



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

**Update prepared by  
Climate Prediction Center / NCEP  
June 30, 2008**



# Outline

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



## Overview

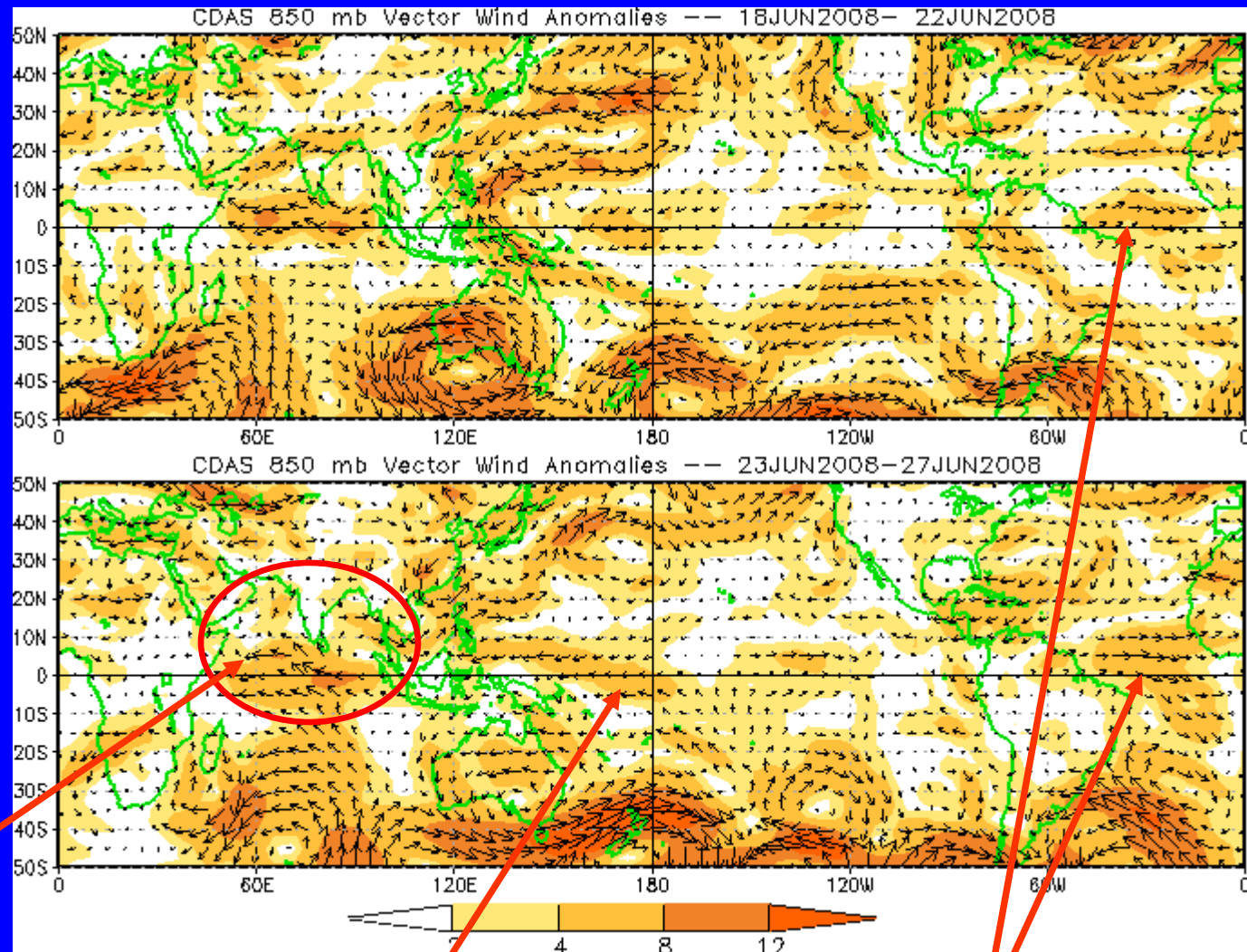
- **The MJO was incoherent during the past week. Most MJO forecast tools indicate the MJO signal will remain incoherent during the next 1-2 weeks.**
- **Some data indicate a large-scale pattern consistent with the MJO, however, there has been little eastward propagation and this pattern is likely the combination of several factors.**
- **The pattern needs to be closely monitored as propagation of this signal, if any, may indicate strengthening of the MJO.**
- **The MJO is expected to contribute little to the patterns of tropical convection during the next 1-2 weeks.**

**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



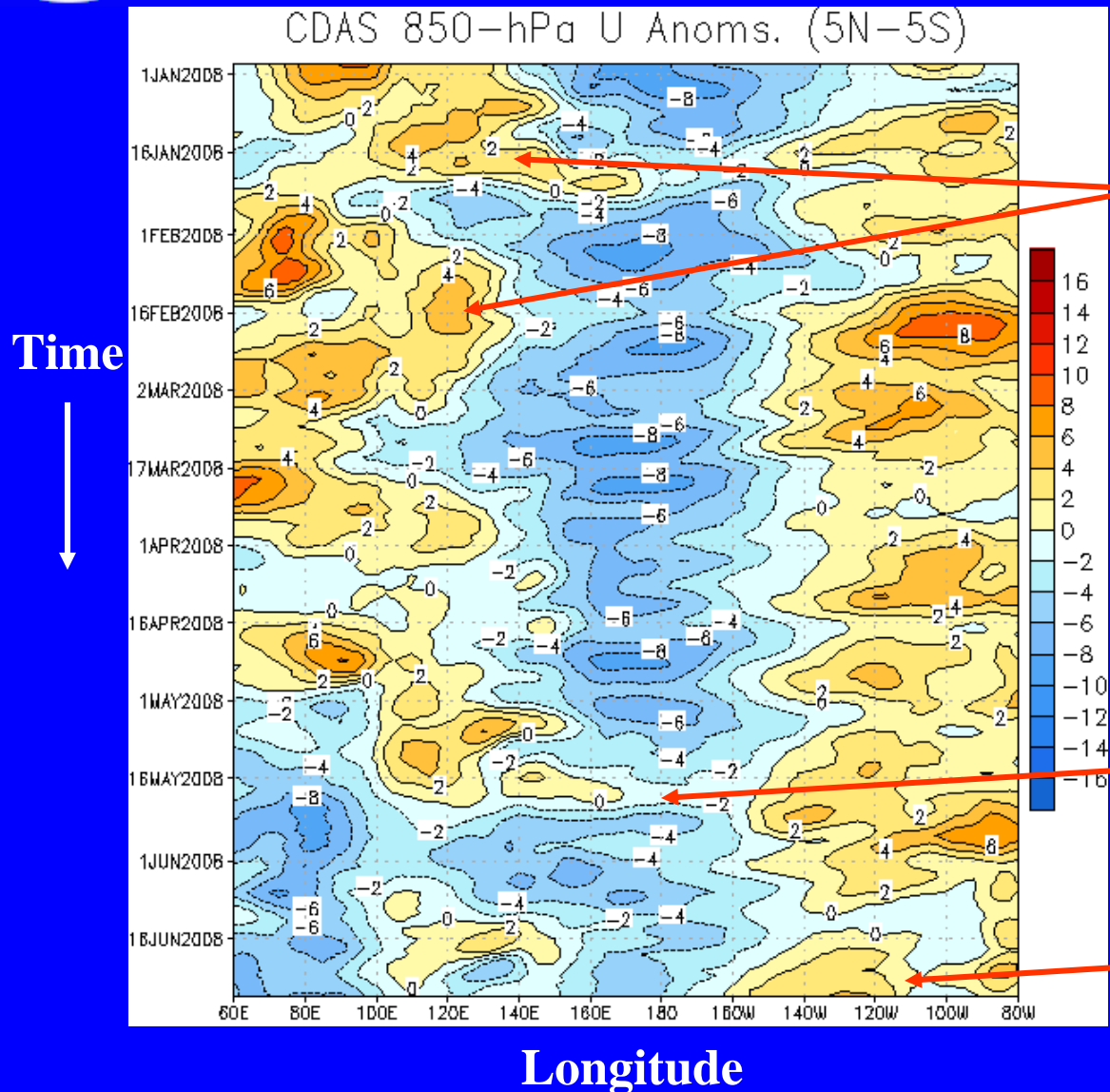
The Indian monsoon flow has weakened during the last five days.

Equatorial easterly anomalies continue near the Date Line.

Equatorial westerly anomalies in the Atlantic continued during the last five days.



# 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

Moderate-to-strong MJO activity is evident from late December 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 mid-January and mid-February.

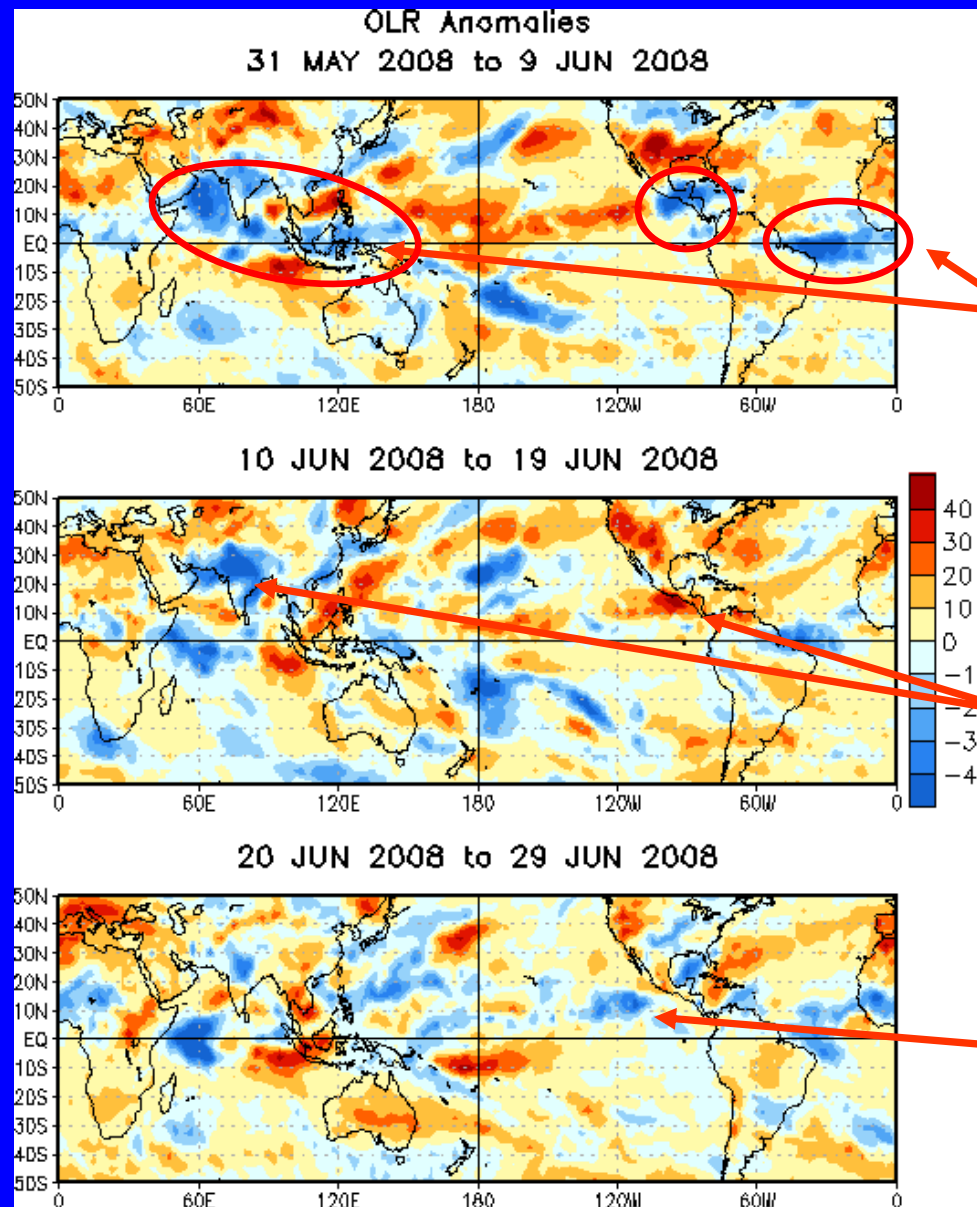
MJO activity was weaker during much of March and April.

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

Recently, the persistent westerly anomalies in the eastern Pacific have once again strengthened.



# OLR Anomalies: Last 30 days



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

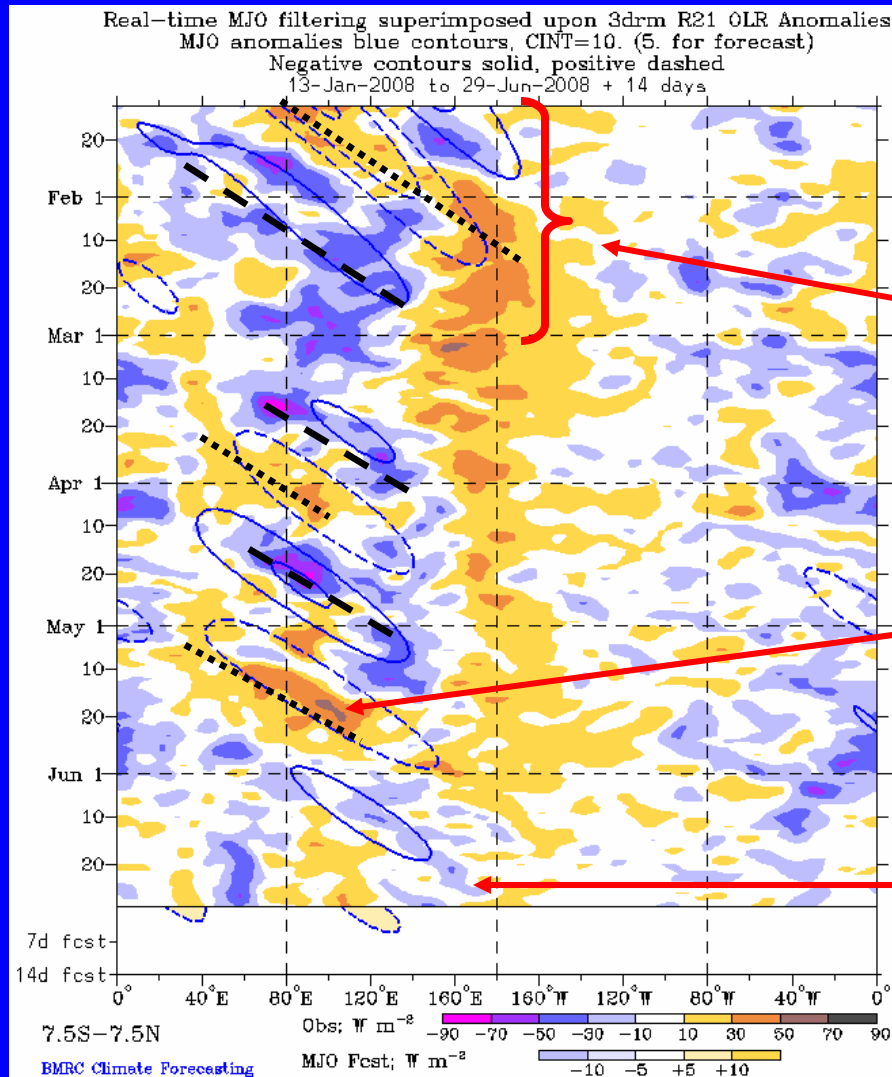
Very active convection was evident across Central America and western Africa during early June. At the same time, wet conditions developed across the Arabian Sea, India and the Maritime Continent.

The Indian monsoon remained very active during the middle of June. Suppressed convection replaced the wet conditions across the eastern Pacific and Central America.

During late-June, convection has been somewhat disorganized across the eastern hemisphere. Tropical cyclone activity has helped to enhance rainfall across the east-central Pacific.



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



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

Wetter-than-normal conditions, negative OLR anomalies (yellow/red shading)

(Courtesy of the Bureau of Meteorology - Australia)

Moderate-to-strong MJO activity was evident during January and into mid-February with coherent eastward propagation of enhanced (suppressed) convection indicated by the dashed (dotted) lines.

MJO activity was evident from mid-March to late-May 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.

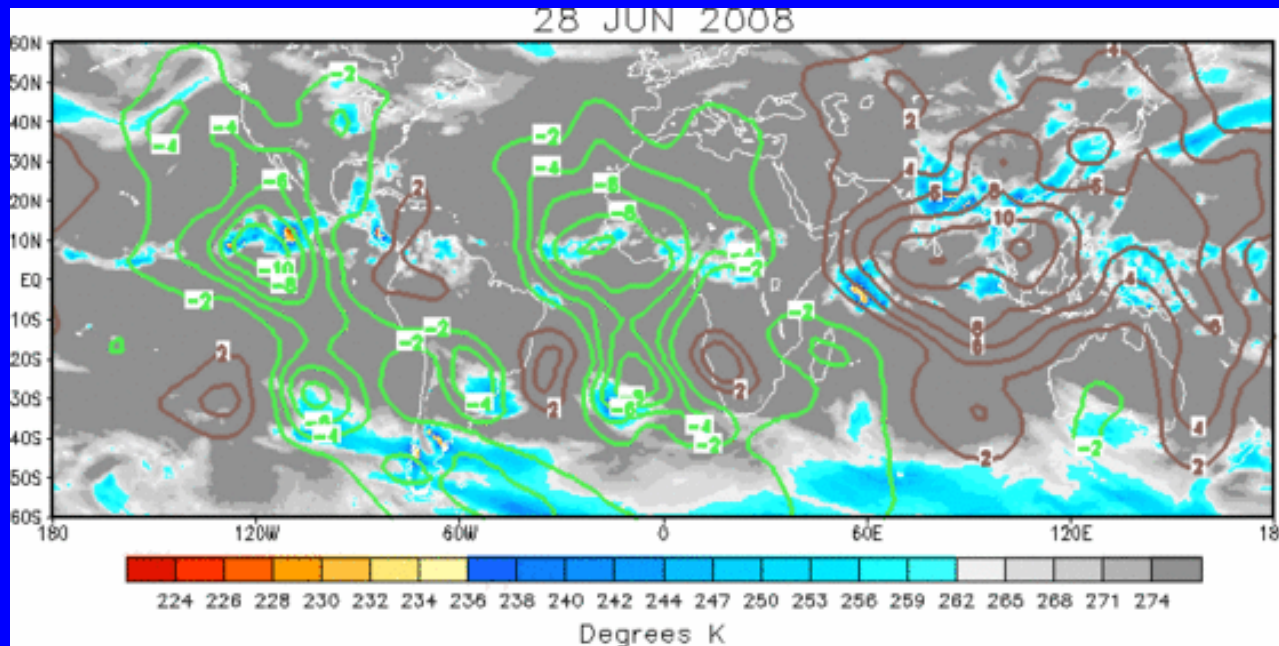
Convection has generally been near-average across much of the equatorial tropics during the past few weeks.



# 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



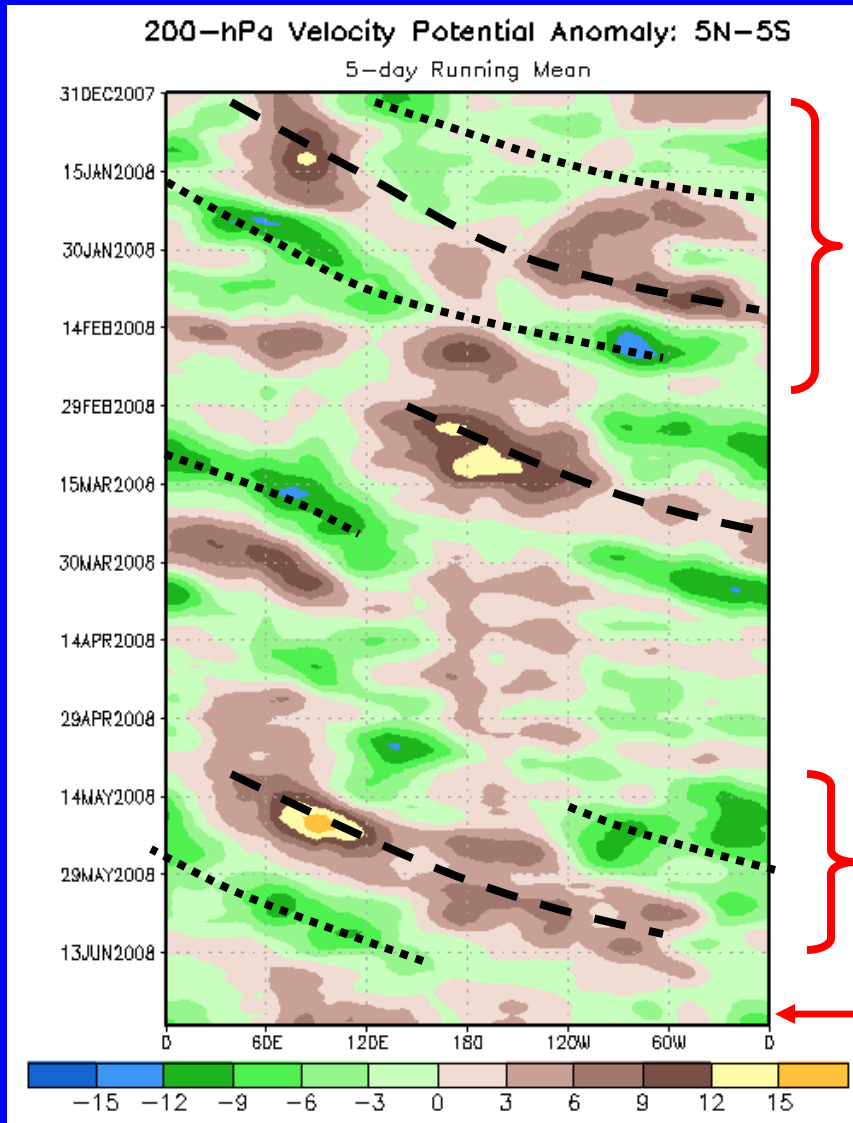
The large-scale wave structure in anomalous velocity potential includes regions of upper-level divergence across parts of the eastern Pacific and western Africa. An extensive area of strong upper-level convergence has developed across the Indian Ocean and Maritime Continent.





# 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



Moderate-to-strong MJO activity was evident during late December to mid-February.

Weak MJO activity was evident during parts of March.

The MJO was largely incoherent during the month of April.

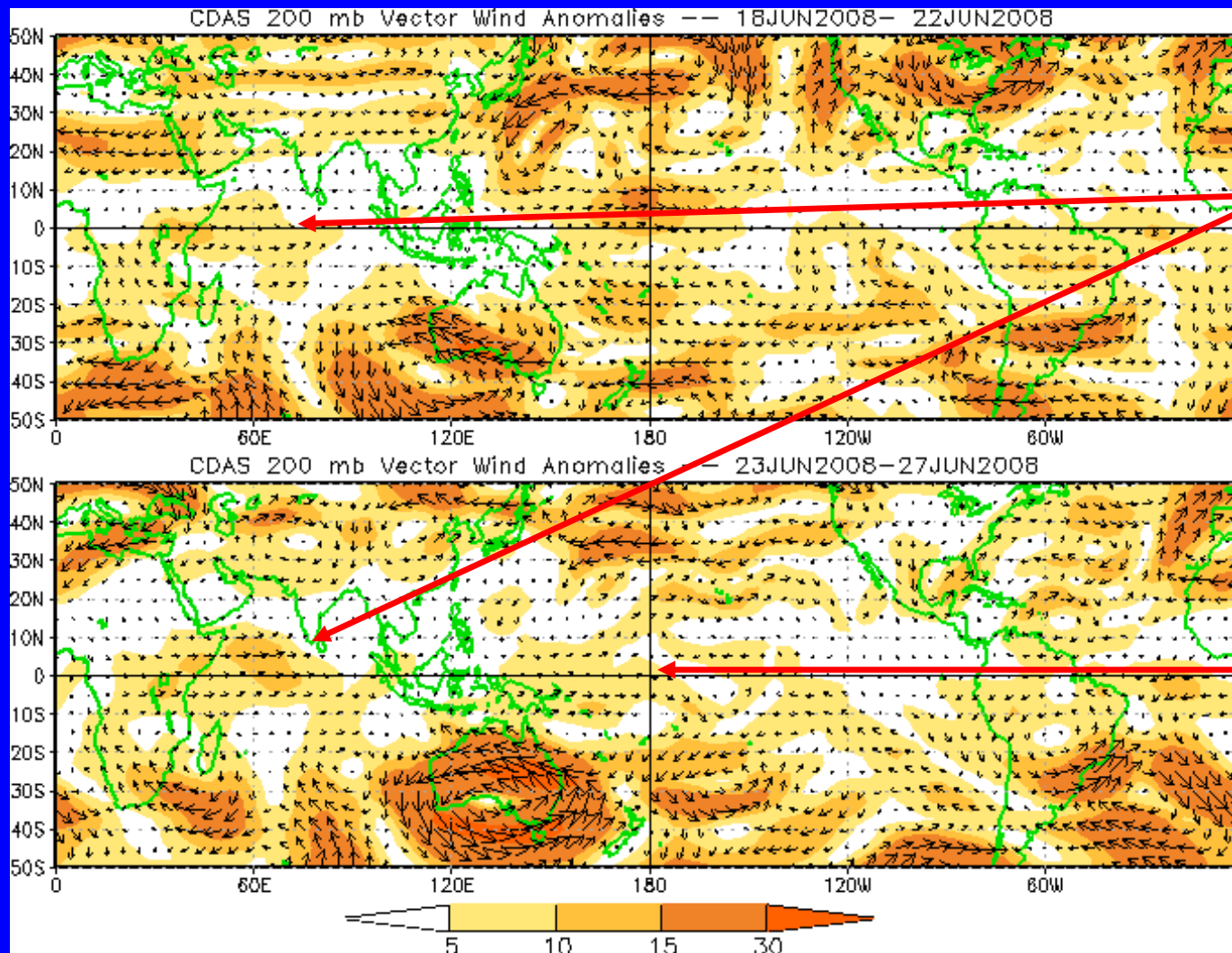
A moderate-to-strong MJO was observed from mid-May through mid-June.

Recently, the velocity potential anomalies have decreased.



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

Note that shading denotes the magnitude of anomalous wind vectors



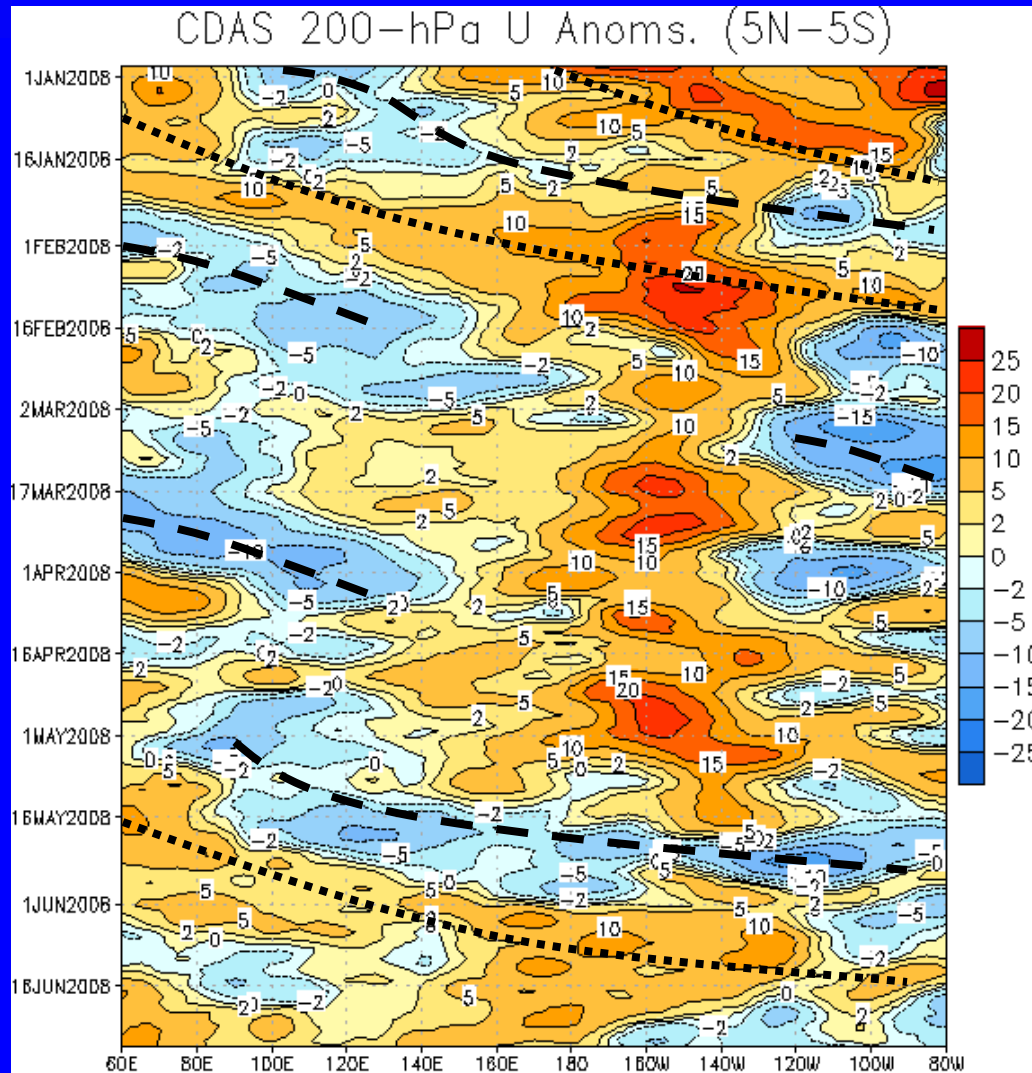
Westerly anomalies have developed during the last ten days across the Indian Ocean.

Westerly anomalies over the central Pacific Ocean have decreased during the last five days.



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

Time



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

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

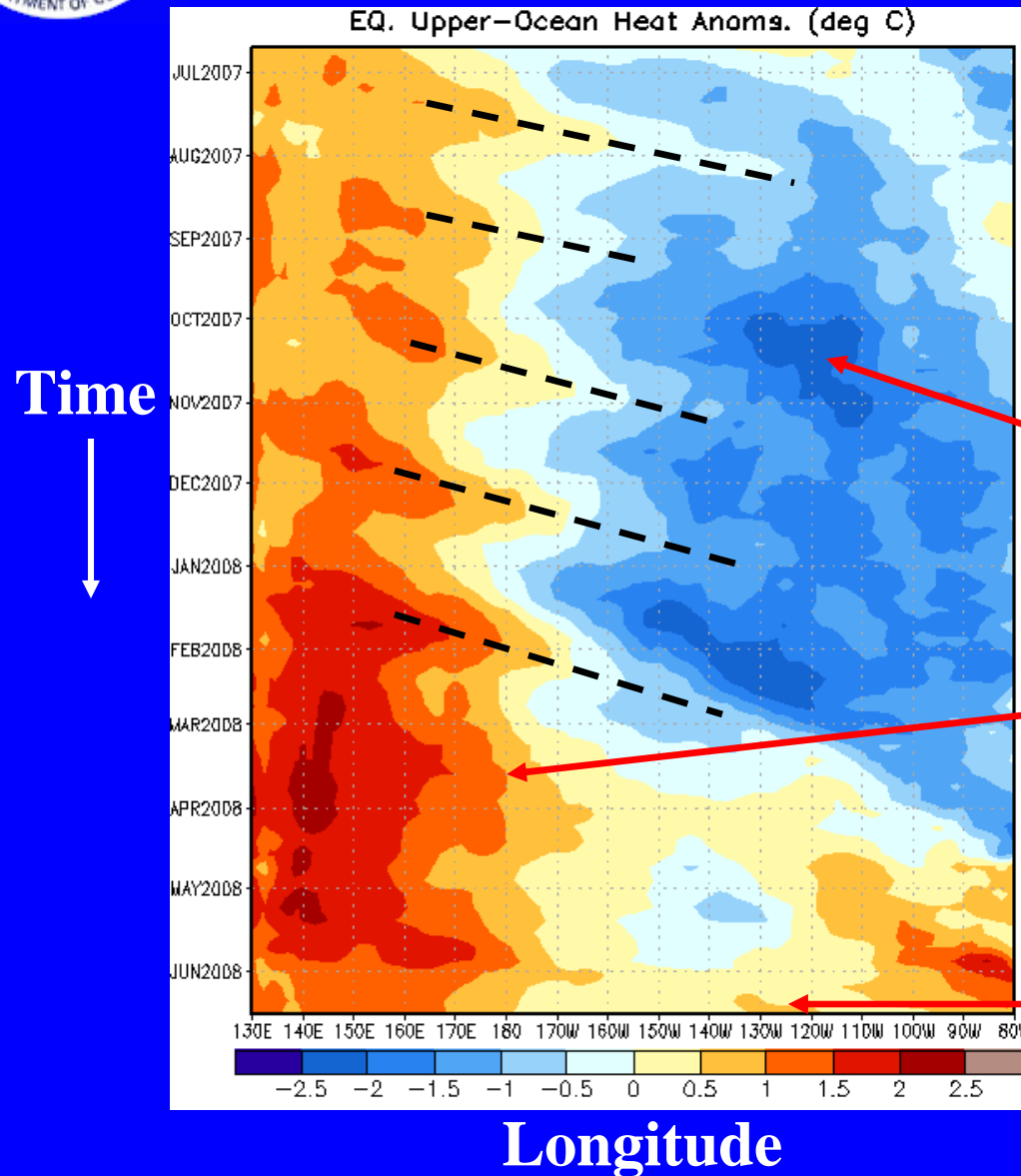
MJO activity is evident in the upper-levels by eastward propagation of easterly (westerly) anomalies by dashed (dotted) lines globally from late December to mid-February.

During May and early June, eastward propagation was evident in the upper-level wind field.

Currently, westerly anomalies are observed across the eastern hemisphere.



# Weekly Heat Content Evolution in the Equatorial Pacific



Kelvin wave activity (downwelling phases indicated by dashed lines) was observed from June 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.

Since April, a region of positive anomalies has strengthened in the eastern Pacific.

Recently, positive heat content anomalies encompass the entire Pacific basin.



# MJO Index -- Information

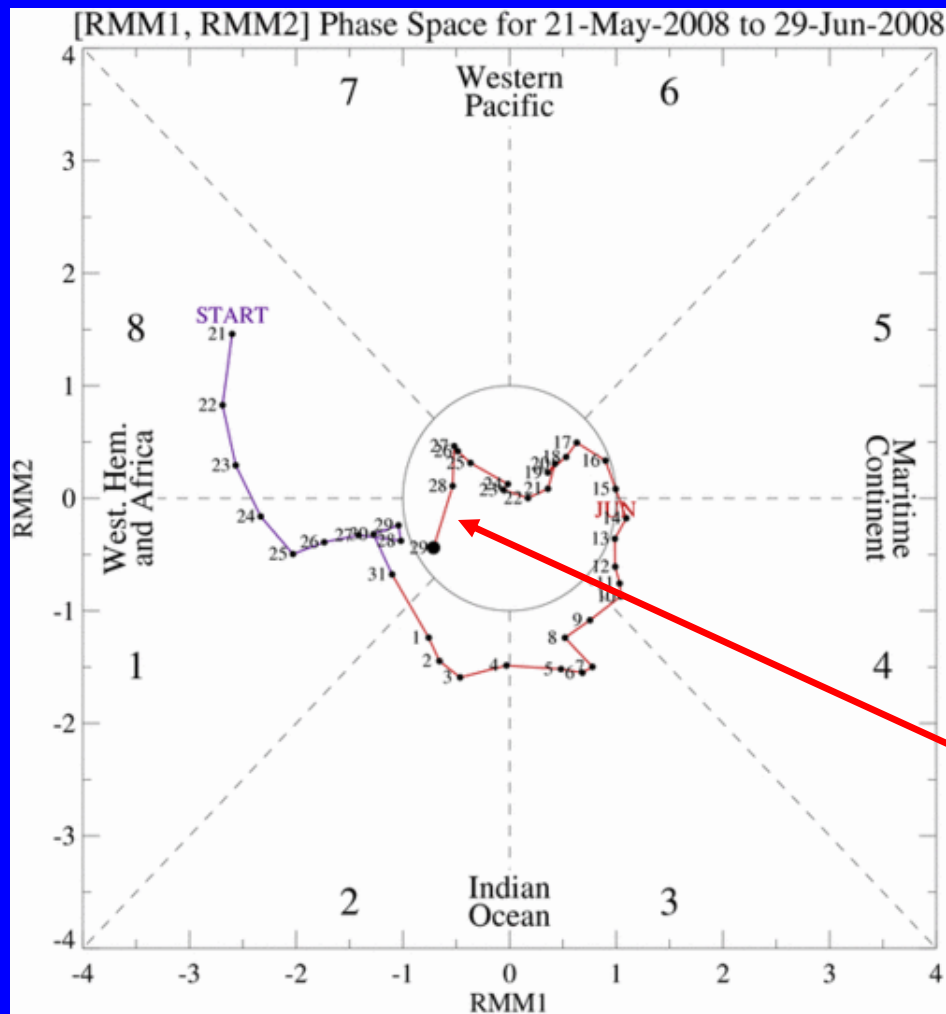
- The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).

**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

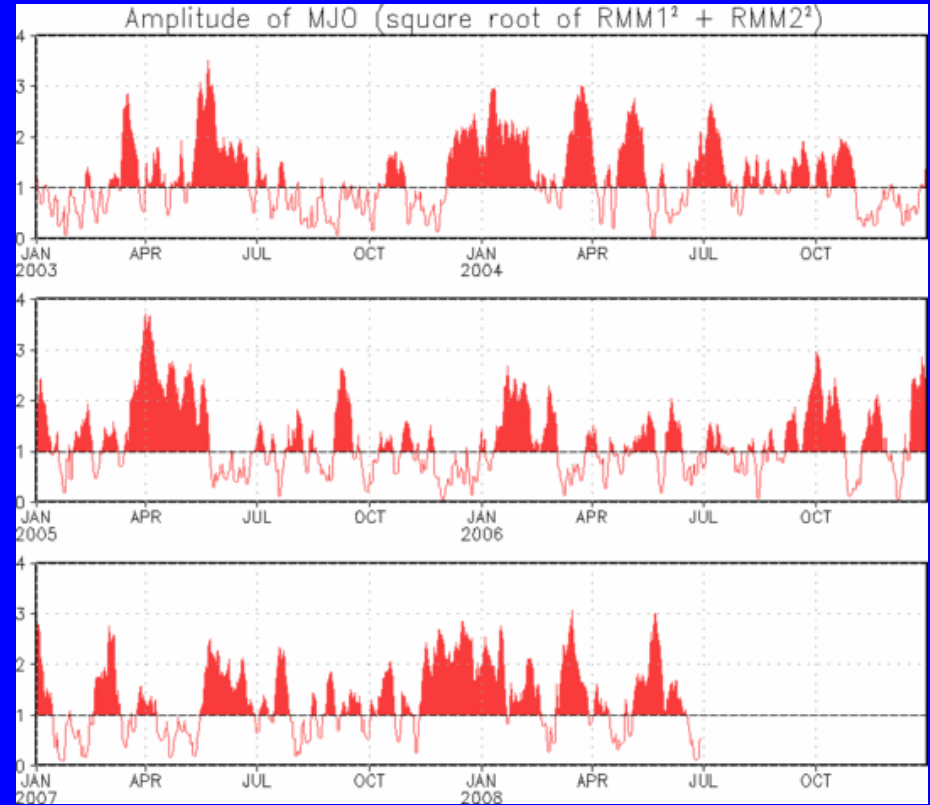
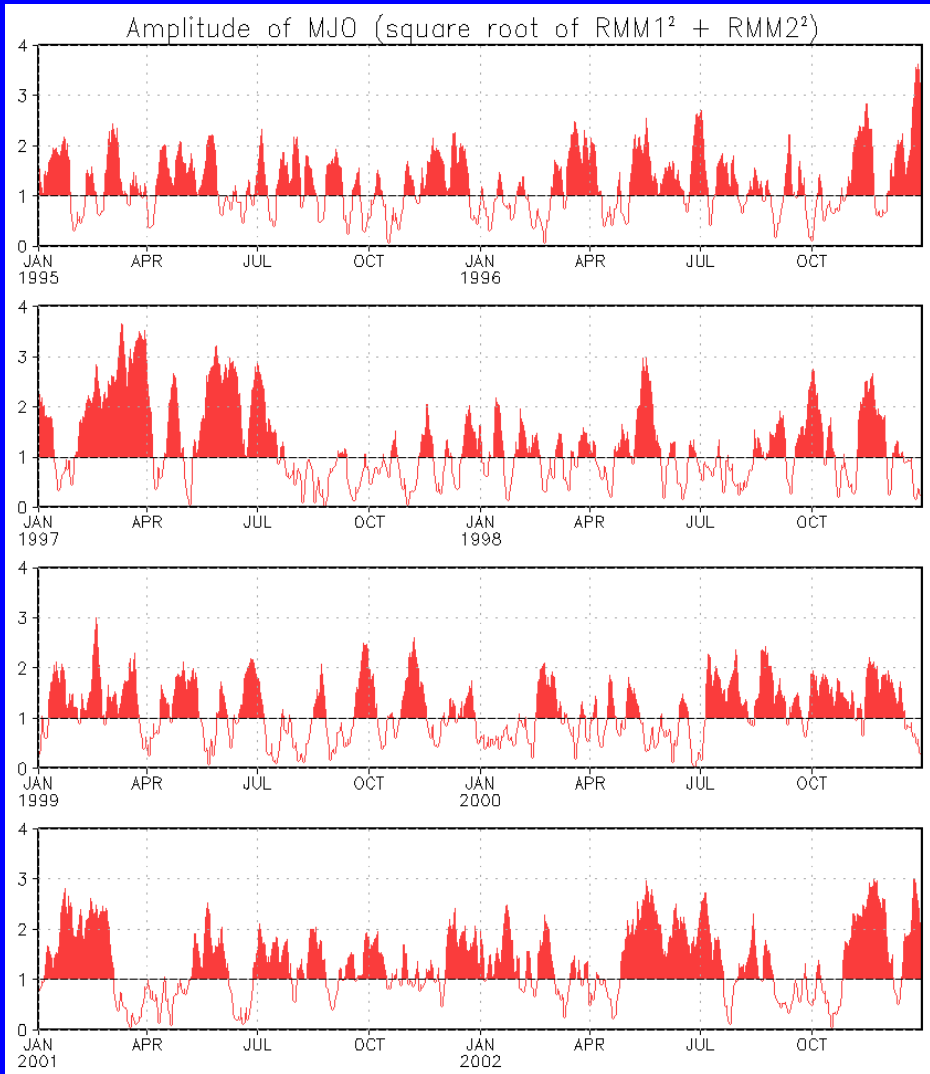


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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

The MJO index continues to indicate little MJO activity.



# 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

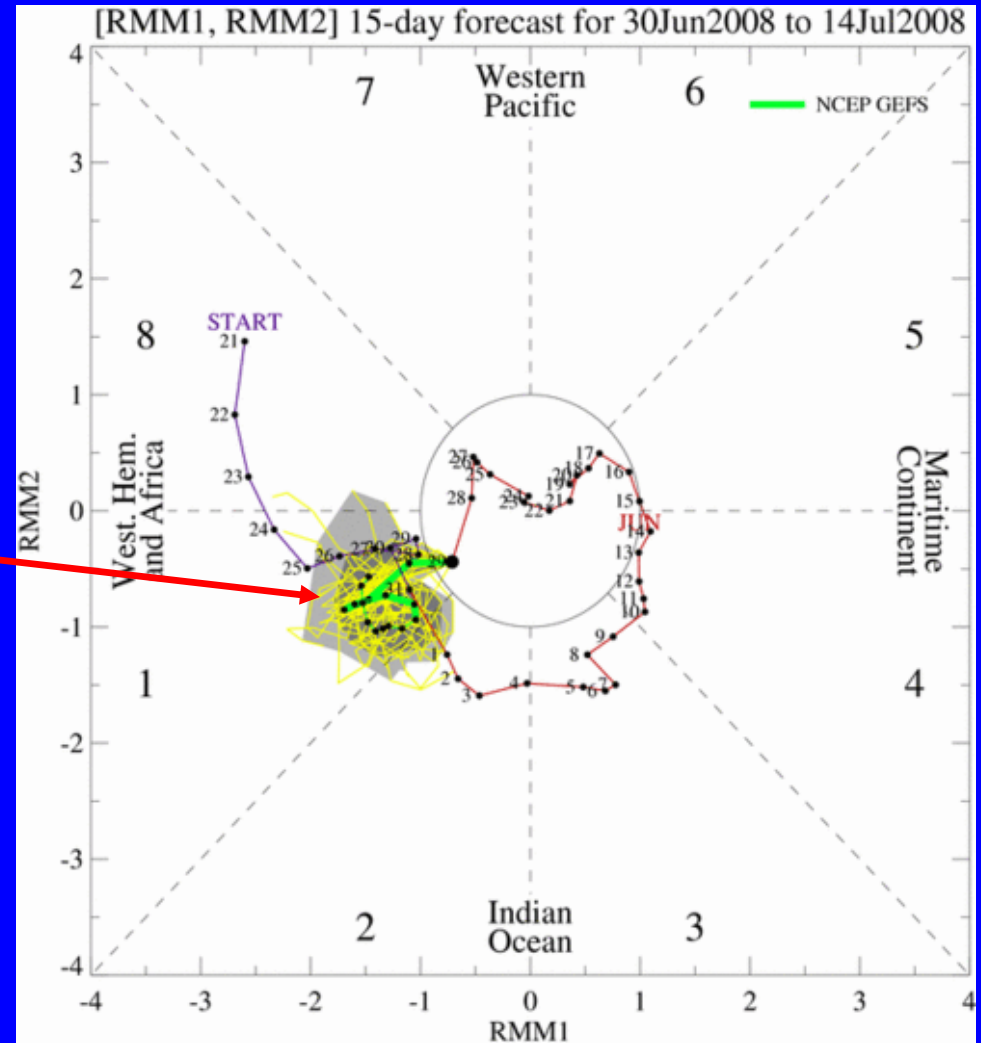
**Yellow Lines** – 20 Individual Members  
**Green Line** – Ensemble Mean

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 the MJO signal to increase during week 1 but no coherent eastward propagation is expected.

Large spread is indicated by the individual member forecasts.



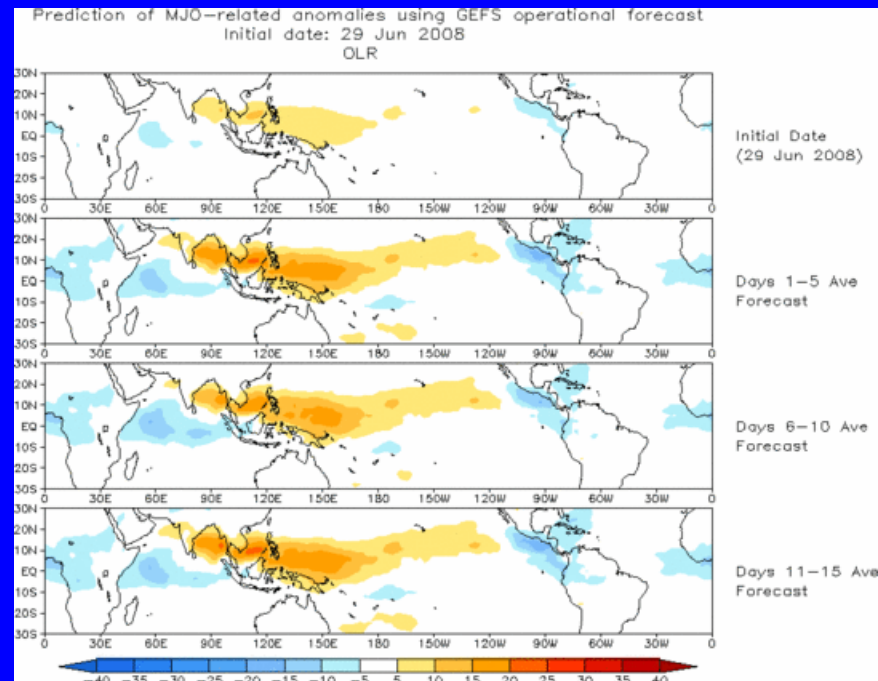




# Ensemble Mean GFS MJO Forecast

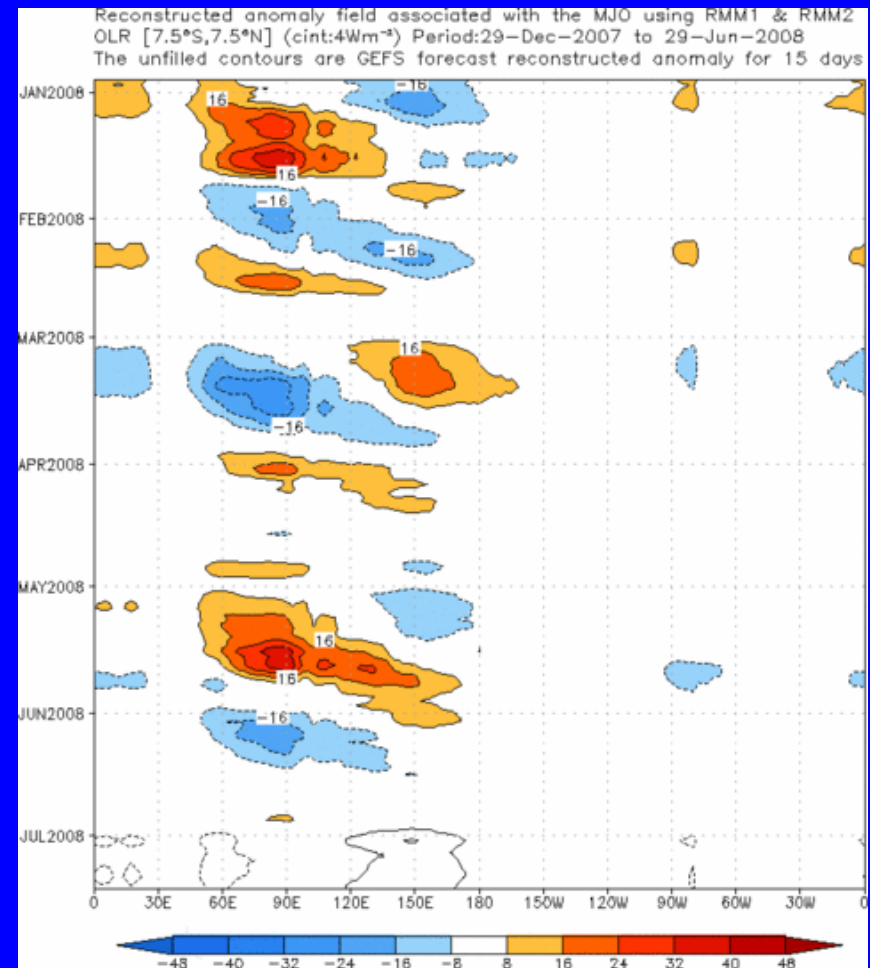
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

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



The forecast from the GEFS is for suppressed convection in the western Pacific with enhanced convection across Central America, Africa and the western Indian Ocean.

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



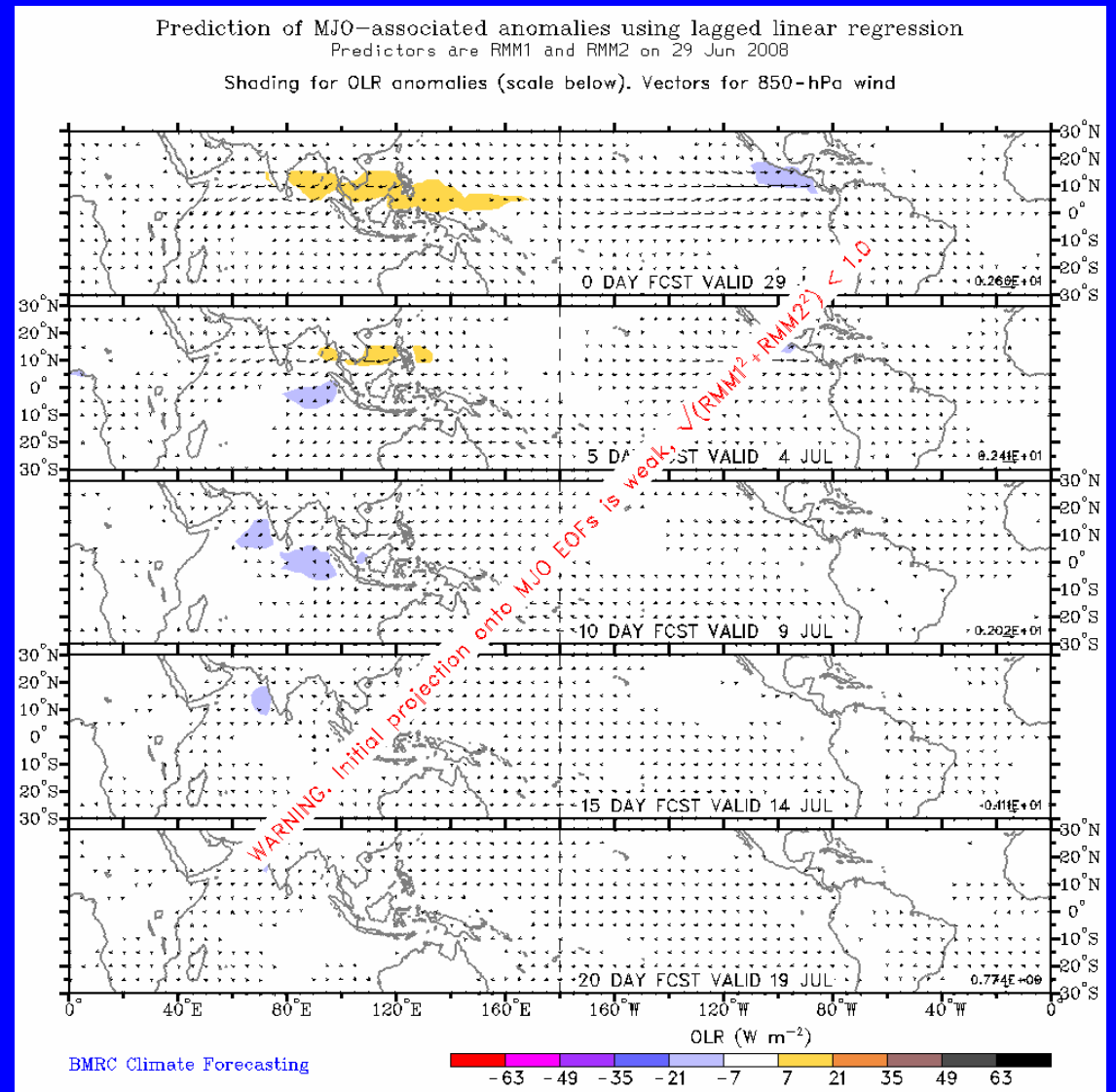


# Statistical MJO Forecast

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)

Weak MJO activity is forecast.





# MJO Composites – Global Tropics

## Precipitation Anomalies (May-Sep)

## 850-hPa Wind Anomalies (May-Sep)

