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

**Update prepared by**
**Climate Prediction Center / NCEP**
**January 26, 2009**

# Outline

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

# Overview

- MJO activity continued during the past week with the enhanced phase entering the Indian Ocean.

- The MJO is expected to continue during the next 1-2 weeks with the enhanced phase shifting to the Maritime Continent during the period.

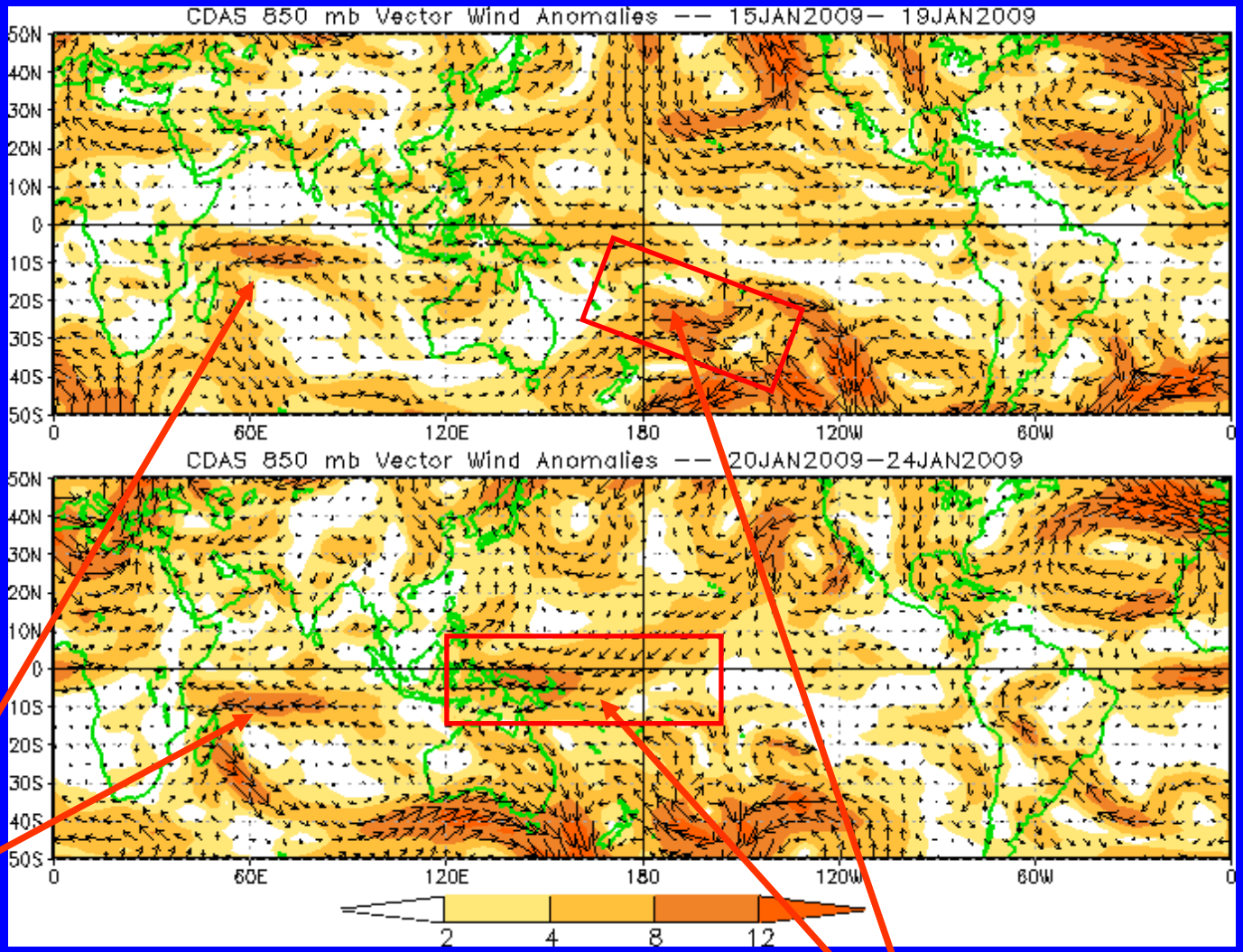
- The MJO is expected to contribute to above-average rainfall for portions of southeast Africa, the Indian Ocean, Indonesia and northern Australia over the period. The threat for tropical cyclone activity across the Indian Ocean is anticipated to increase.

- For the US, a period of transition is expected to continue on the short-term (Week 1). As convection intensifies across Indonesia, however, conditions may tend toward a circulation consistent with La Nina during Weeks 2-3.

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



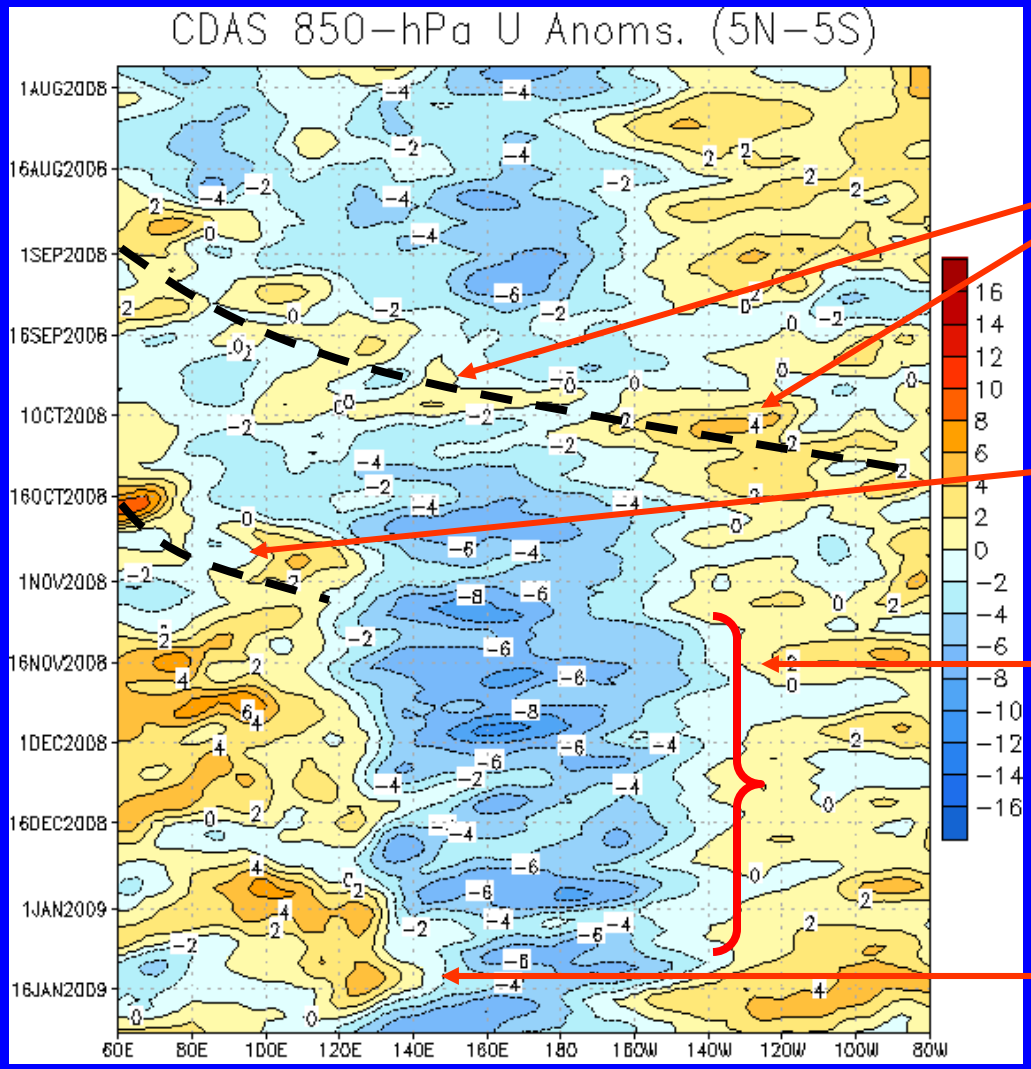

**Easterly anomalies have developed across parts of the Indian Ocean during the last five to ten days.**

**During the last five days, the easterlies have strengthened across the western Pacific while westerly anomalies in the SPCZ region have decreased.**

# 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**




**Time**

**Longitude**

**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.**

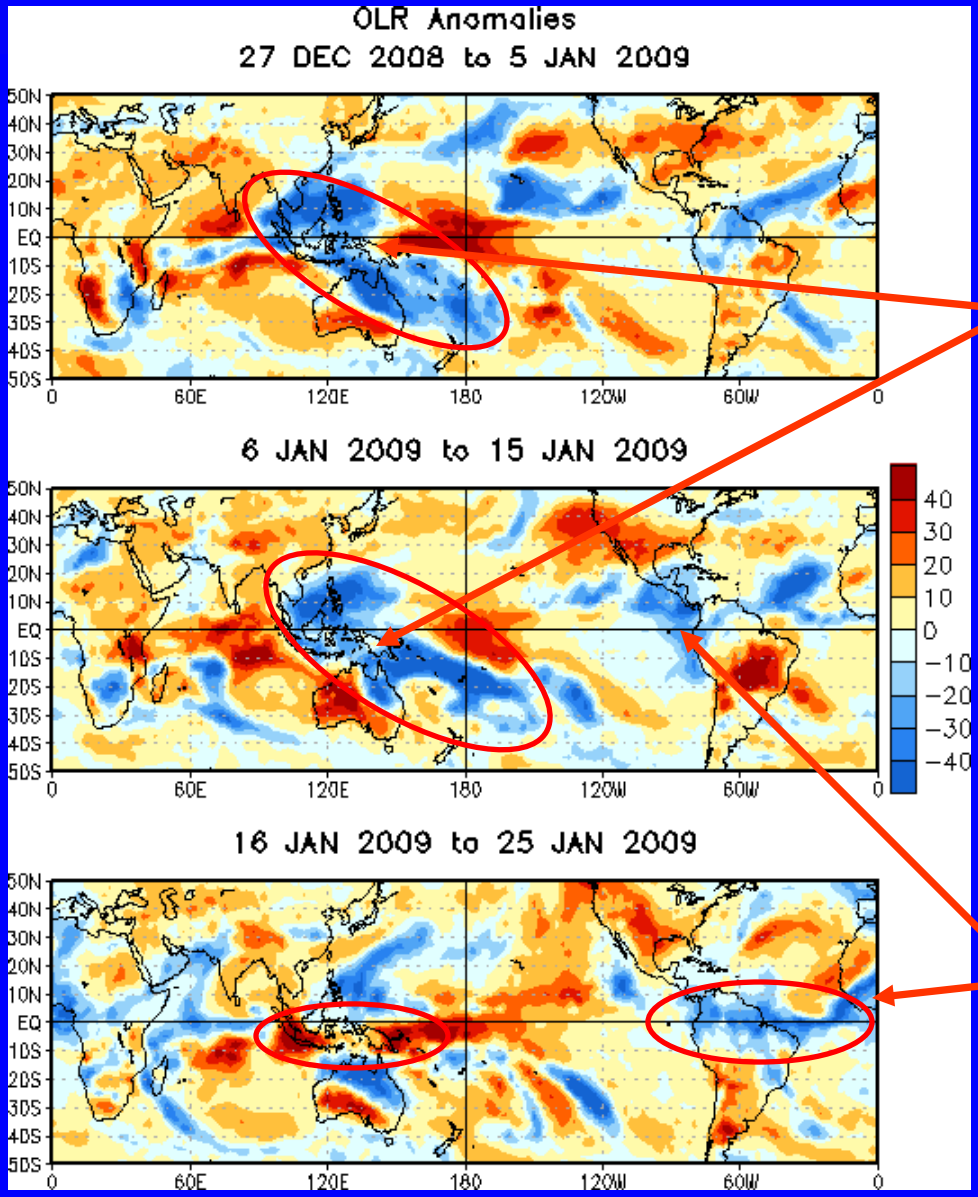
**A persistent pattern of westerly (easterly) anomalies stretching from the Indian Ocean to the central Pacific Ocean was in place during November and December.**

**A slight eastward shift in westerly anomalies is evident during January but eastward movement is more evident south of the equator (not shown).**

# OLR Anomalies: Last 30 days

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

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



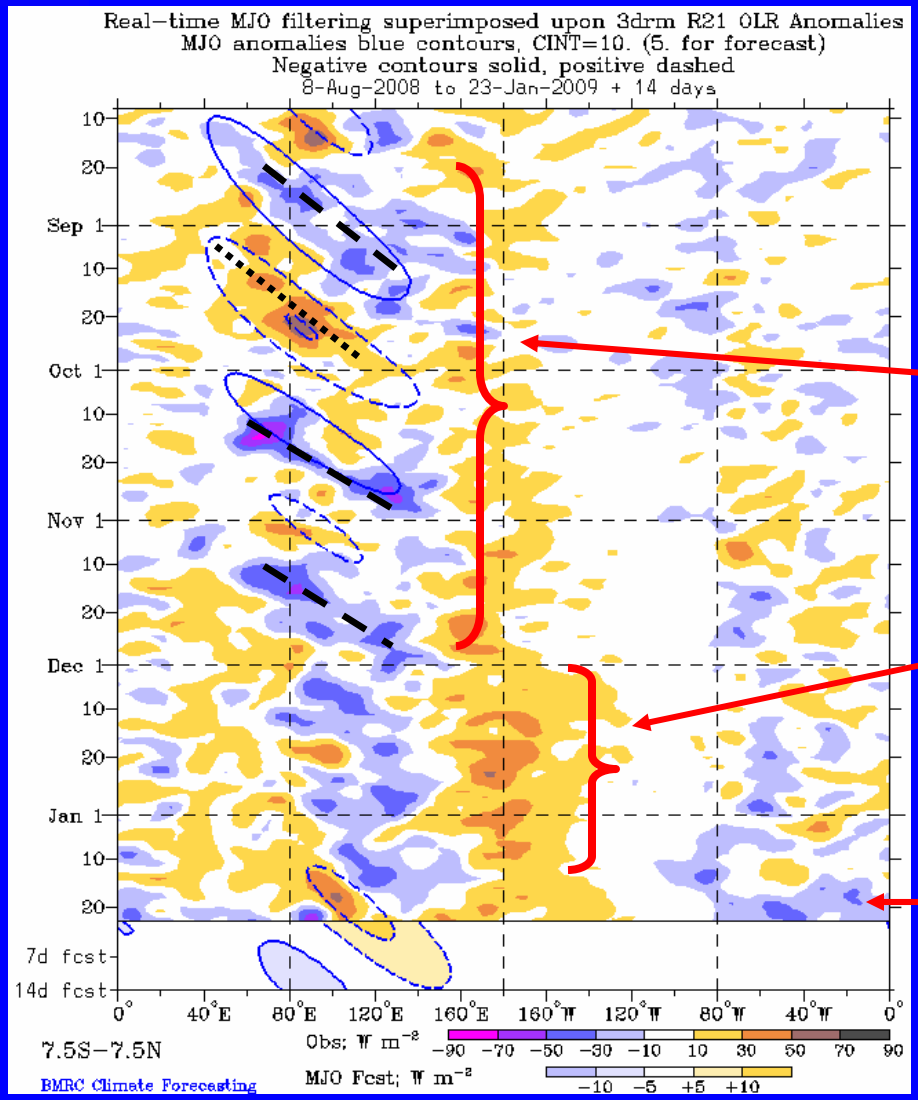

**During late December to mid January, convection intensified across the western Pacific and the South Pacific Convergence Zone (SPCZ).**

**Dry conditions developed across the Indian Ocean and northeast Brazil during mid January.**

**Convection decreased across areas of Indonesia south of the equator and the SPCZ region during mid-to-late January.**

**Enhanced convection was also evident during this time across portions of the eastern Pacific, Central America and northern South America.**

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




Time

Longitude

**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.**

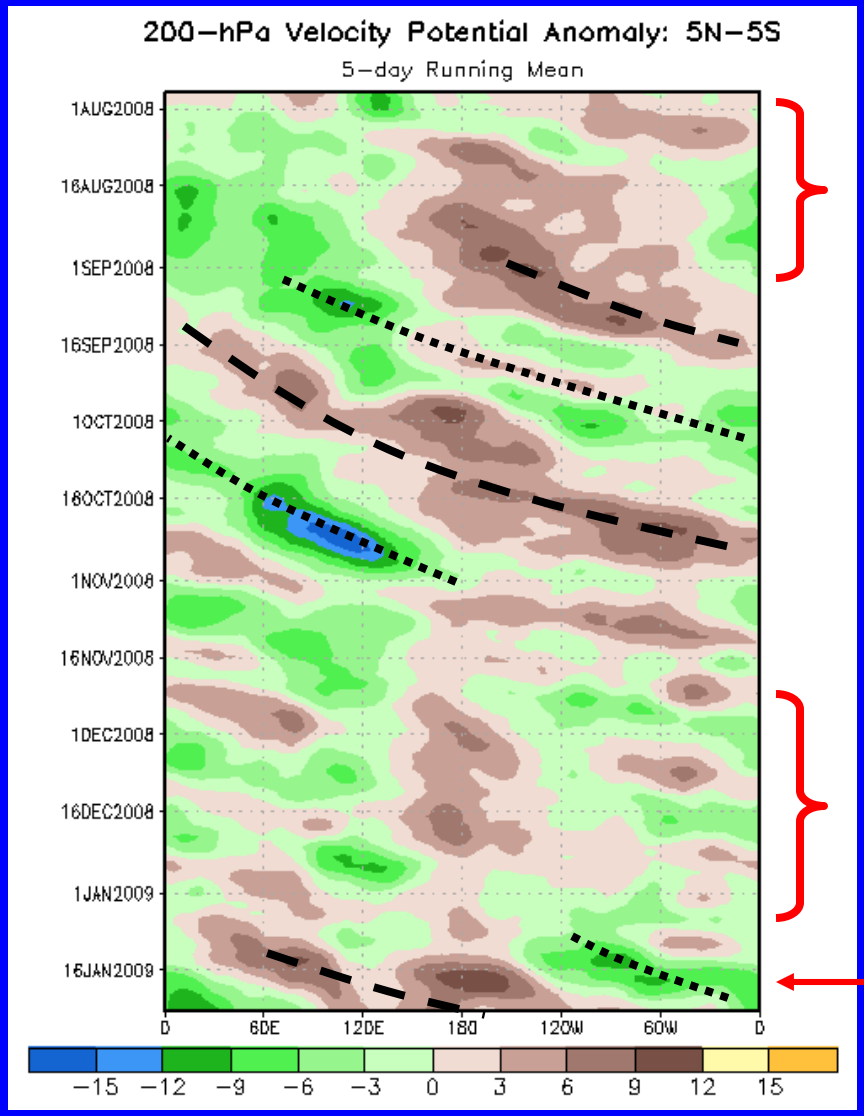
**In December and January, anomalous convection was generally stationary and consistent with La Nina conditions.**

**During mid-January, there was some eastward movement of enhanced convection as seen across the western Hemisphere during the past ten days. Suppressed convection also developed over the Indian Ocean and Indonesia.**

# 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**

**After MJO activity in July, the MJO was weak during August as a more stationary pattern of anomalous velocity potential was evident.**

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

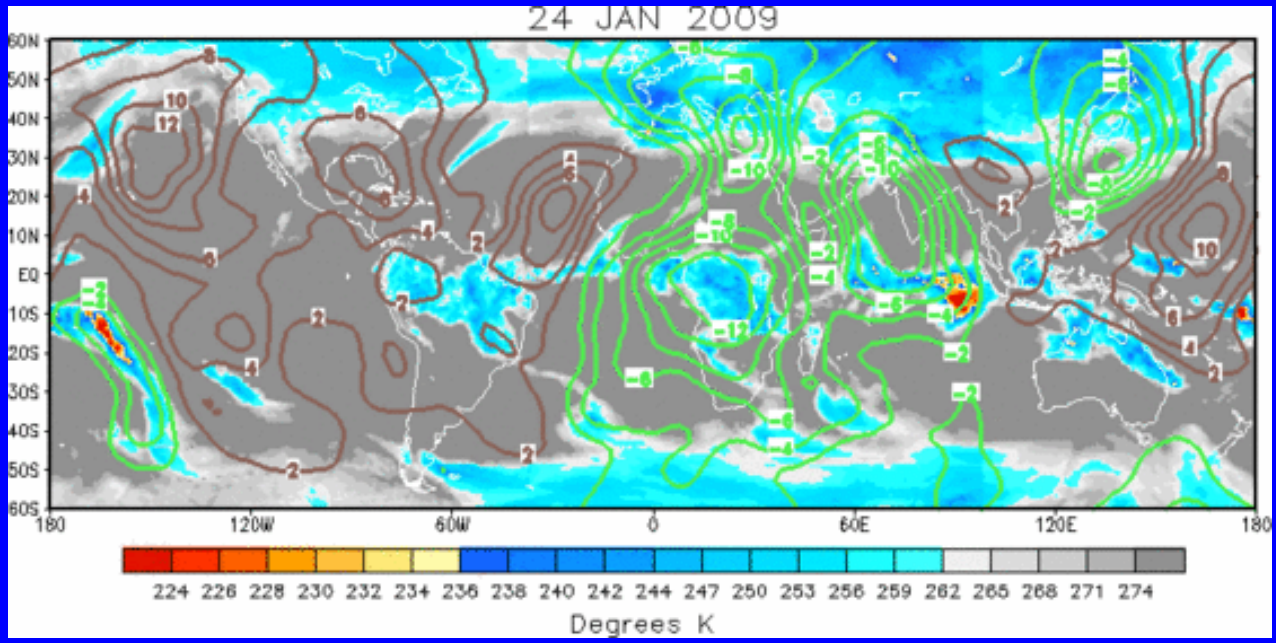
**From mid-November to mid-January, the subseasonal activity organized on a faster time scale and the MJO was weak or incoherent.**

**Velocity potential anomalies have increased and show eastward movement during the past ten days as the MJO strengthened.**

# 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**

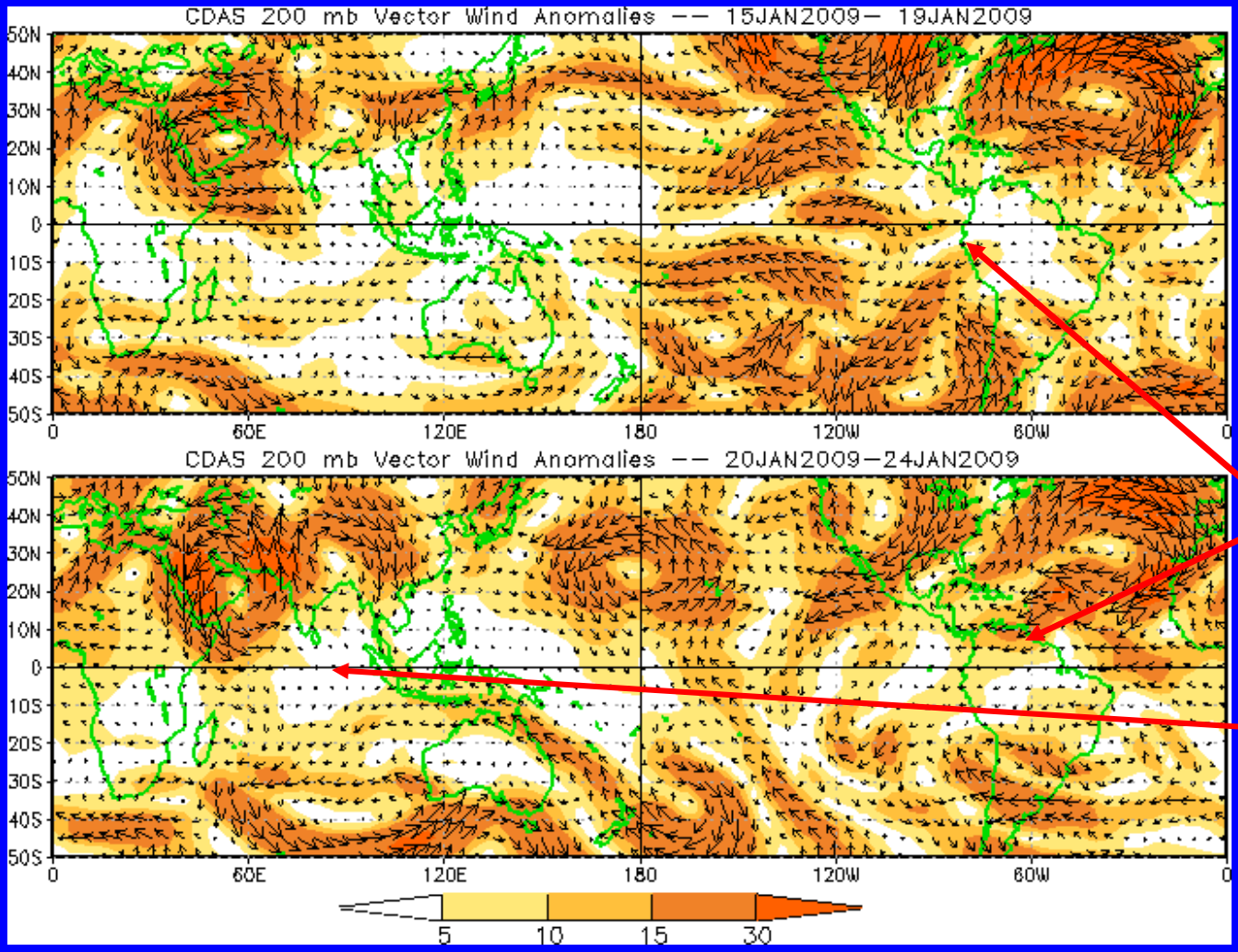



**The velocity potential pattern continues to indicate a generally coherent pattern. The pattern has shifted eastward during the past week.**

**The strongest upper-level divergence is located over Africa and the Indian Ocean while upper-level convergence has increased over the Pacific and across the Americas.**

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

**Note that shading denotes the magnitude of anomalous wind vectors**



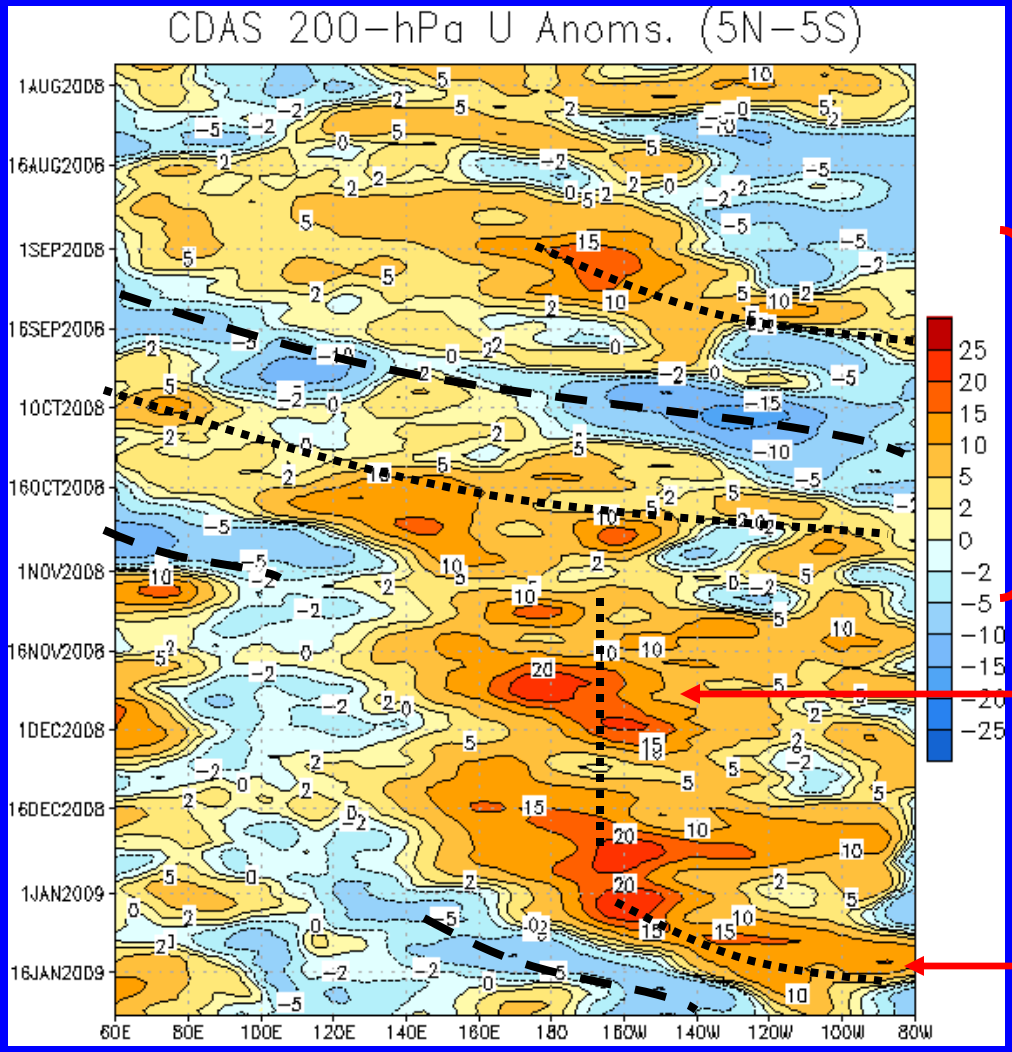

**Wind anomalies along the equator across the western Hemisphere have become more variable during the last five to ten days.**

**Westerly anomalies continue across the Indian Ocean.**

# 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**




Time

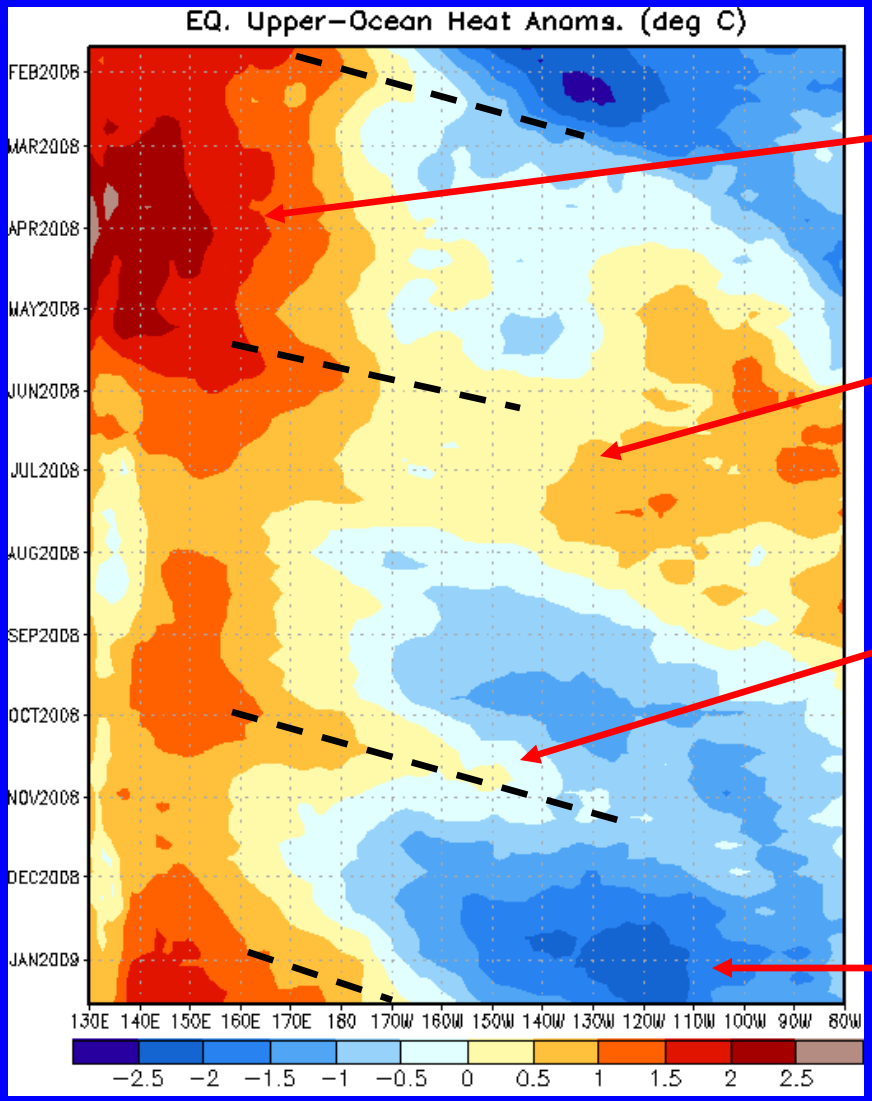
Longitude

**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 recent MJO activity.**

# Weekly Heat Content Evolution in the Equatorial Pacific




Time

Longitude

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, December and January negative anomalies increased across the Pacific. A new Kelvin was initiated in early January 2009.

# MJO Index -- Information

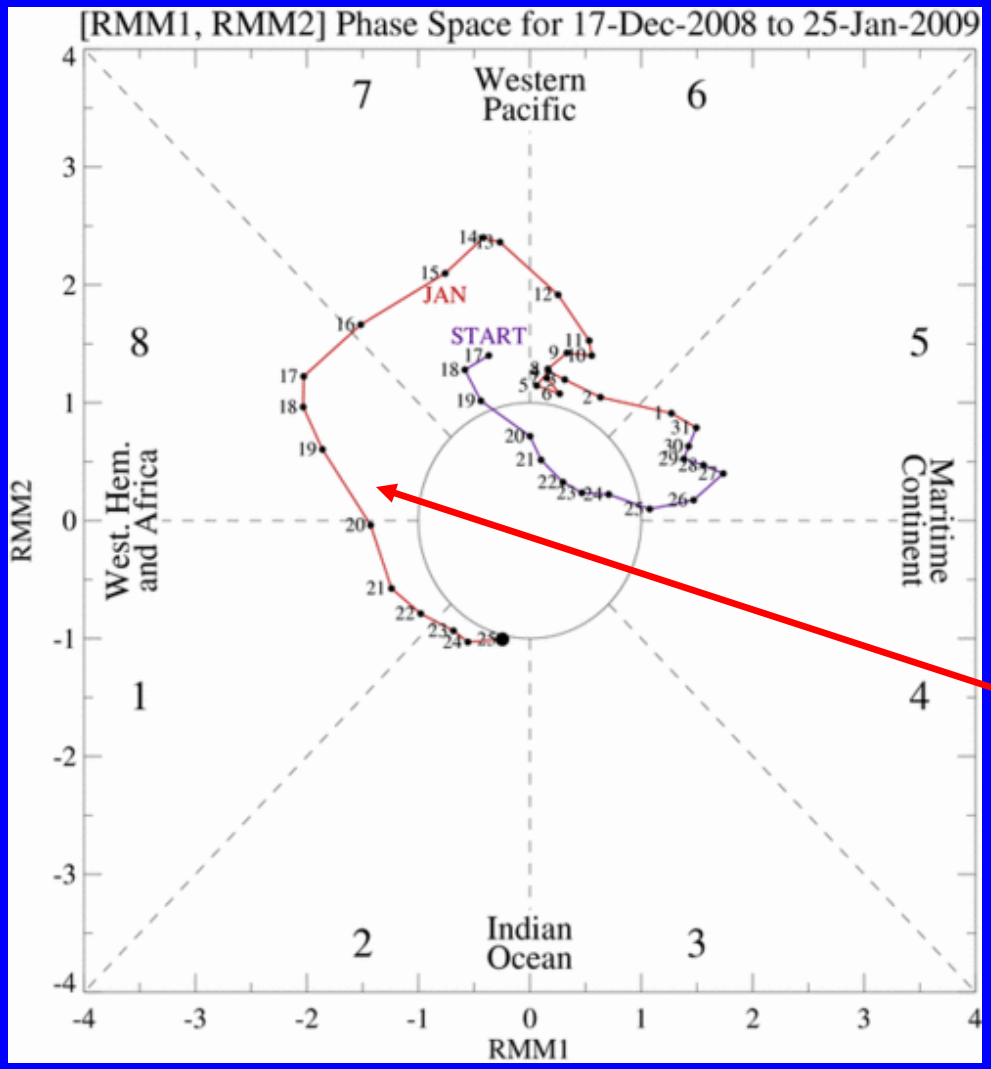
- **The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).**

**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).**

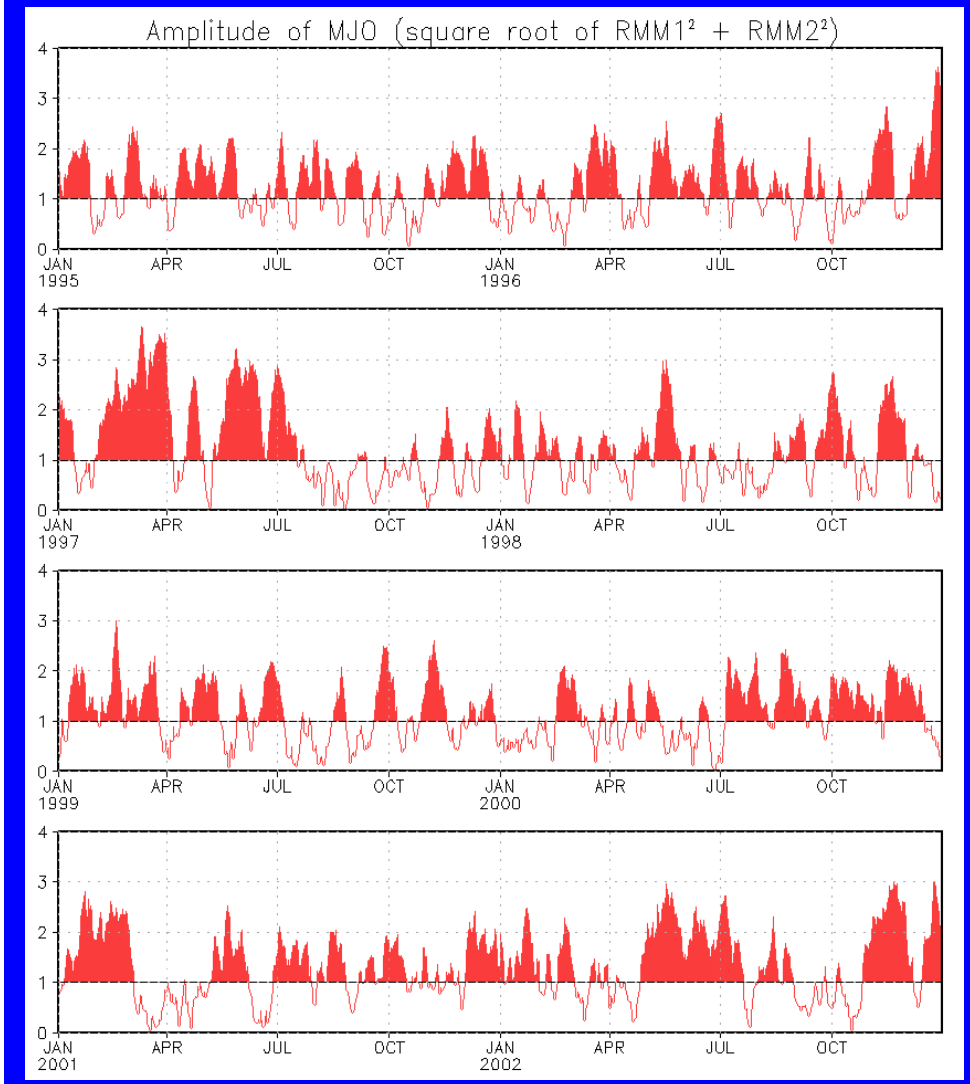
# MJO Index -- Recent Evolution

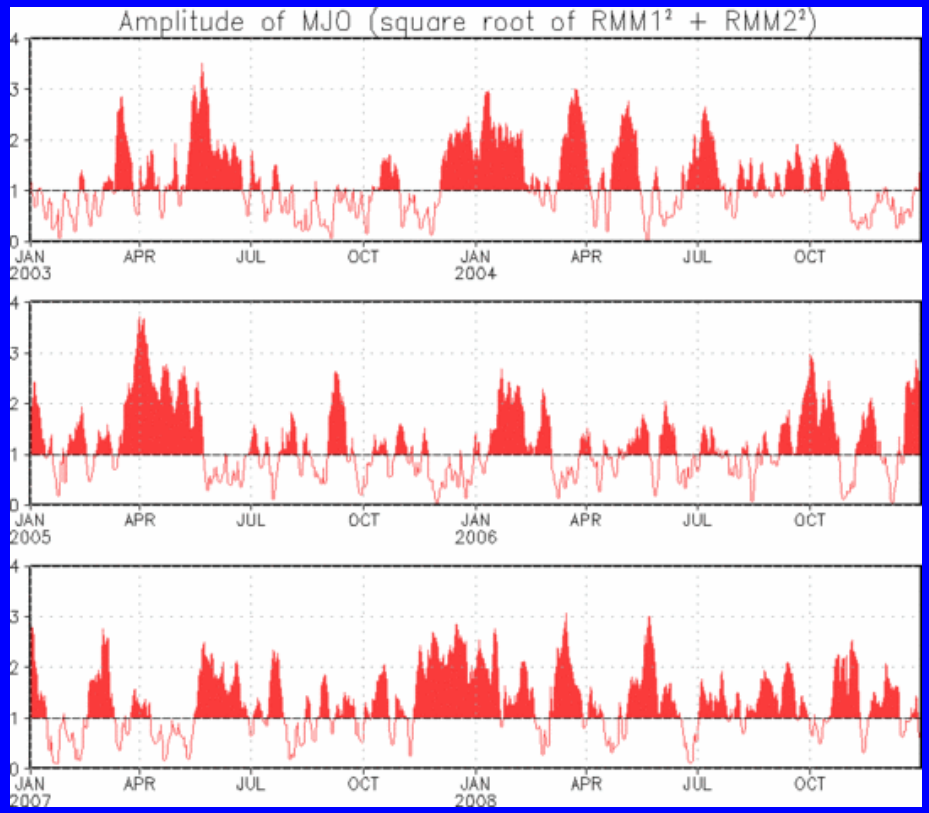



- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the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

**The MJO index indicates continued MJO activity with considerable eastward propagation.**

# MJO Index – Historical Daily Time Series




**Time series of daily MJO index amplitude from 1995 to present**

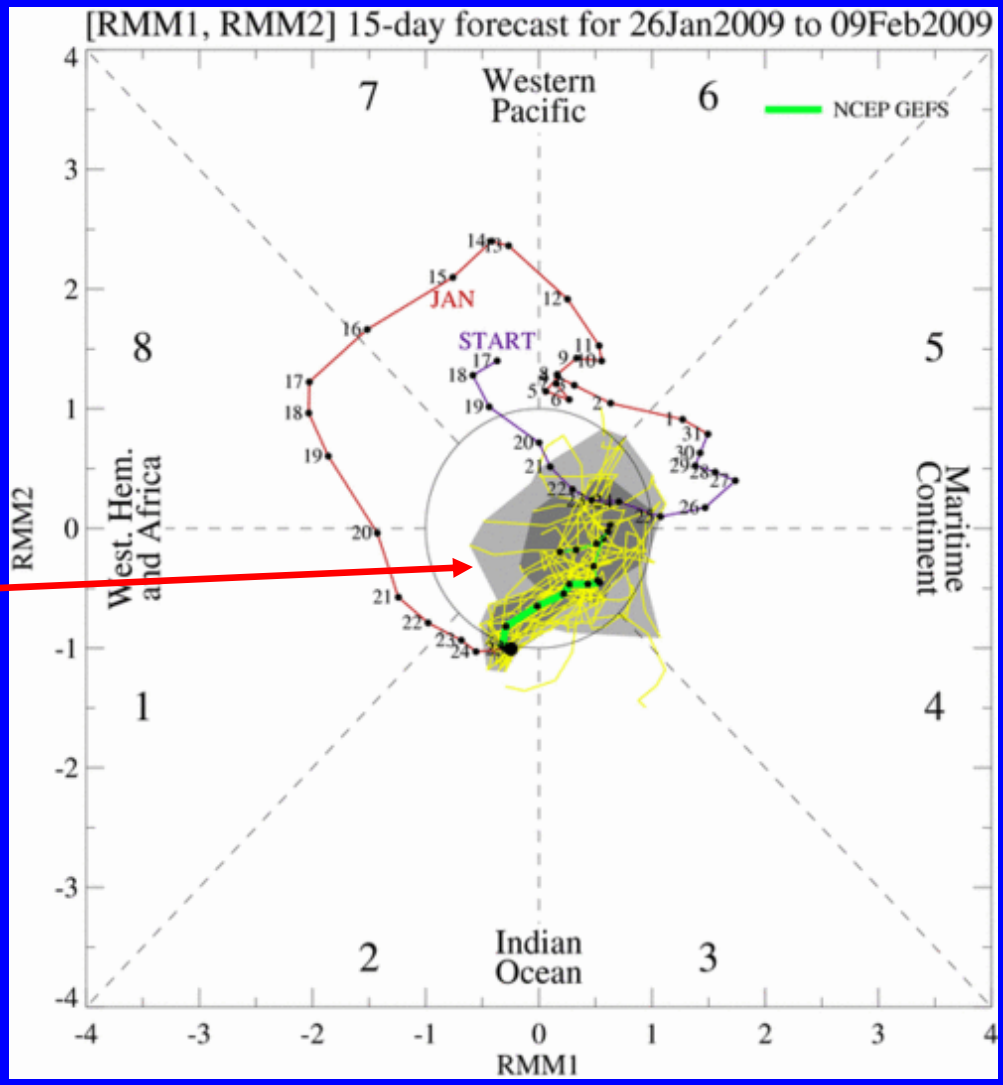
**Plots put current MJO activity in historical context**

# 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**

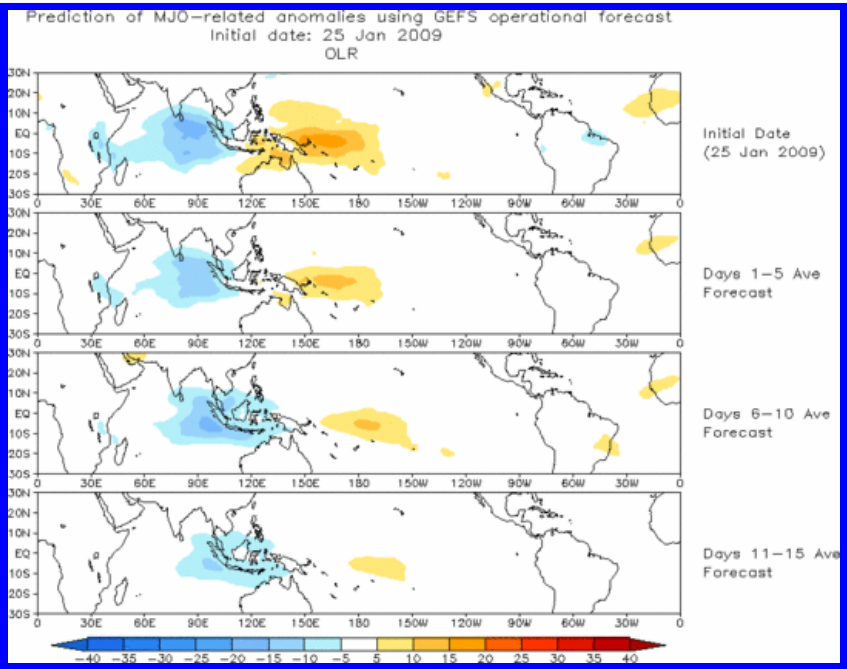



**The GEFS forecasts predict a weakened MJO signal as it propagates to the Indonesia region during the next 1-2 weeks.**

# Ensemble Mean GFS MJO Forecast

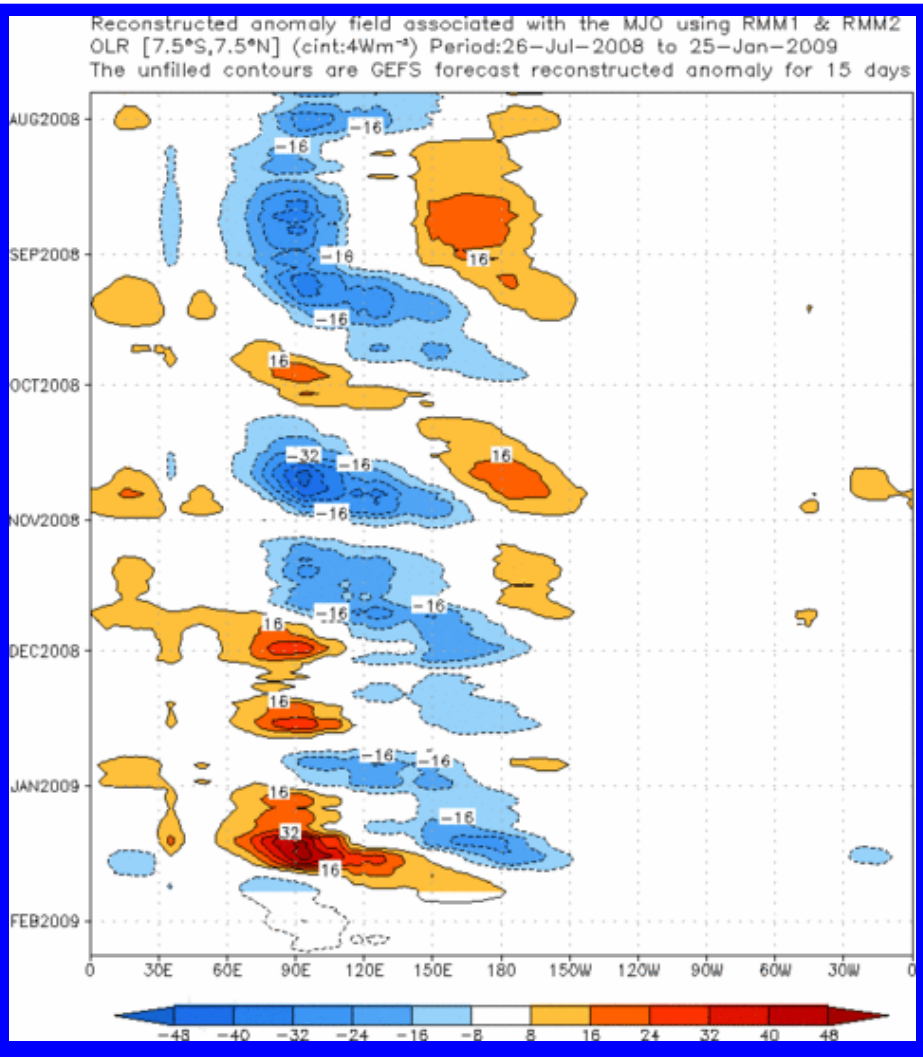
**Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)**

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




**Enhanced convection is expected to intensify across the Indian Ocean and Indonesia 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



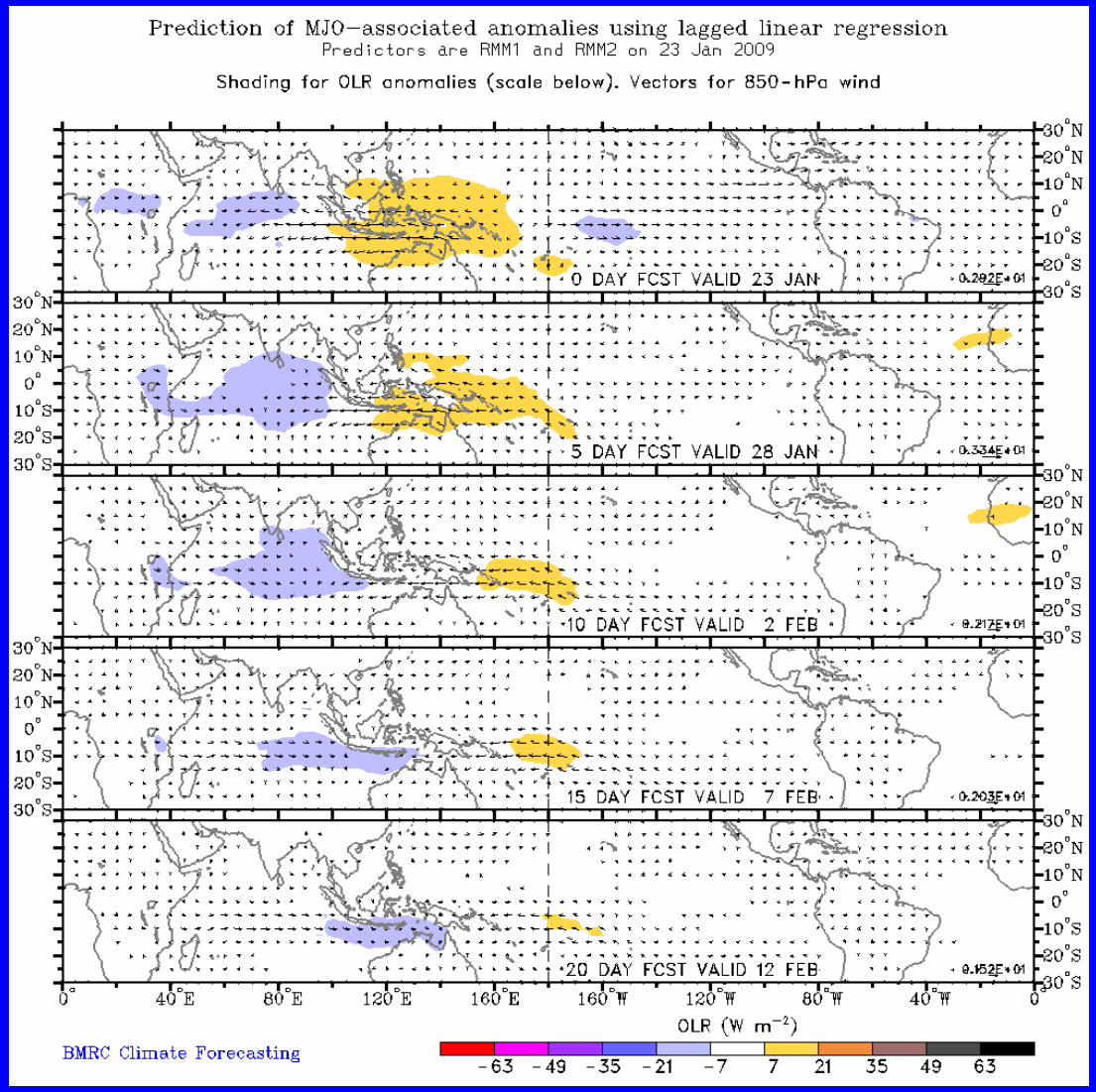
# Statistical MJO Forecast

**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**

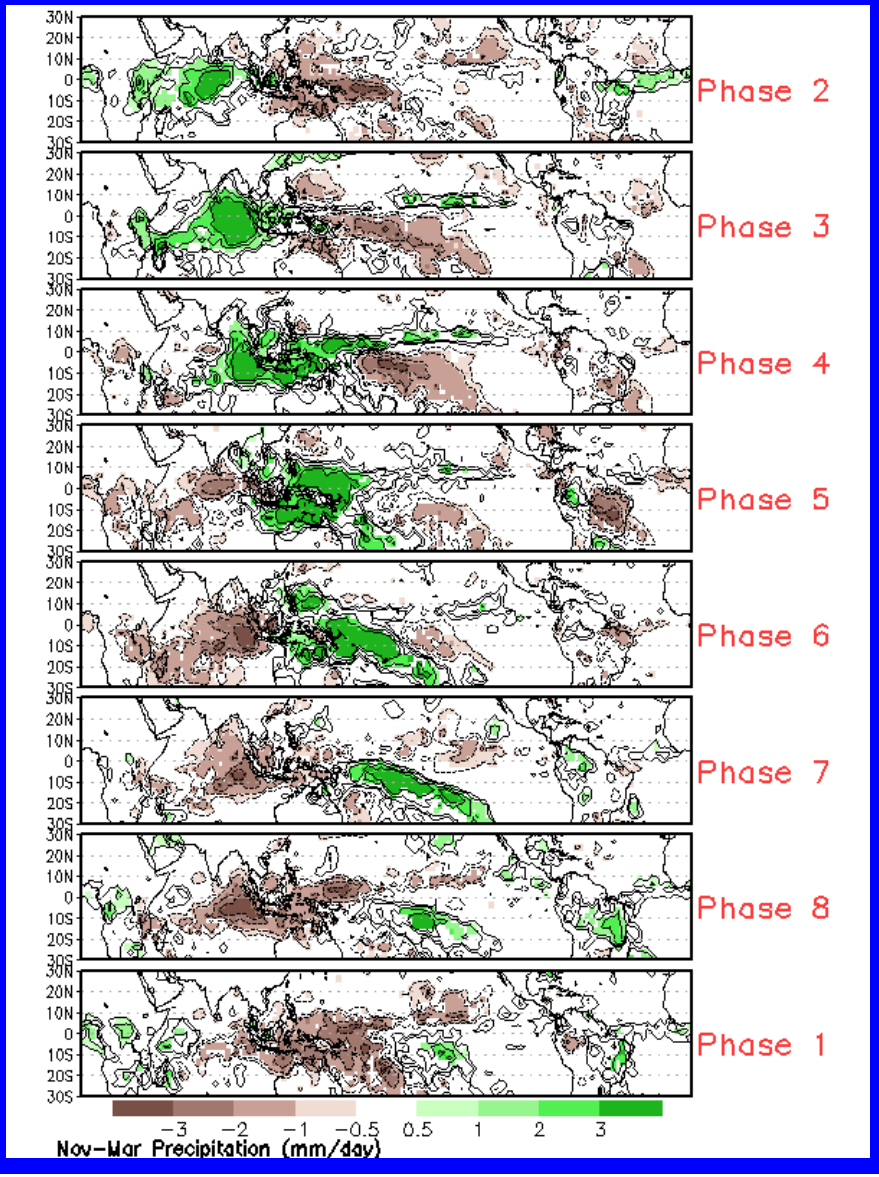
**(Courtesy of the Bureau of Meteorology Research Centre - Australia)**

**A weak-to-moderate MJO signal is forecast with suppressed convection predicted to shift away from the Maritime Continent during the period while enhanced convection increases for the Indian Ocean and Indonesia.**



# MJO Composites – Global Tropics

Precipitation Anomalies (Nov-Mar)




850-hPa Wind Anomalies (Nov-Mar)