



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

**Update prepared by
Climate Prediction Center / NCEP
June 1, 2009**



Outline

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



Overview

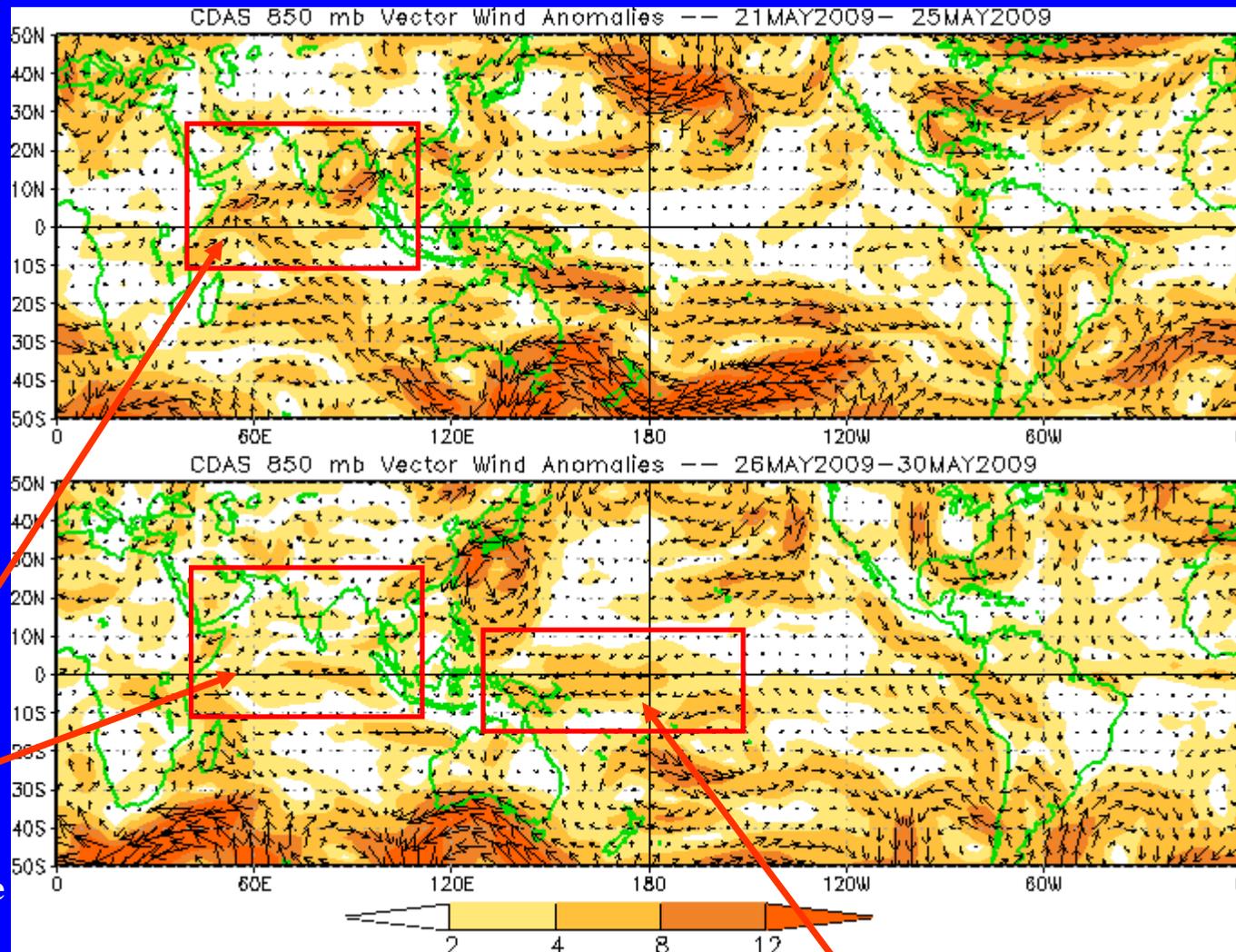
- **The MJO has generally been incoherent during the past week.**
- **Based on the latest observations the MJO is expected to remain weak during the next 1-2 weeks.**
- **The MJO signal is not anticipated to contribute significantly to areas of tropical rainfall or tropical cyclone development during the period.**

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



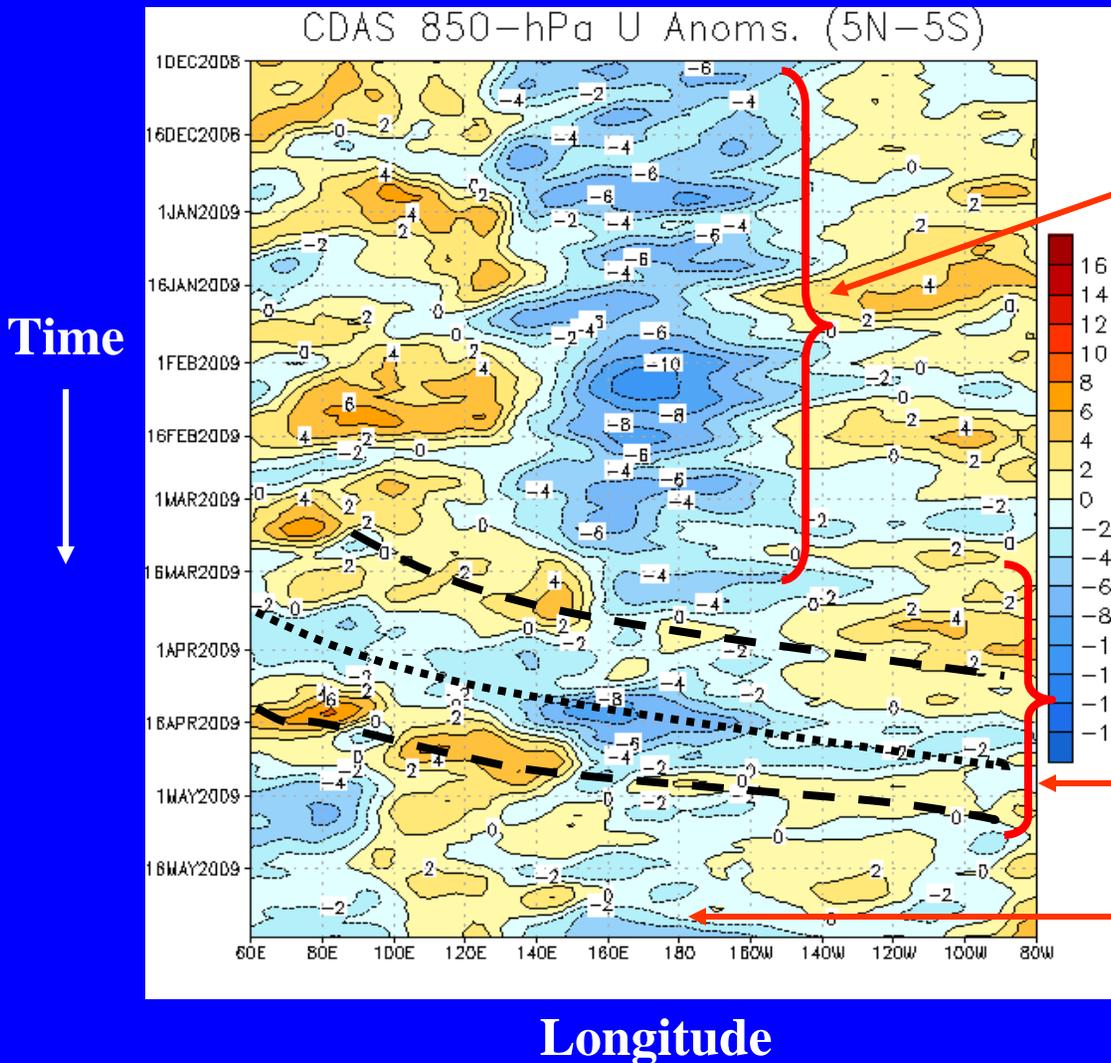
The anomalous monsoon flow weakened during the last five days across the Indian Ocean and India.

Easterly anomalies have returned to the equatorial western Pacific 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



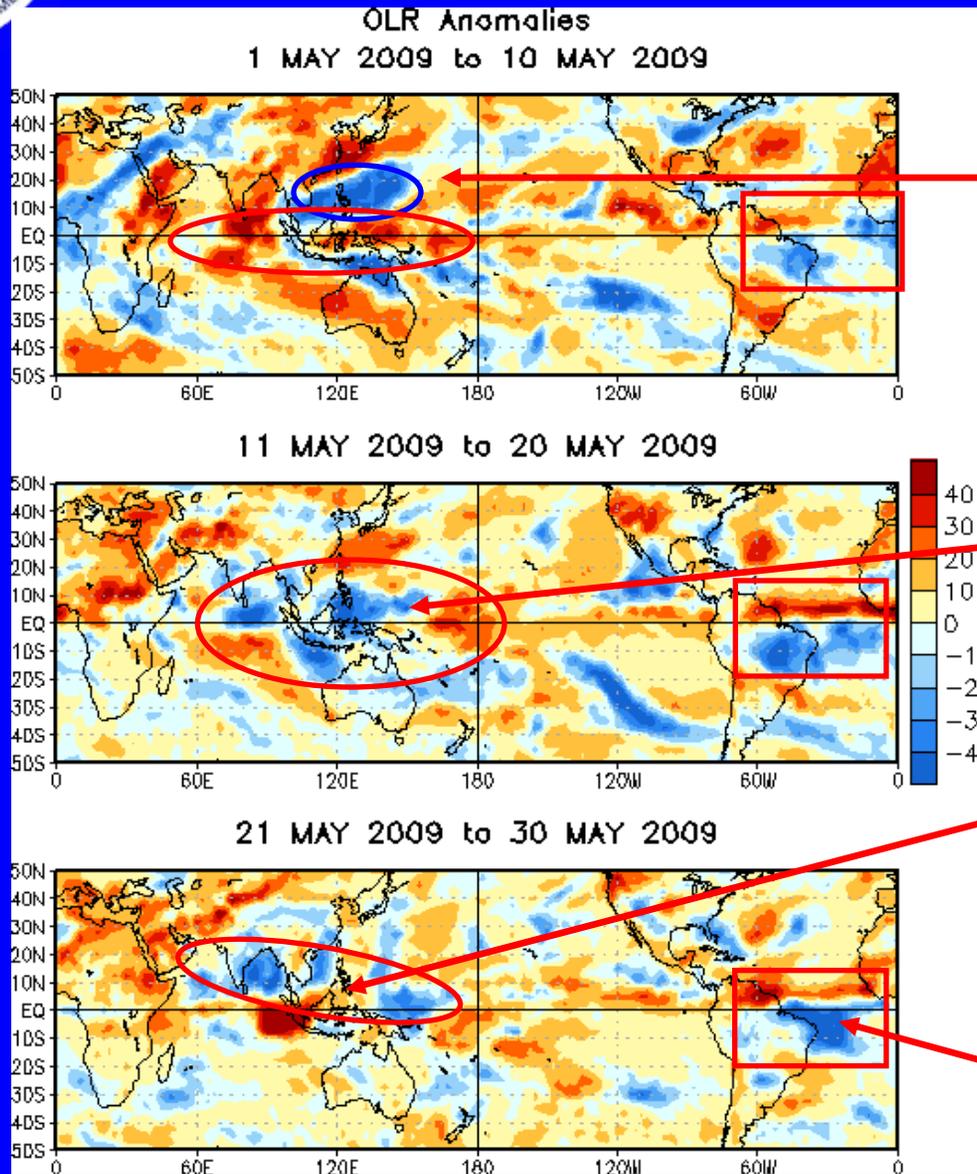
A persistent pattern of westerly (easterly) anomalies over the Indian Ocean (central Pacific Ocean) were in place from December to mid-March.

From the second half of March into May, a pattern of alternating low-level westerly, easterly and again westerly anomalies shifted eastward from the Indian Ocean through the equatorial Pacific associated with the MJO.

Easterly anomalies increased near and just west of the Date Line in late May.



OLR Anomalies: Last 30 days



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

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

In early May, enhanced convection focused near the Philippines while suppressed convection strengthened over the Indian Ocean and extended along the equator to the western Pacific.

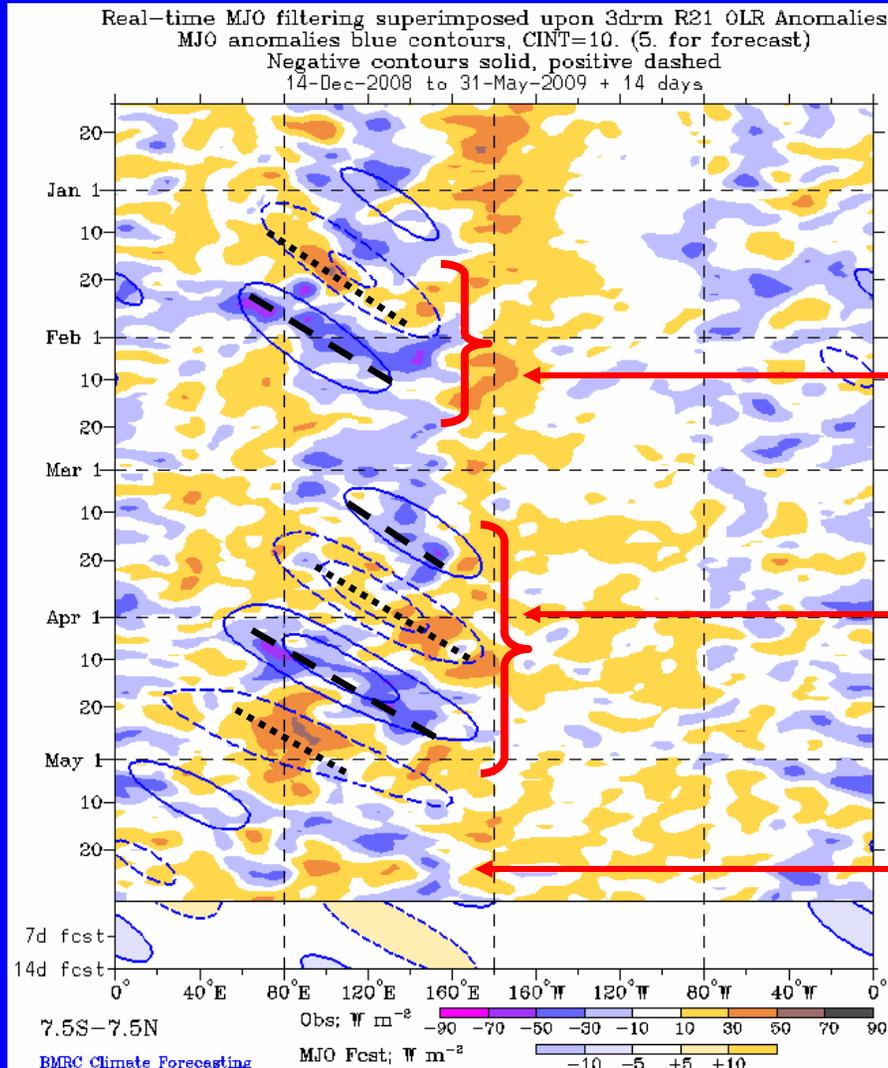
Convection increased across parts of the Maritime continent during mid May while dry conditions were evident across Africa.

During late May, weak enhanced convection continued from India to the western Pacific while Africa was dry.

A couplet of suppressed (enhanced) convection was evident during the entire period across northeast South America in part related to anomalous Atlantic SSTs.



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



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)

From mid-January to mid-February, eastward movement of suppressed (enhanced) convection is observed from the Indian Ocean to portions of Indonesia and the western Pacific.

From mid-March into early May, areas of suppressed and enhanced convection shifted eastward in association with the MJO.

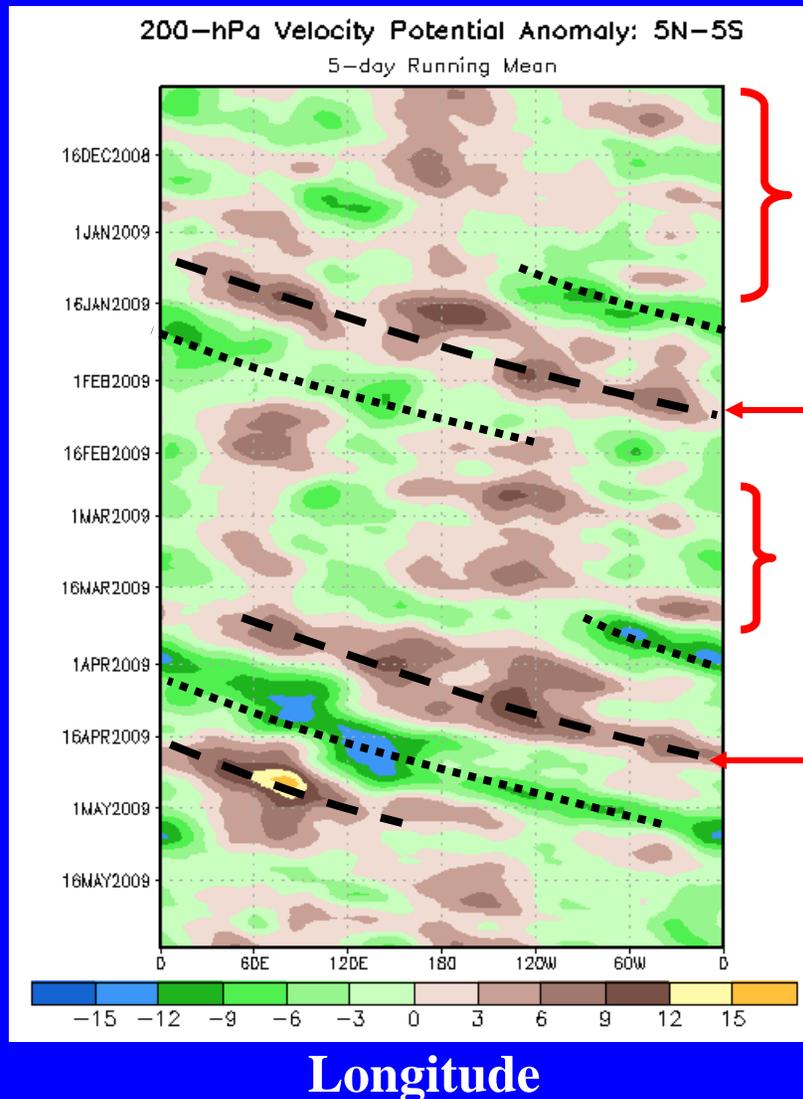
Since mid-May convection has generally been close to average across much of the equatorial Tropics with little eastward propagation on the MJO time scale.



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
↓



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

Velocity potential anomalies increased as the MJO strengthened and shifted eastward during January to mid-February.

The velocity potential anomalies were small from mid-February through early March.

From mid-March to early May, eastward propagating velocity potential anomalies indicated moderate-to-strong MJO activity.

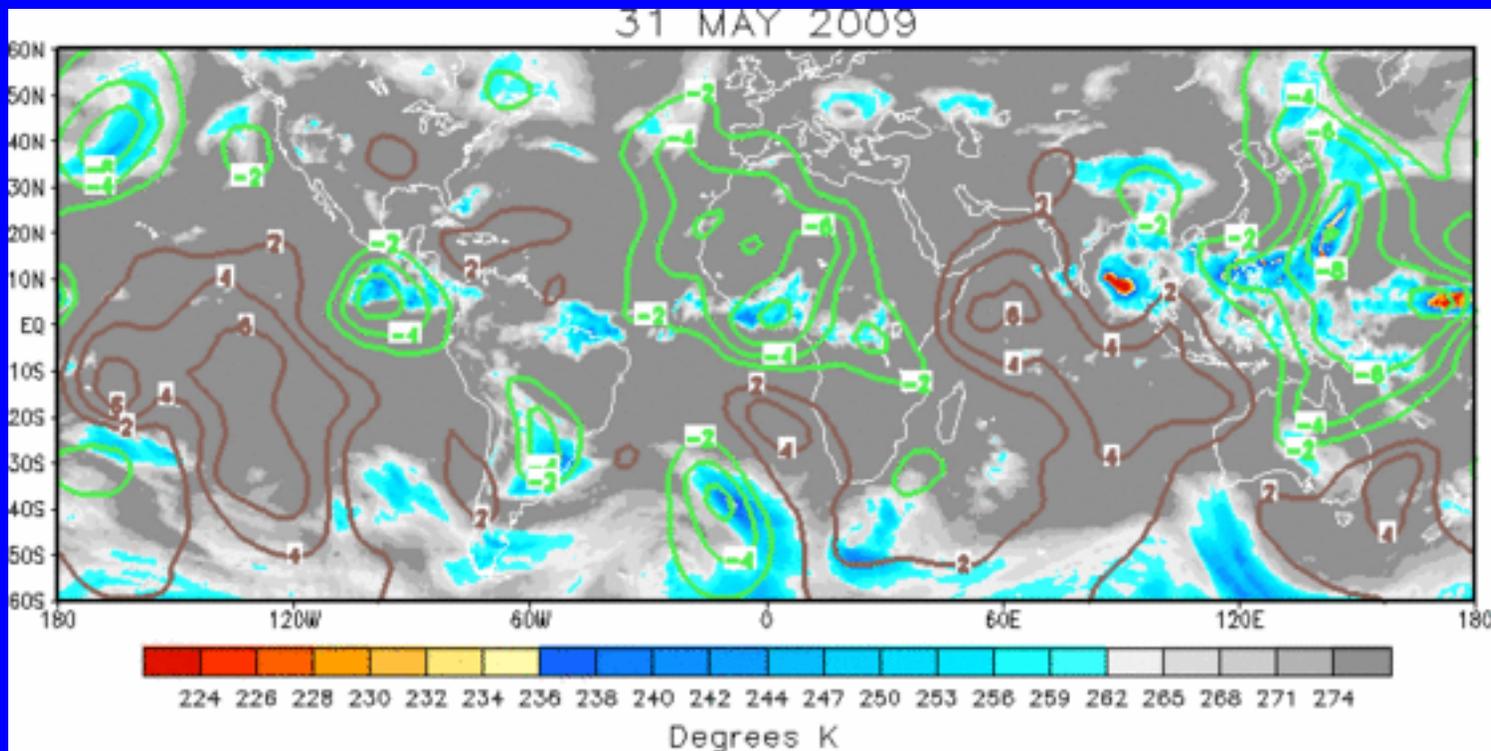
The MJO weakened during mid-May.



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

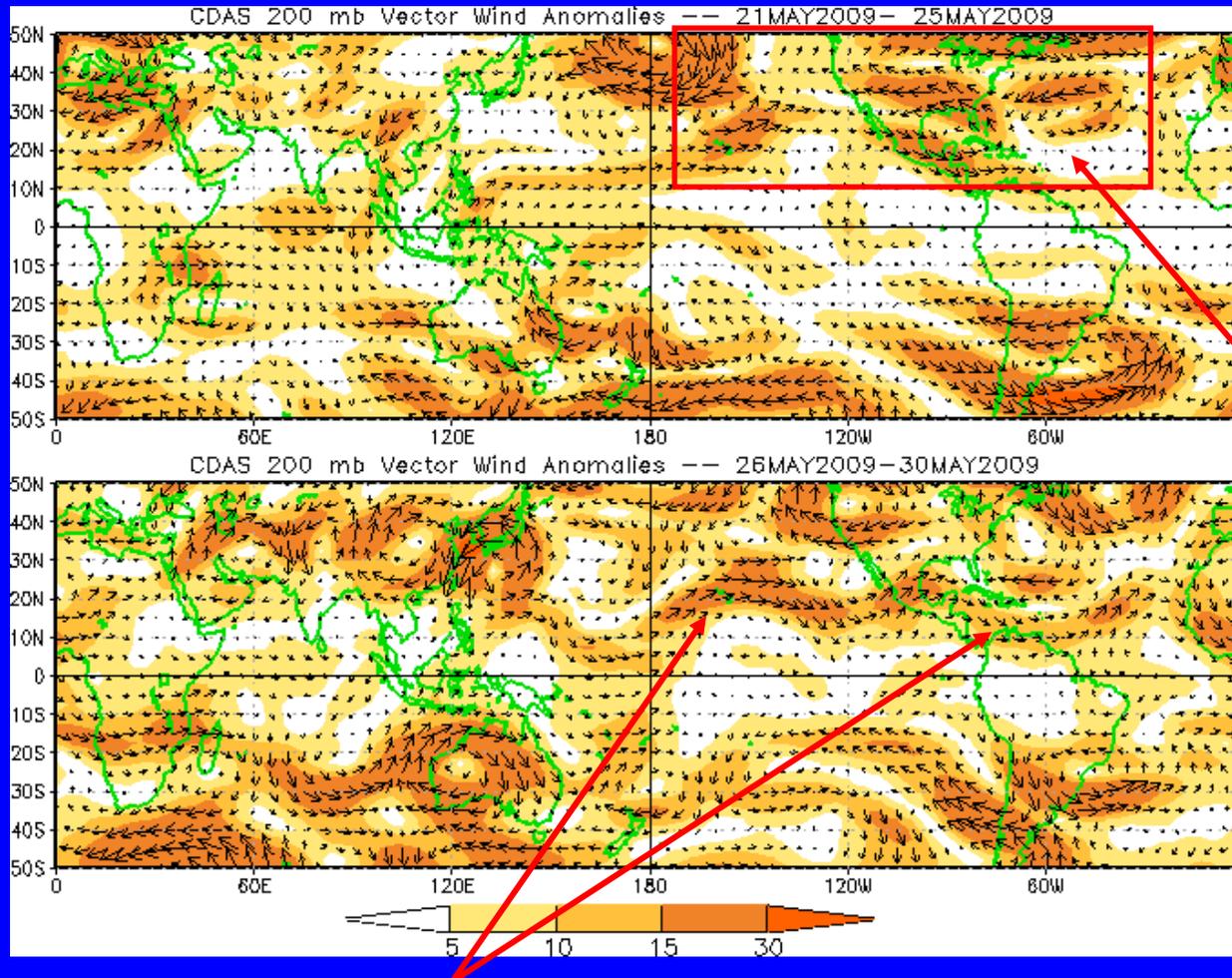


The latest velocity potential pattern indicates the largest anomalies are associated with upper-level divergence across the eastern Pacific Ocean, the Gulf of Guinea region of Africa and parts of the western Pacific.



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

Note that shading denotes the magnitude of anomalous wind vectors



The westerlies across North America were shifted northward during the previous five days with upper-level lows dominating the subtropics of the western Hemisphere.

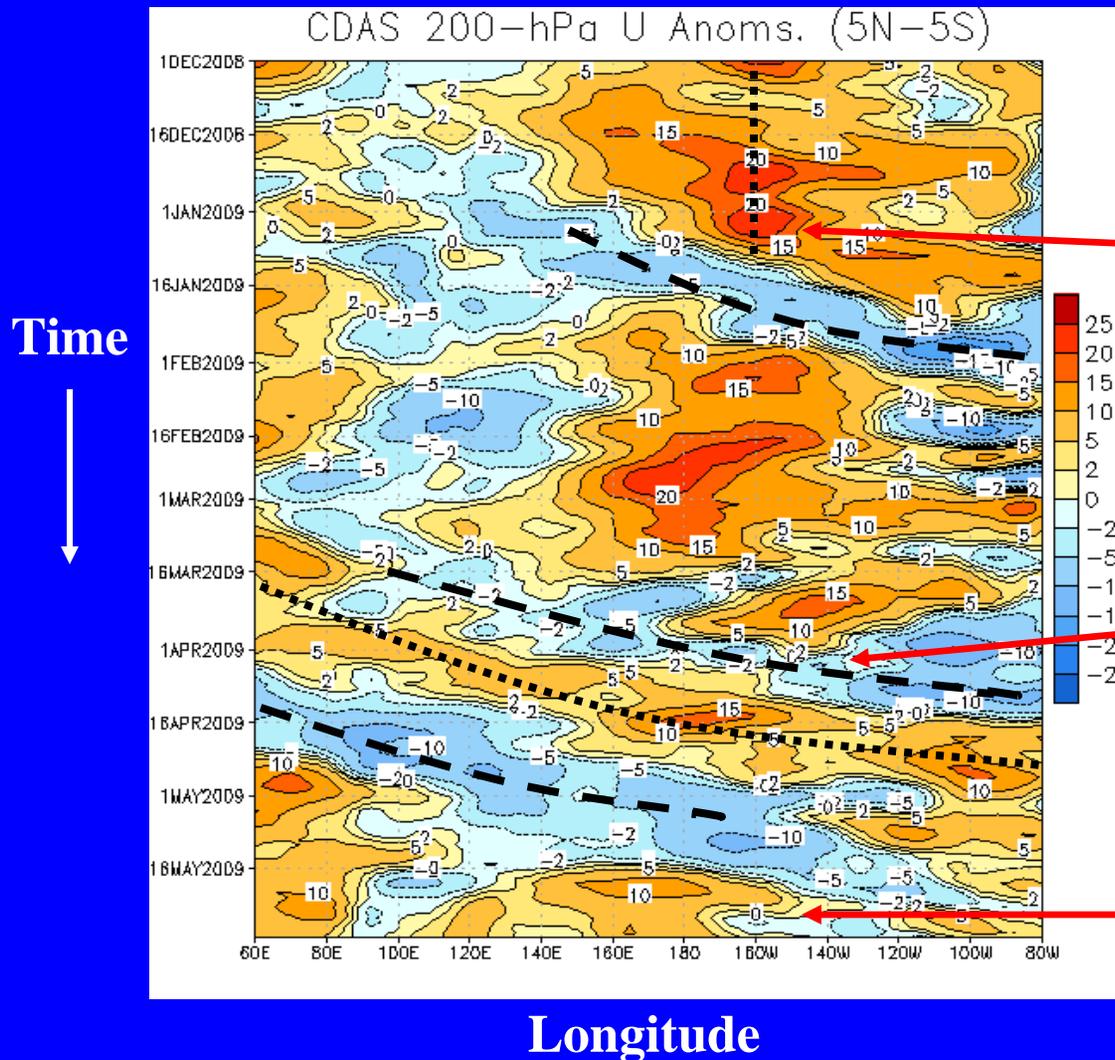
Westerly anomalies are evident across the subtropics from the Pacific to Africa during the last five days.



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



Westerly anomalies strengthened markedly in late-November near the Date Line and persisted through December. These anomalies are consistent with La Nina conditions.

Easterly and westerly anomalies shifted eastward from mid-March to the beginning of May associated with the MJO.

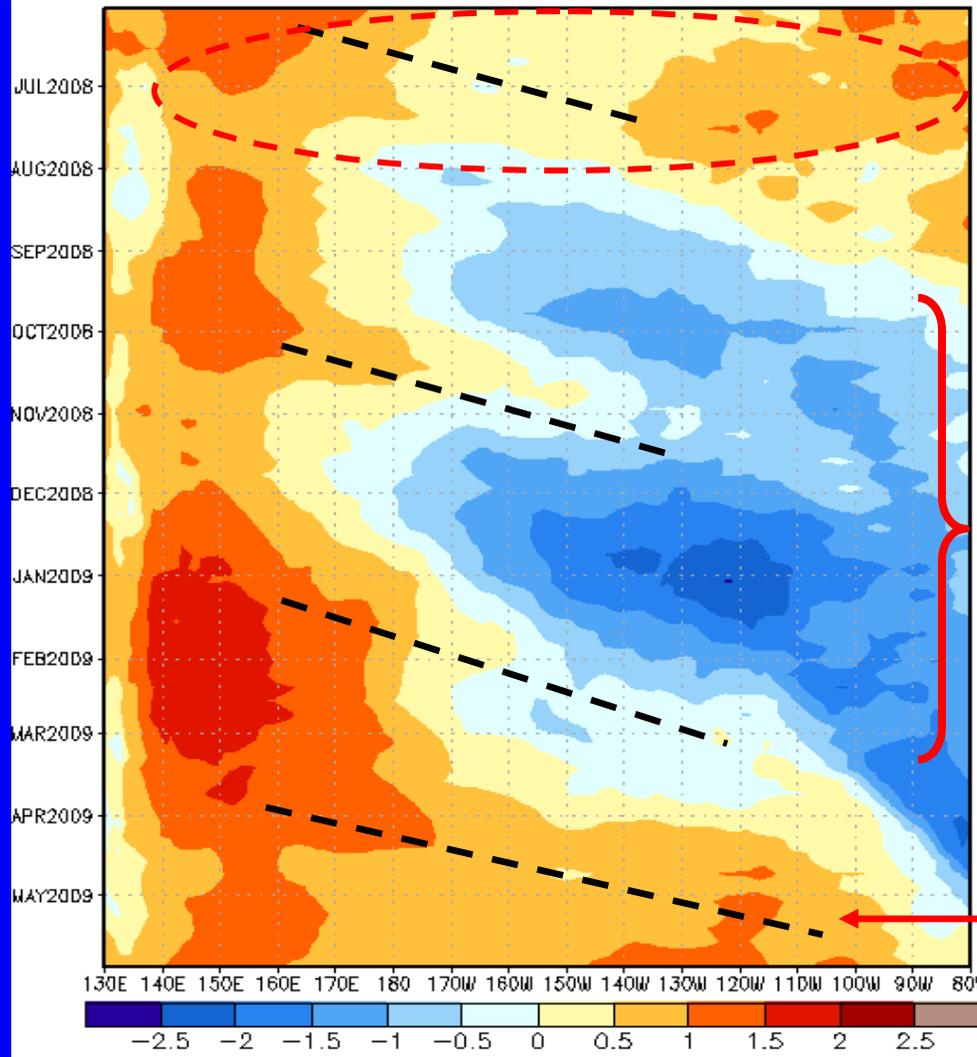
Most recently, westerly anomalies are evident near and to the west of the Date Line.



Weekly Heat Content Evolution in the Equatorial Pacific

EQ. Upper-Ocean Heat Anoms. (deg C)

Time
↓



Longitude

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 increased/expanded eastward through early 2009. There was a pause in this increase during October as a Kelvin wave shifted eastward.

An eastward propagating Kelvin wave during April and May has increased heat content in the eastern half of the Pacific.



MJO Index -- Information

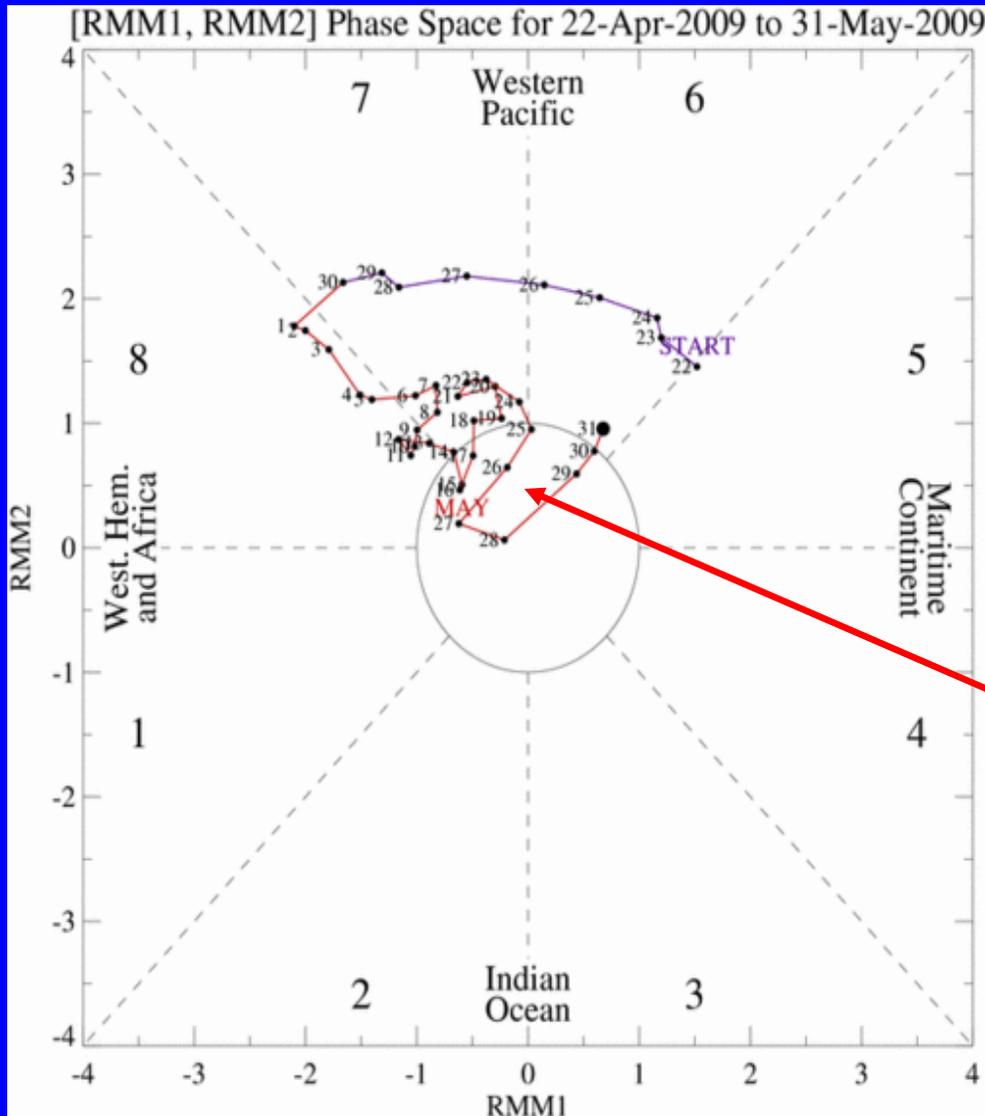
- The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).

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

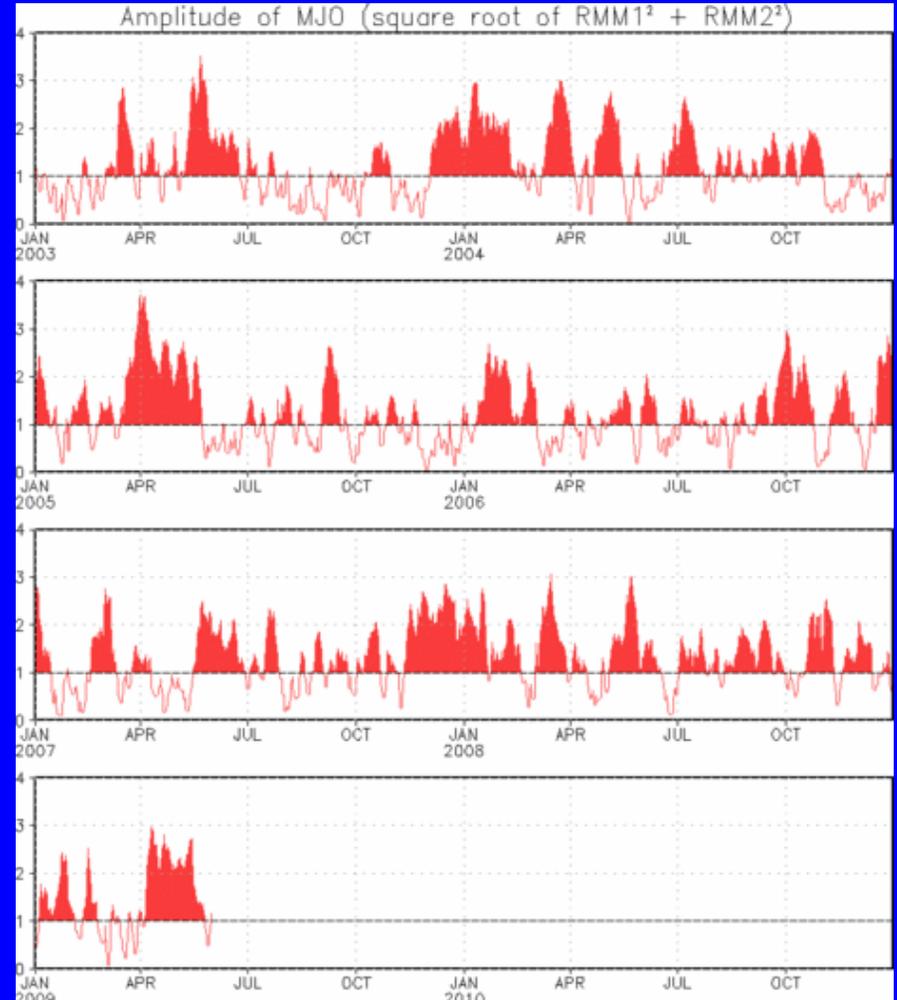
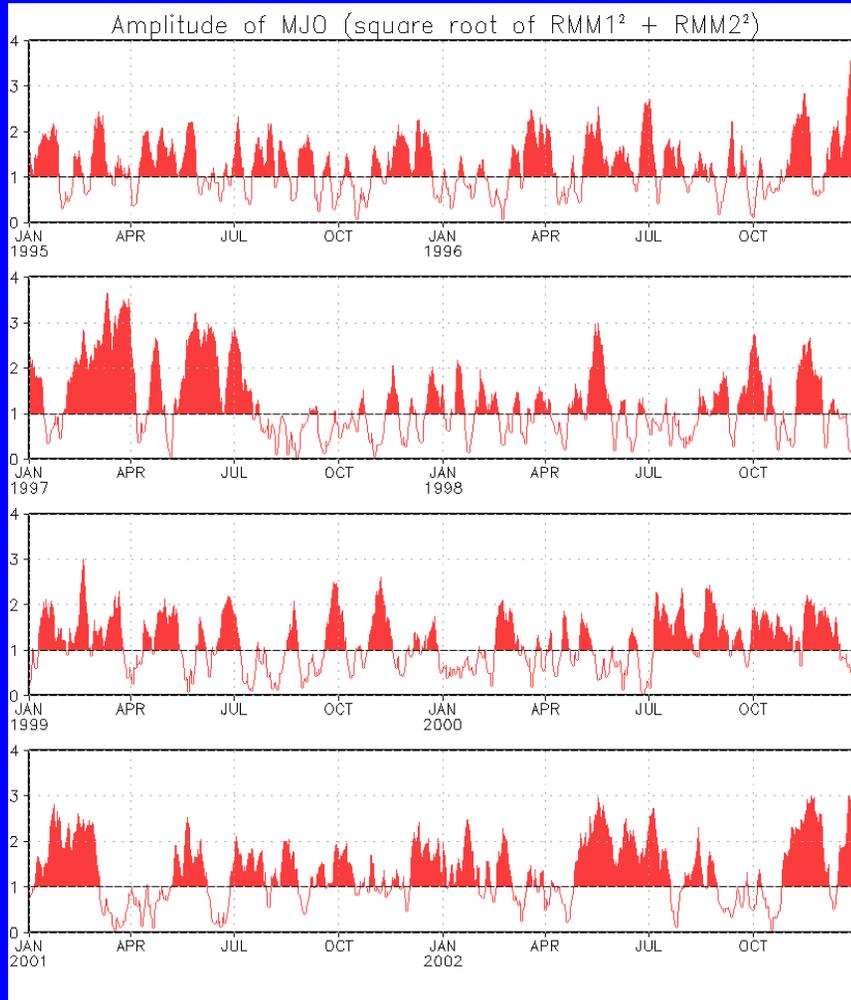


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the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

The MJO index indicated incoherent activity during the past week although the amplitude has increased in recent days.



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

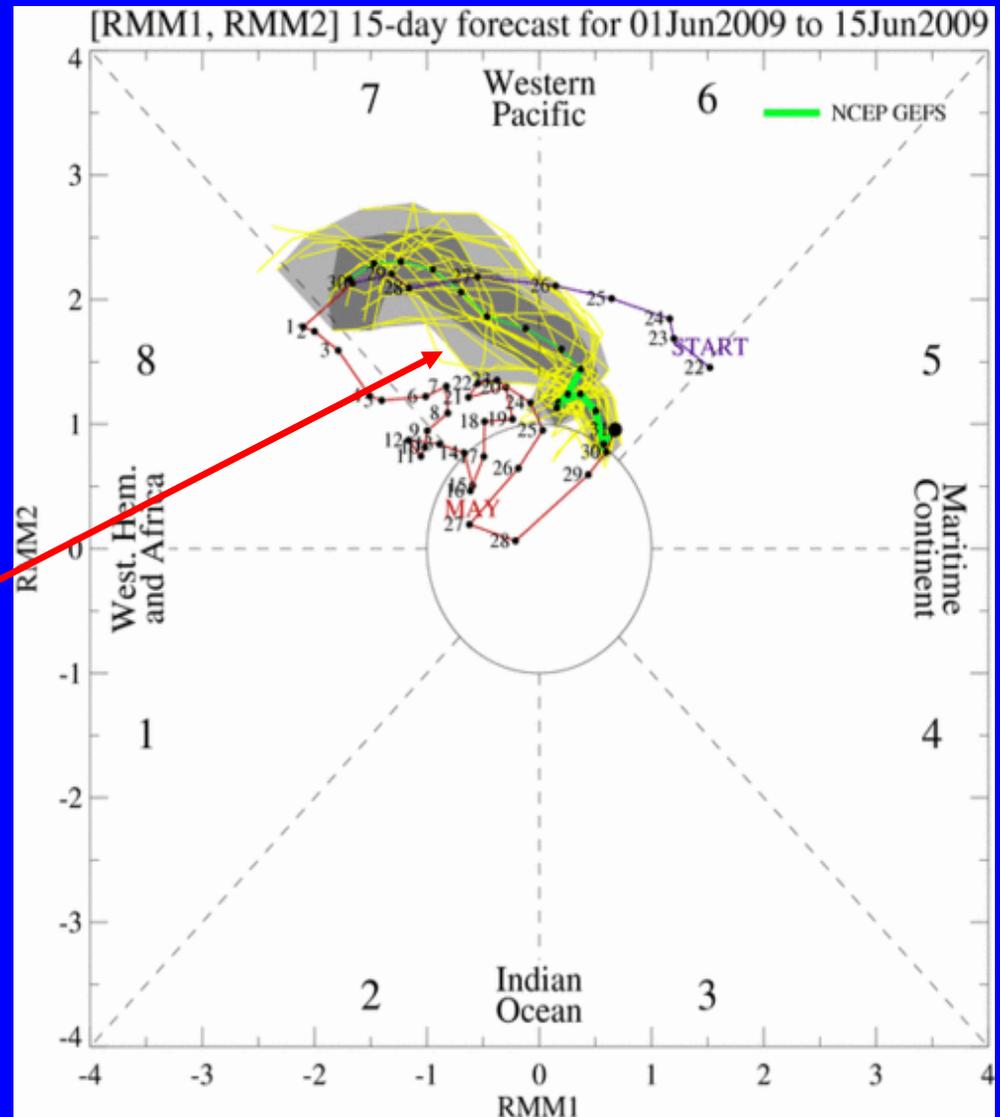
Yellow Lines – 20 Individual Members
Green Line – Ensemble Mean

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 indicate a strengthening MJO signal during the period especially during Week-2 as eastward propagation increases.

The evolution is most likely a result of a combination of subseasonal coherent tropical variability as opposed to a developing MJO.

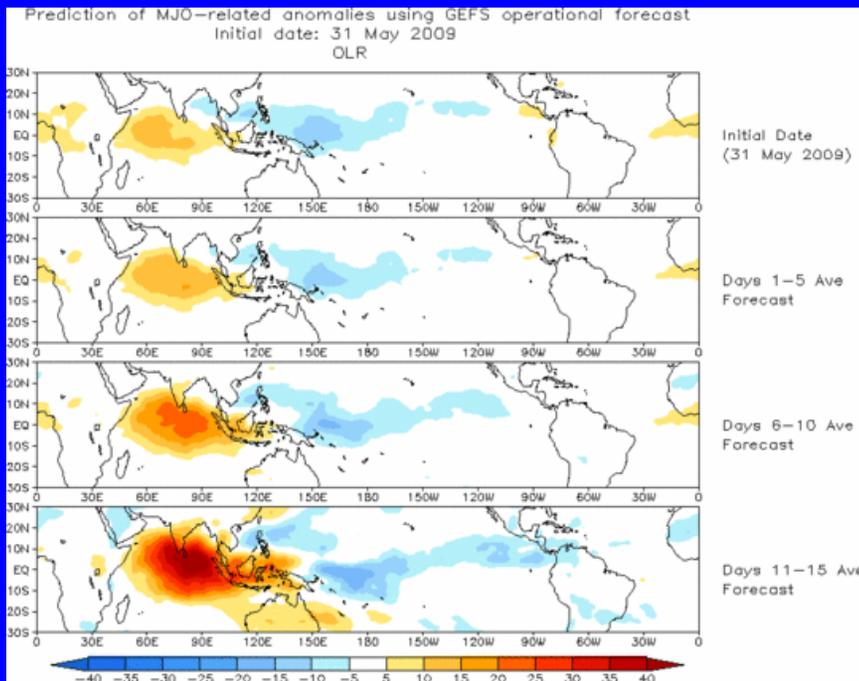




Ensemble Mean GFS MJO Forecast

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)

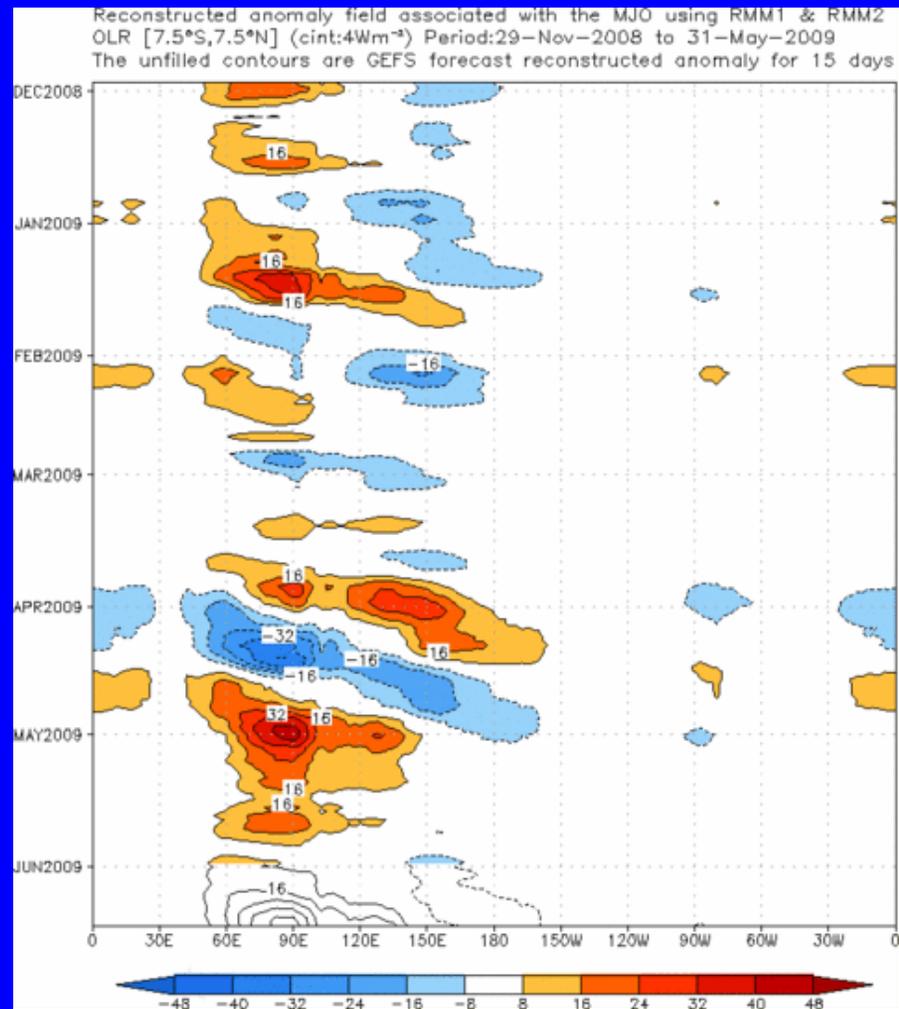
Spatial map of OLR anomalies for the next 15 days



Suppressed convection is forecast across the Indian Ocean and western Maritime Continent over the period with slight eastward propagation.

Enhanced convection may impinge on Central America 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





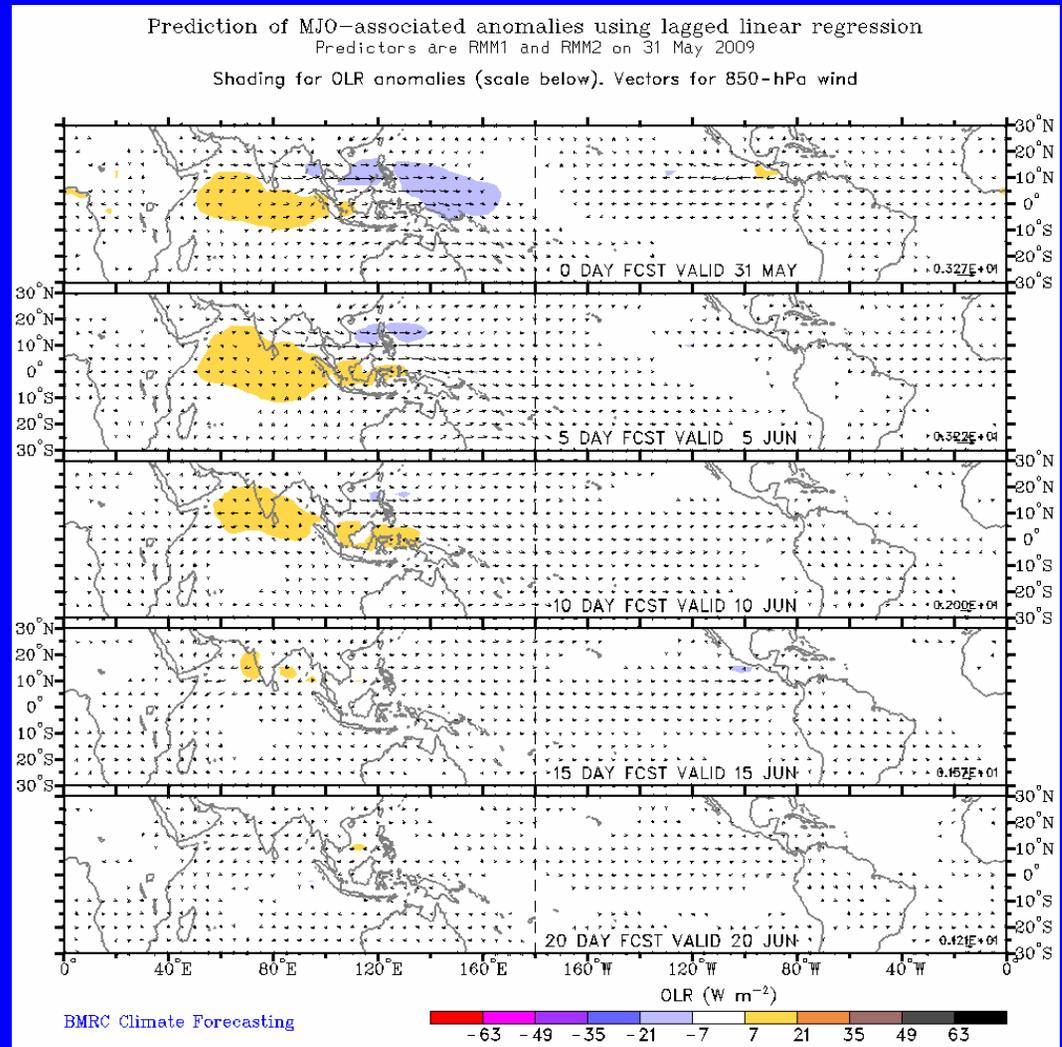
Statistical MJO Forecast

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)

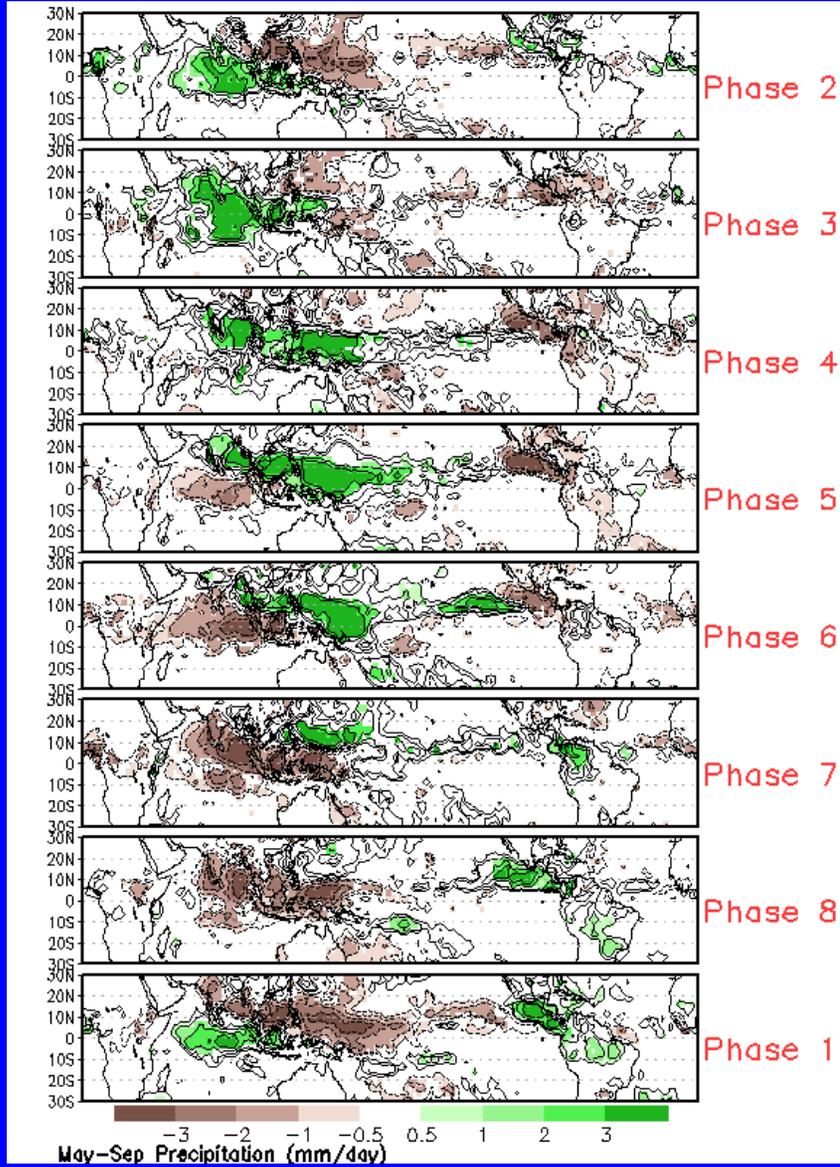
A statistical forecast indicates weak MJO activity during the next 1-2 weeks.





MJO Composites – Global Tropics

Precipitation Anomalies (May-Sep)



850-hPa Wind Anomalies (May-Sep)

