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

**Update prepared by**
**Climate Prediction Center / NCEP**
**August 4, 2008**

# Outline

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

# Overview

- The MJO has weakened during the past week.

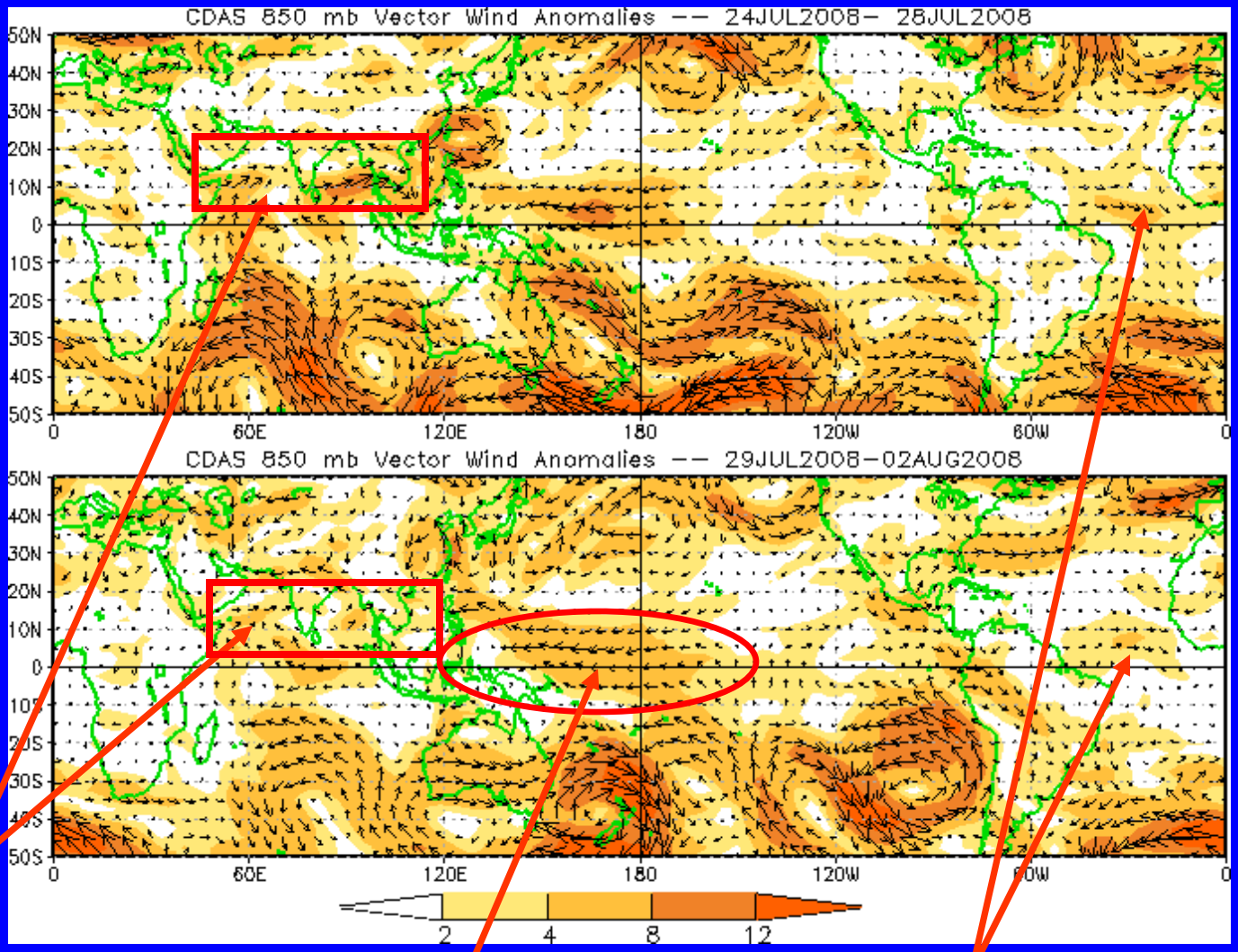
- Considerable spread exists in model forecasts of the MJO signal. Based on this and the most recent observations, the MJO is expected to remain weak during the next 1-2 weeks.

- Residual effects from the MJO signal may contribute to enhanced convection across portions of India, the Bay of Bengal, Southeast Asia, and the Philippines during week 1 while dry conditions are expected for the eastern Indian Ocean and western Indonesia.

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




**During the last ten days, areas of anomalous westerly flow are evident across southern Asia and nearby waters.**

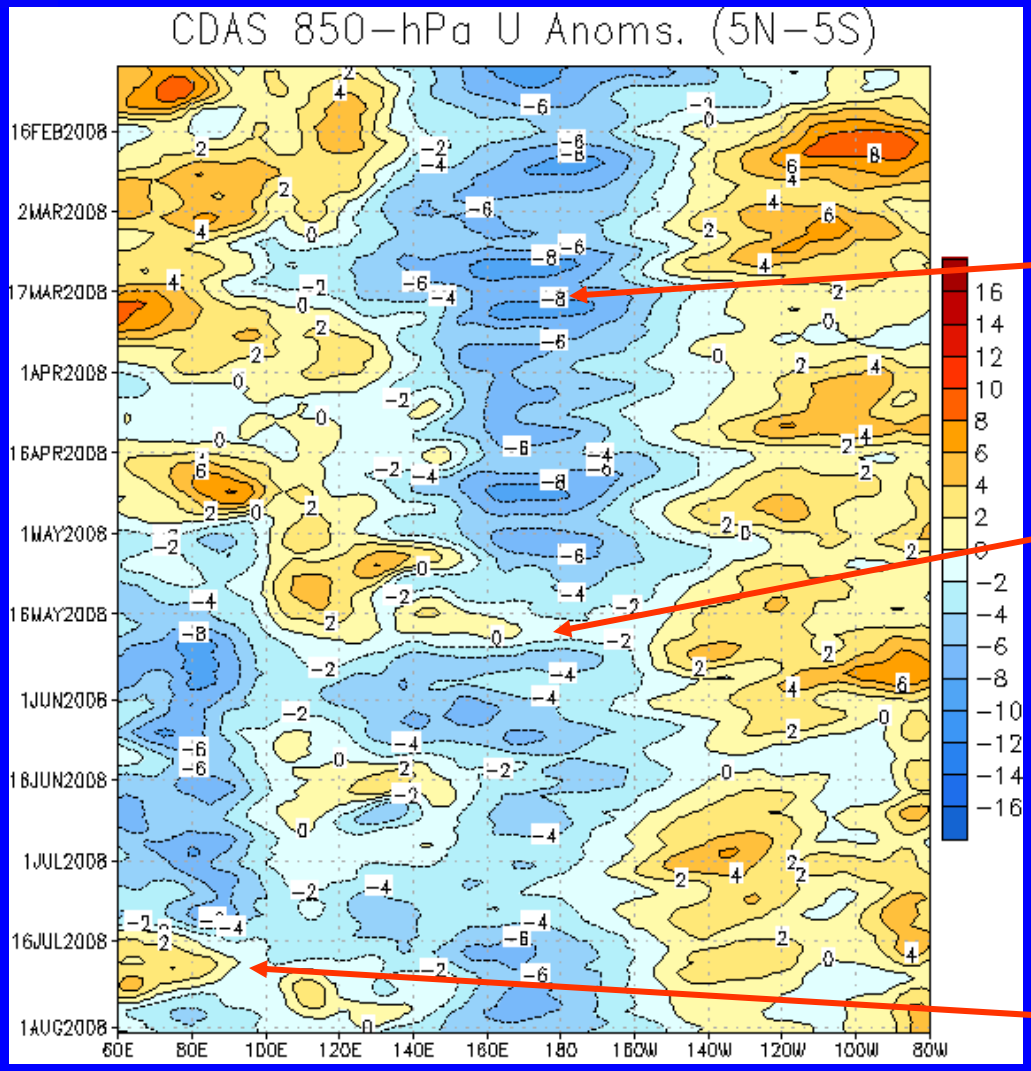
**Low-level easterly anomalies continue in the western Pacific.**

**Equatorial westerly anomalies across the Atlantic 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

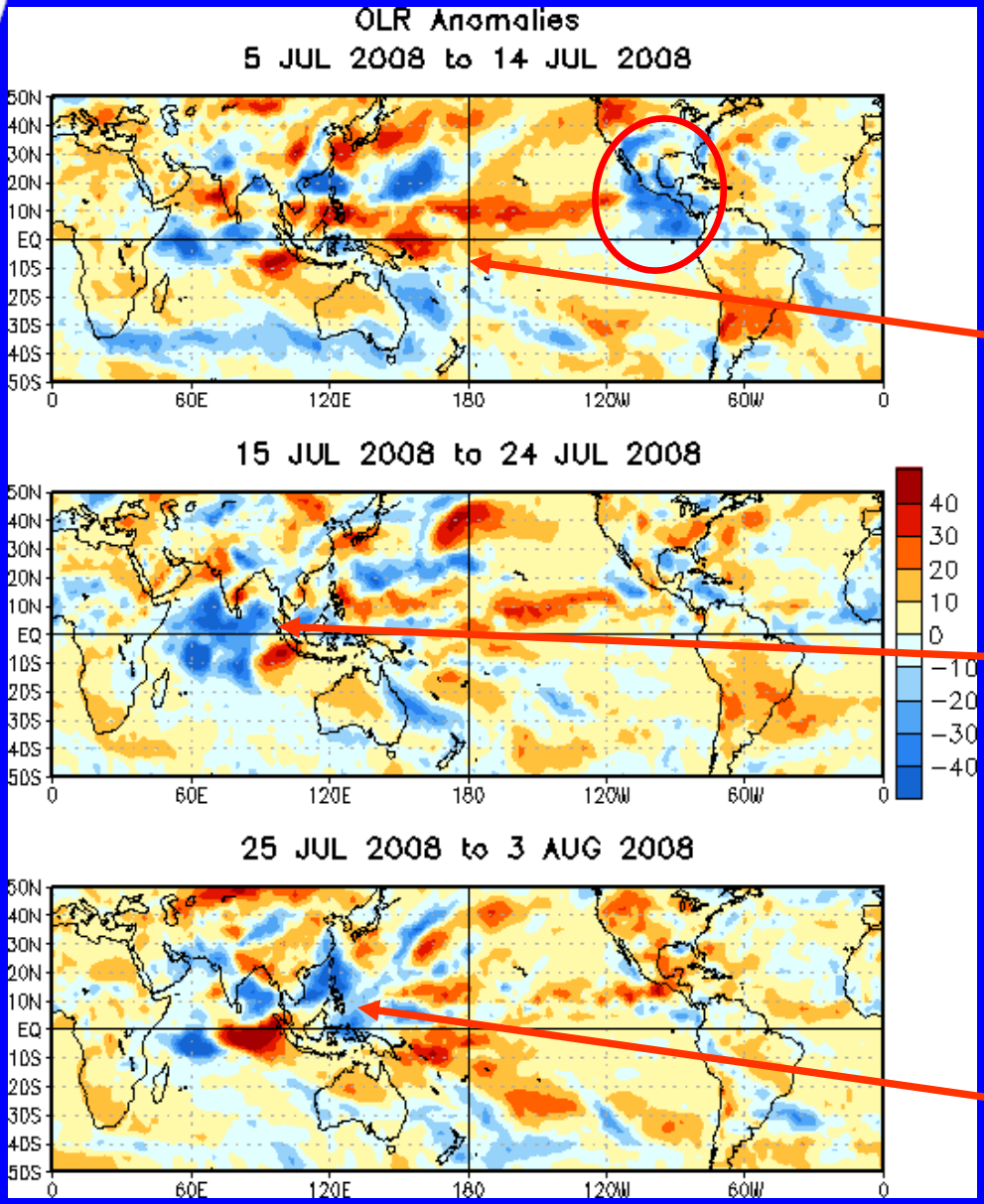
**MJO activity was weak during much of March and April with strong anomalous easterlies continuing.**

**During mid-May, easterlies weakened near the Date Line associated with moderate MJO activity.**

**Easterly anomalies prevailed across much of the eastern hemisphere from late May into mid July.**

**Westerly anomalies were evident across parts of the Indian Ocean and Indonesia during the second half of July associated with the recent weak MJO activity.**

# OLR Anomalies: Last 30 days




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

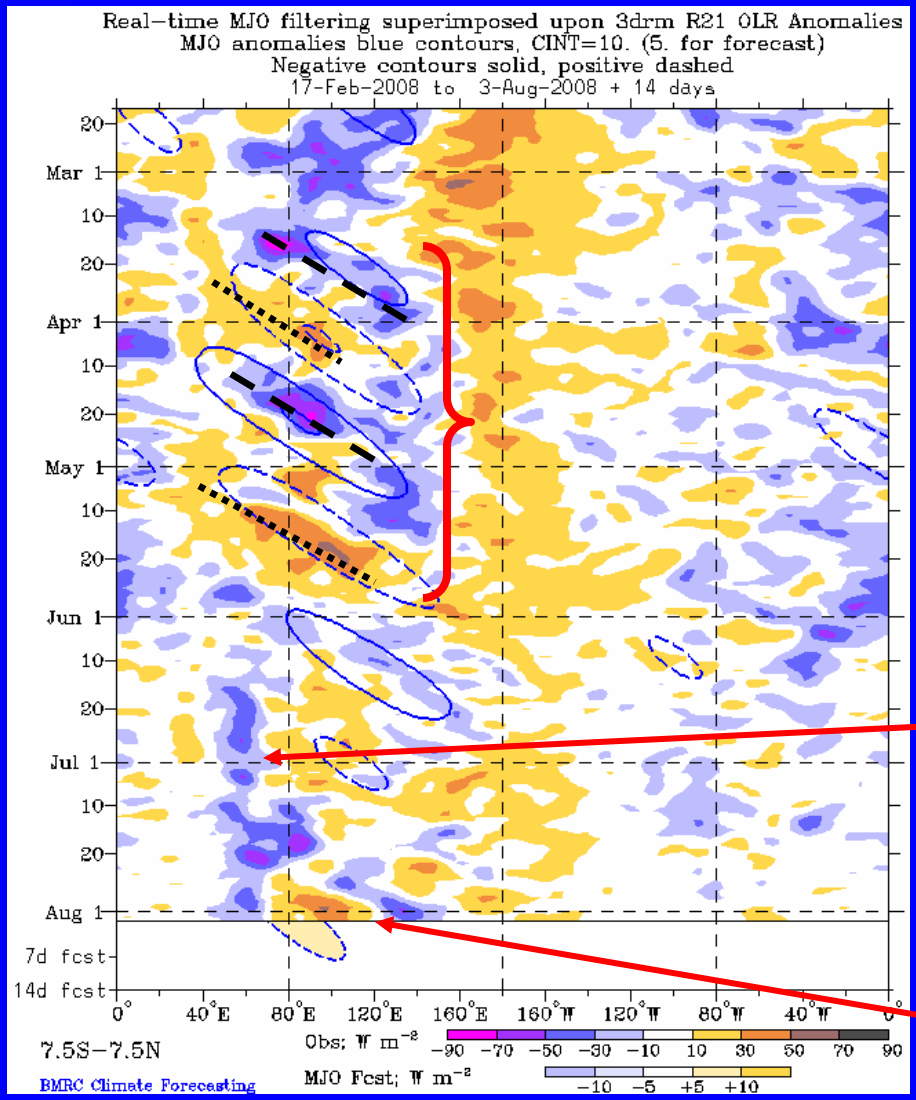
**Wetter-than-normal conditions, negative OLR anomalies (blue shading)**

**During early-mid July, a very active North American monsoon is evident while the western Pacific was generally drier than average.**

**Enhanced convection developed across the entire equatorial Indian Ocean during mid-July.**

**Northeast propagation of enhanced convection is evident during late-July and is indicative of weak MJO activity.**

# 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)**

**MJO activity was evident from mid-March into early June at varying levels of intensity. The strongest MJO activity occurred as strong suppressed convection organized across the Indian Ocean and shifted eastward during mid-to-late May.**

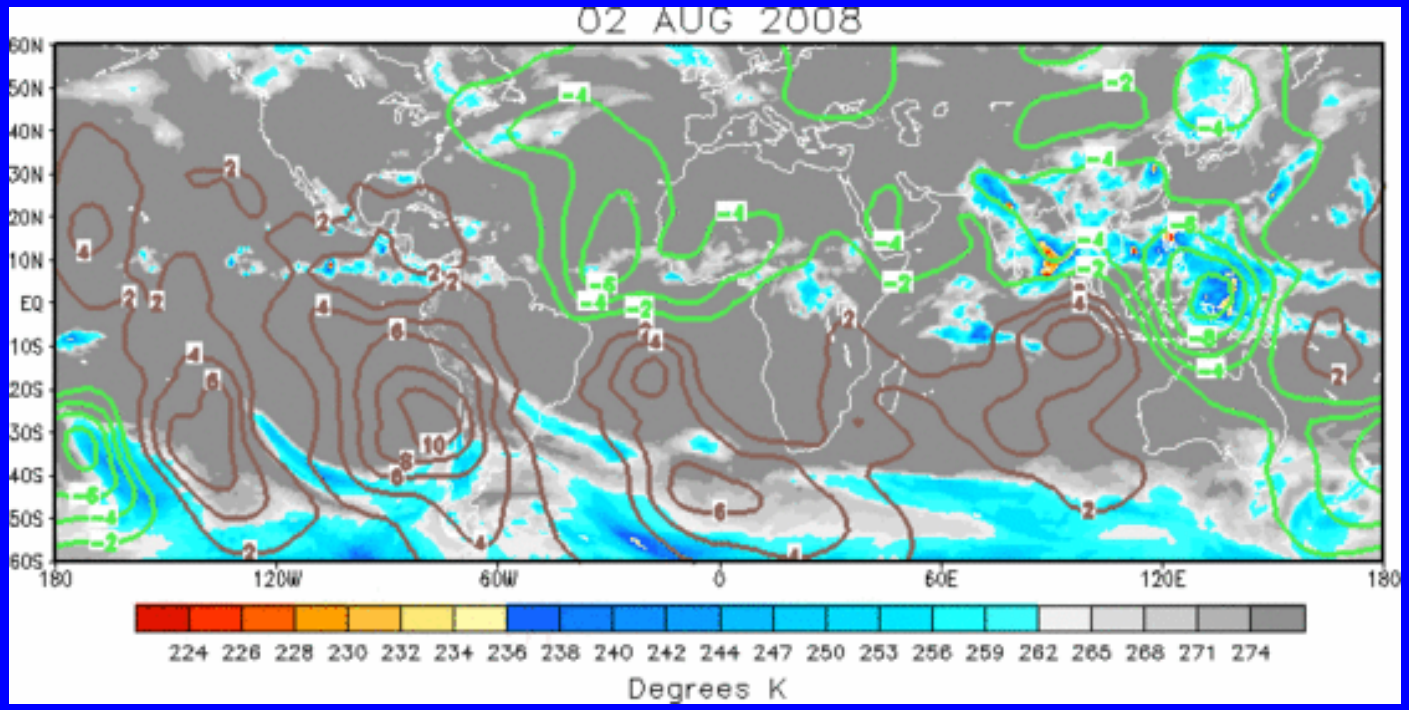
**Persistent enhanced convection has been evident across the western Indian Ocean since mid-July.**

**During the past week, suppressed convection is evident across the equatorial Indian Ocean.**

# 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**

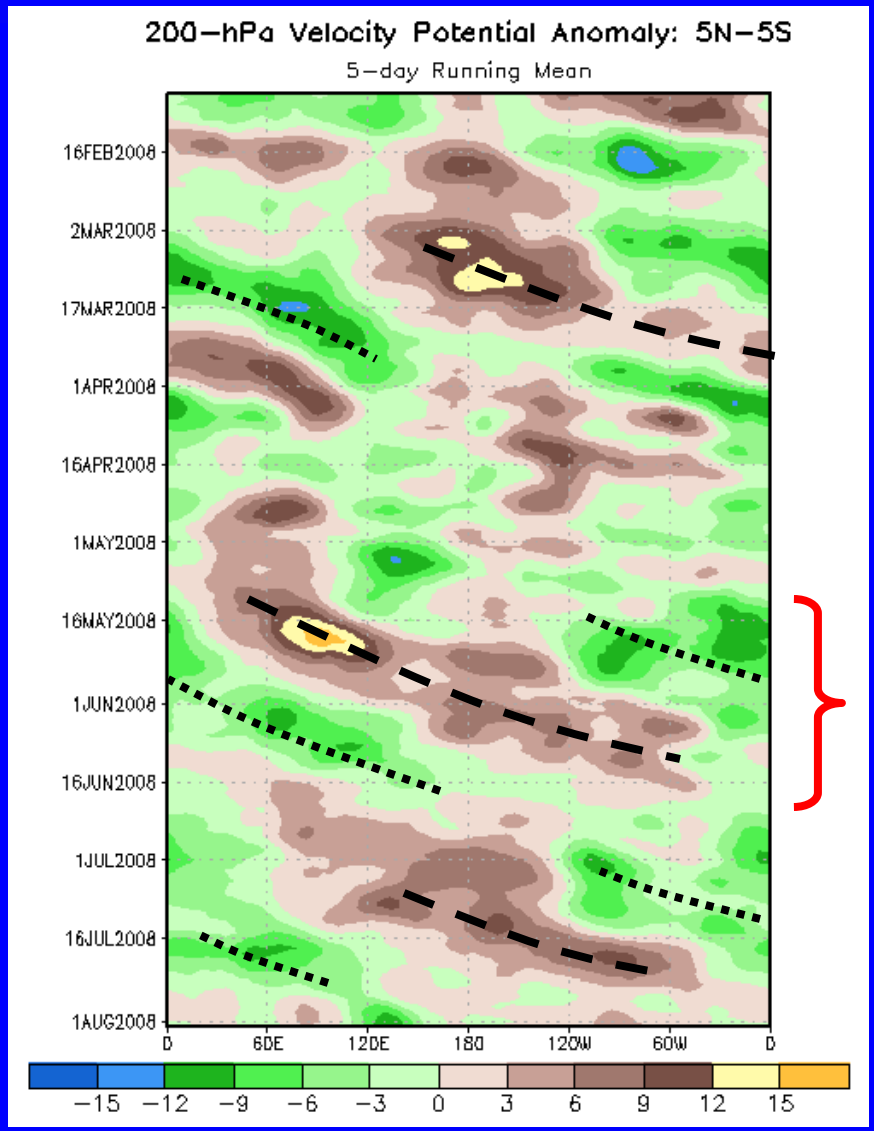



**Velocity potential anomalies indicate moderate-to-strong upper-level divergence across southern Asia and the western Pacific Ocean. Weak upper-level convergence is evident across much of the western hemisphere tropics.**

# 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

**Weak-to-moderate MJO activity was evident during parts of March.**

**The MJO was largely incoherent during the month of April.**

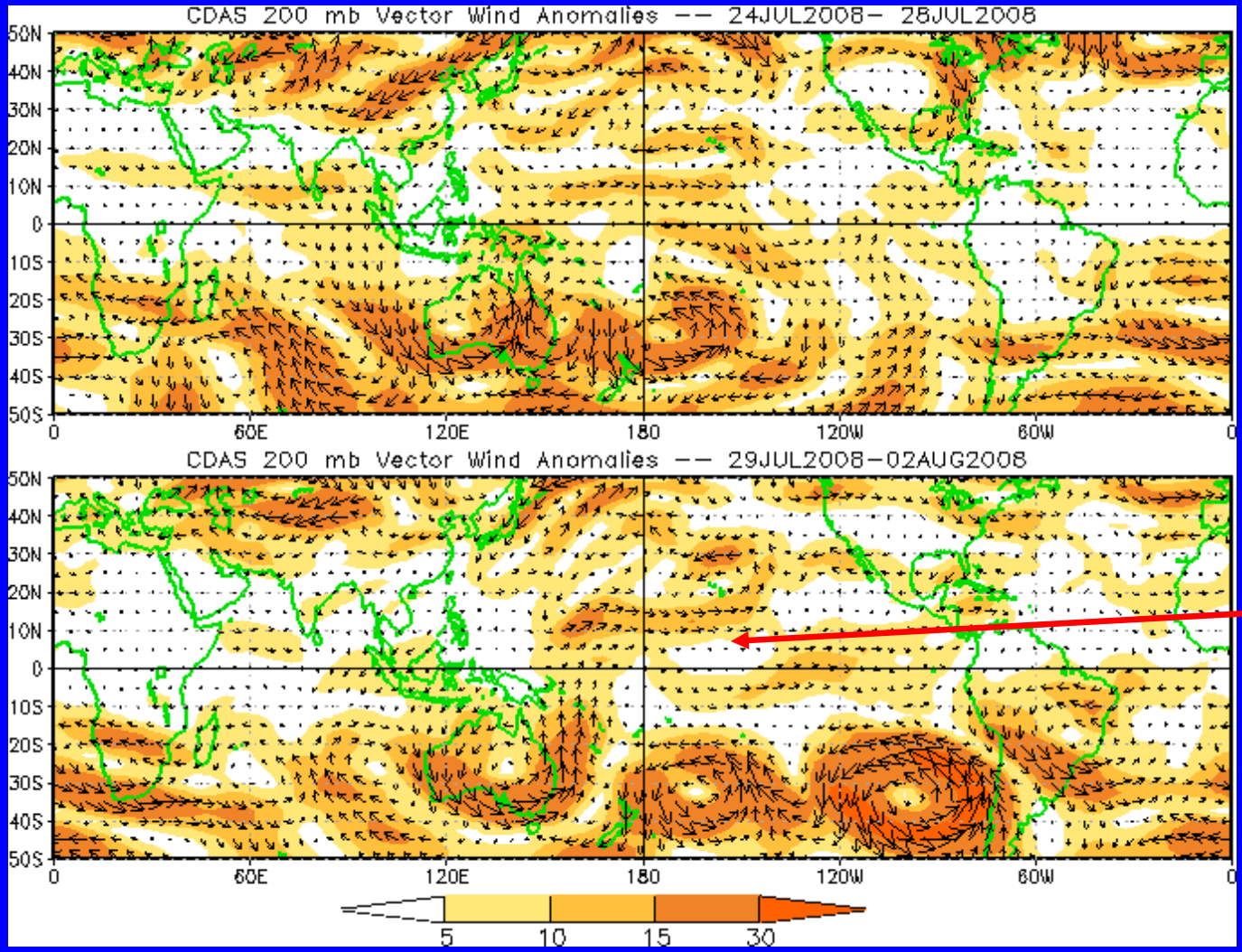
**A moderate-to-strong MJO was observed from mid-May through mid-June as eastward propagation was more coherent and longer-lived.**

**Weaker MJO weakened during late June.**

**The MJO strengthened during mid-July but has once again weakened during late July.**

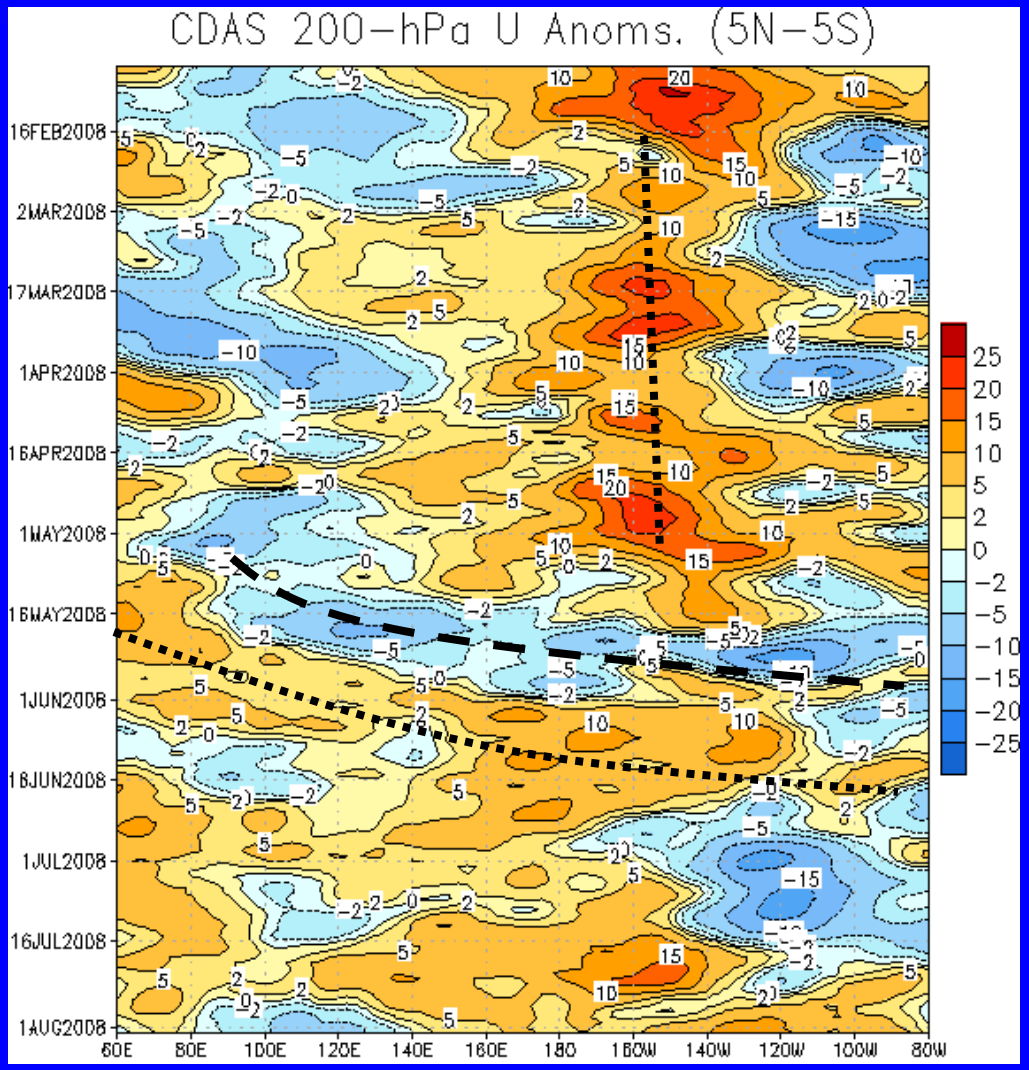
# 200-hPa Vector Wind Anomalies (m $s^{-1}$)

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




**Upper-level westerly anomalies have decreased across the western Pacific Ocean during the last five days.**

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




Time

Longitude

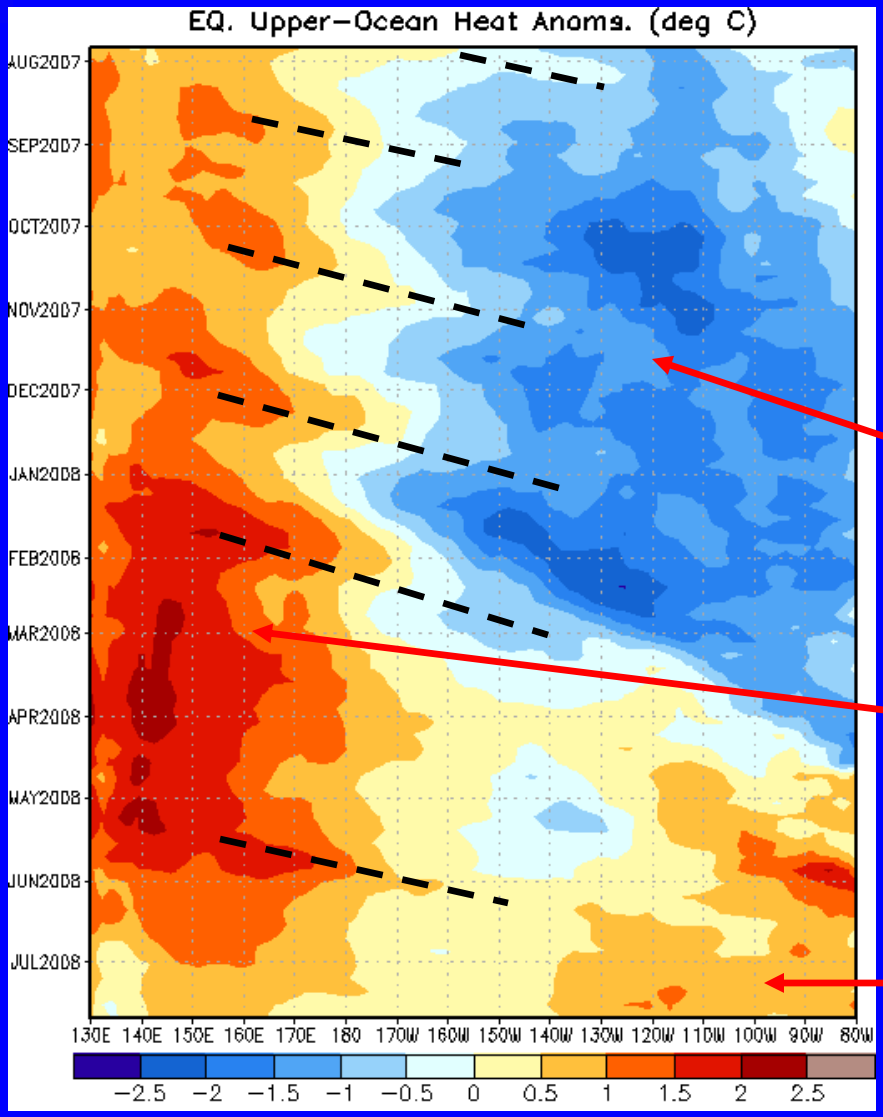
**Westerly anomalies (orange/red shading) represent anomalous west-to-east flow**

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

**The MJO was weak or incoherent for much of the period from mid-February through April and upper-level winds indicate generally strong and persistent westerly anomalies near and east of the Date Line.**

**During May and early June, eastward propagation was evident in the upper-level wind field and was associated with the moderate-to-strong MJO activity during this time.**

# Weekly Heat Content Evolution in the Equatorial Pacific




Time

Longitude

Kelvin wave activity (downwelling phases indicated by dashed lines) was observed from August 2007 to February 2008 and affected sub-surface temperature departures at varying degrees across the Pacific Ocean.

During September and October, negative heat content anomalies increased markedly across the eastern Pacific Ocean and continued until February 2008.

Beginning in March, increasingly positive anomalies have developed across parts of the western and central Pacific.

Positive heat content anomalies now encompass the entire Pacific basin in part associated with a Kelvin wave initiated during May 2008.

# MJO Index -- Information

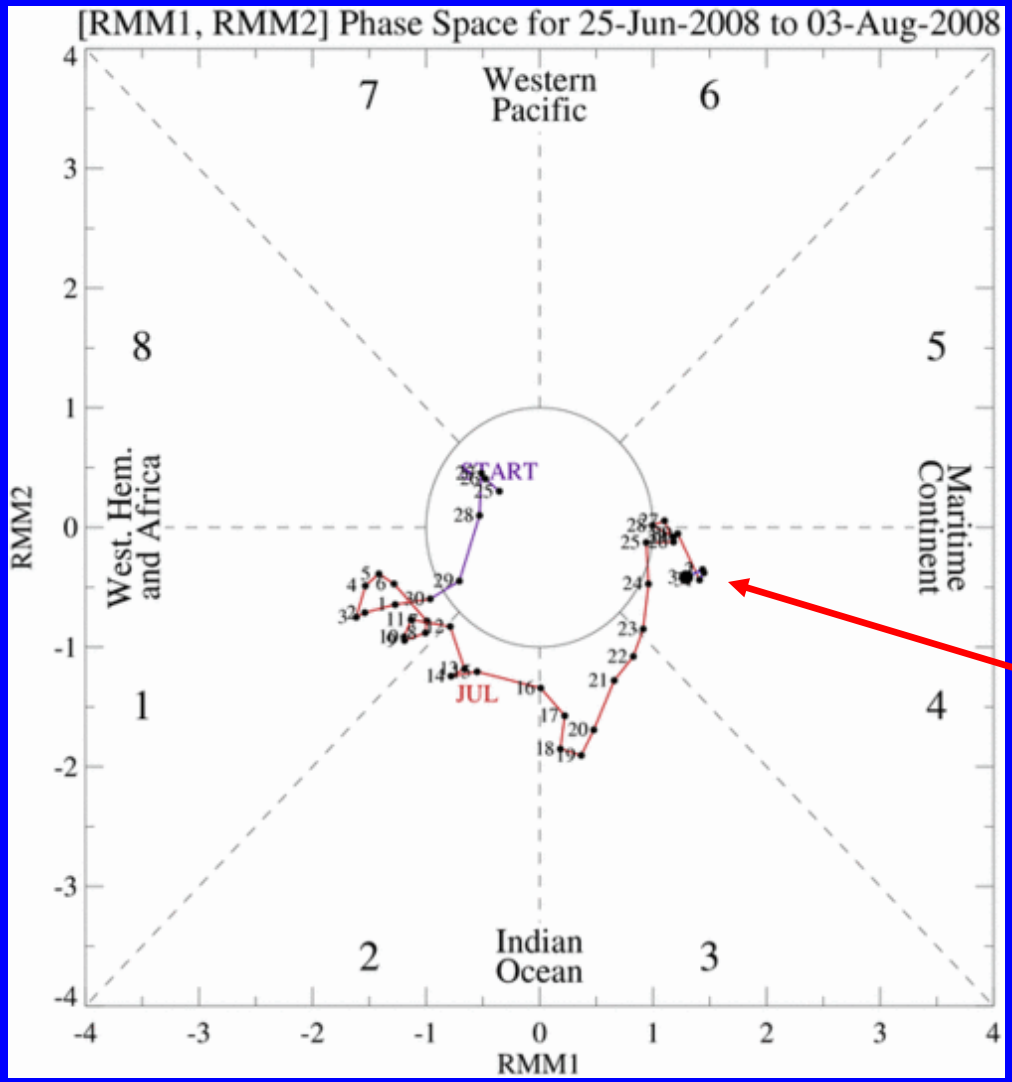
- **The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).**

**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).**

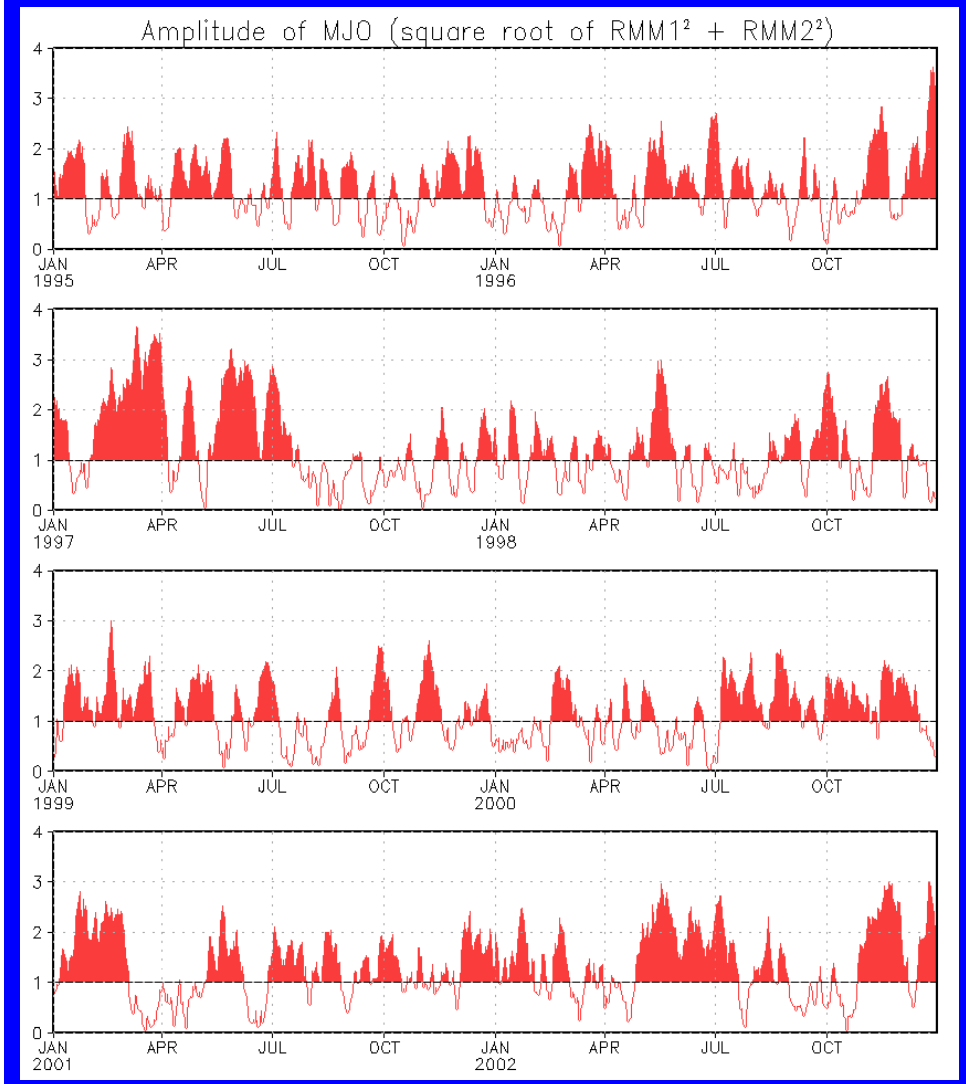
# MJO Index -- Recent Evolution

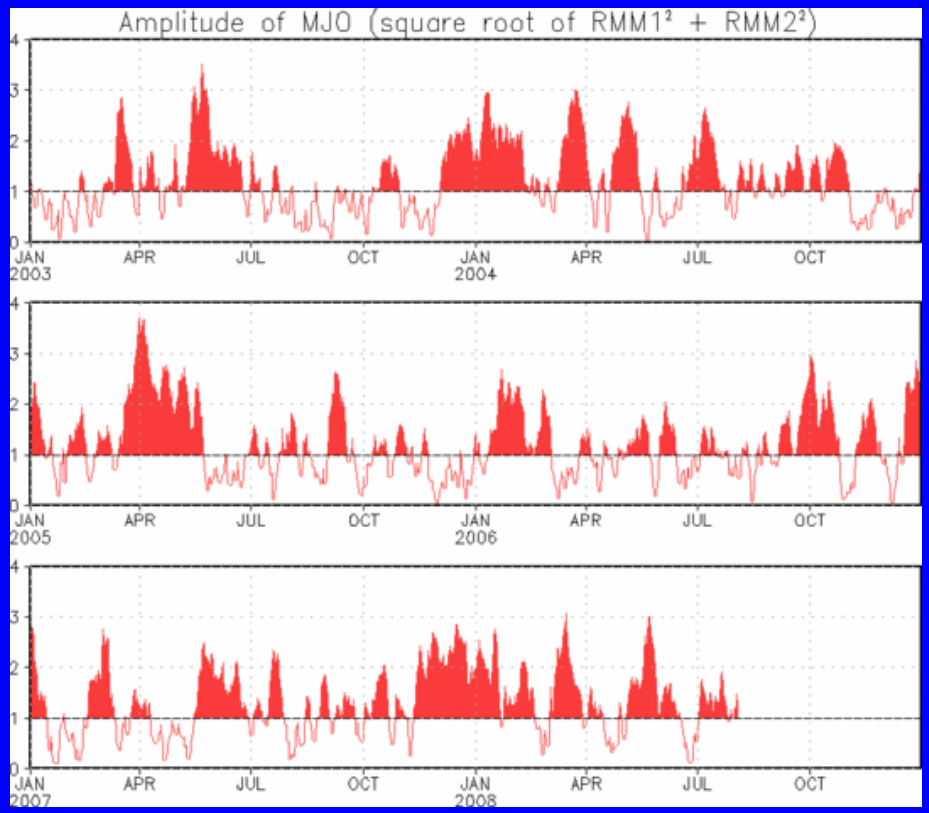



- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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

**The MJO index indicates the MJO has become less coherent during the past week and that eastward propagation has stopped.**

# 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**

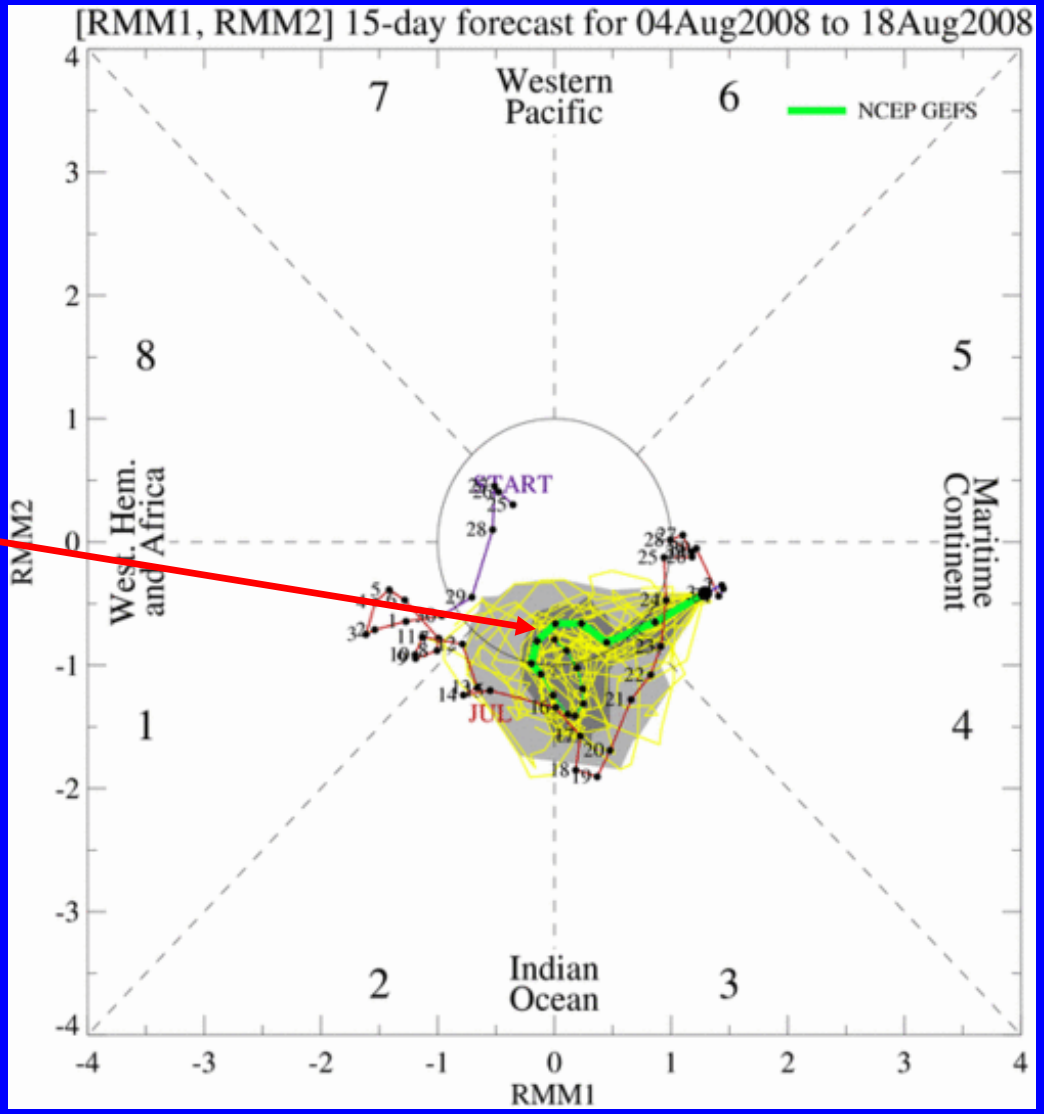
# Ensemble GFS MJO Forecasts

**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**

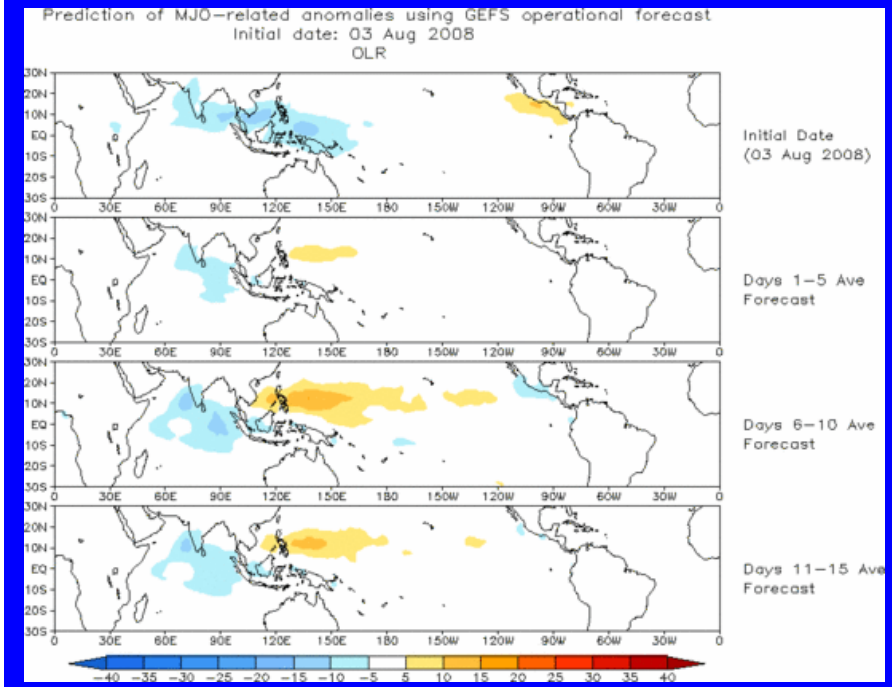
**The GEFS predicts a westward shift in enhanced convection during the next 1-2 weeks and is not consistent with a continuation of the MJO.**



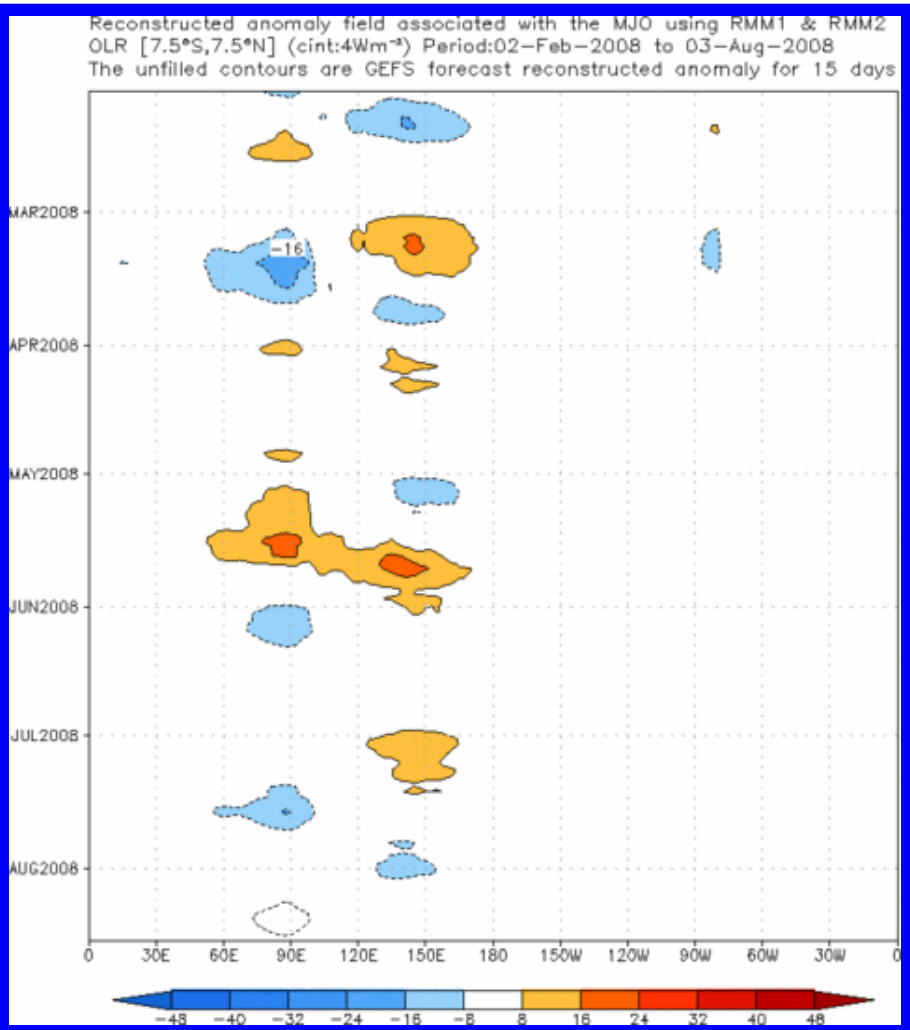
# Ensemble Mean GFS MJO Forecast

**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




**The forecast from the ensemble mean GEFS indicates mainly weak enhanced convection focusing across the Indian Ocean by Week 2.**

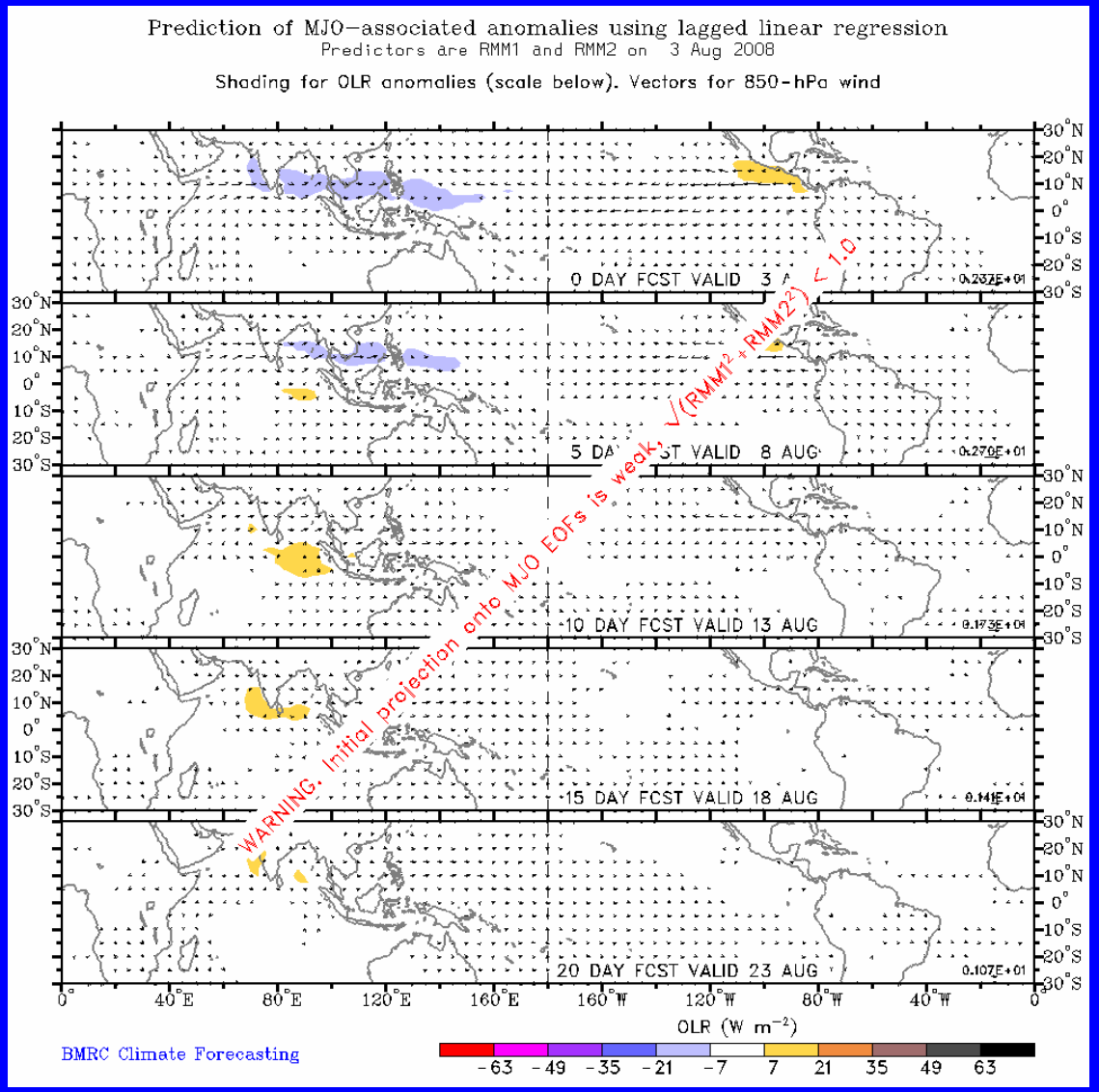
# Statistical MJO Forecast

**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**

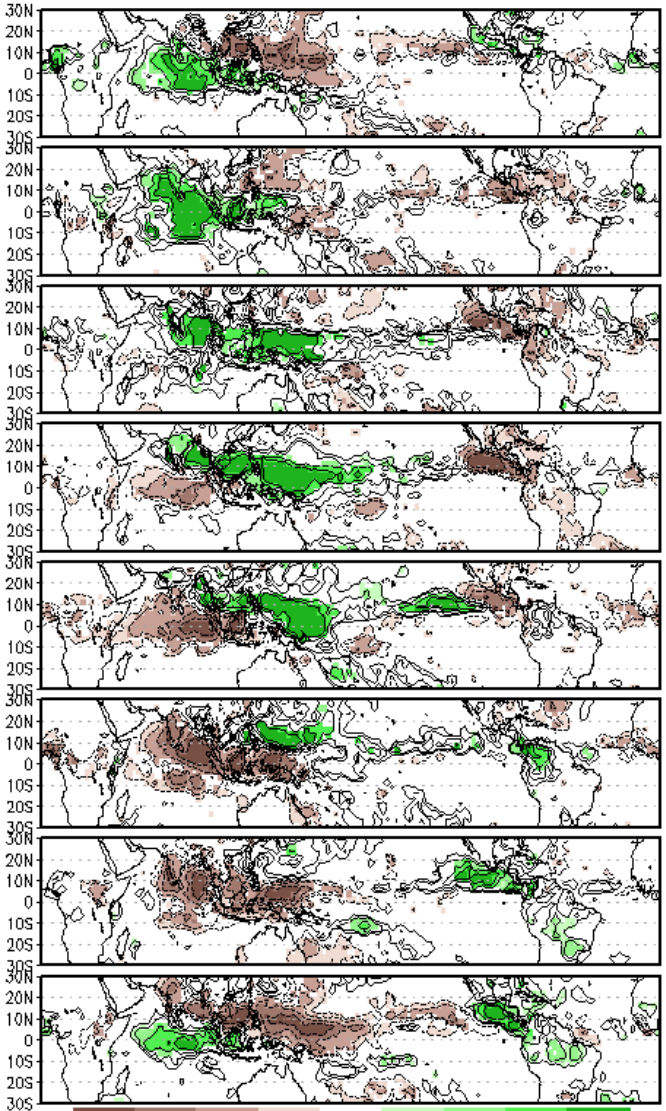
**(Courtesy of the Bureau of Meteorology Research Centre - Australia)**

**Weak MJO activity is forecast during the next two weeks.**



# MJO Composites – Global Tropics

Precipitation Anomalies (May-Sep)




850-hPa Wind Anomalies (May-Sep)