



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

**Update prepared by
Climate Prediction Center / NCEP
June 29, 2009**



Outline

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



Overview

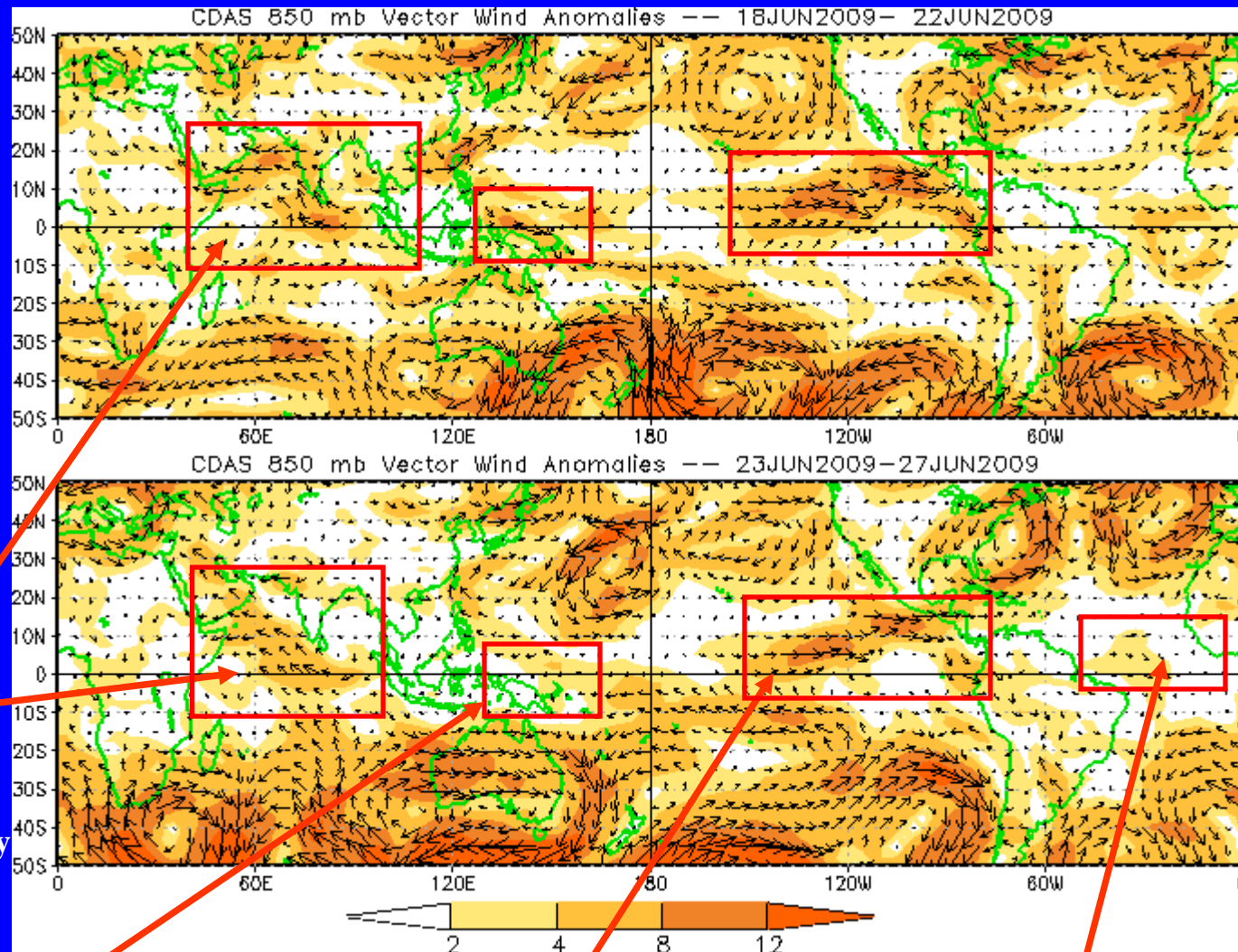
- The MJO signal remains weak.
- Based on the latest observations and model forecasts, MJO activity is expected to remain weak during the next 1-2 week forecast period.
- At the current time, the MJO is not anticipated to contribute significantly to the pattern of tropical rainfall and tropical cyclogenesis.

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



Anomalous flow across the Indian Ocean has taken on a more southerly component.

A westerly wind burst during mid-June has ended near Papua New Guinea.

Westerly anomalies have continued across much of the eastern Pacific.

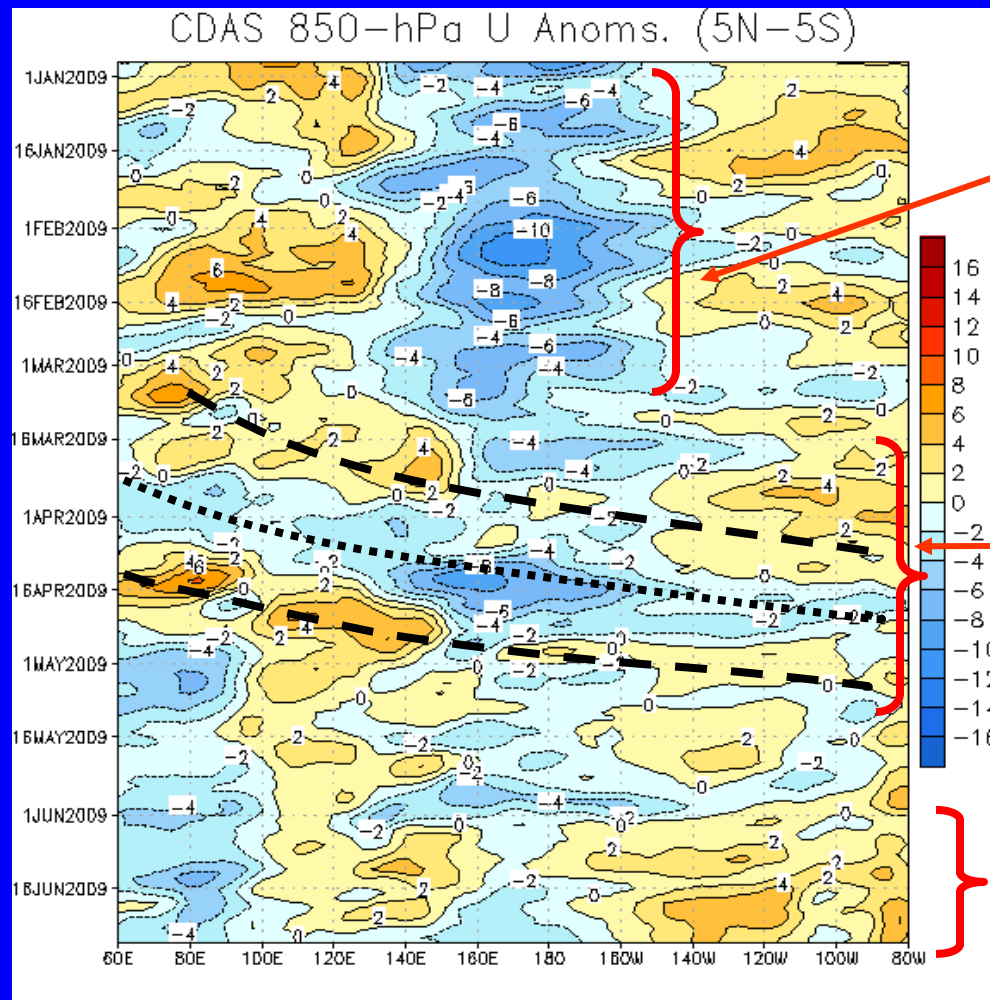
Westerly anomalies across the tropical Atlantic continue to decrease.



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

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

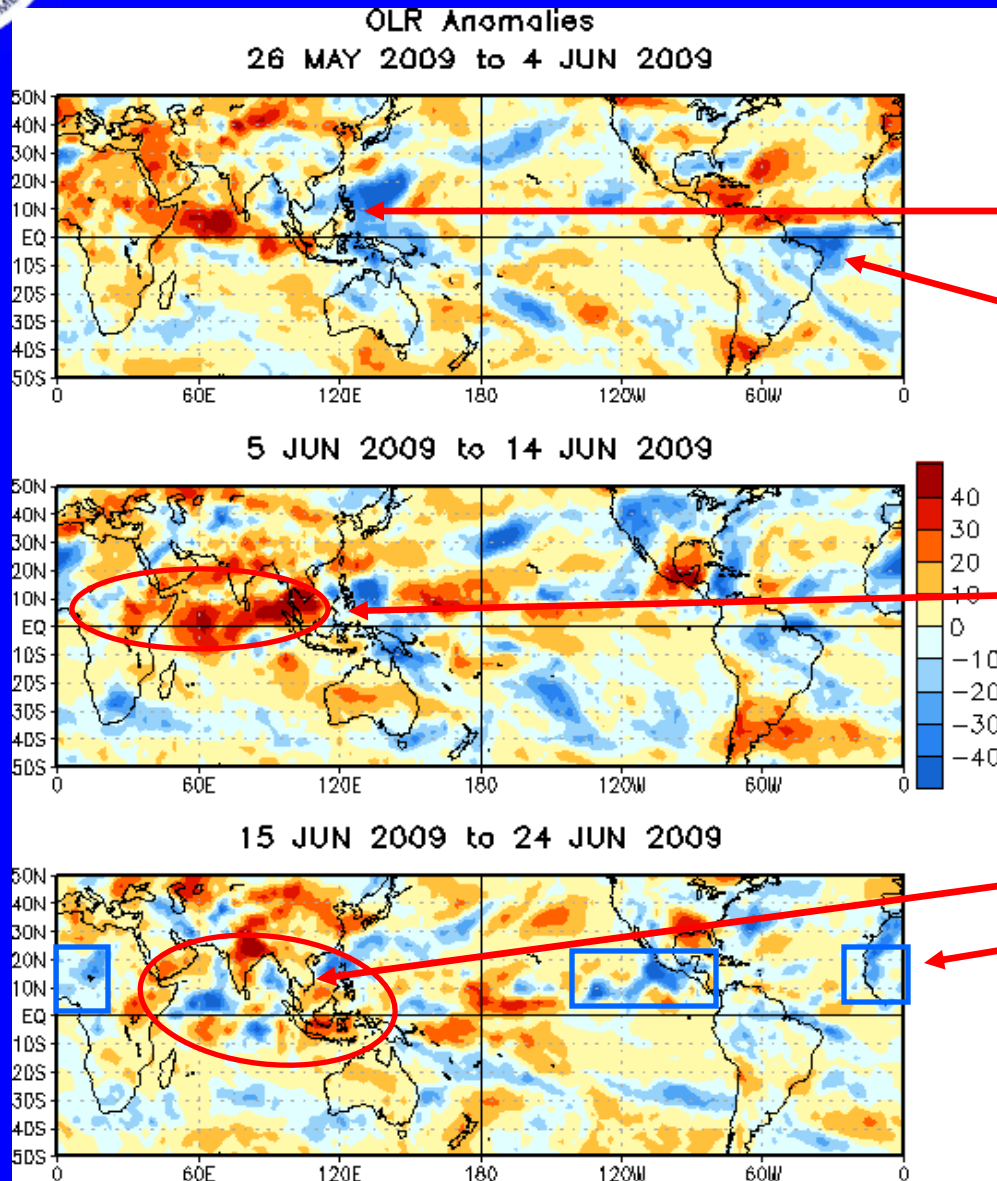
From mid-March to early May, a pattern of alternating low-level westerly, easterly and again westerly anomalies shifted eastward from the Indian Ocean through the equatorial Pacific associated with the MJO.

The wind field was quite persistent across much of the Indian Ocean, Maritime continent and Pacific Ocean during much of June. Weak easterly anomalies now extend from the Indian Ocean to the Date Line.



OLR Anomalies: Last 30 days

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



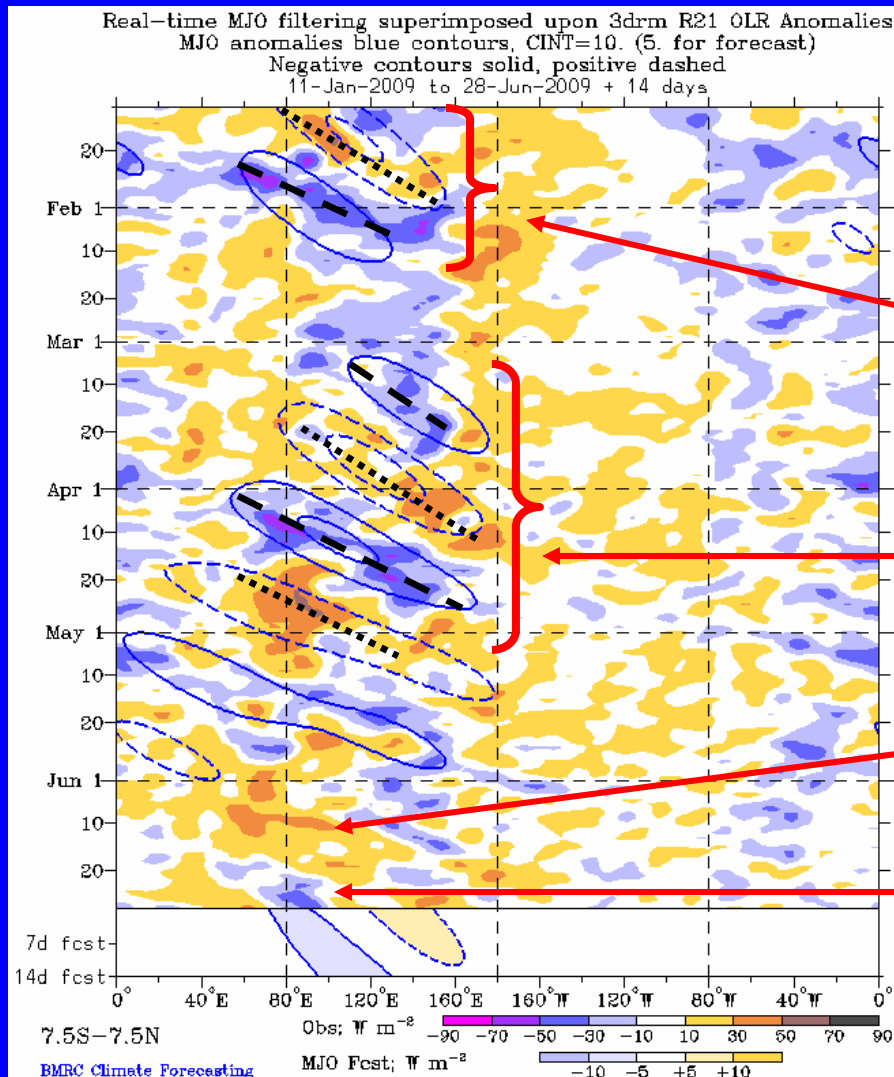
In late May, convection was strongest across the Western North Pacific and the Atlantic with suppressed convection over much of Africa, the Caribbean Sea and the Indian Ocean.

During early-to-mid June, suppressed convection dominated the Indian Ocean and southern Asia.

Convection was close to average across much of the eastern Hemisphere while wet conditions increased across western Africa, the eastern Pacific and Central America.



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 the western Pacific.

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

During mid-June, suppressed convection prevailed across much of the Indian Ocean and Maritime Continent.

Most recently, convection has increased across the Indian Ocean.

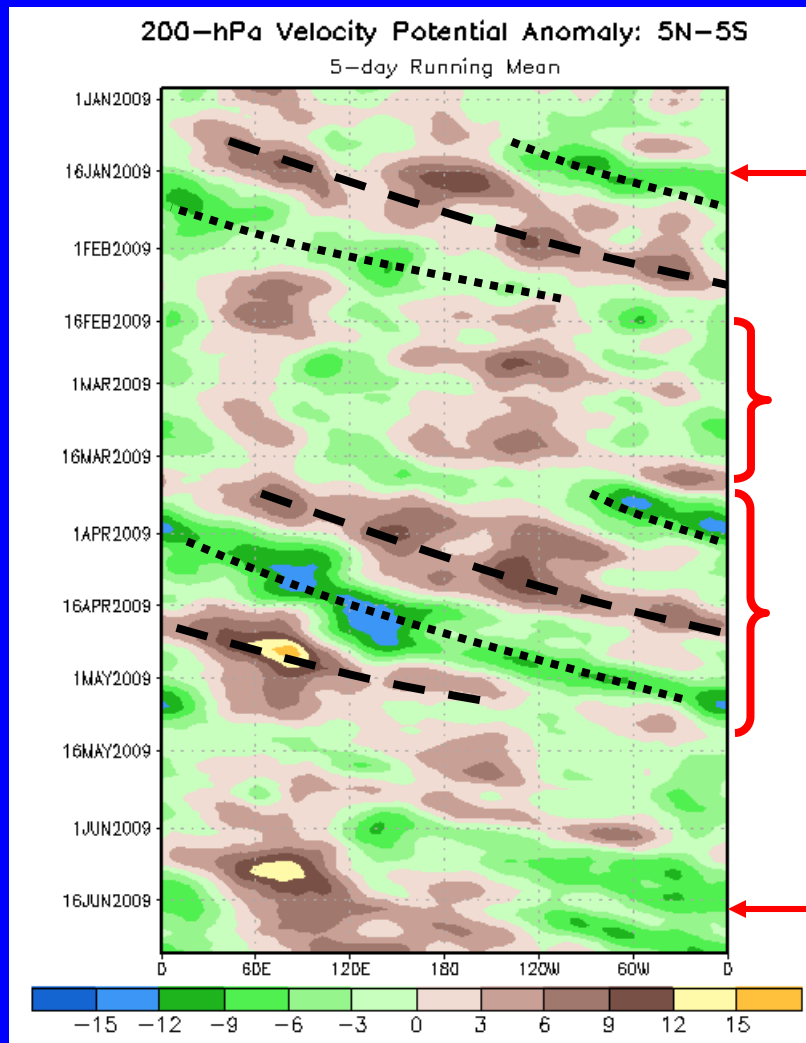


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time
↓



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

No coherent pattern was exhibited in the weak velocity potential anomalies 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 in May.

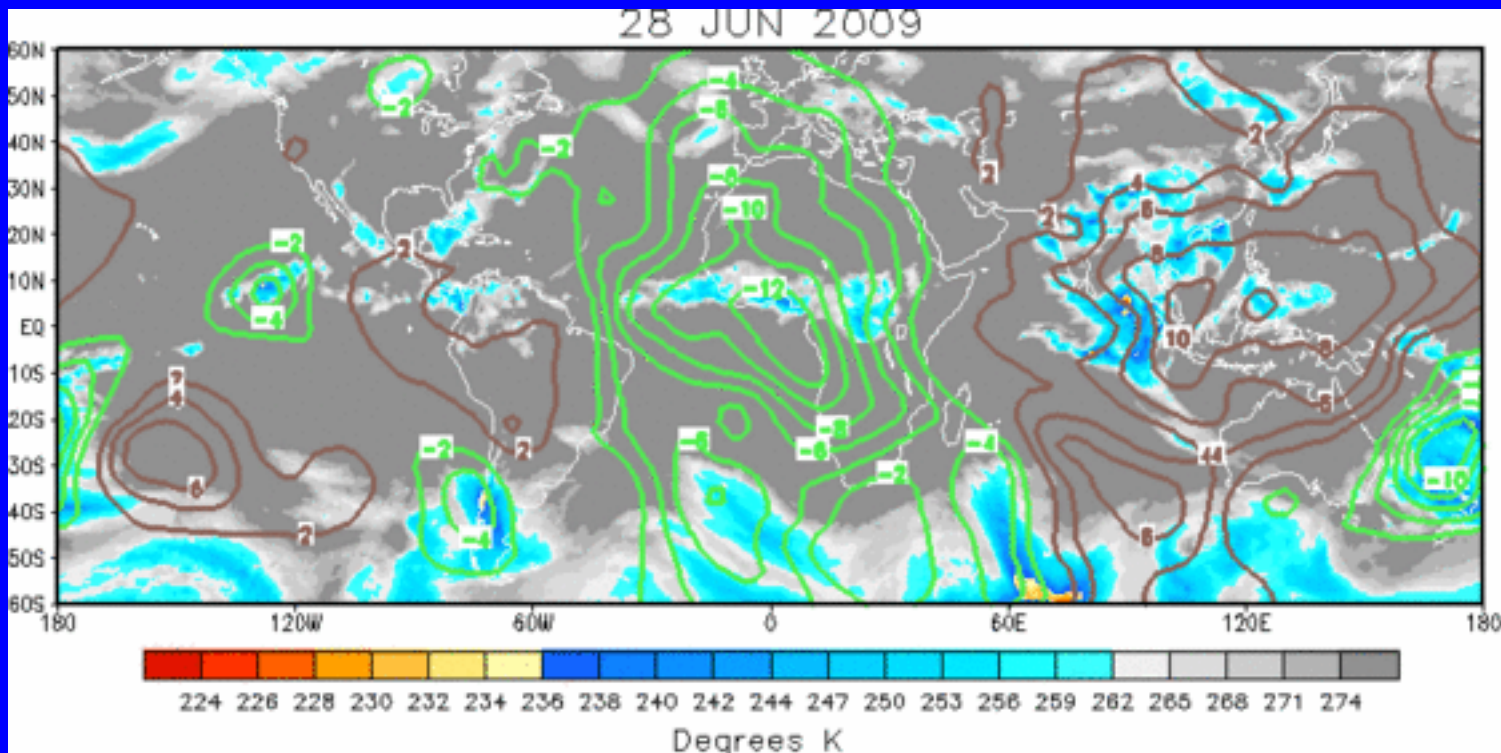
Velocity potential anomalies increased during June as the MJO showed signs of strengthening. Most recently, the MJO weakened as the pattern has become more persistent.



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



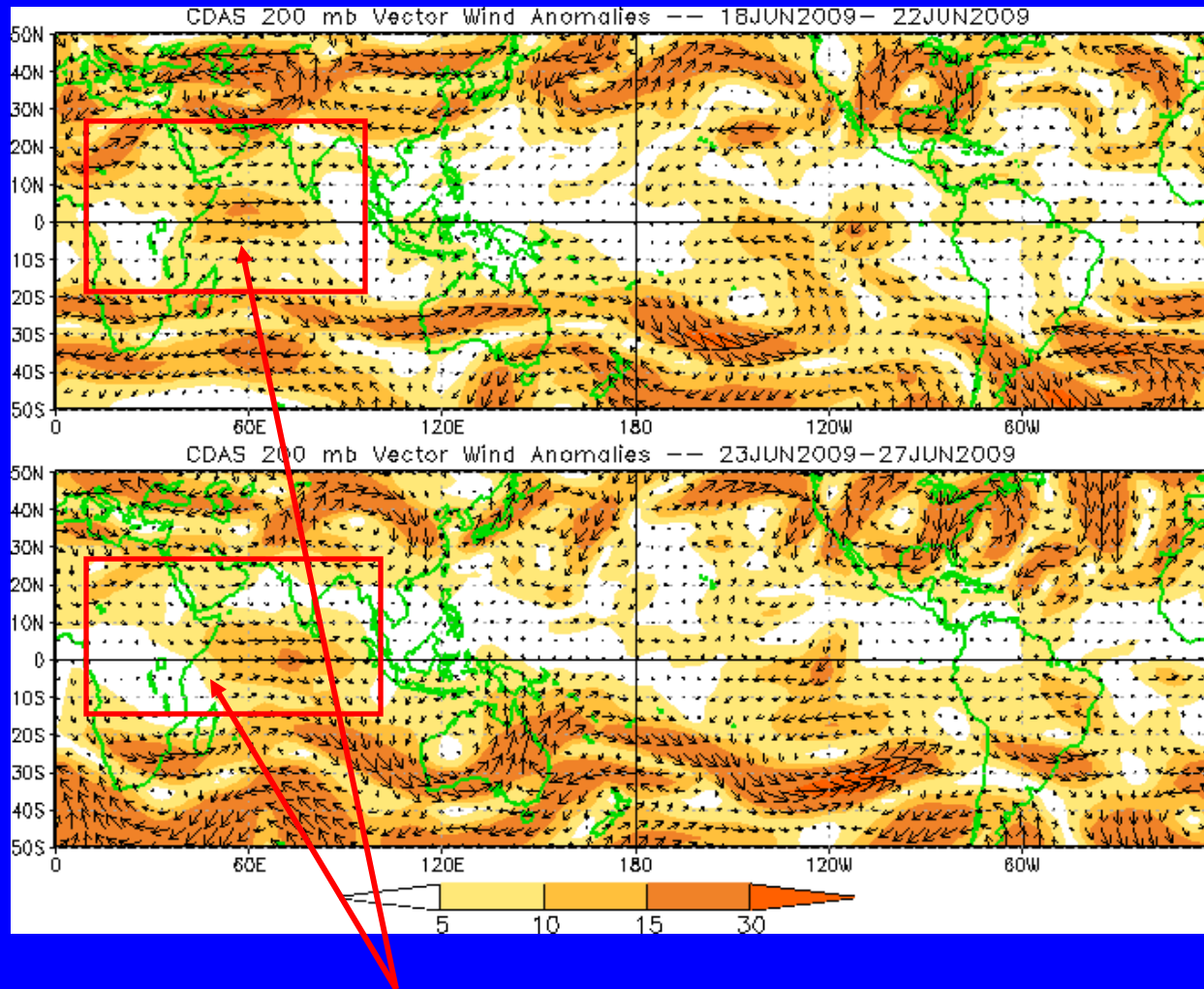
The latest velocity potential pattern still exhibits some coherent large-scale structure but no eastward propagation has occurred.

Upper-level divergence continues across the Atlantic Ocean and Africa while upper-level convergence is indicated for the Maritime continent and western Pacific.



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

Note that shading denotes the magnitude of anomalous wind vectors



Anomalous westerlies over the western Indian Ocean have weakened some but continue.

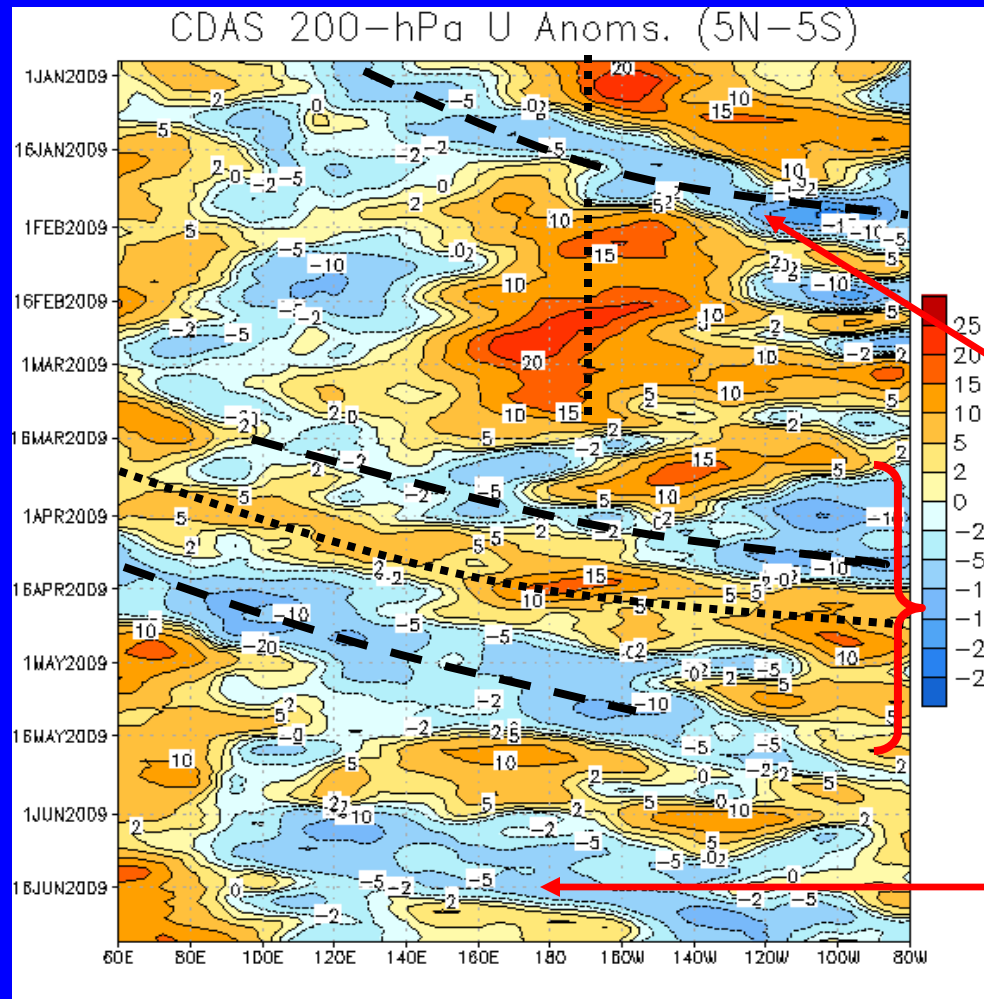


200-hPa Zonal Wind Anomalies (m s^{-1})

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

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

Time
↓



Longitude

Westerly anomalies strengthened markedly in late December 2008 near the Date Line and persisted into March 2009. These anomalies are consistent with La Nina conditions. The period was interrupted by MJO activity as easterly anomalies shifted eastward through this region during January.

Easterly and westerly anomaly patterns consistent with MJO activity shifted eastward from mid-March to the beginning of May

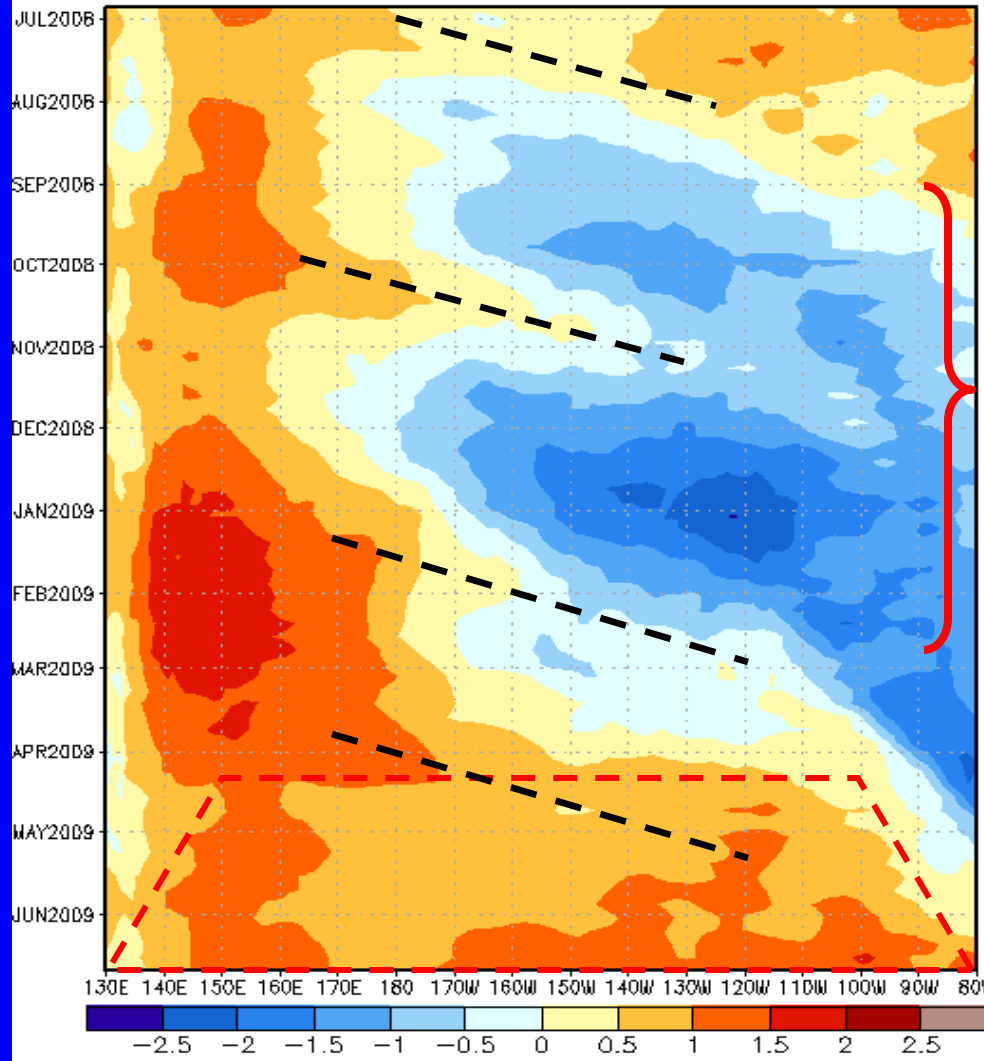
Easterly anomalies developed over much of the Pacific during the month of June but have been replaced by westerlies near the Date Line.



Weekly Heat Content Evolution in the Equatorial Pacific

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

Time
↓



Longitude

During 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 contributed to increased heat content in the eastern half of the Pacific.

Positive anomalies in the Pacific have increased in magnitude and coverage during May and June 2009.



MJO Index -- Information

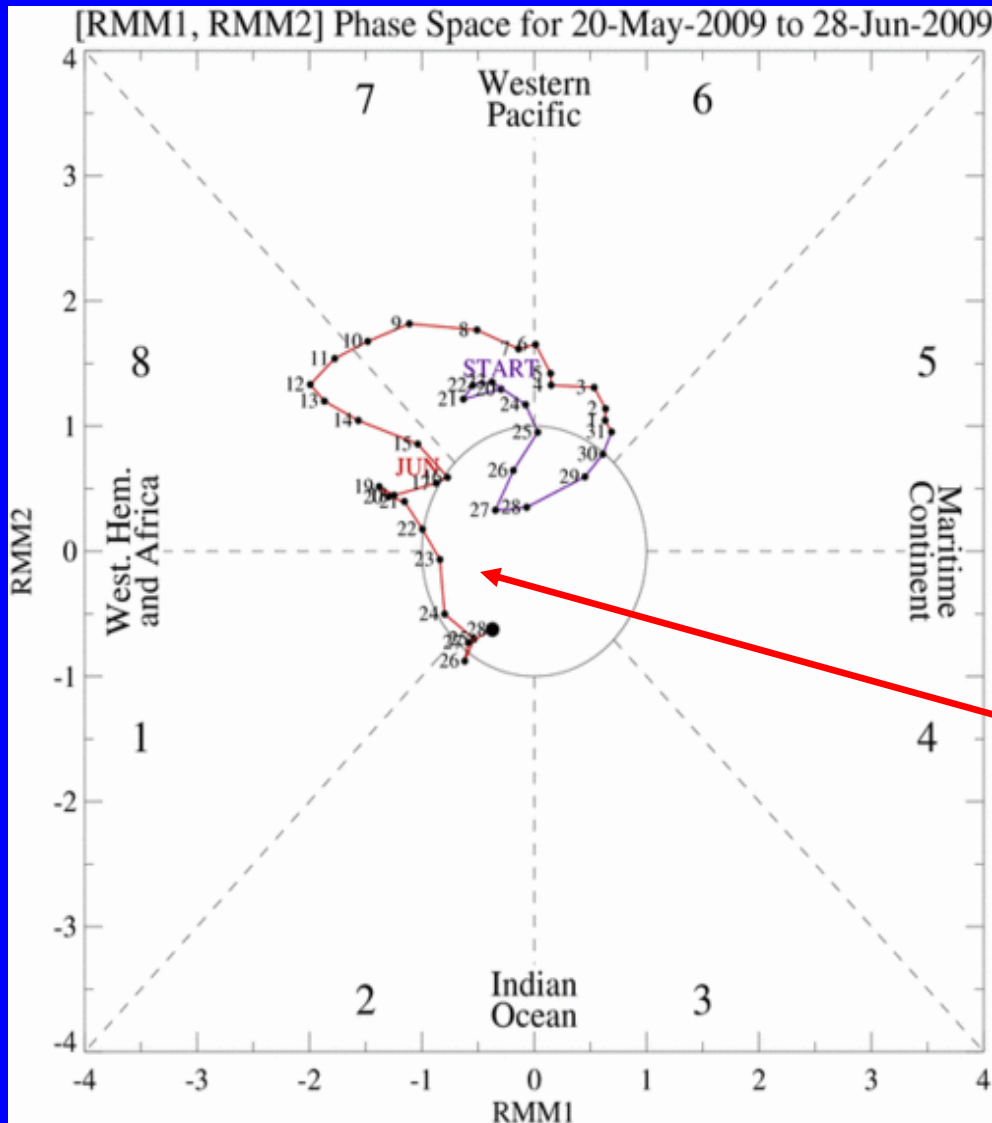
- The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).

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 or when the ENSO signal is large.
- 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

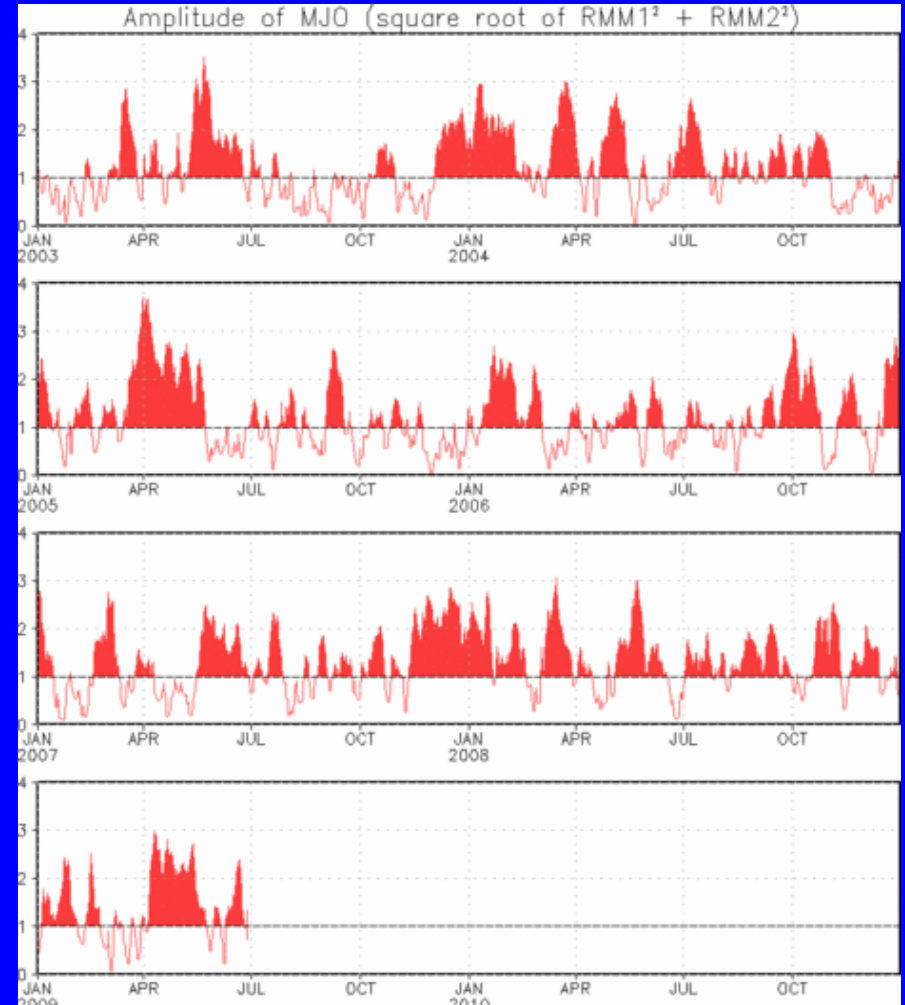
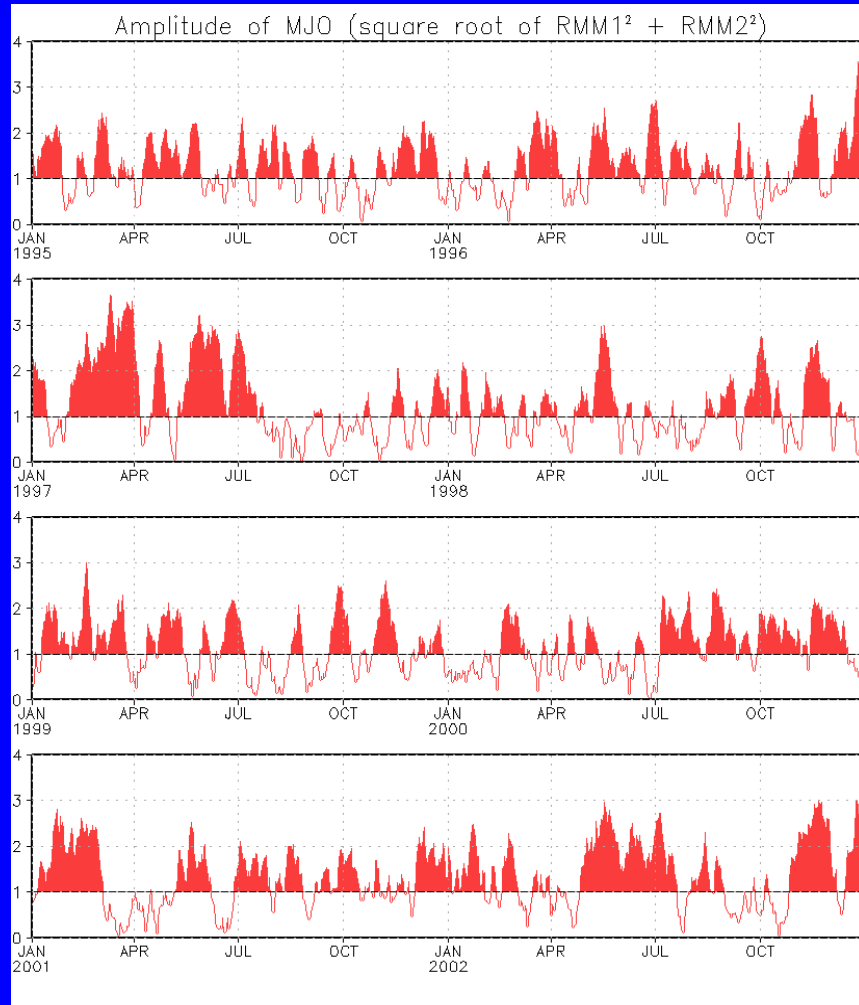


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the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

The MJO index continued to indicate a weak signal over the past week.



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.**



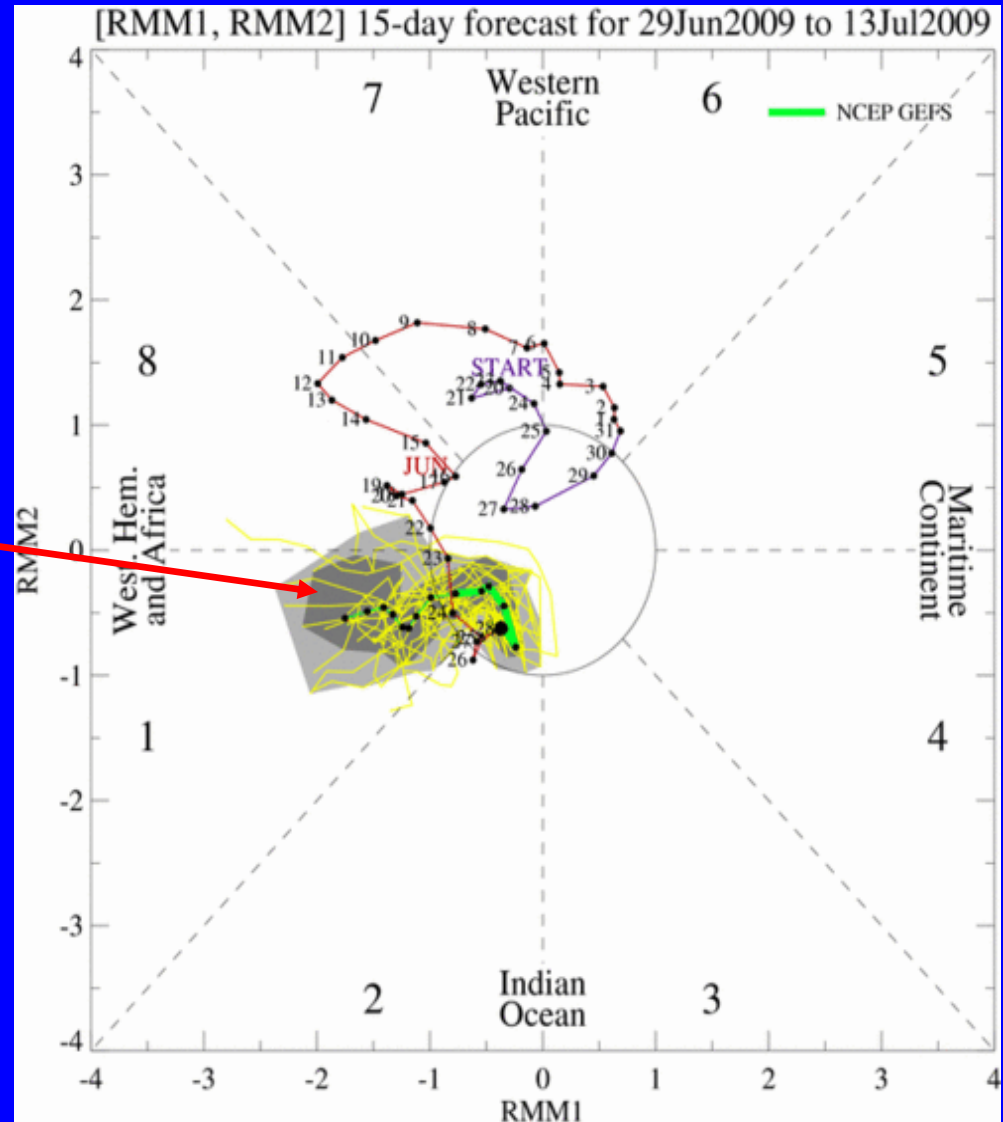
Ensemble GFS (GEFS) MJO Forecast

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 little coherent MJO signal during the next 1-2 weeks as the signal is forecast to shift westward during Week-1 with no eastward propagation thereafter.

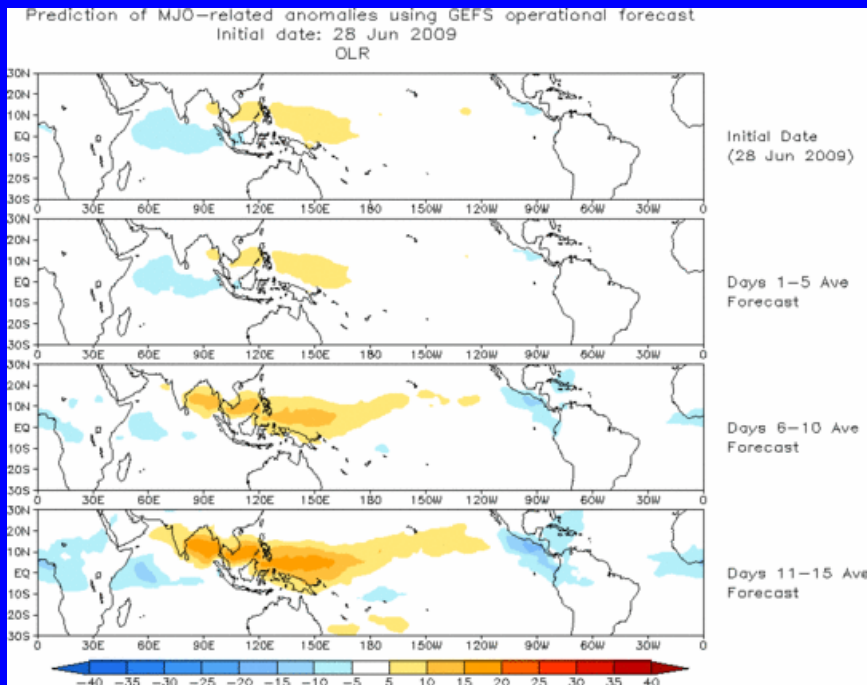




Ensemble Mean GFS MJO Forecast

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)

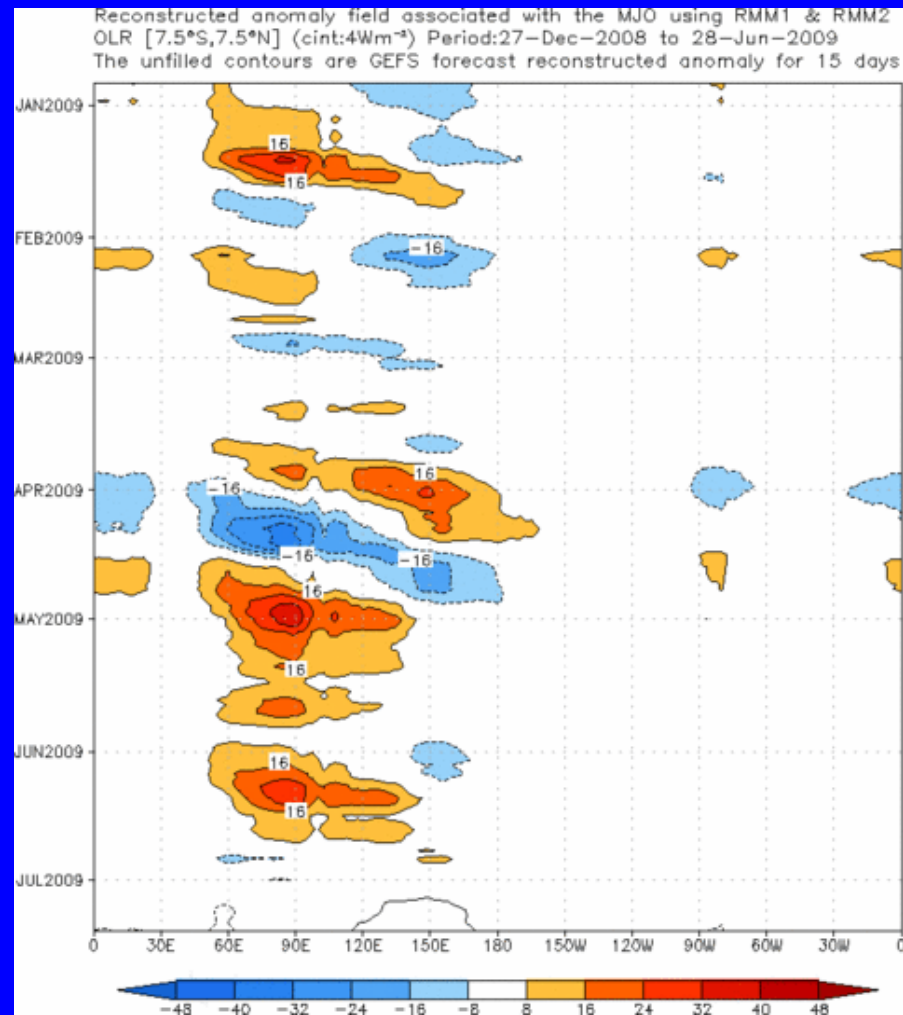
Spatial map of OLR anomalies for the next 15 days



Suppressed convection is forecast across parts of the Bay of Bengal, south Asia and the Maritime continent over the period.

Enhanced convection is forecast for Central America, equatorial Africa, and the Western Indian Ocean late in 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





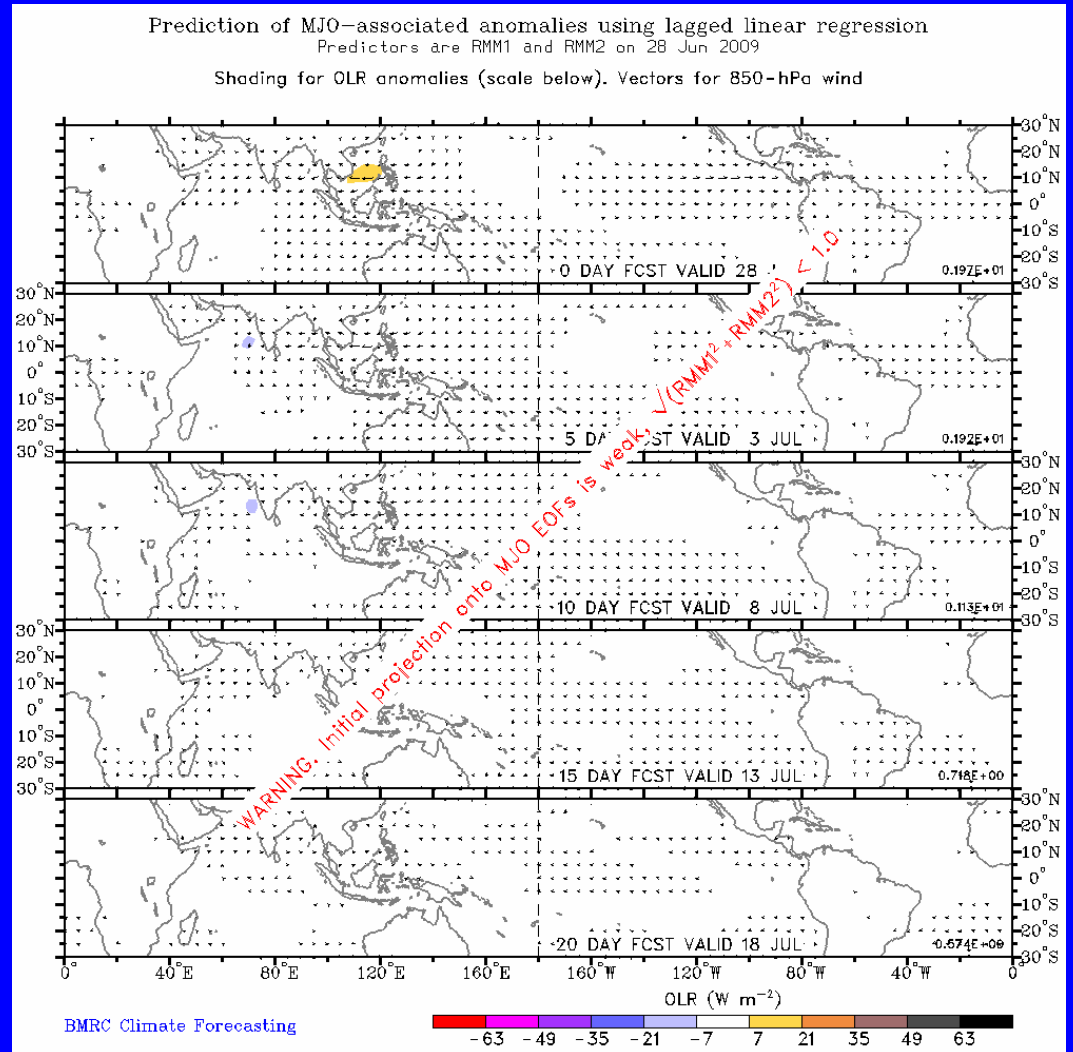
Statistical MJO Forecast

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 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)

