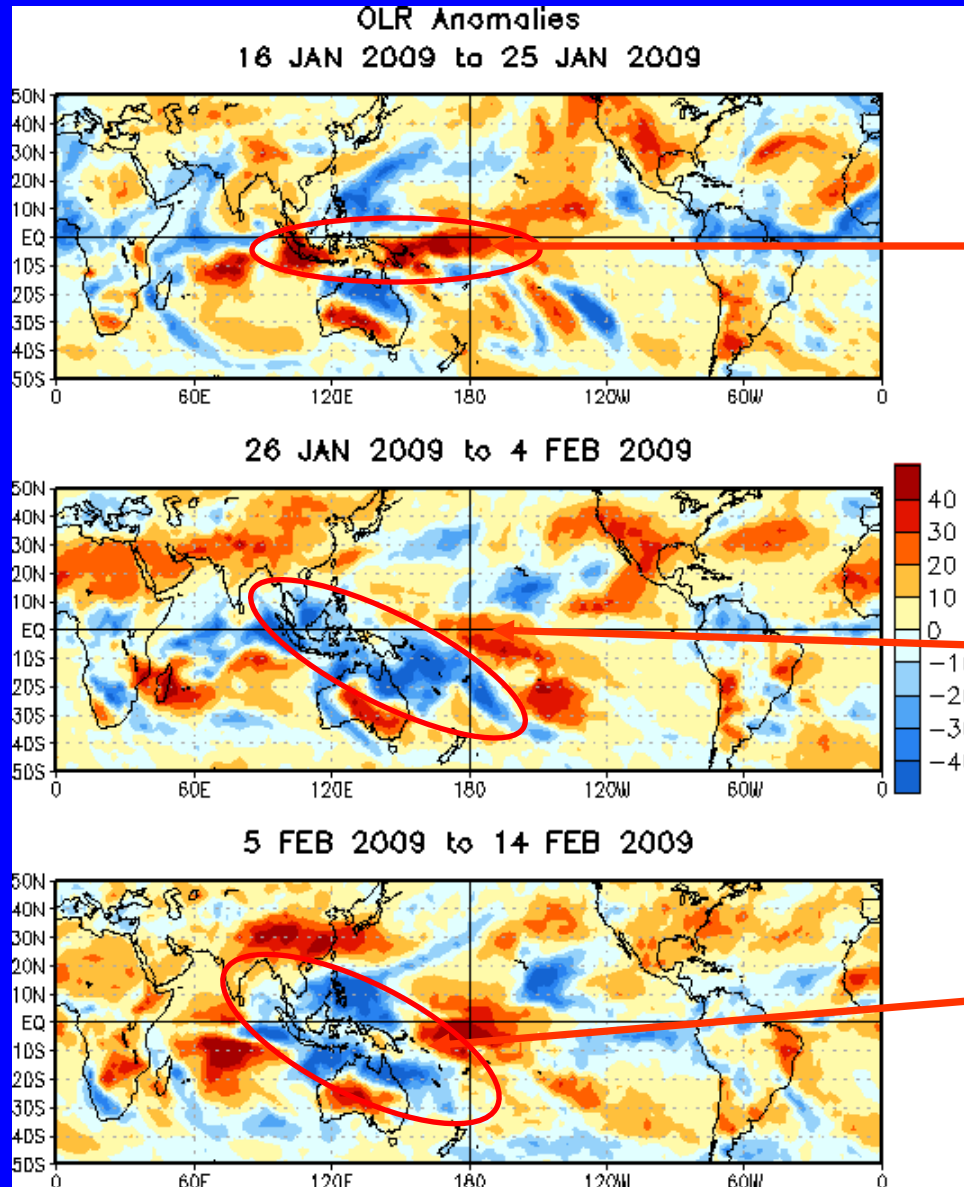
After a break in mid-January - associated with the MJO - westerly anomalies have once again developed across the Indian Ocean and Maritime Continent.

Recently, easterly anomalies have weakened near the Date Line.



# OLR Anomalies: Last 30 days

**Drier-than-normal conditions, positive OLR anomalies (yellow/red shading)**  
**Wetter-than-normal conditions, negative OLR anomalies (blue shading)**



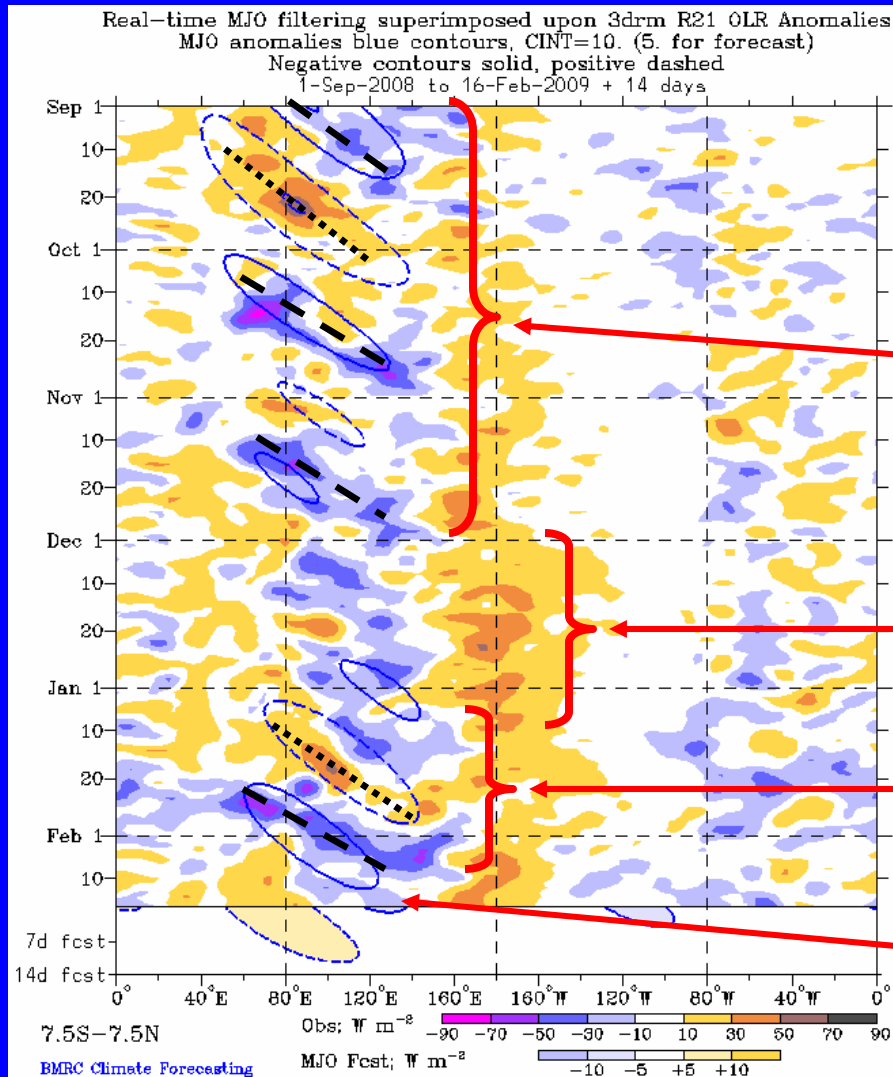
**In mid-to-late January, the area of suppressed convection shifted over the equatorial Maritime Continent.**

**In late-January to early-February, enhanced convection developed over the Indian Ocean and Maritime Continent.**

**Enhanced convection has remained nearly stationary over the Maritime Continent during early-to-mid February, while convection has been suppressed over the Indian Ocean.**



# 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 weakened and become more stationary over the Maritime Continent.

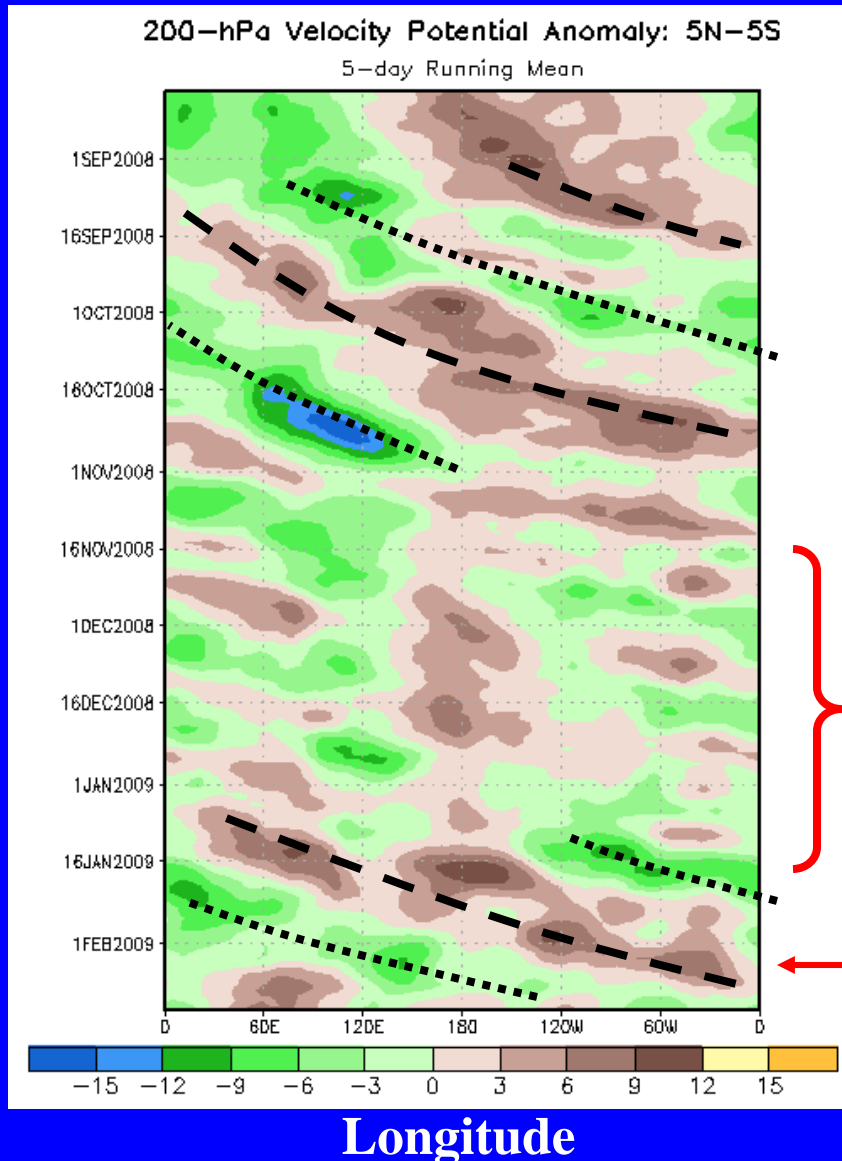
Time  
↓

Longitude



# 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



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 decreased.

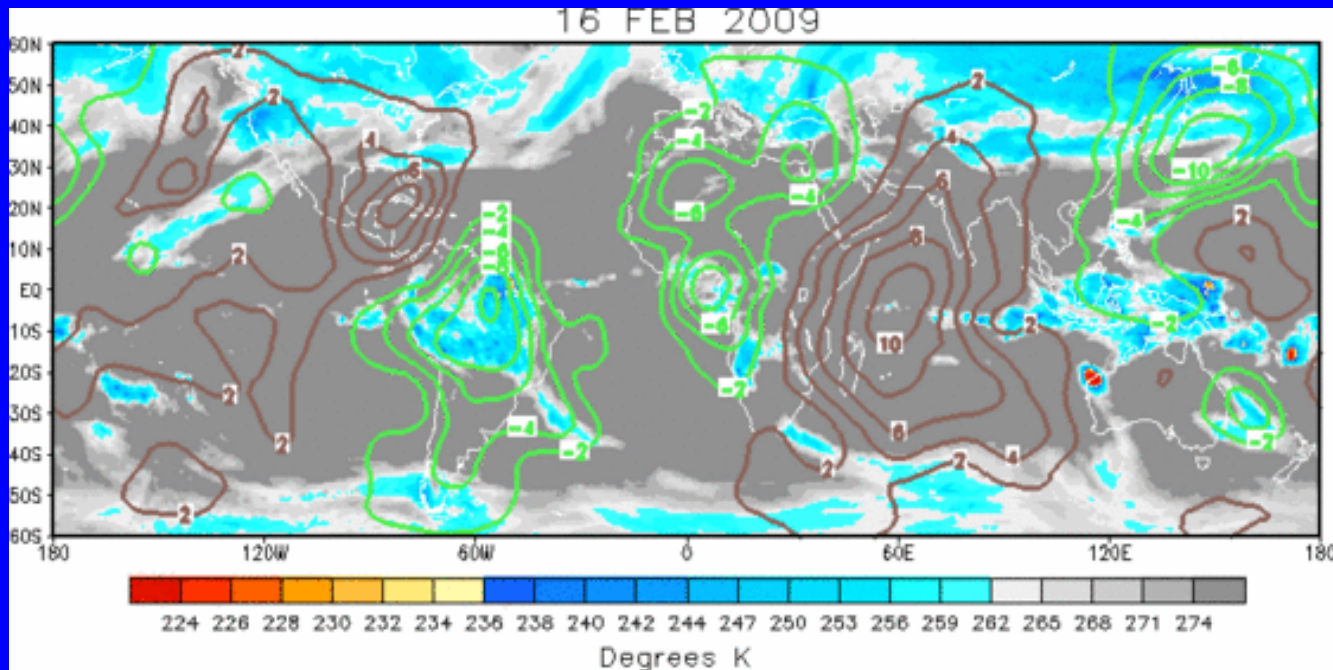




# IR Temperatures (K) / 200-hPa Velocity Potential Anomalies

Positive anomalies (brown contours) indicate unfavorable conditions for precipitation

Negative anomalies (green contours) indicate favorable conditions for precipitation

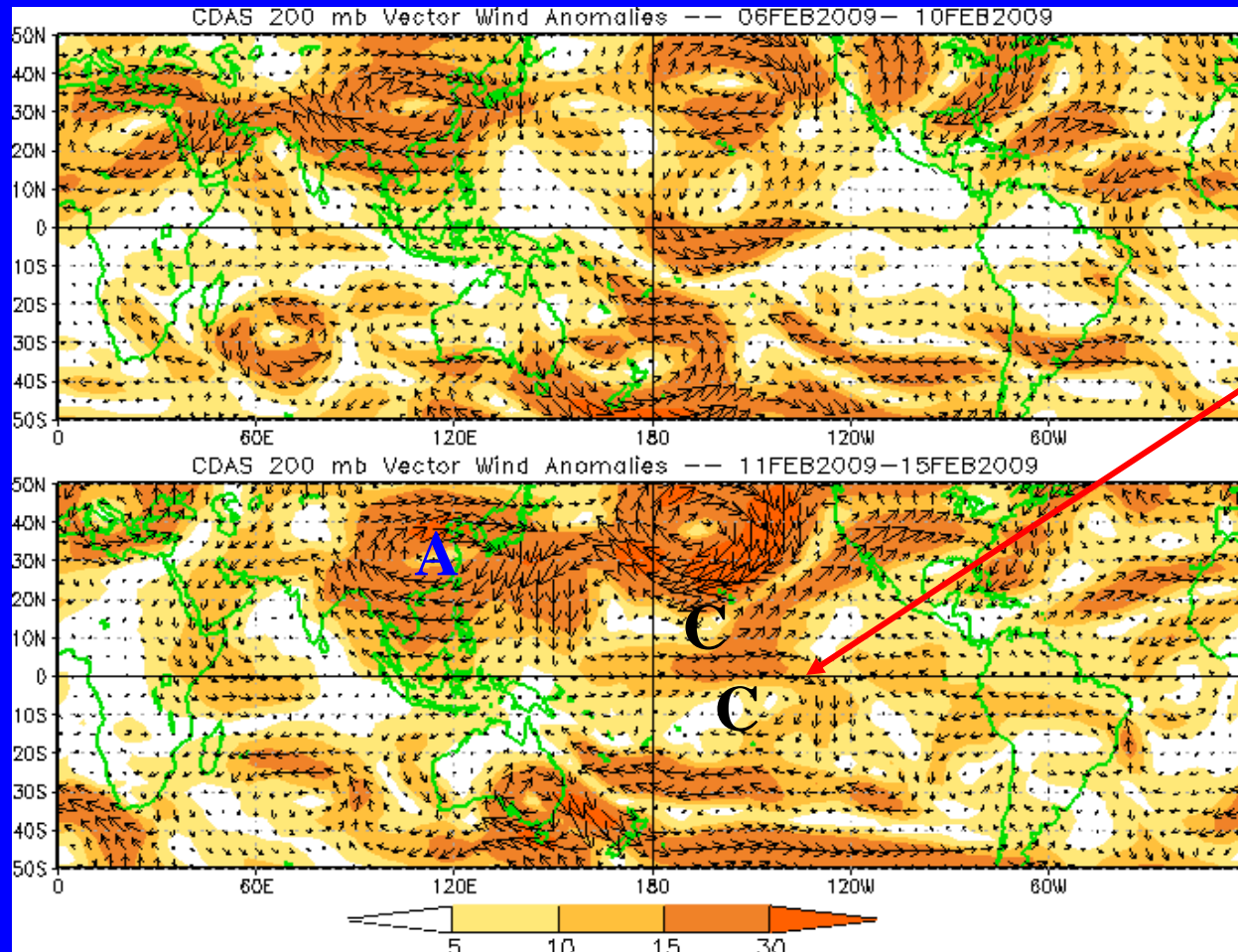


The velocity potential anomalies have amplitude over South America and western Africa (upper-level divergence) and the Indian Ocean (upper-level convergence).



# 200-hPa Vector Wind Anomalies ( $\text{m s}^{-1}$ )

Note that shading denotes the magnitude of anomalous wind vectors



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

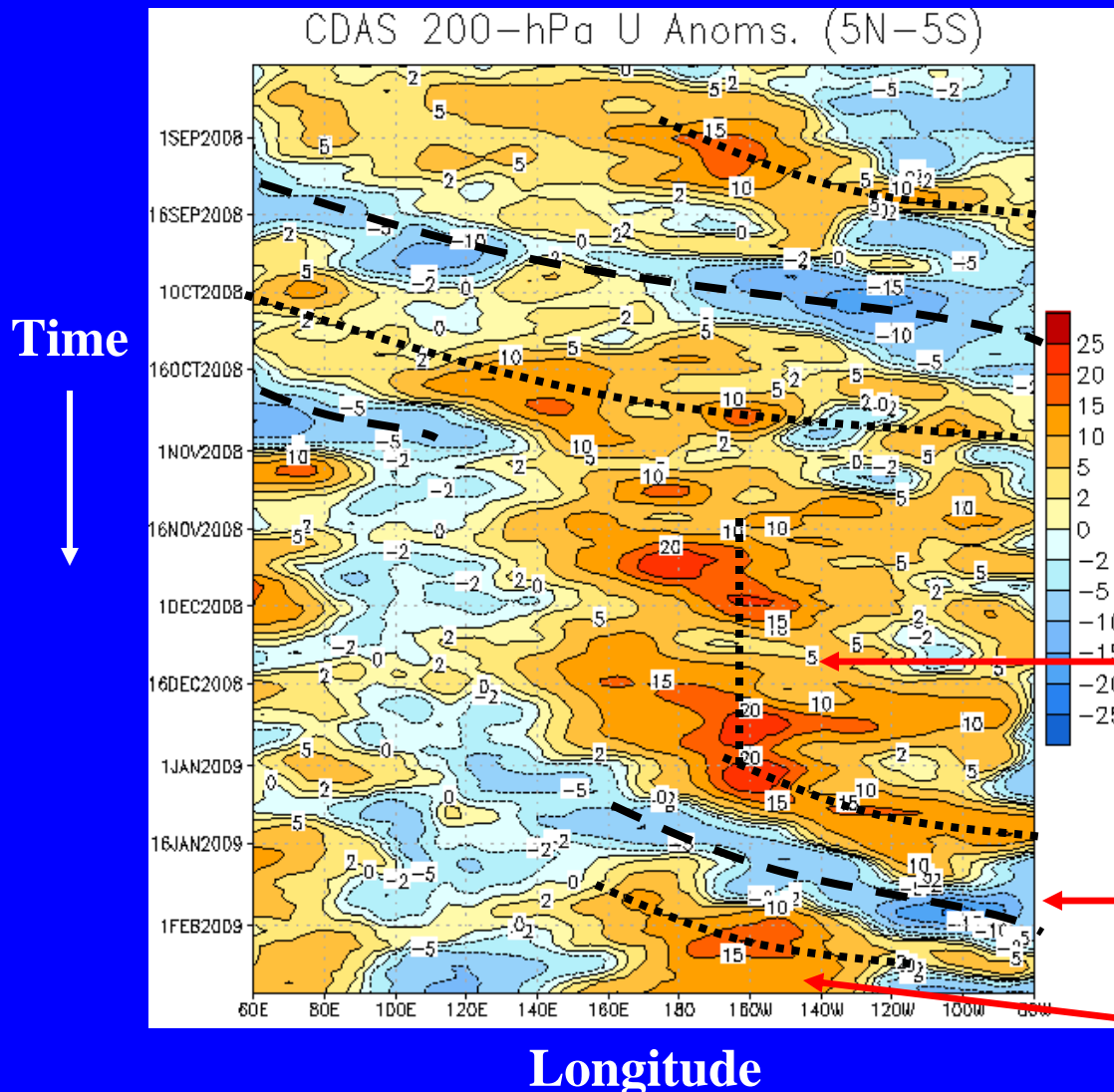
Cyclonic (C) and anti-cyclonic (A) circulations are evident north and south of the equator across the central Pacific and Eastern Hemisphere respectively. They are associated in part with anomalous suppressed and enhanced convection in the deep tropics.



# 200-hPa Zonal Wind Anomalies ( $\text{m s}^{-1}$ )

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.

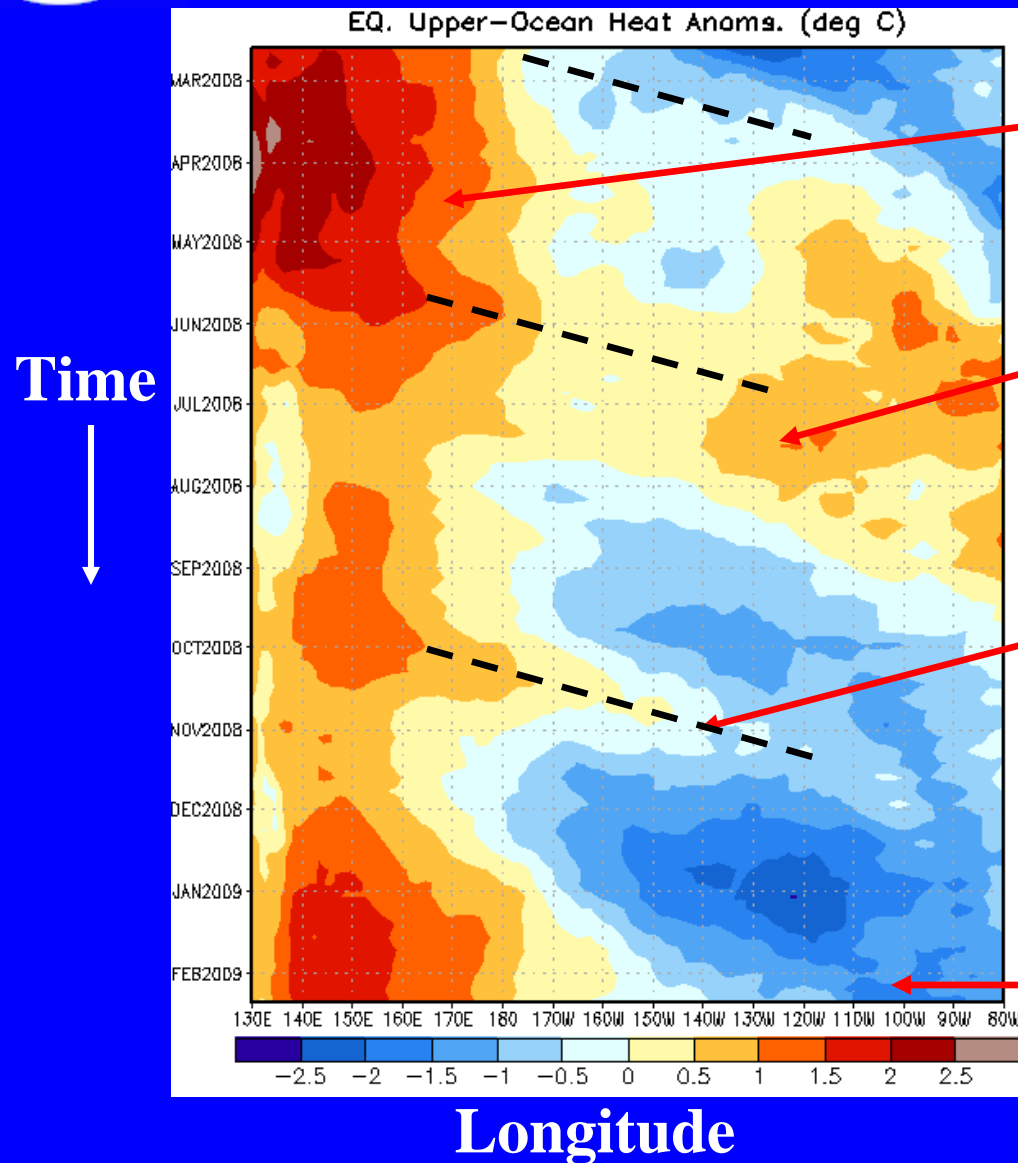
Westerly anomalies strengthened markedly in mid-November near the Date Line and persisted through December. These anomalies are consistent with La Nina conditions.

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

Westerly anomalies have become more stationary over the central Pacific.



# Weekly Heat Content Evolution in the Equatorial Pacific



Beginning in February, increasingly positive anomalies developed across parts of the western and central Pacific but have since decreased.

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 – January, negative anomalies increased across the Pacific.

During late January- February, negative anomalies decreased in the eastern Pacific.



# MJO Index -- Information

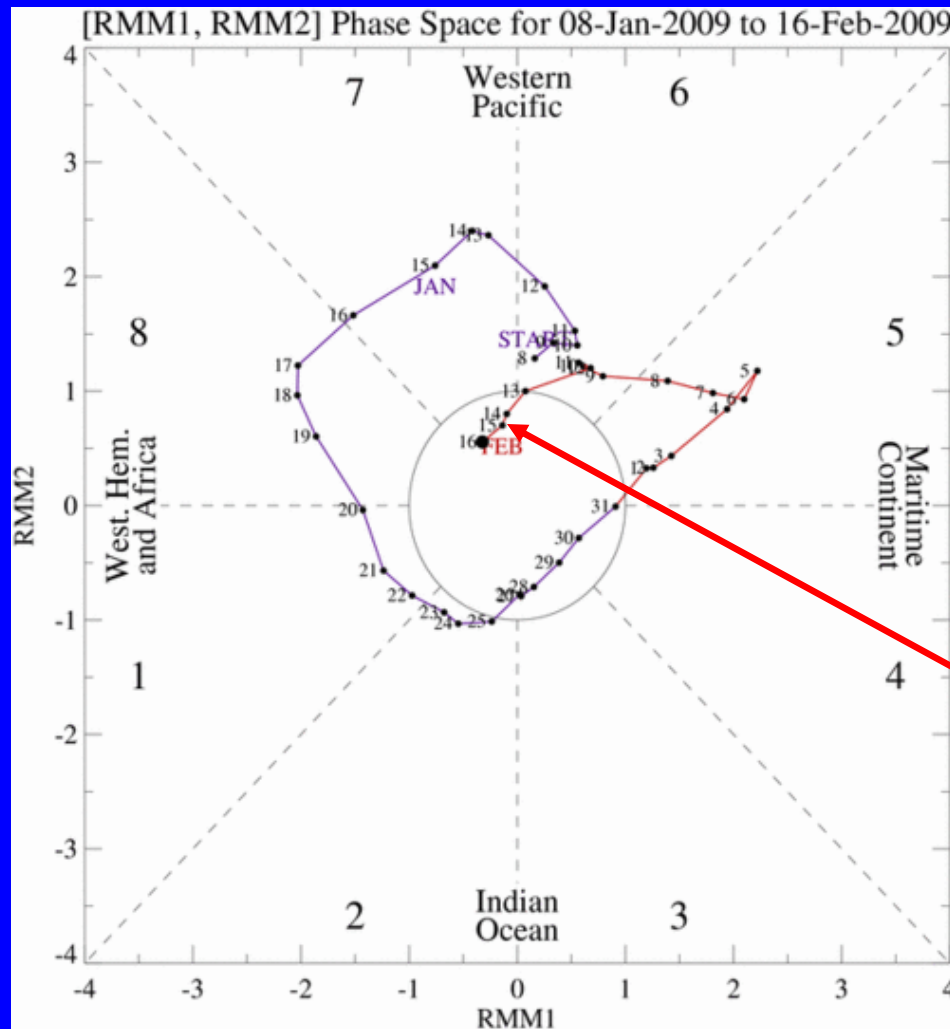
- The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).

**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

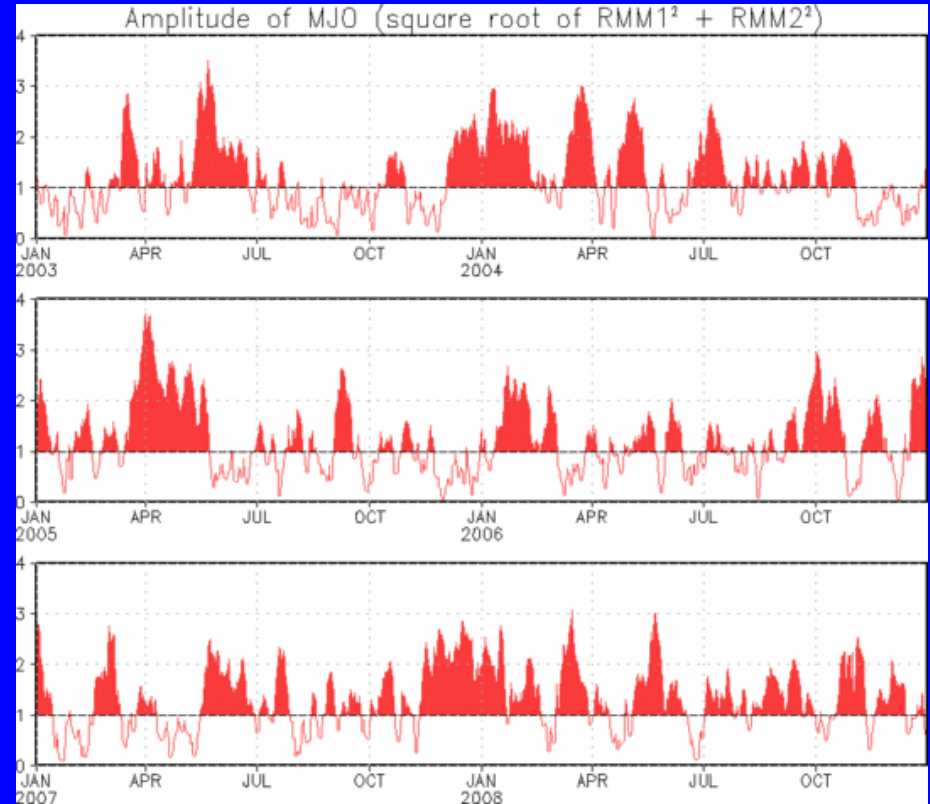
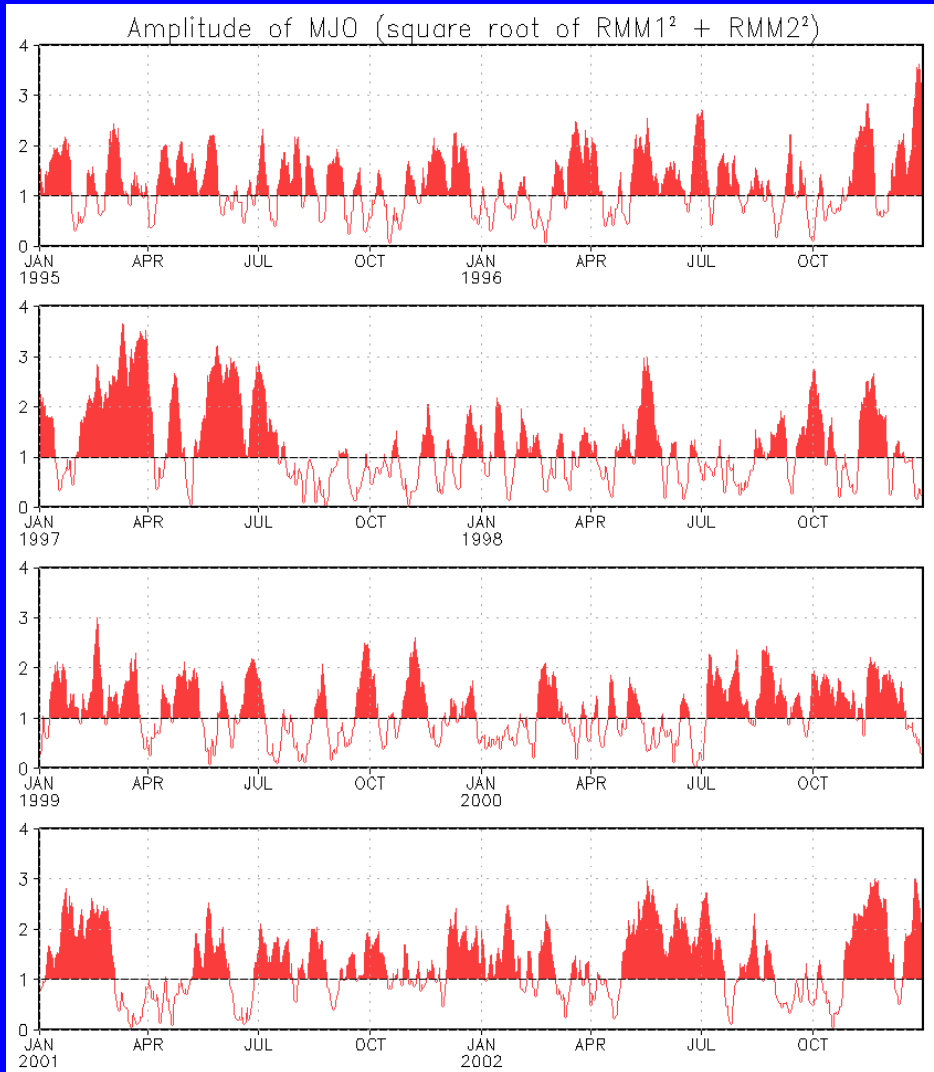


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the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

The MJO index amplitude has decreased with weak eastward propagation.



# 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**



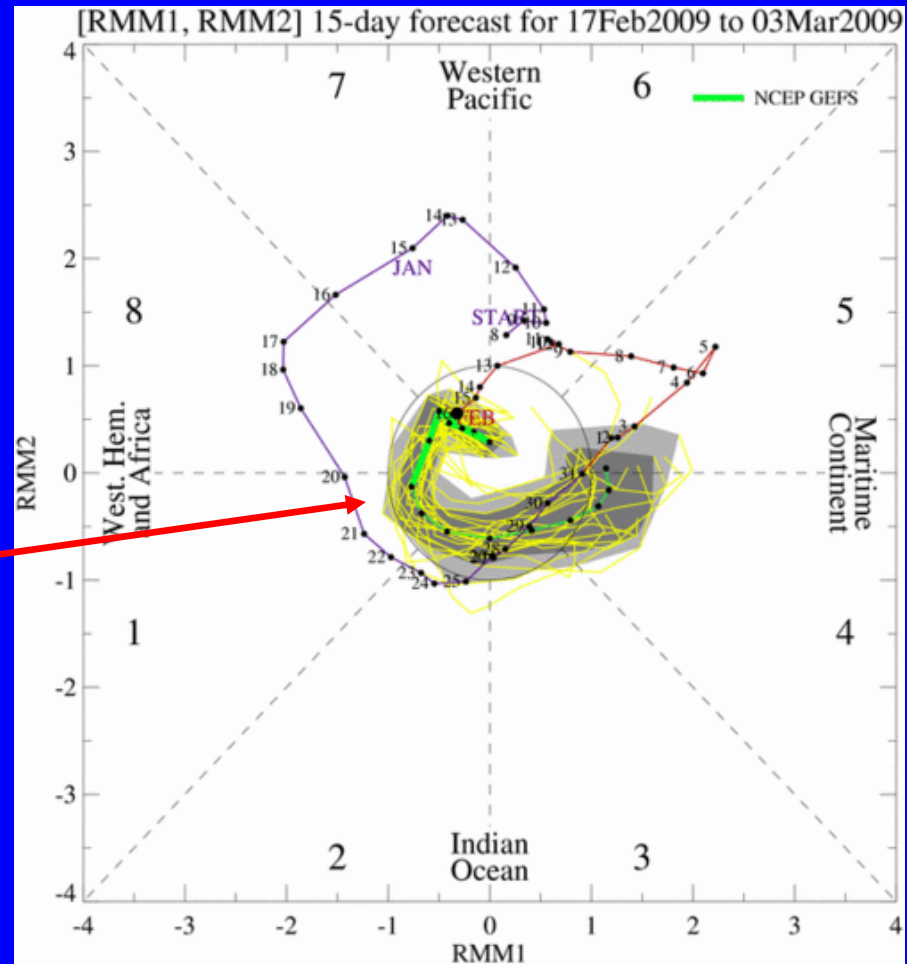
# Ensemble GFS (GEFS) MJO Forecast

**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 over the next 1-2 weeks.



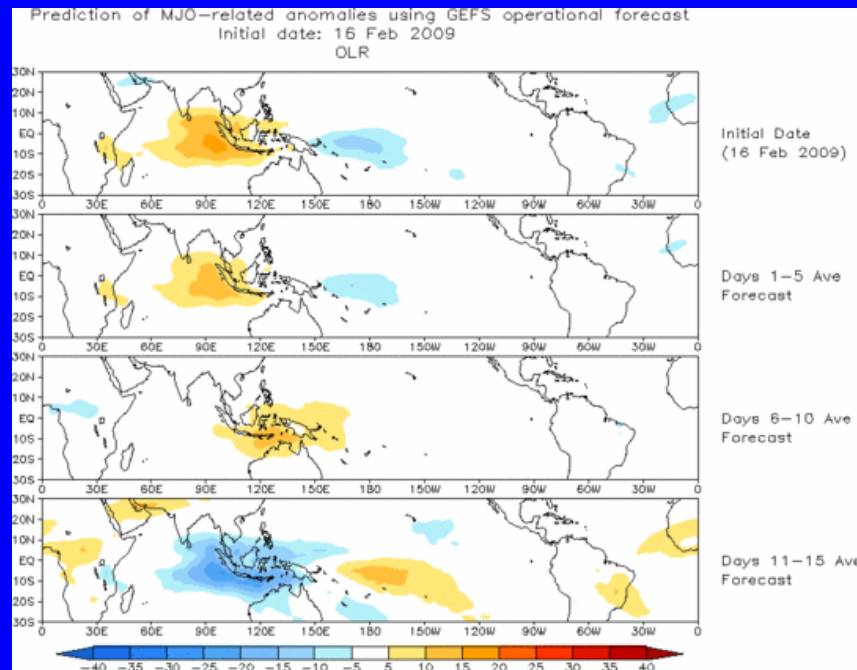




# Ensemble Mean GFS MJO Forecast

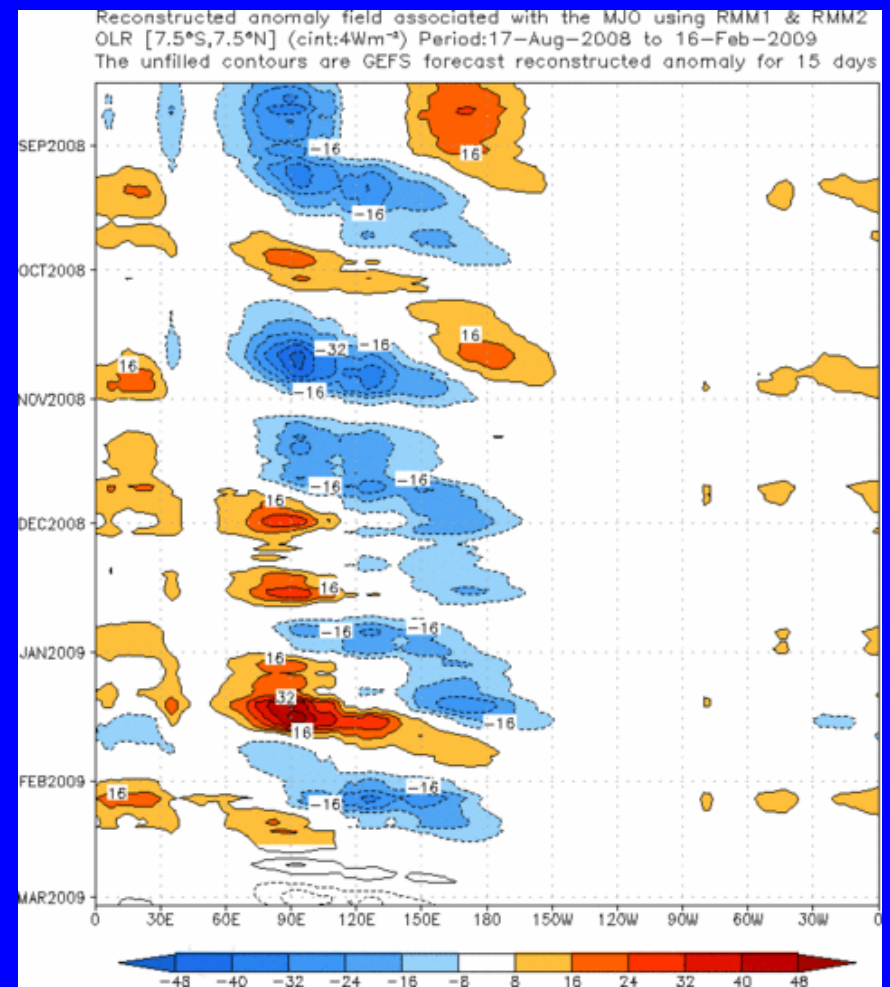
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

## Spatial map of OLR anomalies for the next 15 days



Suppressed convection is expected to strengthen over the Indian Ocean and shift eastward over the Maritime Continent during the period.

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



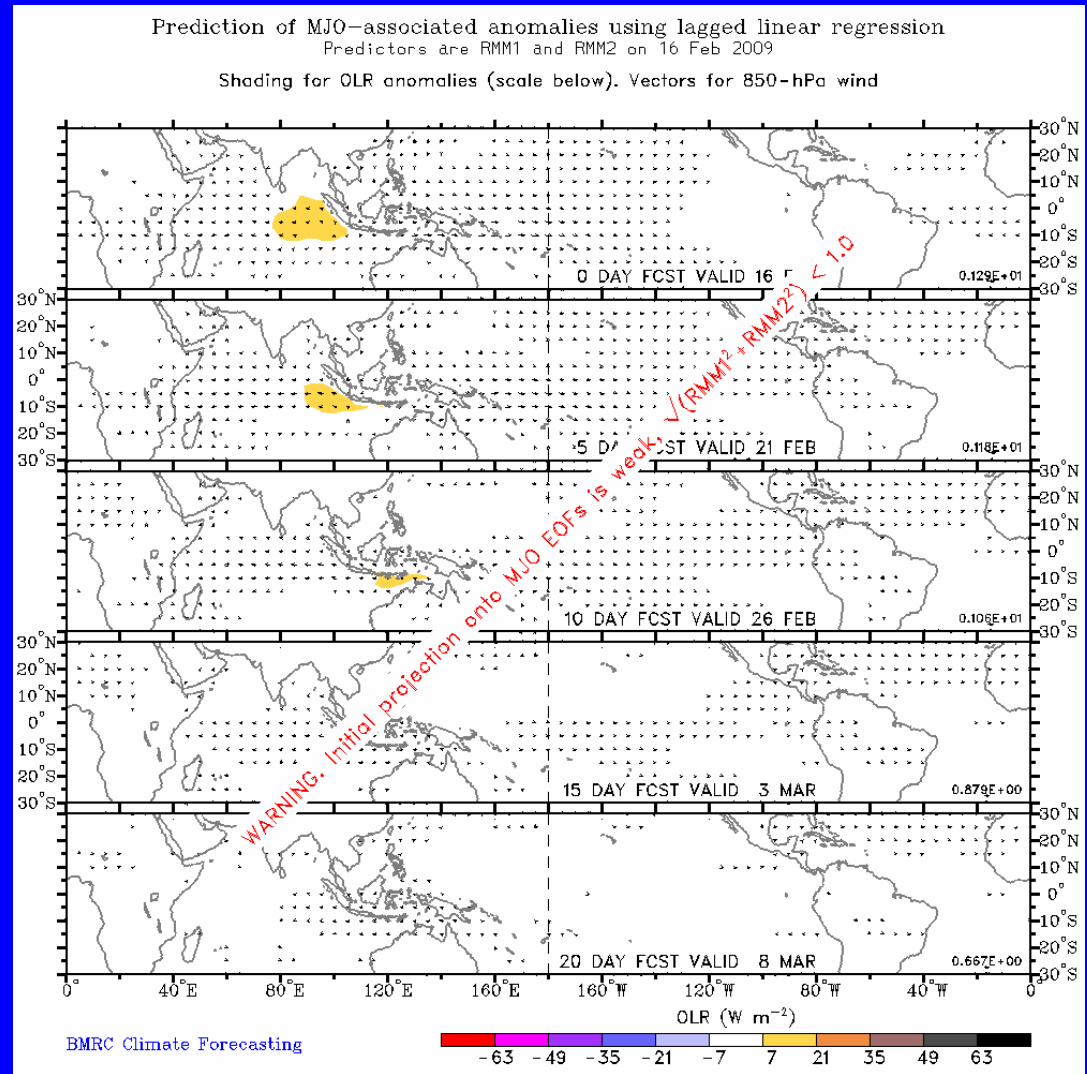


# Statistical MJO Forecast

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.





# MJO Composites – Global Tropics

## Precipitation Anomalies (Nov-Mar)

## 850-hPa Wind Anomalies (Nov-Mar)

