



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

**Update prepared by  
Climate Prediction Center / NCEP  
May 5, 2008**



# Outline

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



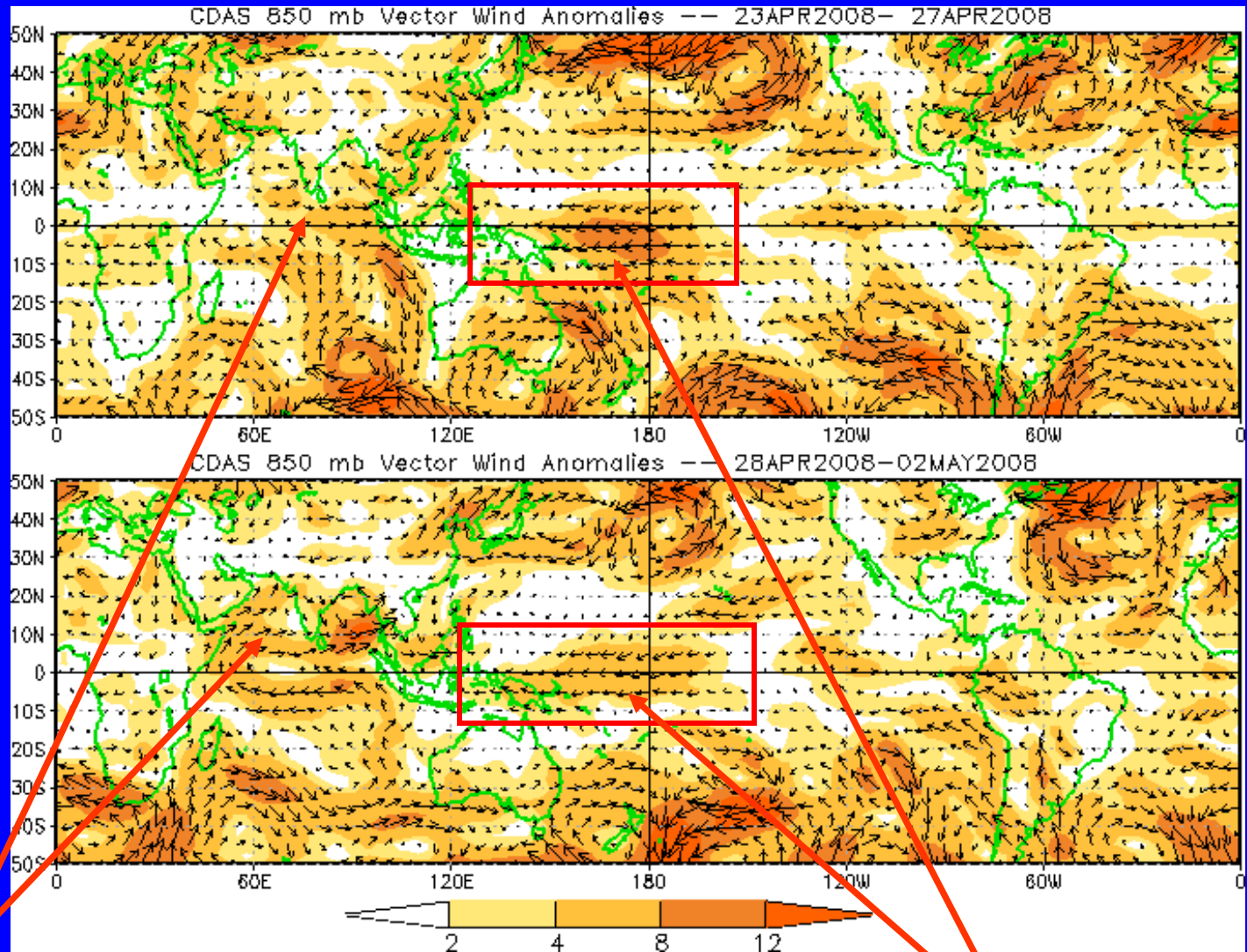
# Overview

- **The MJO signal has become generally incoherent during the last month.**
- **Continued incoherent or weak MJO activity is expected during the next 1-2 weeks.**
- **At this time, it is not expected that the MJO will contribute largely to the patterns of tropical rainfall during the period.**



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

Note that shading denotes the magnitude of anomalous wind vectors



Westerly anomalies in the Indian Ocean have shifted north of the equator and is in part due to tropical cyclone activity in the Bay of Bengal.

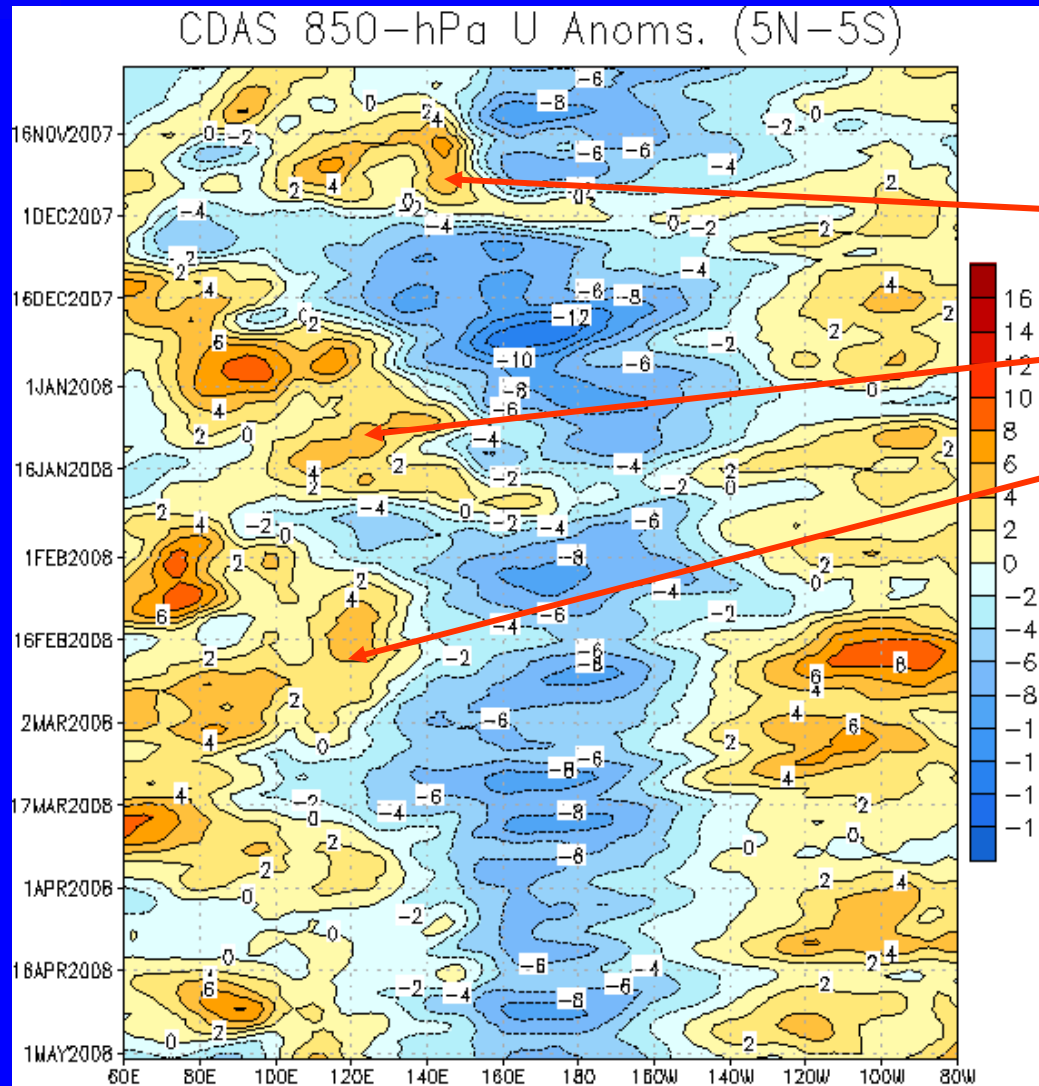
Easterly anomalies continue across the western Pacific but have decreased in magnitude.



# 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

Time



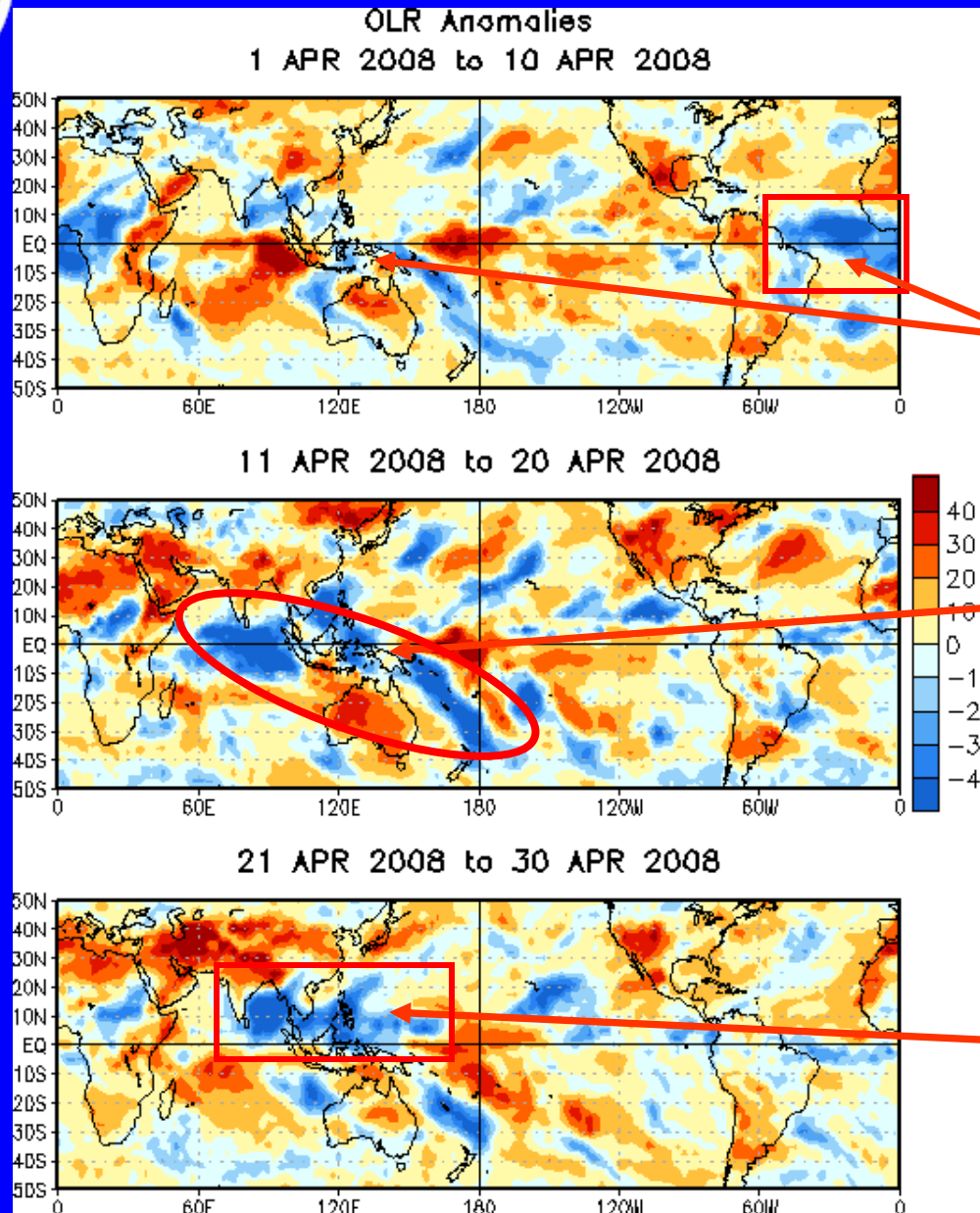
Longitude

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.

Recently, the most important features remain the continuation of easterly (westerly) anomalies across the central (eastern) Pacific Ocean associated with La Nina conditions.



# OLR Anomalies: Last 30 days



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

**During early April, wet conditions were observed across the Atlantic Ocean and Africa.**

**Tropical convection increased markedly across the Indian Ocean, Indonesia and the South Pacific Convergence Zone (SPCZ) during mid-April.**

**Enhanced convection shifted northward during late April in part associated with tropical cyclone activity.**





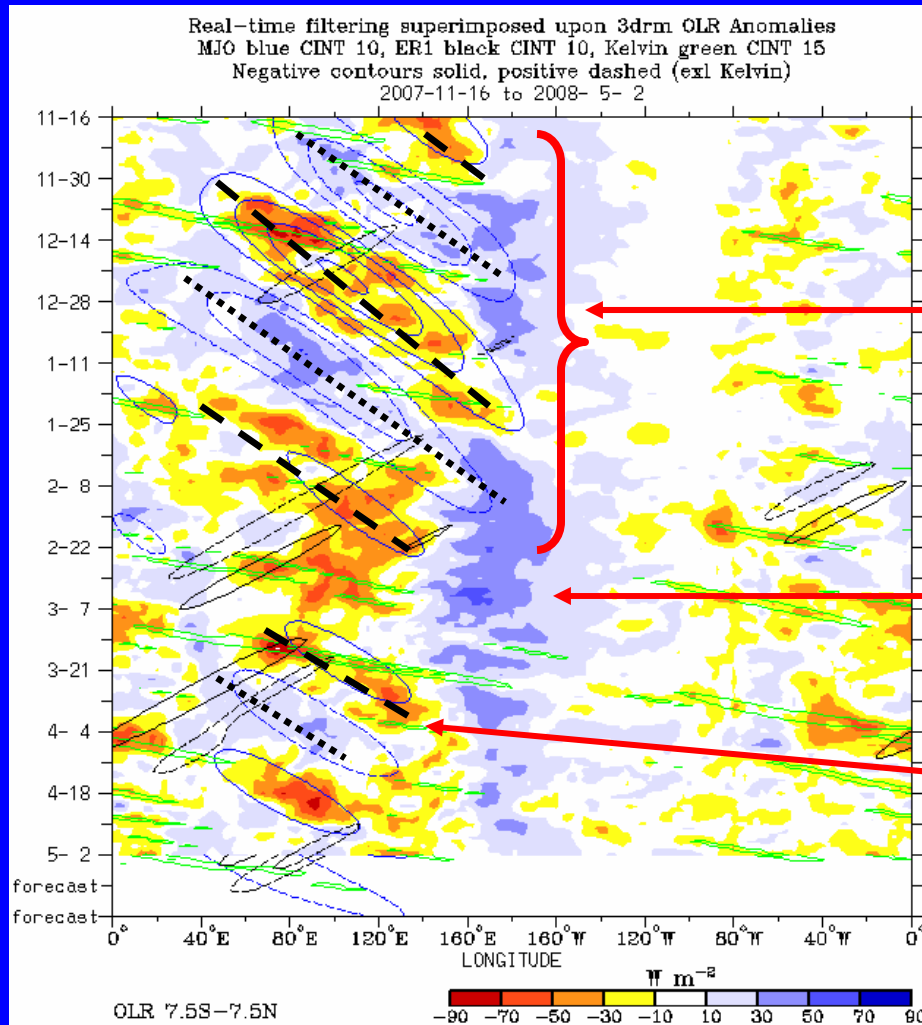
# Outgoing Longwave Radiation (OLR) Anomalies (7.5°S-7.5°N)

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

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

(Courtesy of Earth System Research Laboratory)

Time  
↓



Longitude

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 to early-mid March, a more stationary pattern of anomalous convection was evident.

Weak MJO activity was evident during mid-late March as enhanced then suppressed convection shifted east across the Indian Ocean.

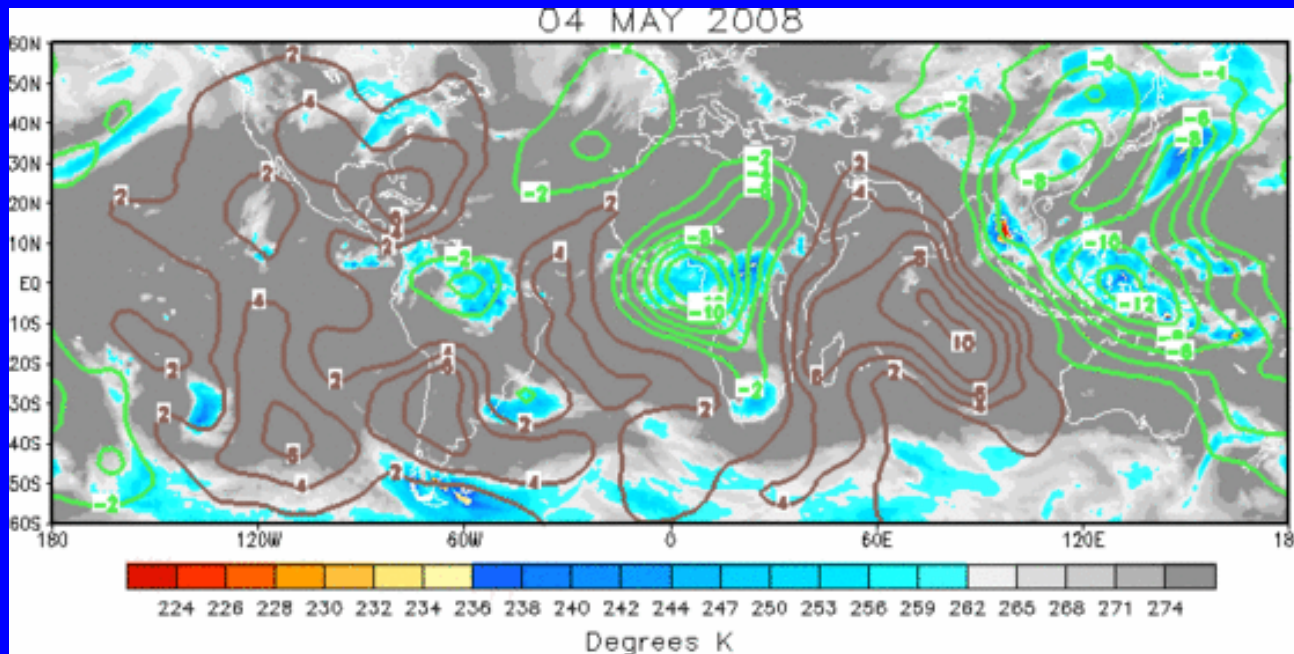
Recently, convection has increased along the equator in the western Pacific.



# 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 velocity potential anomalies show generally regional areas of upper-level divergence over Southeast Asia, Indonesia, western Africa and parts of South America.



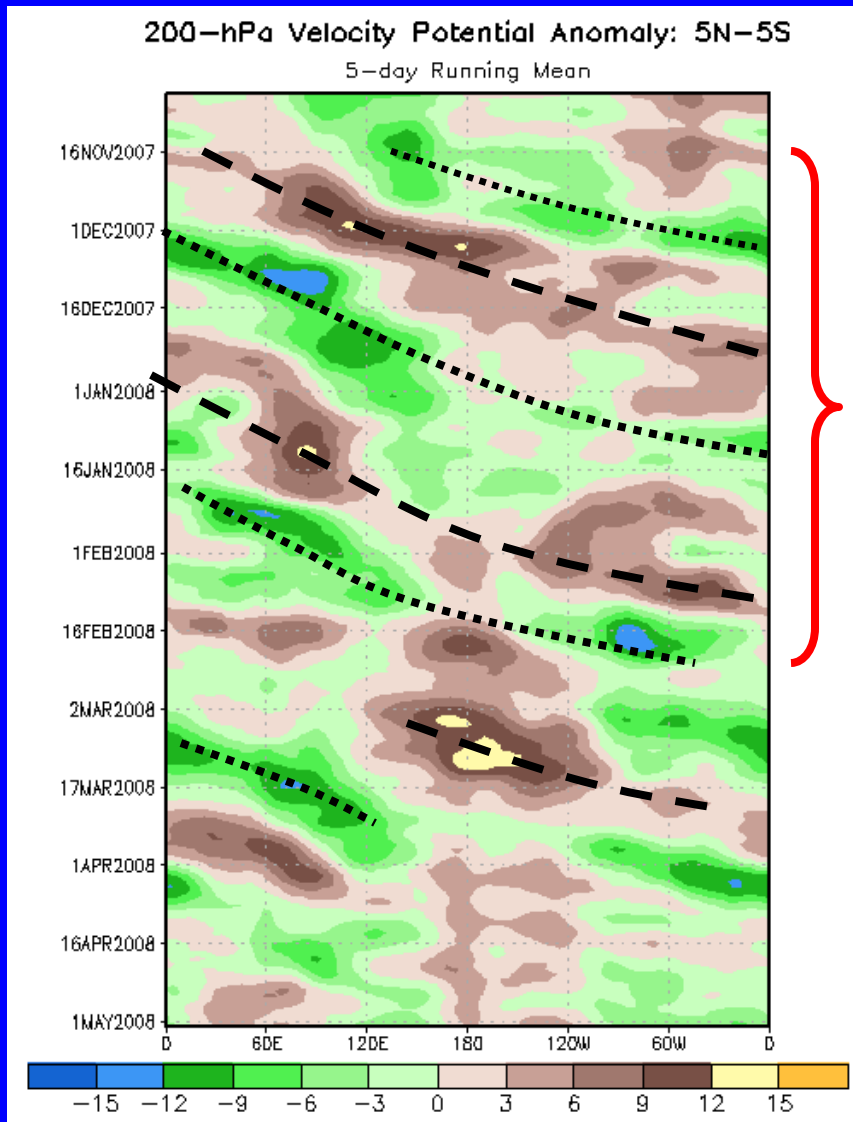


# 200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time



Longitude

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

The MJO weakened during the second half of February.

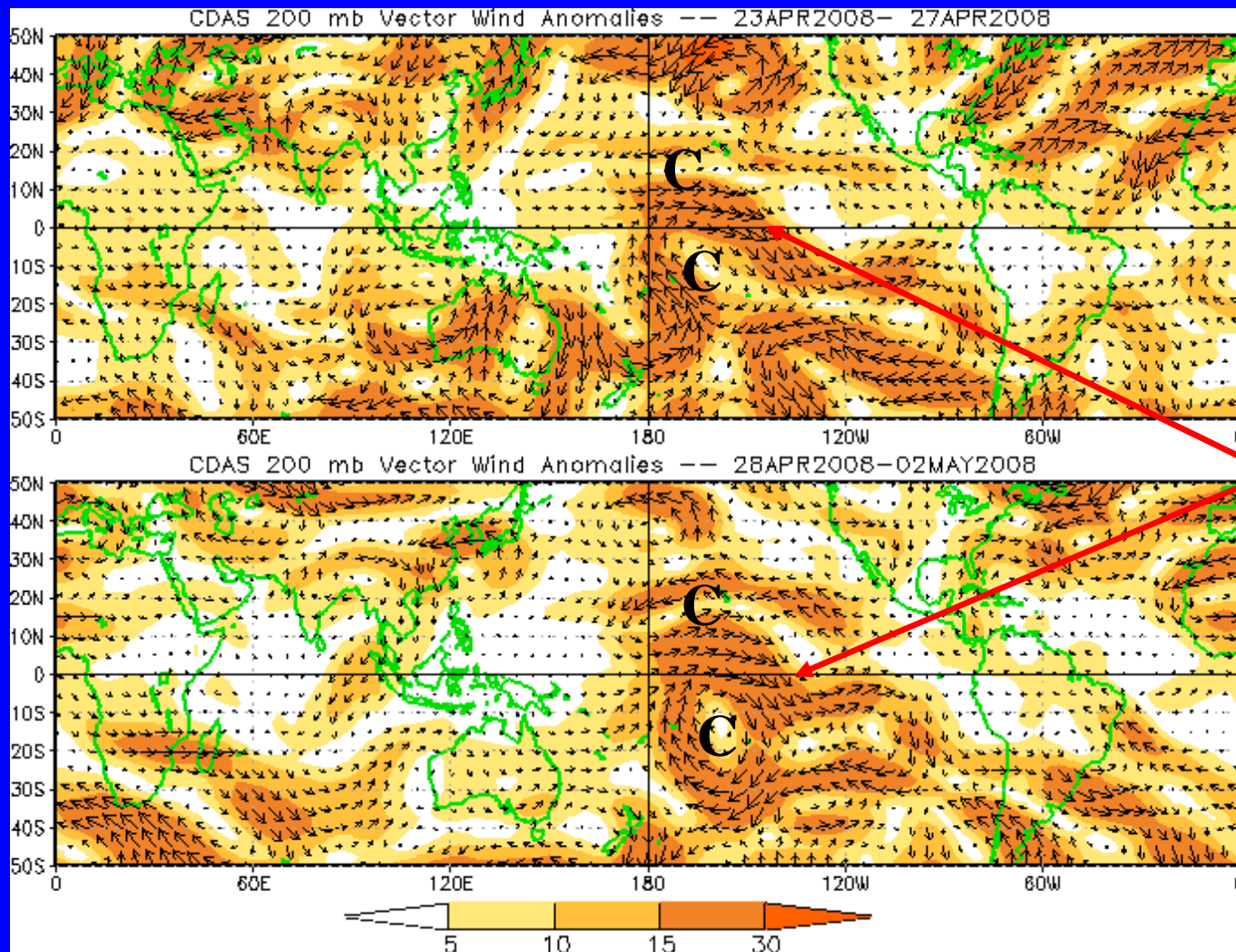
During March, velocity potential anomalies increased and some eastward propagation was evident

The MJO has been mainly incoherent during the month of April.



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

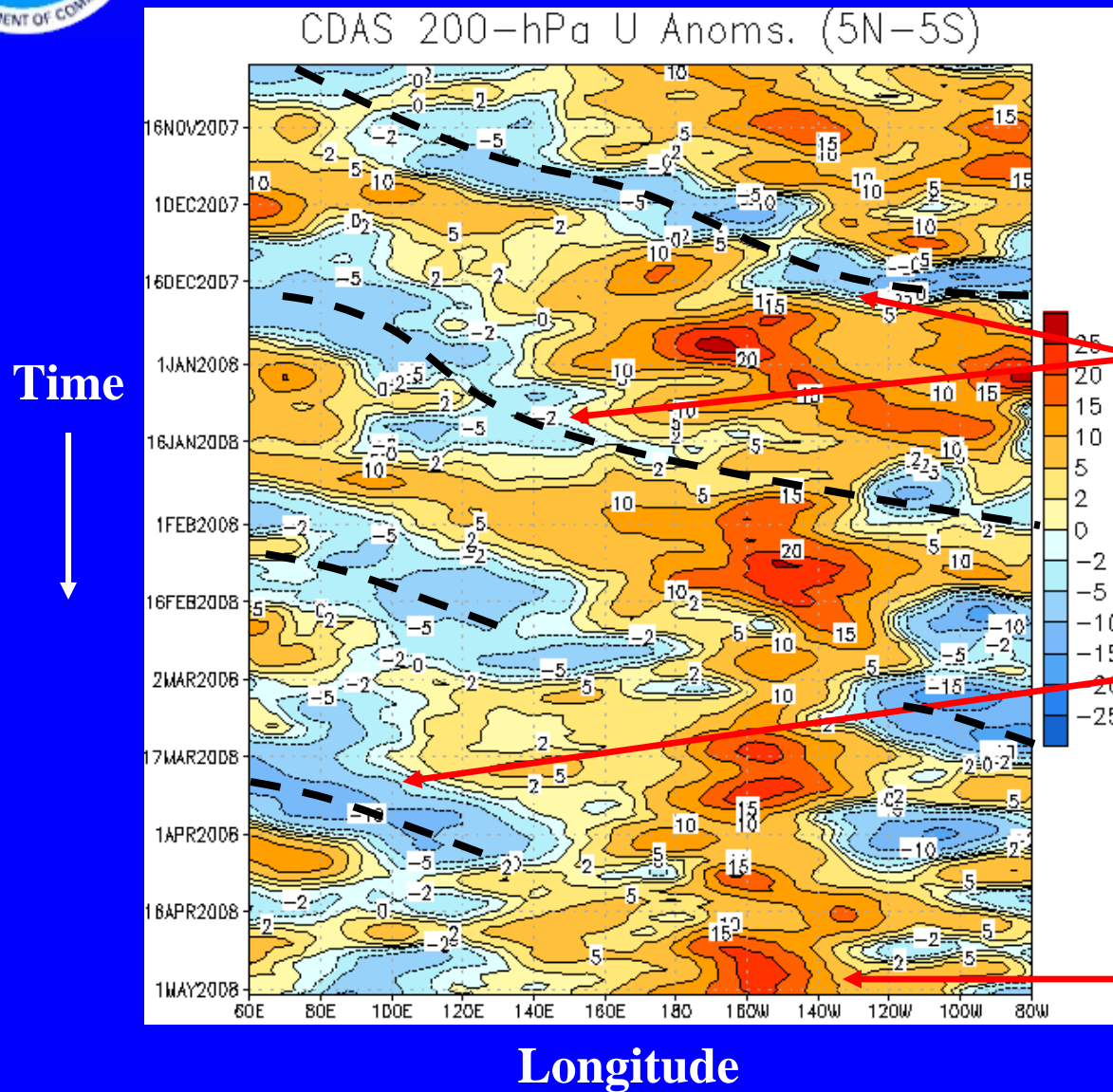
Note that shading denotes the magnitude of anomalous wind vectors



The main tropical features during the last 5-10 days are cyclonic circulations (C) north and south of the equator and equatorial westerly anomalies across the central Pacific Ocean. These features are consistent with continuing La Nina conditions.



# 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

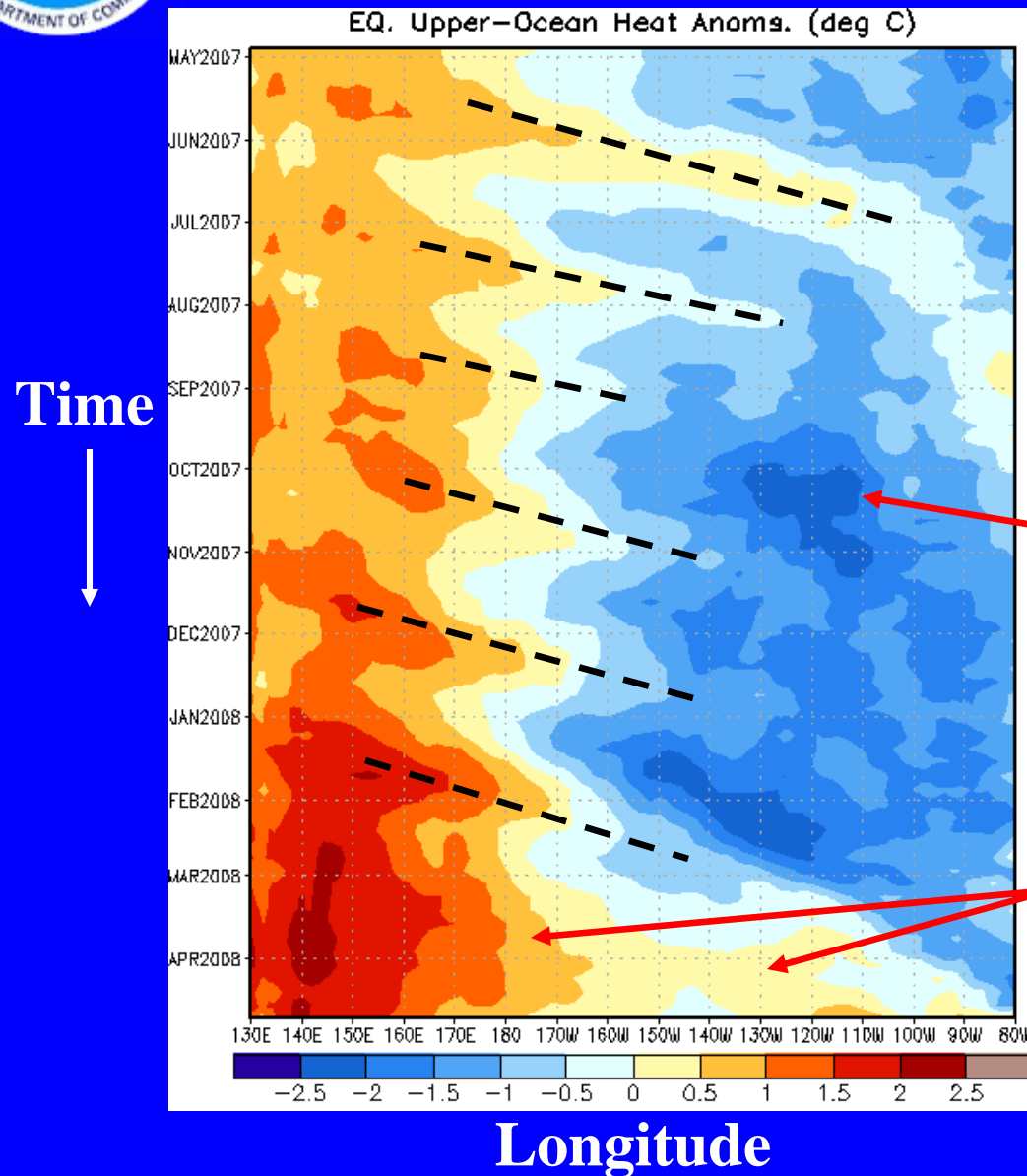
MJO activity is evident in the upper-levels by eastward propagation of easterly anomalies (dashed lines) globally from early November to mid-February.

During March, easterly anomalies propagated quickly eastward from the western hemisphere to the Maritime continent region in part associated with weak MJO activity.

Recently, westerly anomalies have increased east of the Date Line.



# Weekly Heat Content Evolution in the Equatorial Pacific



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

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 and have extended eastward into the eastern Pacific during April.



# 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.**

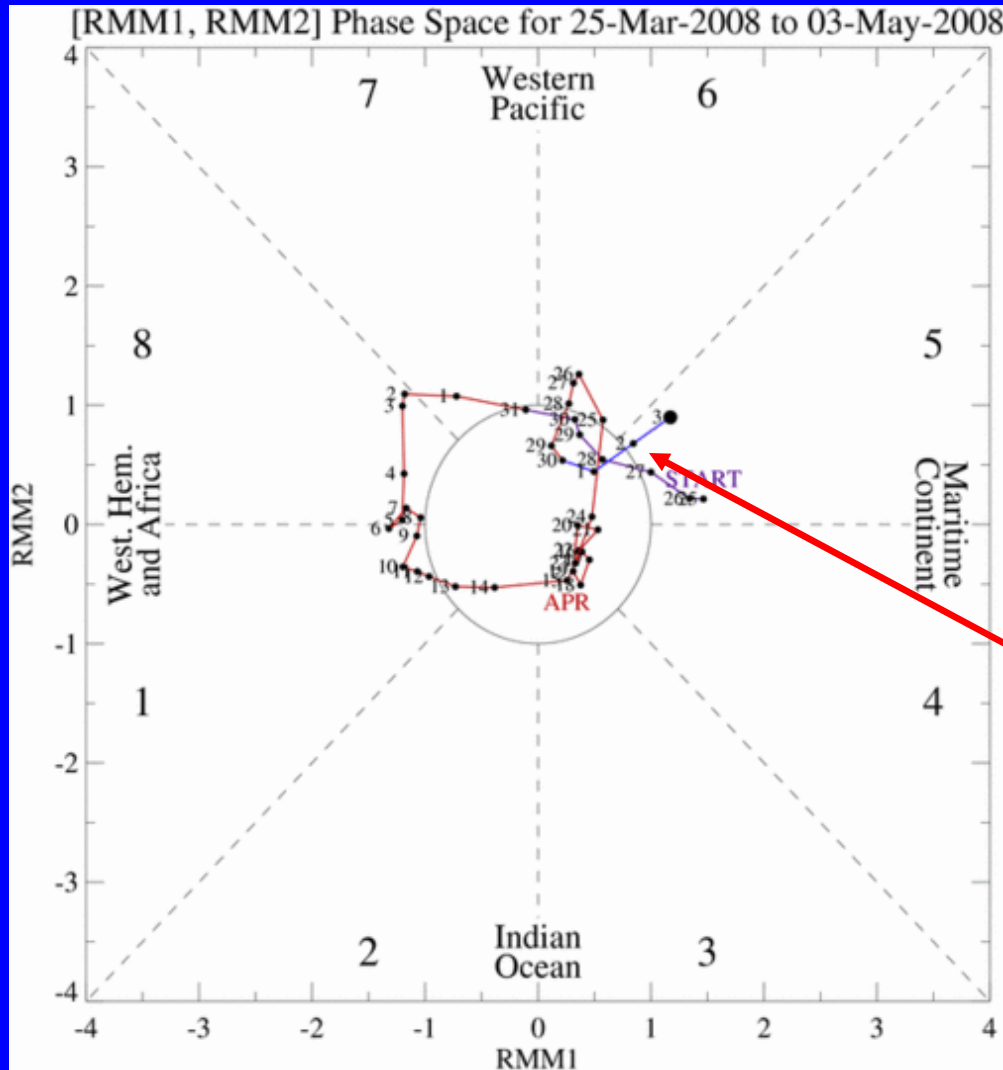
- The methodology is nearly identical to that described in WH2004 but small deviations from the BMRC figure are possible at times due to differences in input data and methodology. These typically occur during weak MJO periods.
- The index is based on a combined Empirical Orthogonal Function (EOF) analysis using fields of near-equatorially-averaged 850-hPa and 200-hPa zonal wind and outgoing longwave radiation (OLR).





# MJO Index -- Recent Evolution

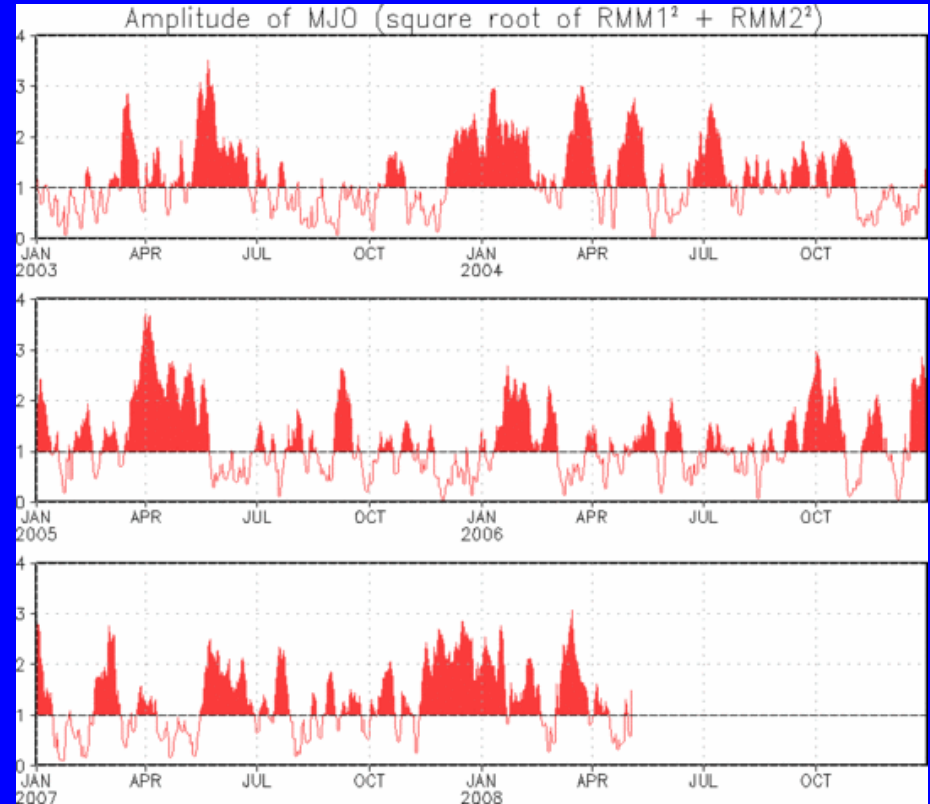
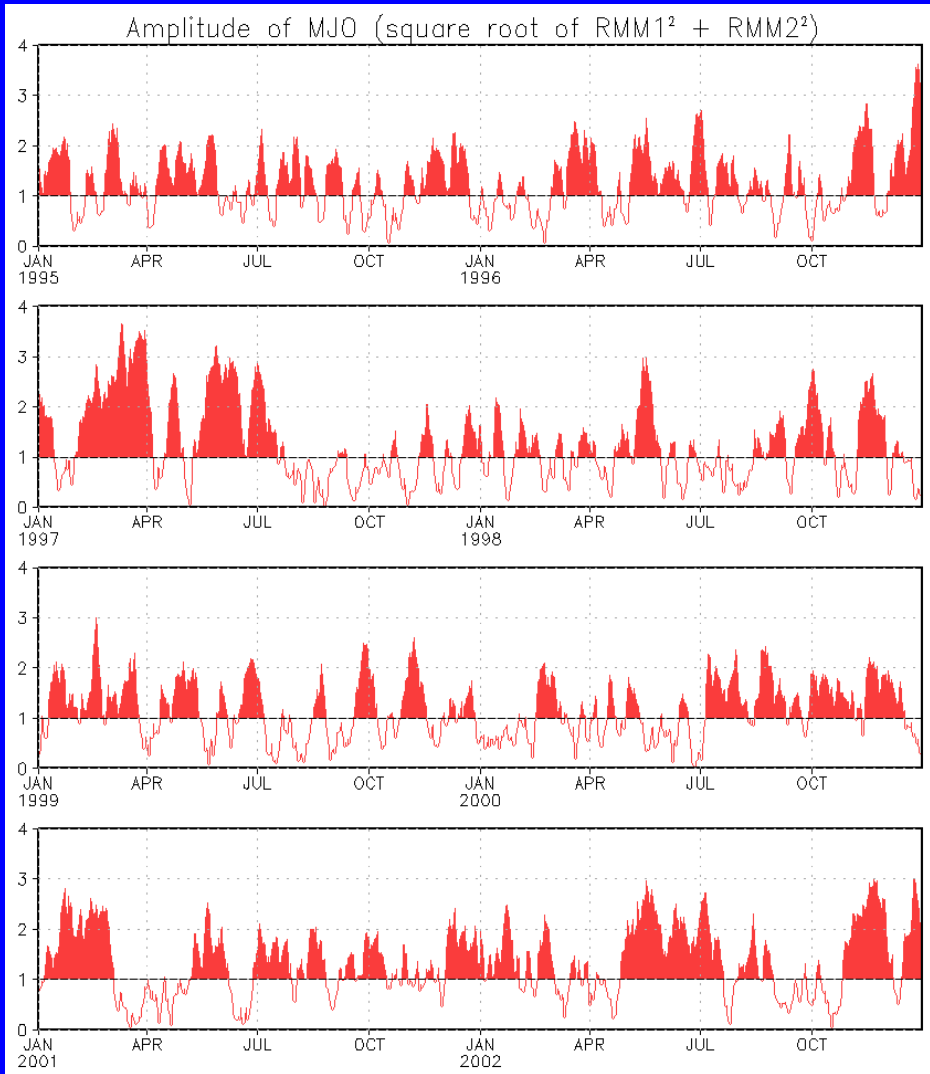
- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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



The MJO signal remains generally weak.



# 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**



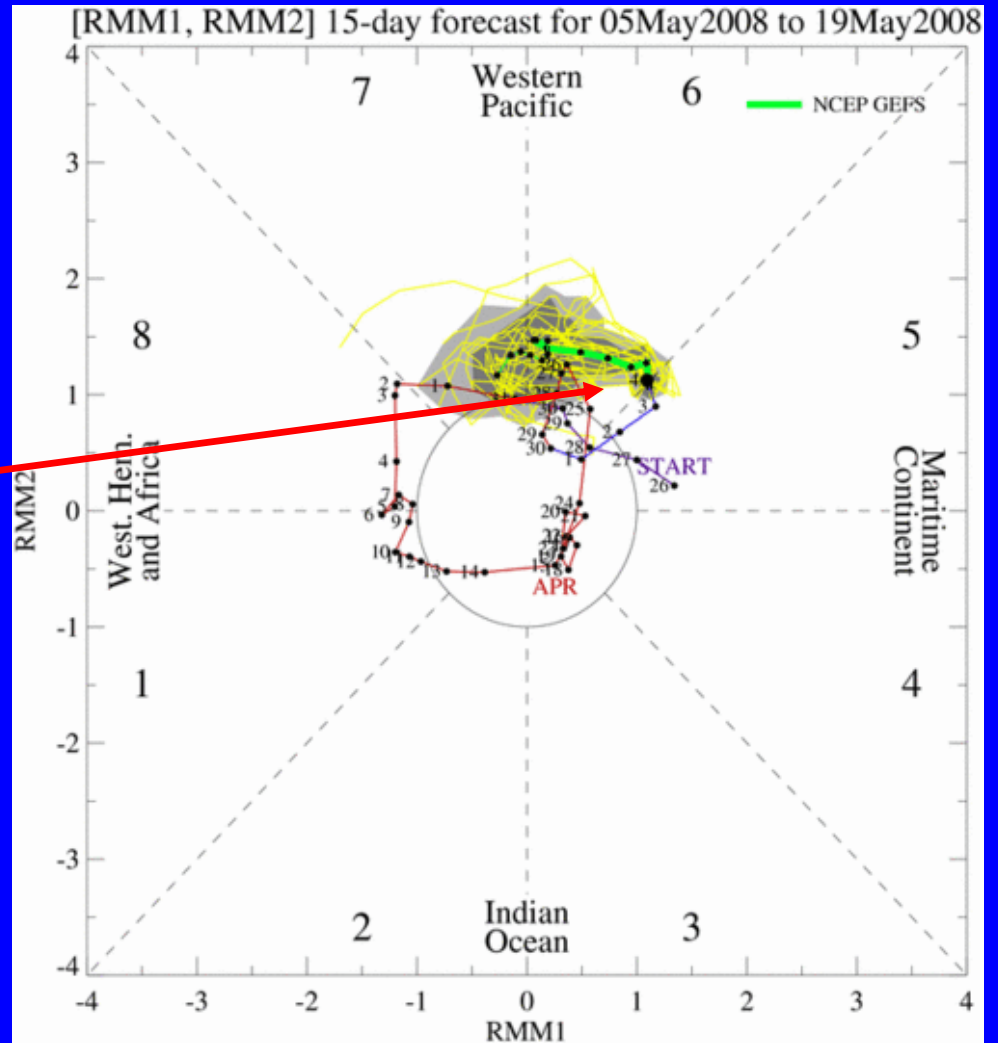
# Ensemble GFS MJO Forecasts

**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 generally weak MJO activity during the period with considerable uncertainty.

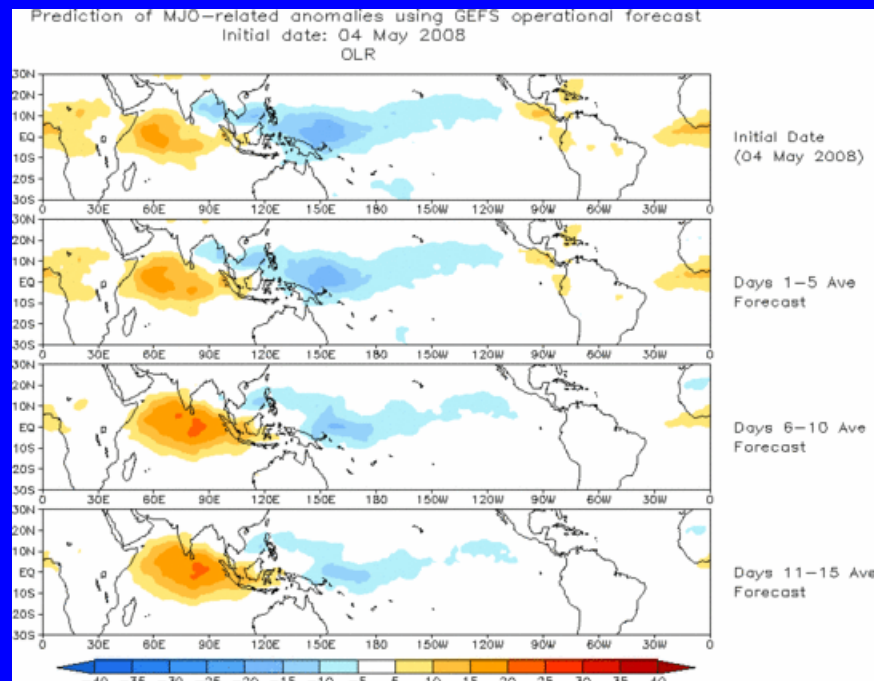




# Ensemble Mean GFS MJO Forecast

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)

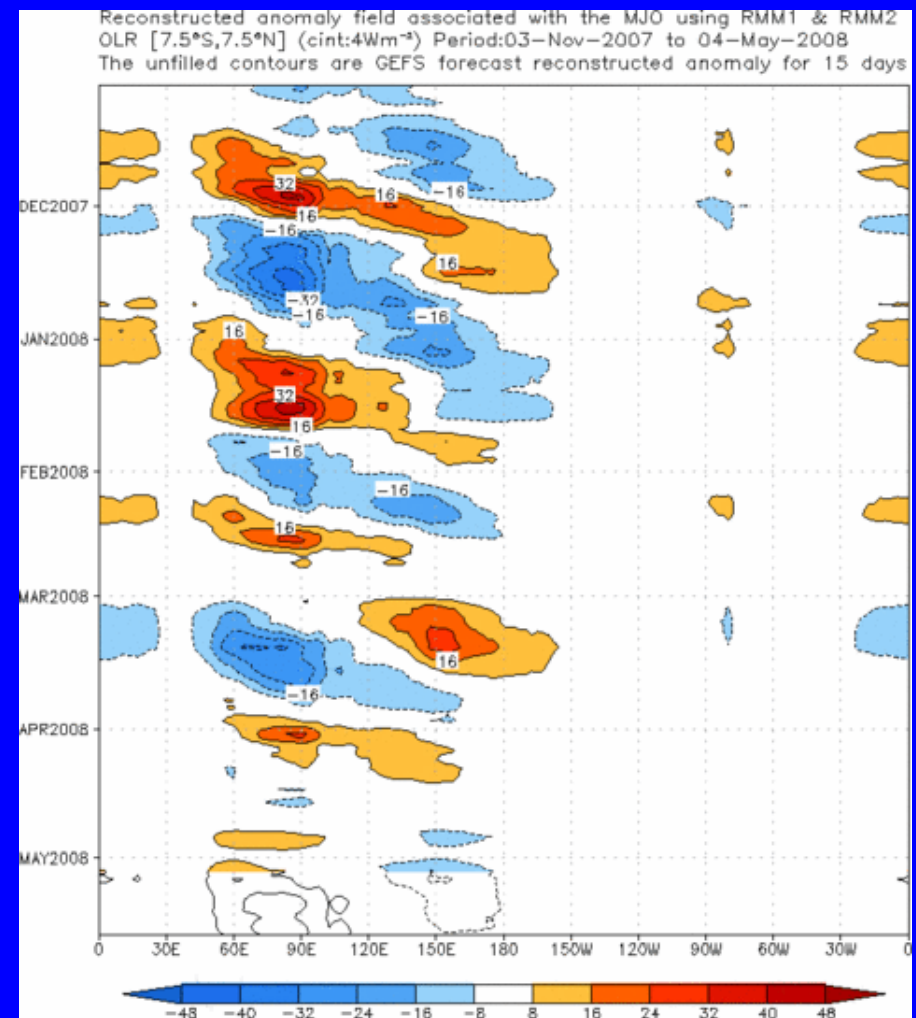
## Spatial map of OLR anomalies for the next 15 days



The forecast from the GEFS for MJO-associated convection indicates suppressed (enhanced) convection for the Indian Ocean (western Pacific) during the period.

It is unlikely that the MJO will contribute strongly to the tropical rainfall 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

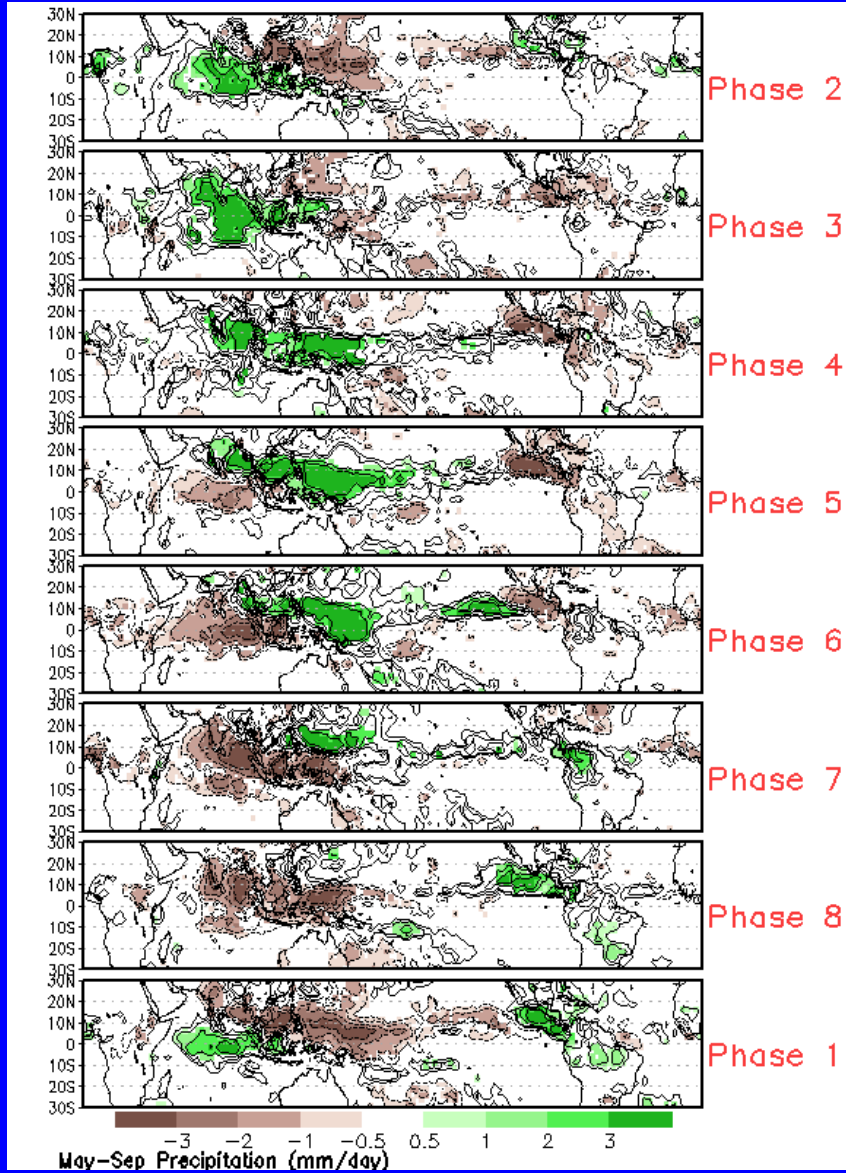






# MJO Composites – Global Tropics

## Precipitation Anomalies (May-Sep)



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

