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

**Update prepared by**
**Climate Prediction Center / NCEP**
**March 24, 2008**

# Outline

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

# Overview

- The MJO signal has decreased during the past week but has continued to shift eastward with the enhanced phase now entering the Indonesia region.

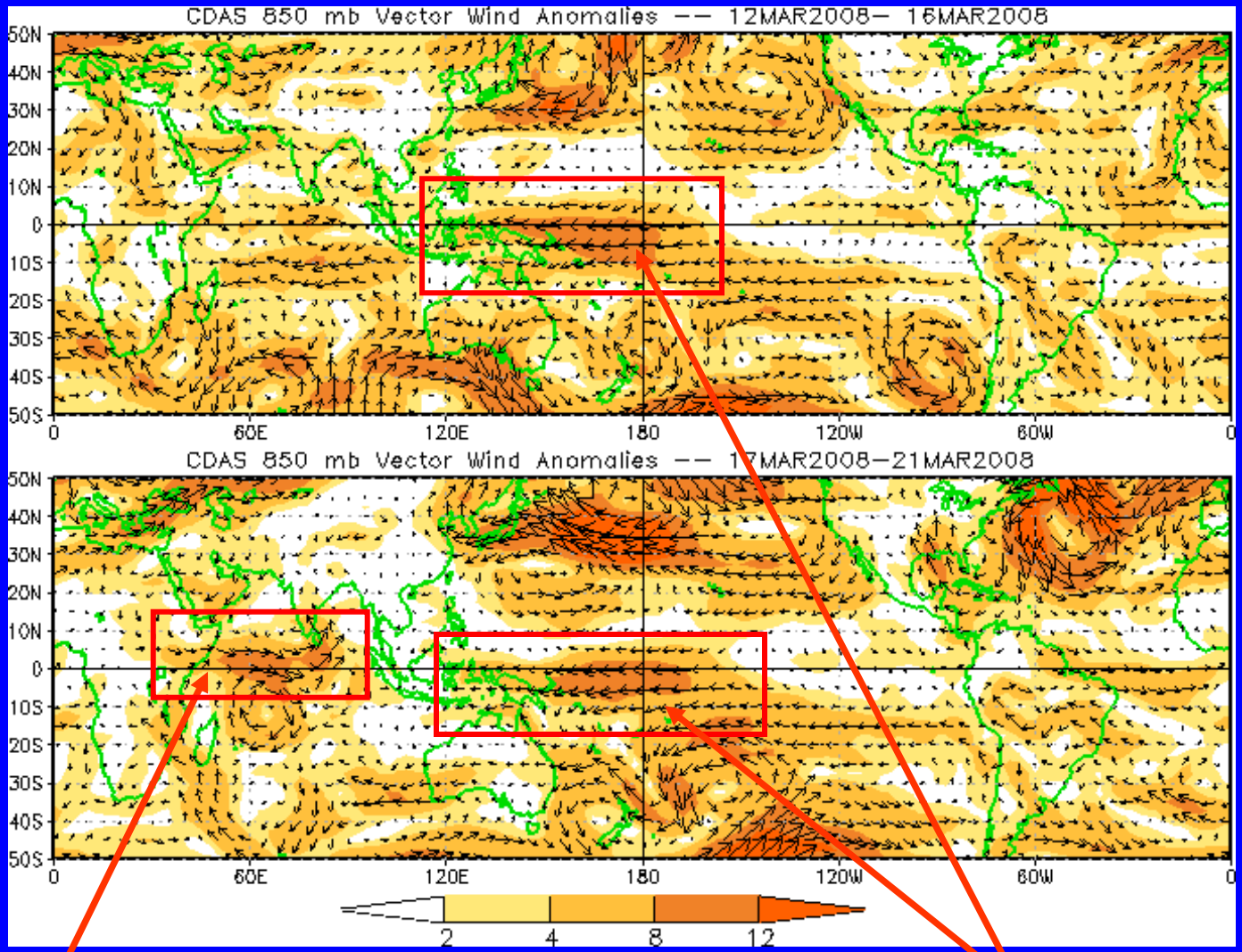
- Considerable uncertainty exists for the future strength and movement of the MJO during the next 1-2 weeks but continued eastward propagation now appears more likely.

- Enhanced tropical rainfall is expected across the Maritime Continent and the South Pacific Convergence Zone (SPCZ) during the period through contributions from both weak MJO activity and ongoing La Nina conditions.

- Tropical cyclone activity is favored for waters near Australia during the period.

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

Note that shading denotes the magnitude of anomalous wind vectors



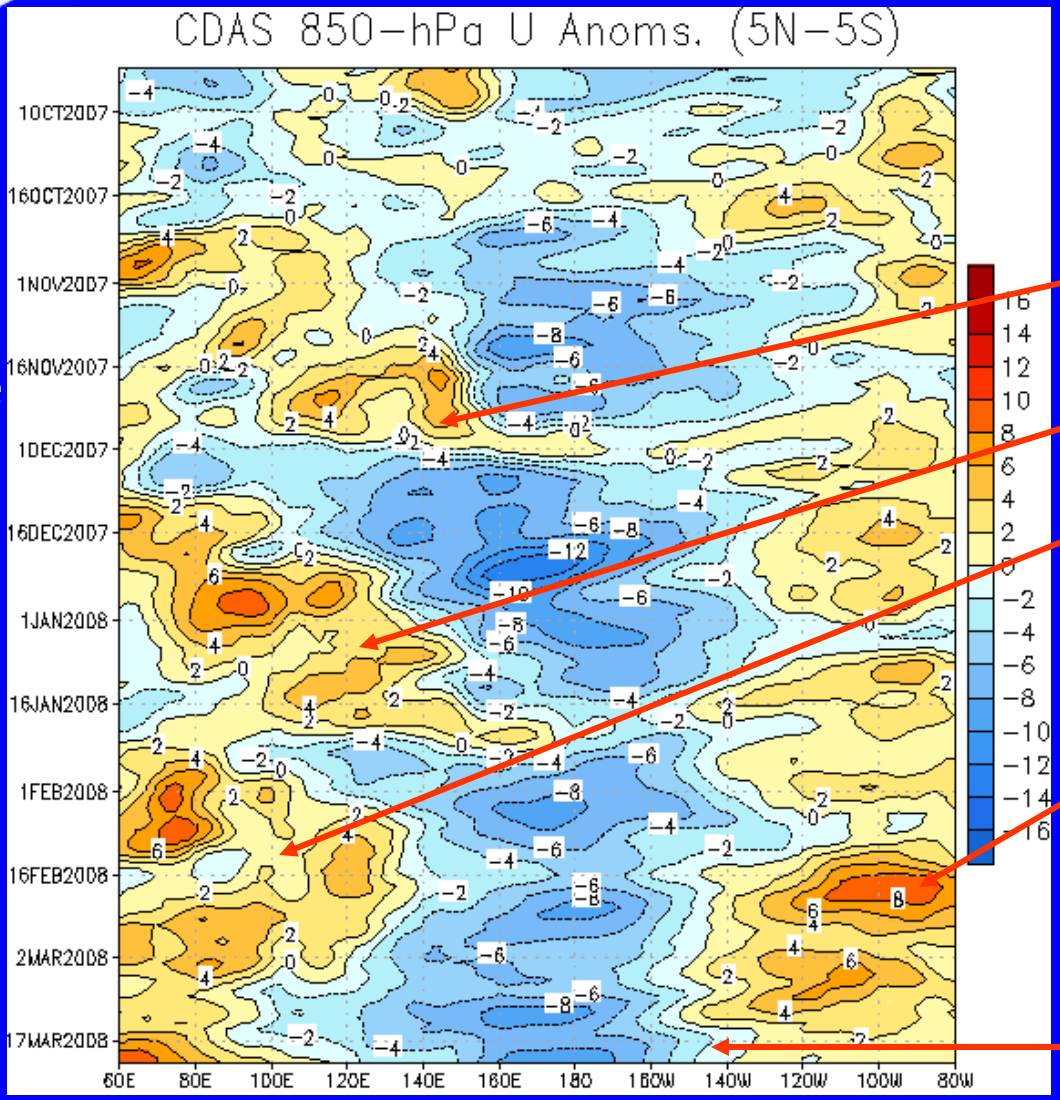

**Westerly anomalies have increased across the Indian Ocean during the last five days.**

**Easterly anomalies continue across the Maritime continent and the western Pacific. Anomalies have shifted slightly eastward during the last five days.**

# 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

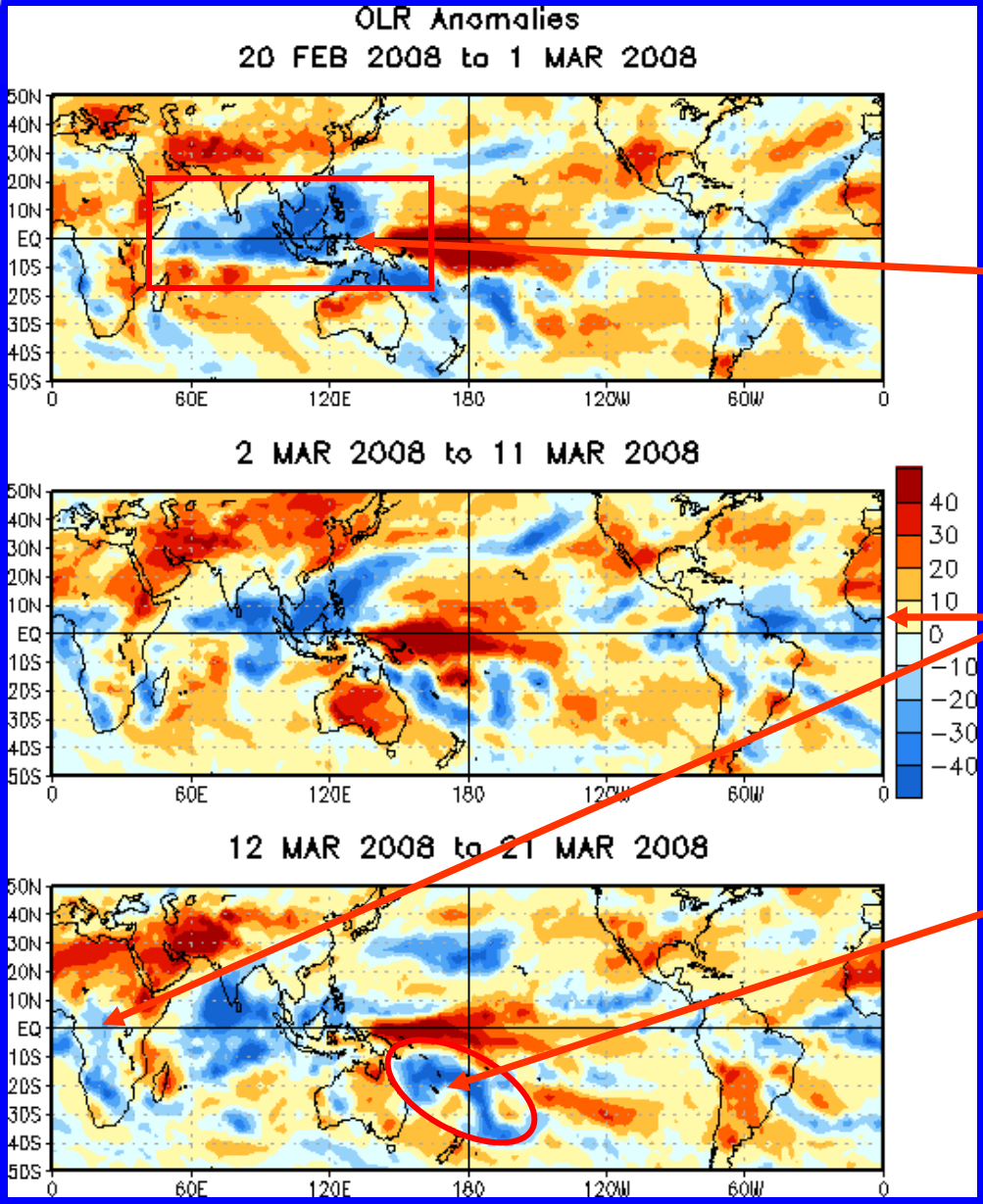
Longitude

**Moderate-to-strong MJO activity was evident from late October to mid-late February as shown by westerly anomalies shifting eastward from the Indian Ocean across Indonesia and a weakening of the easterlies at the Date Line during early December, mid-January and mid-February.**

**Westerly anomalies increased during mid-February across the eastern Pacific.**

**Recently, westerly anomalies have begun to shift eastward across the Indian Ocean. Low-level easterlies remain entrenched across much of the Pacific.**

# OLR Anomalies: Last 30 days




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

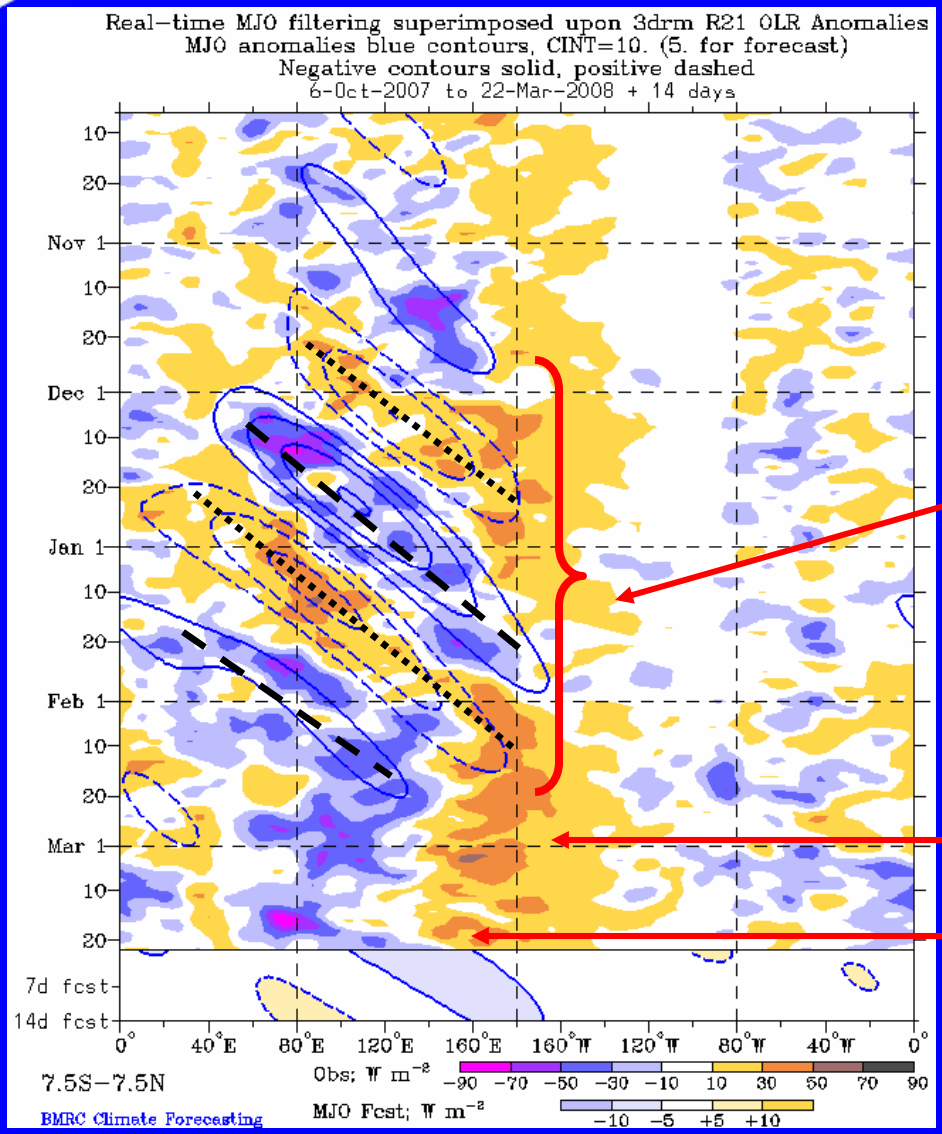
**Wetter-than-normal conditions, negative OLR anomalies (blue shading)**

**Wet conditions were observed across the Indian Ocean, Maritime Continent, and northern Australia during late February.**

**During early-mid March, convection increased across parts of South America, the Atlantic Ocean, and Africa.**

**Associated with La Nina, the South Pacific Convergence Zone (SPCZ) has been convectively active while suppressed convection continues across the west-central Pacific throughout the period.**

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




Time

Longitude

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

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

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

**Moderate-to-strong MJO activity was evident from mid-November to mid-February with coherent eastward propagation of enhanced (suppressed) convection indicated by the dashed (dotted) lines.**

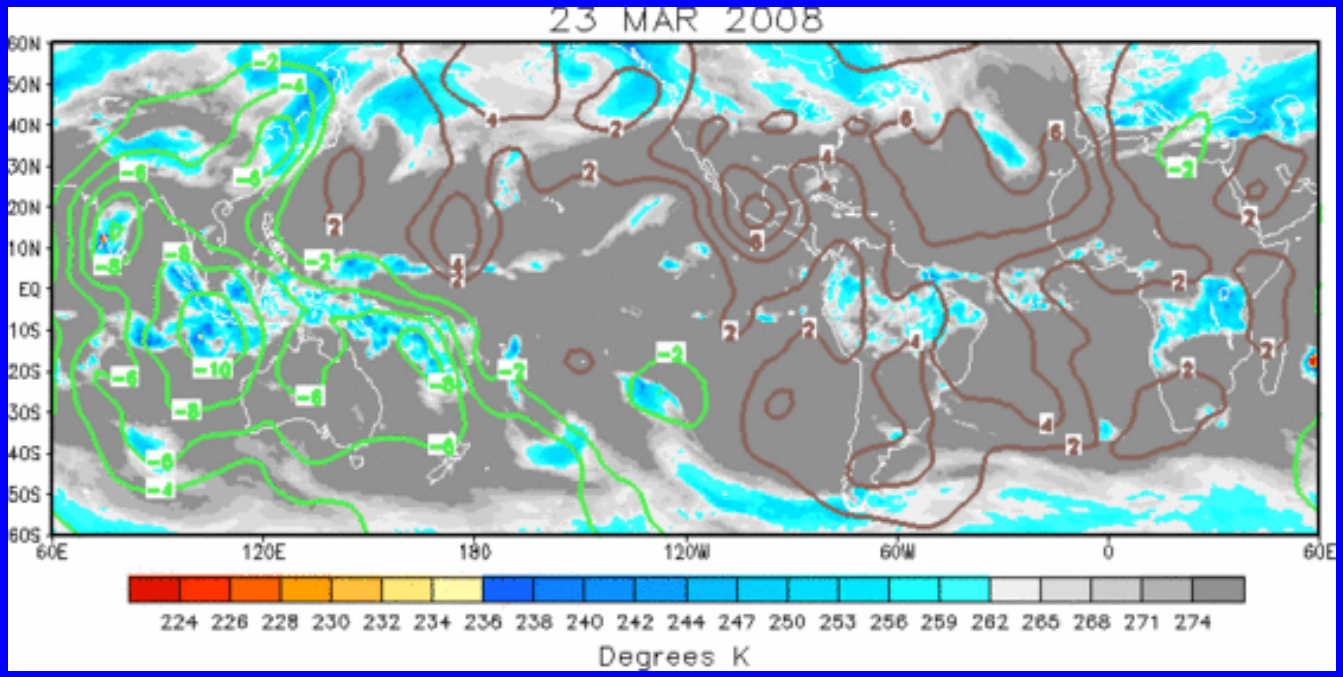
**From mid-February into early March, a more stationary pattern of anomalous convection was evident.**

**In recent days, strong enhanced convection has developed across the Indian Ocean and has rapidly shifted eastward.**

# 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**



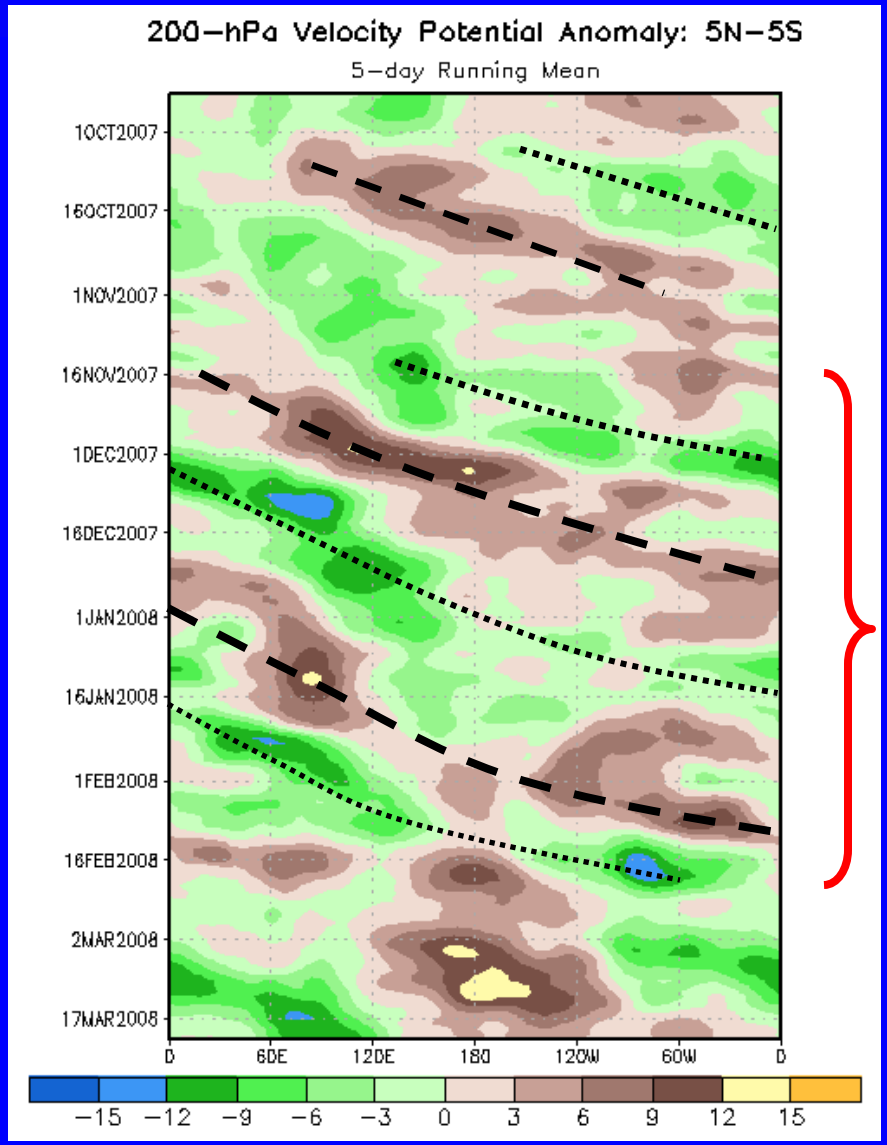

**The current global velocity potential anomalies indicate a somewhat weaker pattern as anomalies have decreased.**

**Upper-level divergence is indicated across the Indian Ocean and Maritime Continent while upper-level convergence prevails for the western hemisphere.**

# 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 during October but coherent propagation was generally short-lived.**

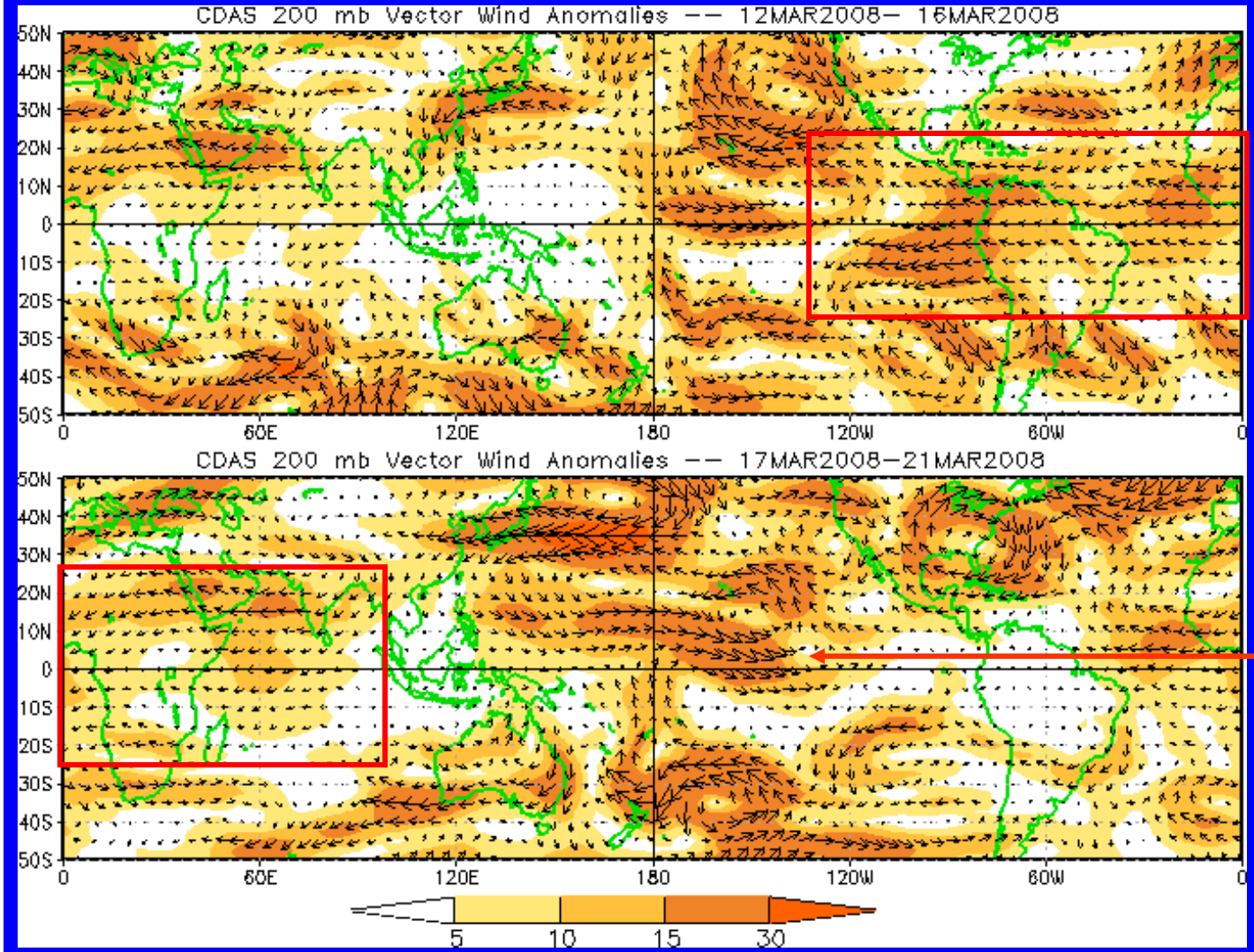
**Moderate-to-strong MJO activity developed in mid-November and continued into mid-February.**

**The MJO weakened during the second half of February.**

**During March, velocity potential anomalies increased and some eastward propagation is evident.**

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

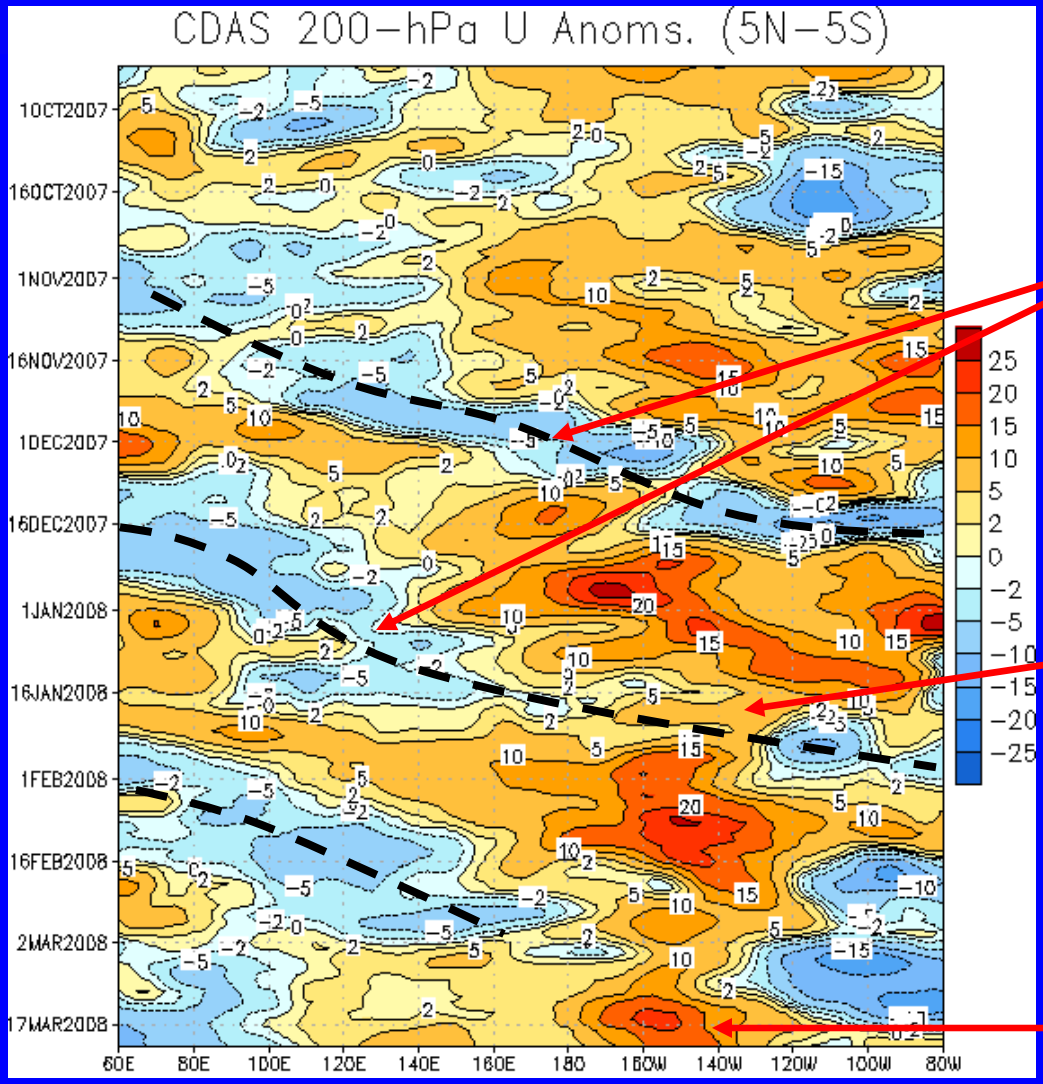
**Note that shading denotes the magnitude of anomalous wind vectors**




**Easterly anomalies across the tropics have shifted eastward to include much of Indian Ocean and Africa over the last ten days.**

**Westerly anomalies are evident across parts of the equatorial Pacific.**

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




Time

Longitude

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

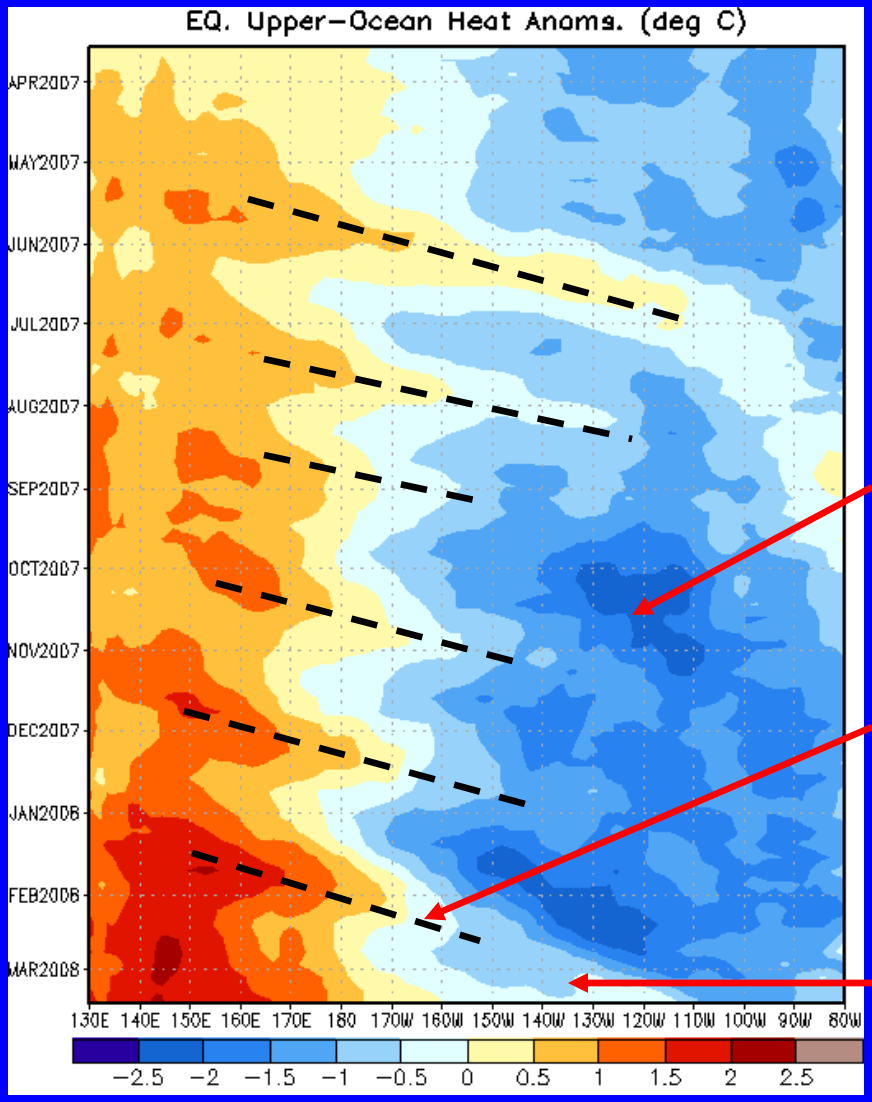
**Easterly anomalies (blue shading) represent anomalous east-to-west flow**

**MJO activity is evident in the upper-levels by eastward propagation of easterly anomalies (dashed lines) globally from early November into February.**

**The signal of cycle 2 of this MJO activity was somewhat weaker and less distinct across the central Pacific Ocean due to strong La Nina conditions.**

**Most recently, westerly anomalies have increased from the Date Line to 120W.**

# Weekly Heat Content Evolution in the Equatorial Pacific




Time

Longitude

Kelvin wave activity (downwelling phases indicated by dashed lines) has been observed since May and has affected the sub-surface temperature departures at varying degrees across the Pacific Ocean. The strongest wave occurred during May and June.

During September and October, negative heat content anomalies increased markedly across the eastern Pacific Ocean.

From late January into early February, increasingly positive anomalies developed across the western Pacific and shifted eastward associated with the latest downwelling Kelvin wave.

Negative anomalies have decreased in the last few weeks across the central Pacific.

# MJO Index -- Information

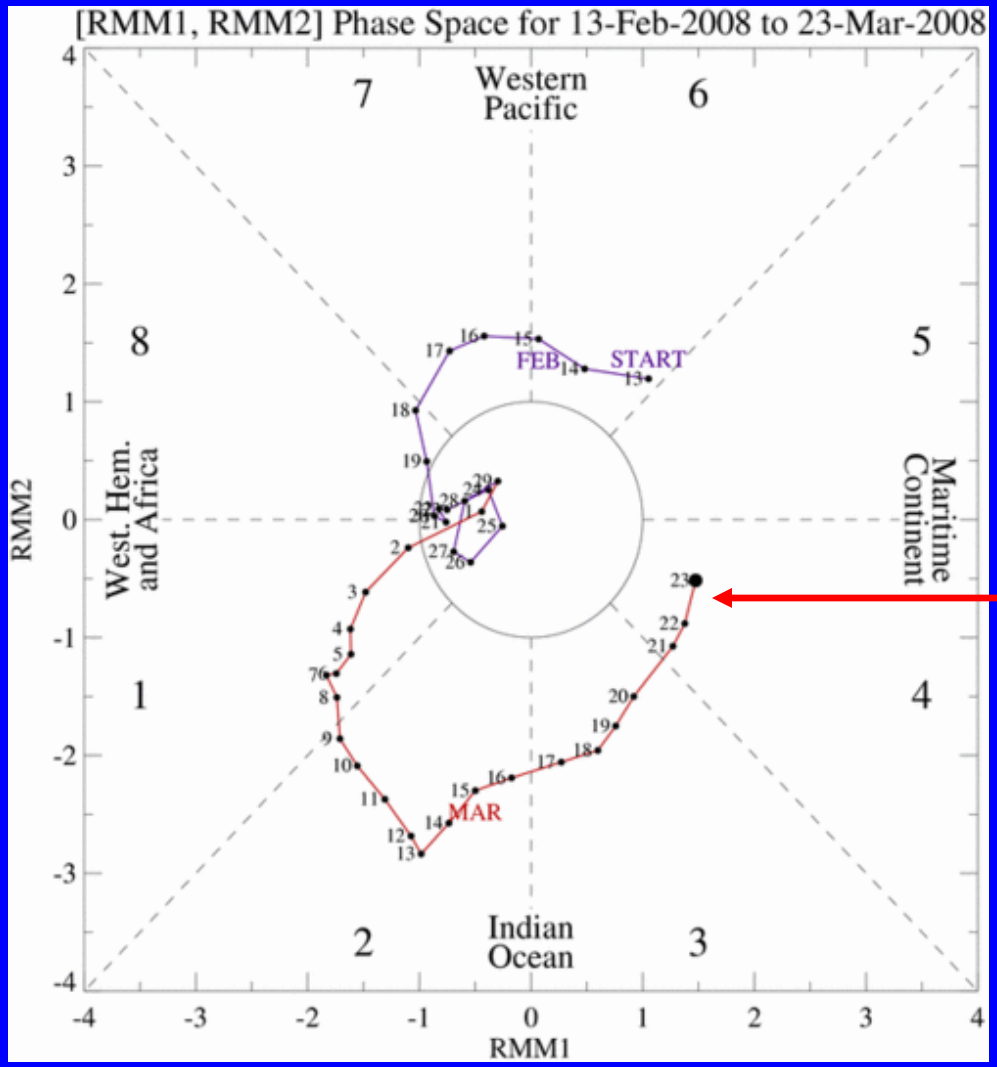
- **The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).**

**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).**

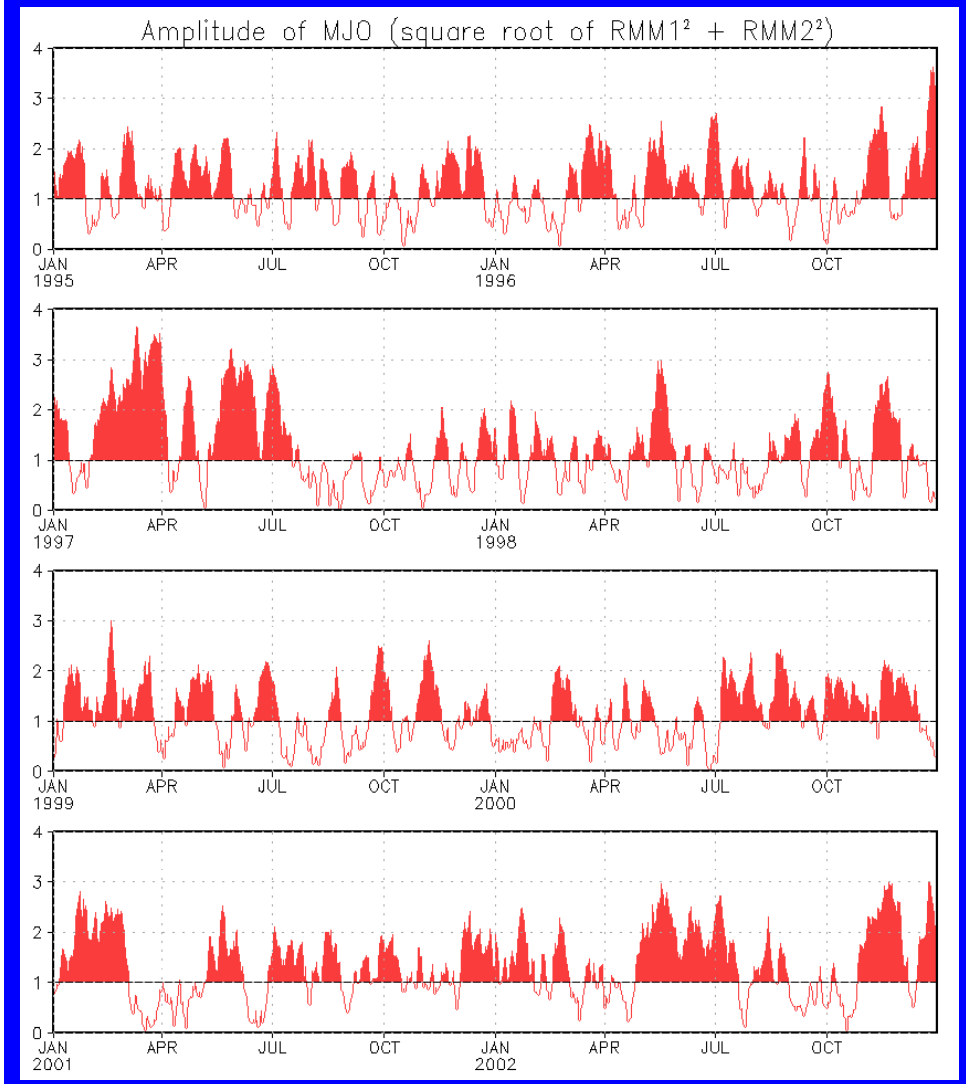
# MJO Index -- Recent Evolution

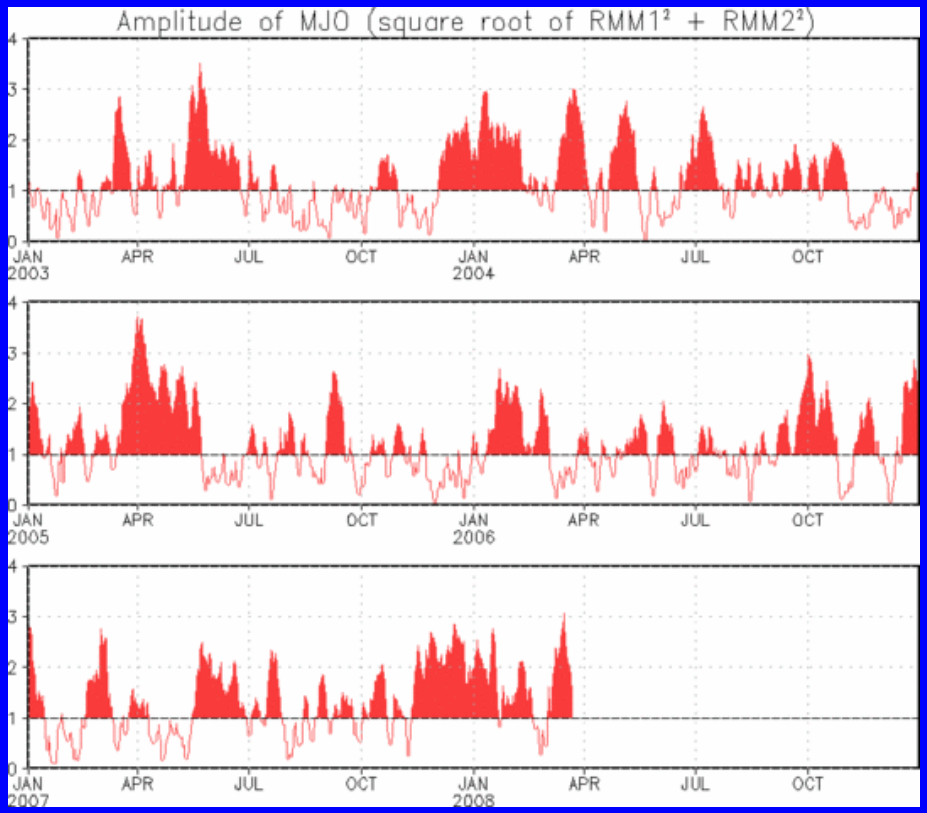



- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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

**The MJO index amplitude has gradually weakened during the past week. The signal has continued to shift eastward, however.**

# 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**

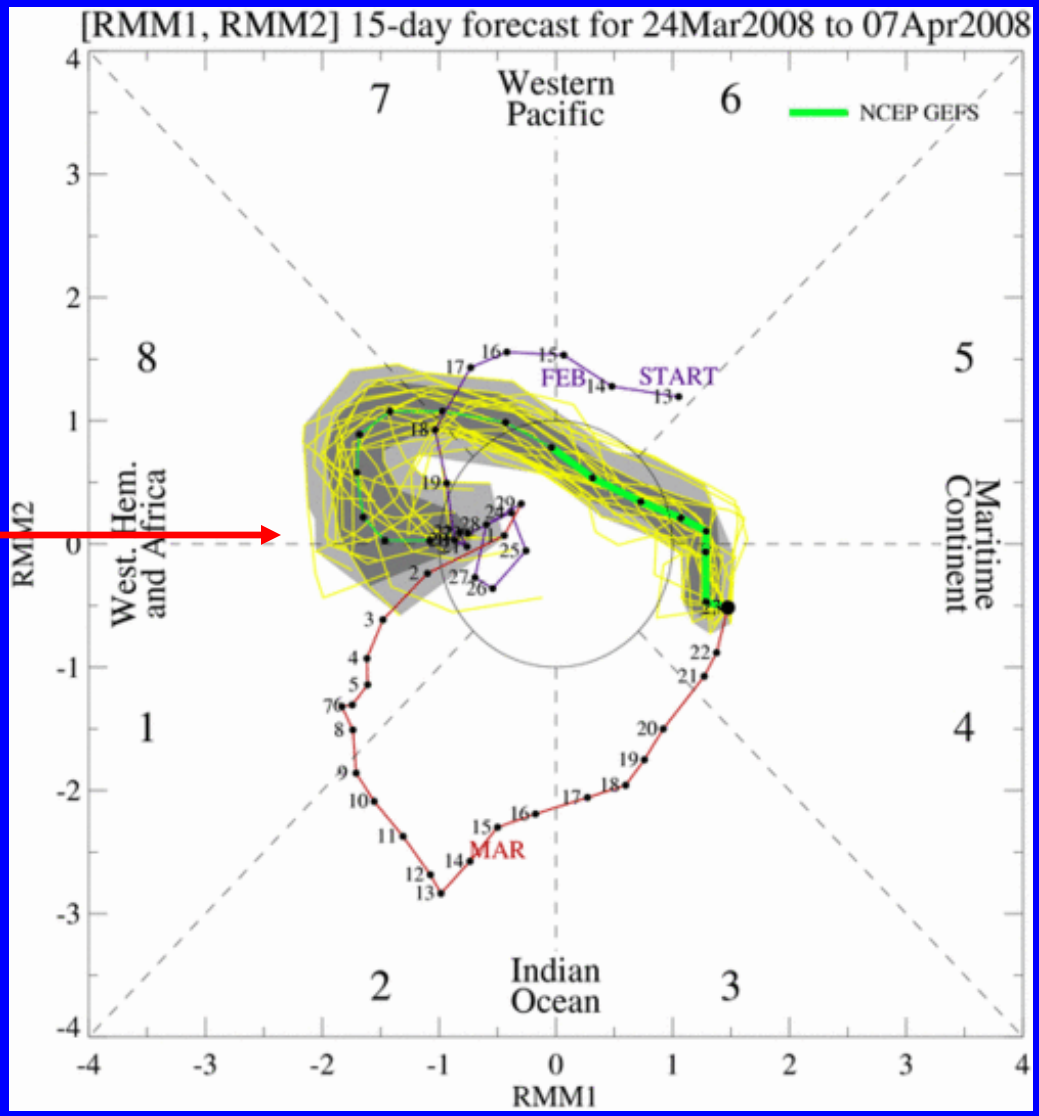
# Ensemble GFS MJO Forecasts

**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**

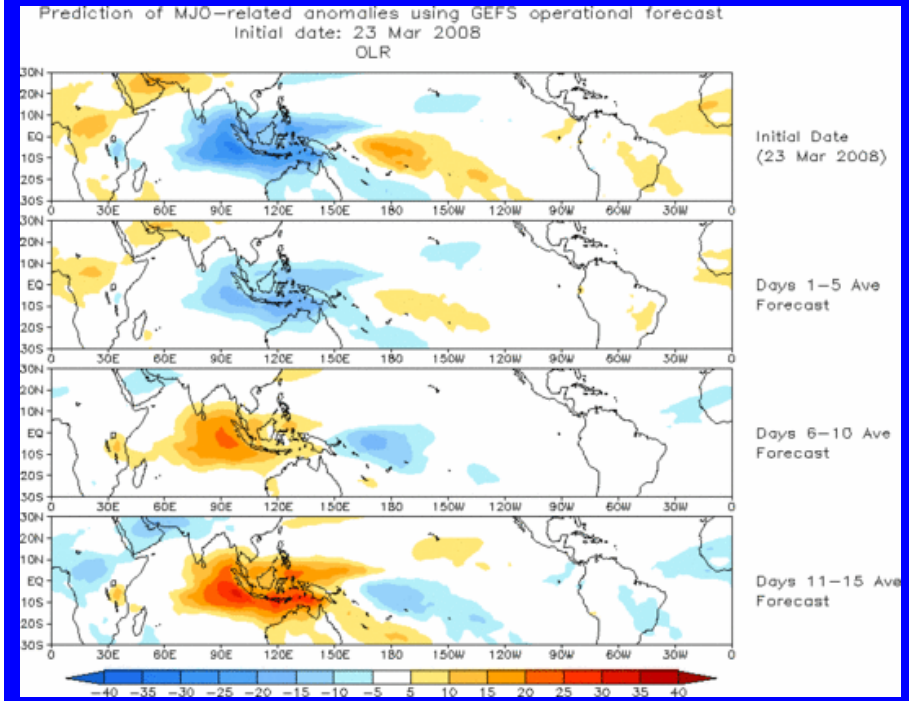
**The GEFS ensemble mean predicts a moderate MJO signal during the next 15 days with propagation into the western hemisphere.**



# Ensemble Mean GFS MJO Forecast

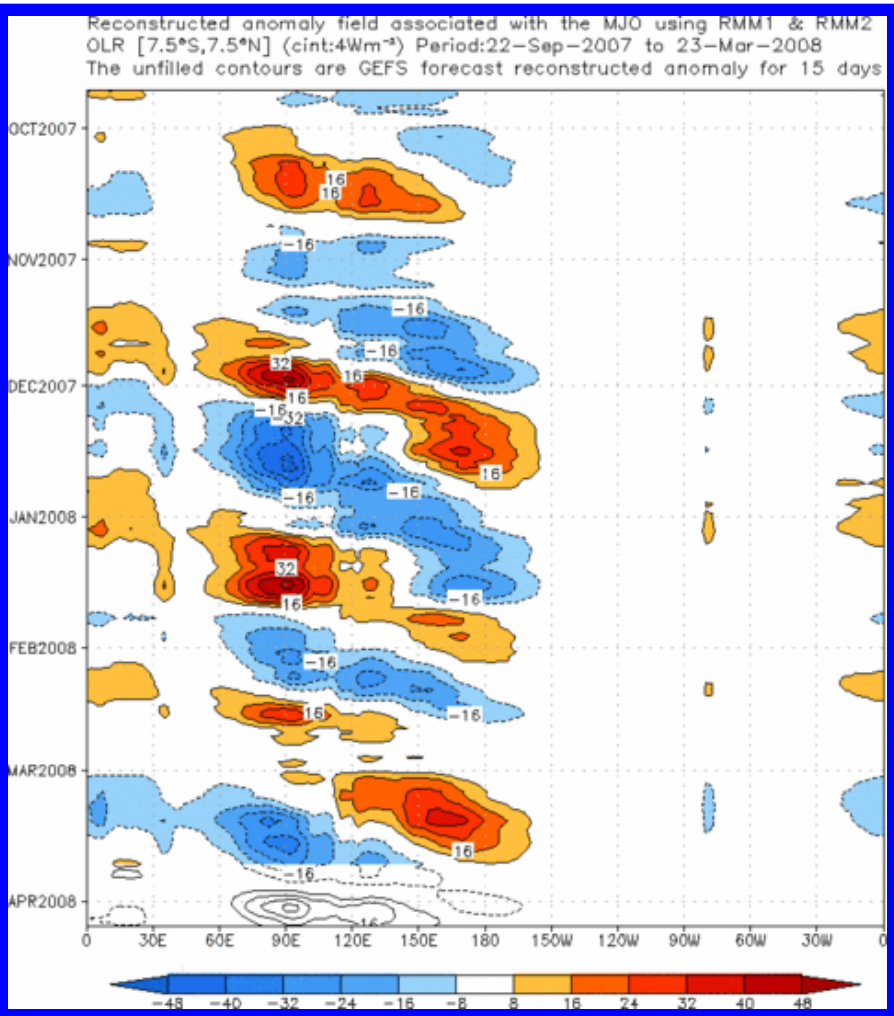
**Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)**

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




**MJO-related enhanced convection is forecast to shift from Indonesia to parts of Africa over the period. Suppressed convection, associated with the MJO only, is forecast for the Maritime continent by the end of week 2.**

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



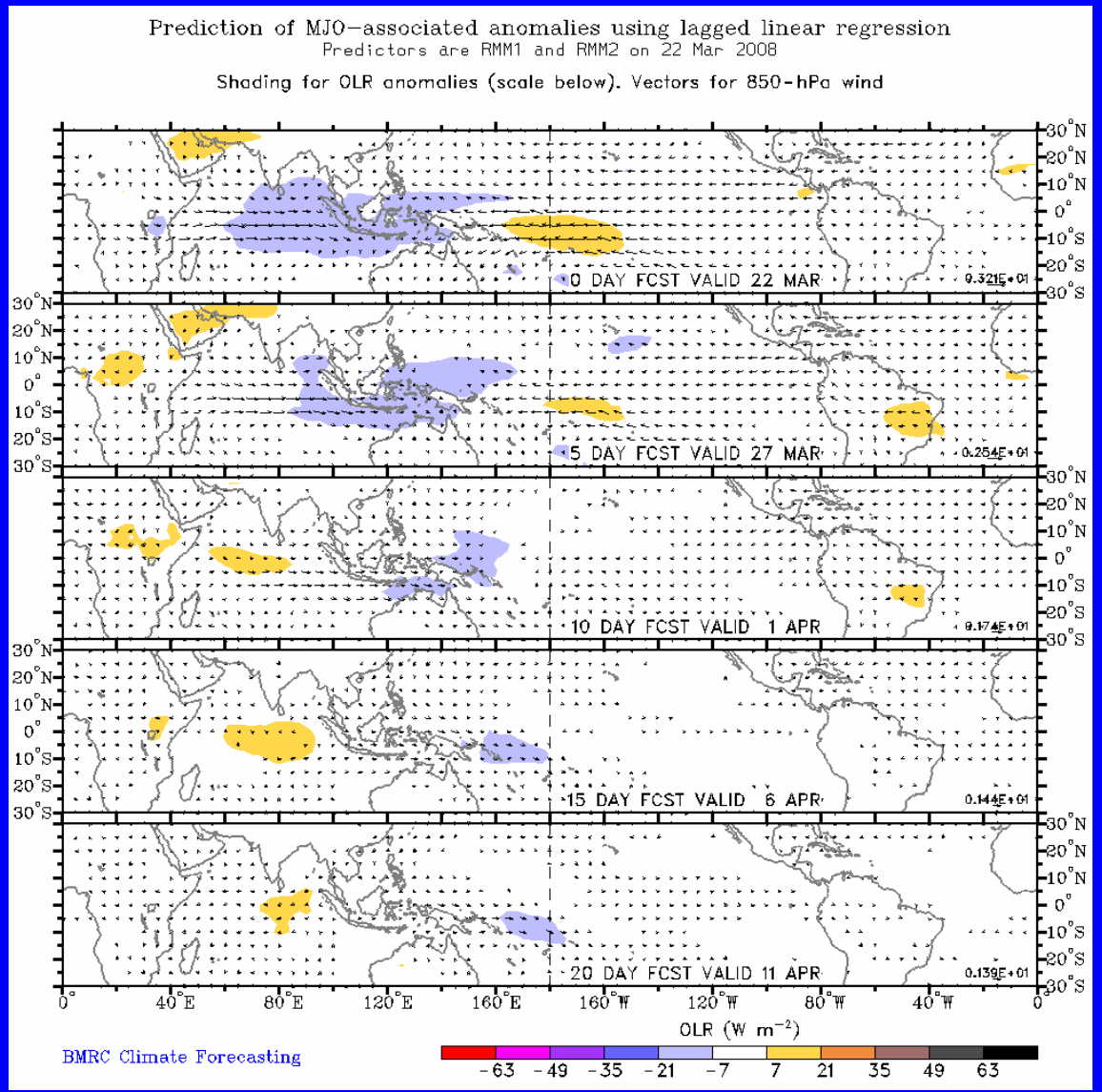
# Statistical MJO Forecast

**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**

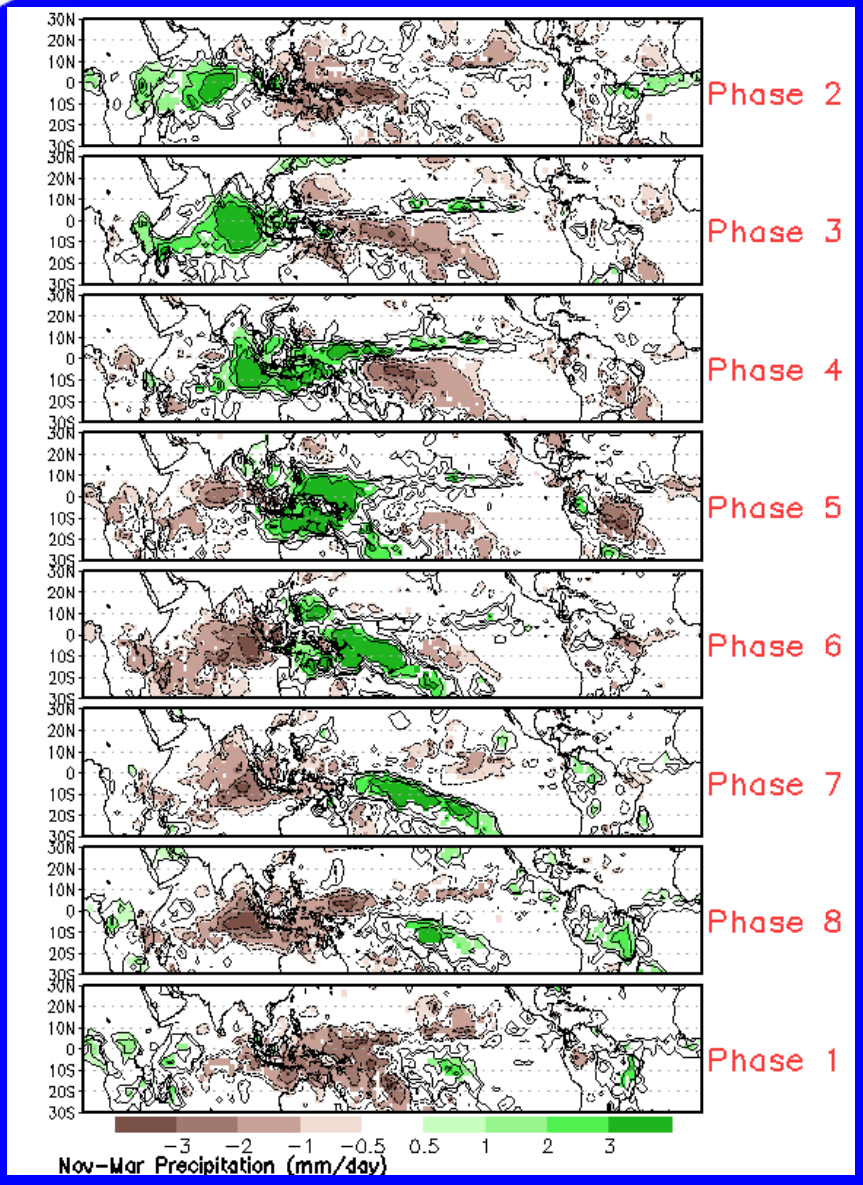
**(Courtesy of the Bureau of Meteorology Research Centre - Australia)**

**The statistical method forecasts weak-moderate MJO activity during the next 1-2 weeks with enhanced convection shifting from Indonesia into the western Pacific Ocean.**



# MJO Composites – Global Tropics

## Precipitation Anomalies




## 850-hPa Wind Anomalies