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

Update prepared by
Climate Prediction Center / NCEP
July 20, 2009

Outline

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

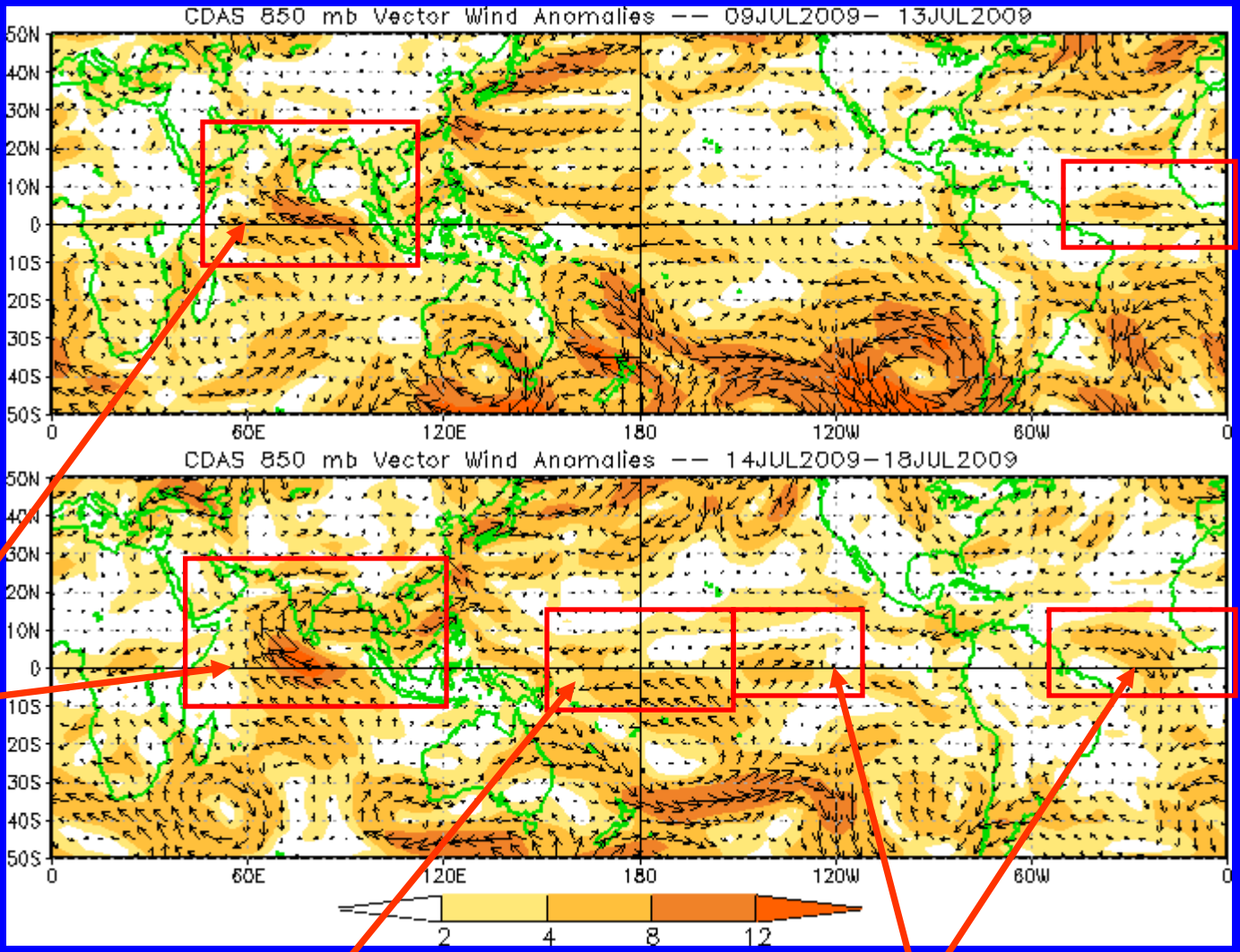
Overview

- The MJO is currently not active.
- Based on the latest observations and model forecasts, MJO activity is not expected during the next 1-2 weeks.
- At the current time, the MJO is not forecast 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



The monsoonal flow continued to strengthen across the Indian Ocean and southern Asia during the last five days.

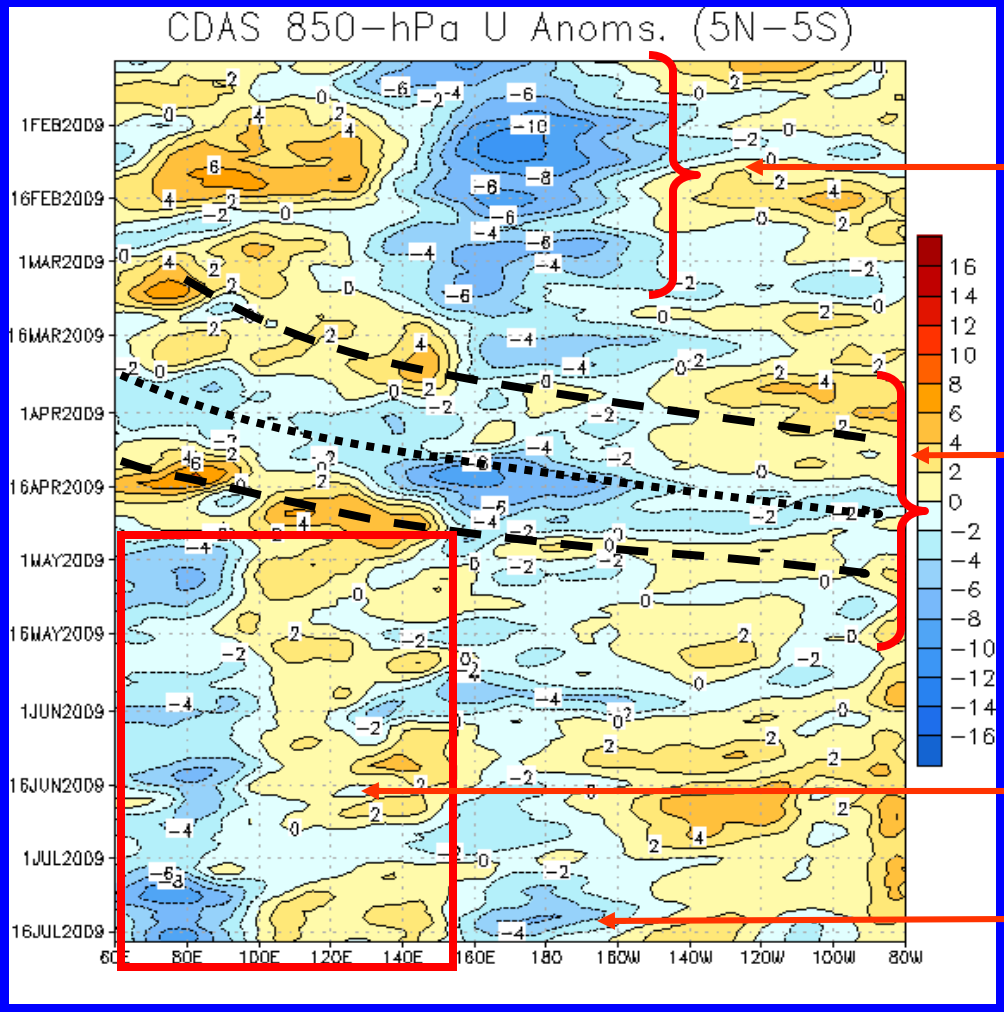
Low-level easterly anomalies have strengthened near the Date Line.

Westerly anomalies strengthened across the east-central Pacific and Atlantic 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



Time

Longitude

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

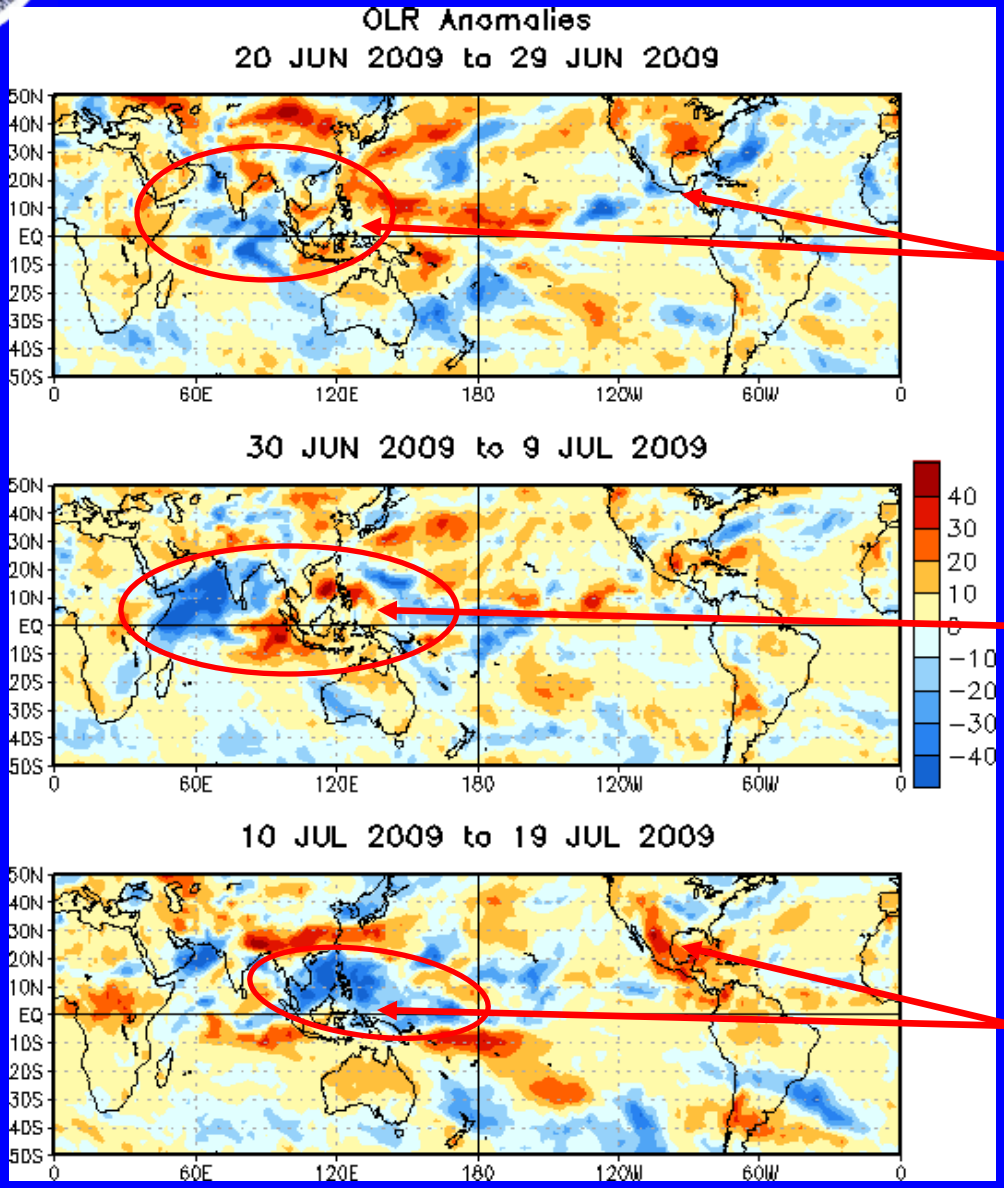
From mid-March to early May, a pattern of alternating low-level westerly, easterly and again westerly anomalies associated with the MJO shifted eastward from the Indian Ocean through the equatorial Pacific.

During much of the period from May to mid July, a persistent pattern of easterly (westerly) anomalies is evident across the Indian Ocean (Indonesia) areas. The Easterlies have increased near and just west of 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)

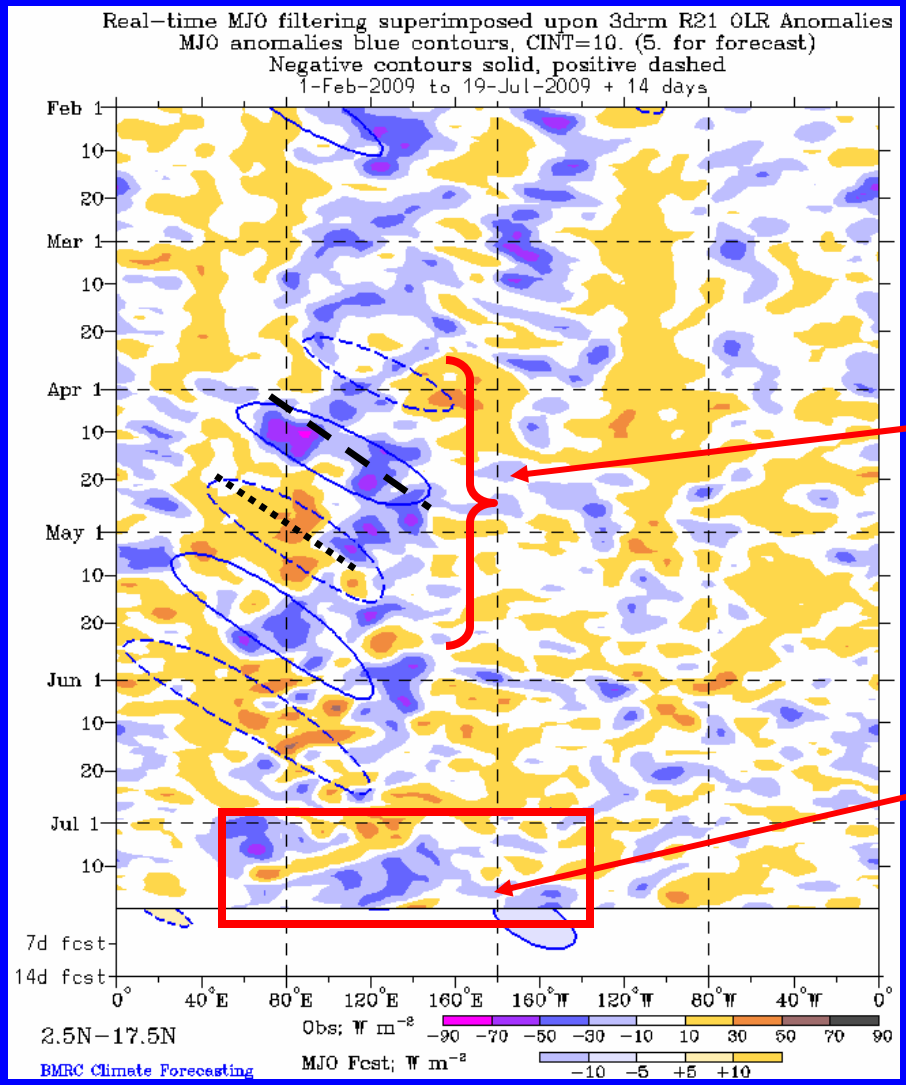


In late June, anomalous convection was variable across much of the tropical Eastern Hemisphere. Areas of suppressed convection are noted across the western Pacific. Enhanced convection is indicated across the eastern Pacific and central Indian Ocean.

During late June and early July, enhanced convection increased across parts of the western Indian Ocean, Arabian Sea and India while suppressed convection dominated the Philippines and eastern Indian Ocean.

In mid-July, enhanced convection increased over the western Pacific and Philippines and suppressed convection developed across Mexico and Central America.

Outgoing Longwave Radiation (OLR) Anomalies (2.5°N-17.5°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)

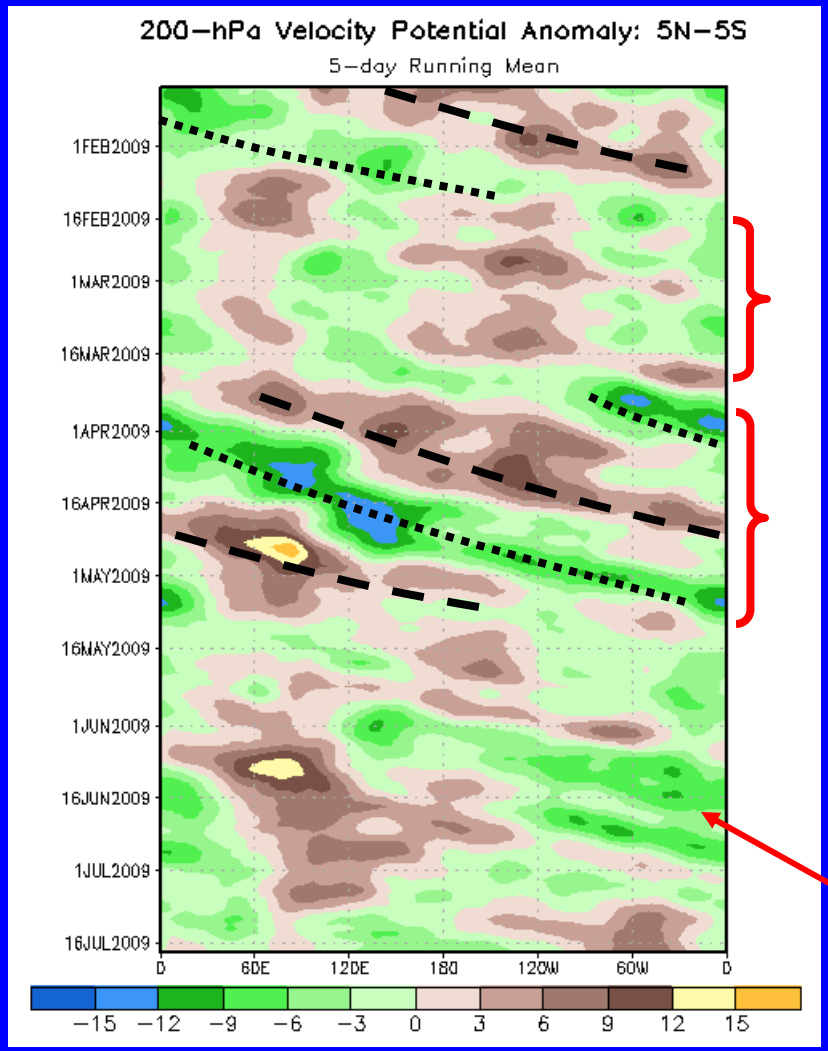
From mid-March into early May, areas of suppressed and enhanced convection shifted eastward in association with the MJO (also see equatorial version of this diagram at BOM as it is more suitable for the boreal Spring).

Enhanced convection has developed over the last 10 days across the Philippines and parts of the western and central Pacific.

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

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.

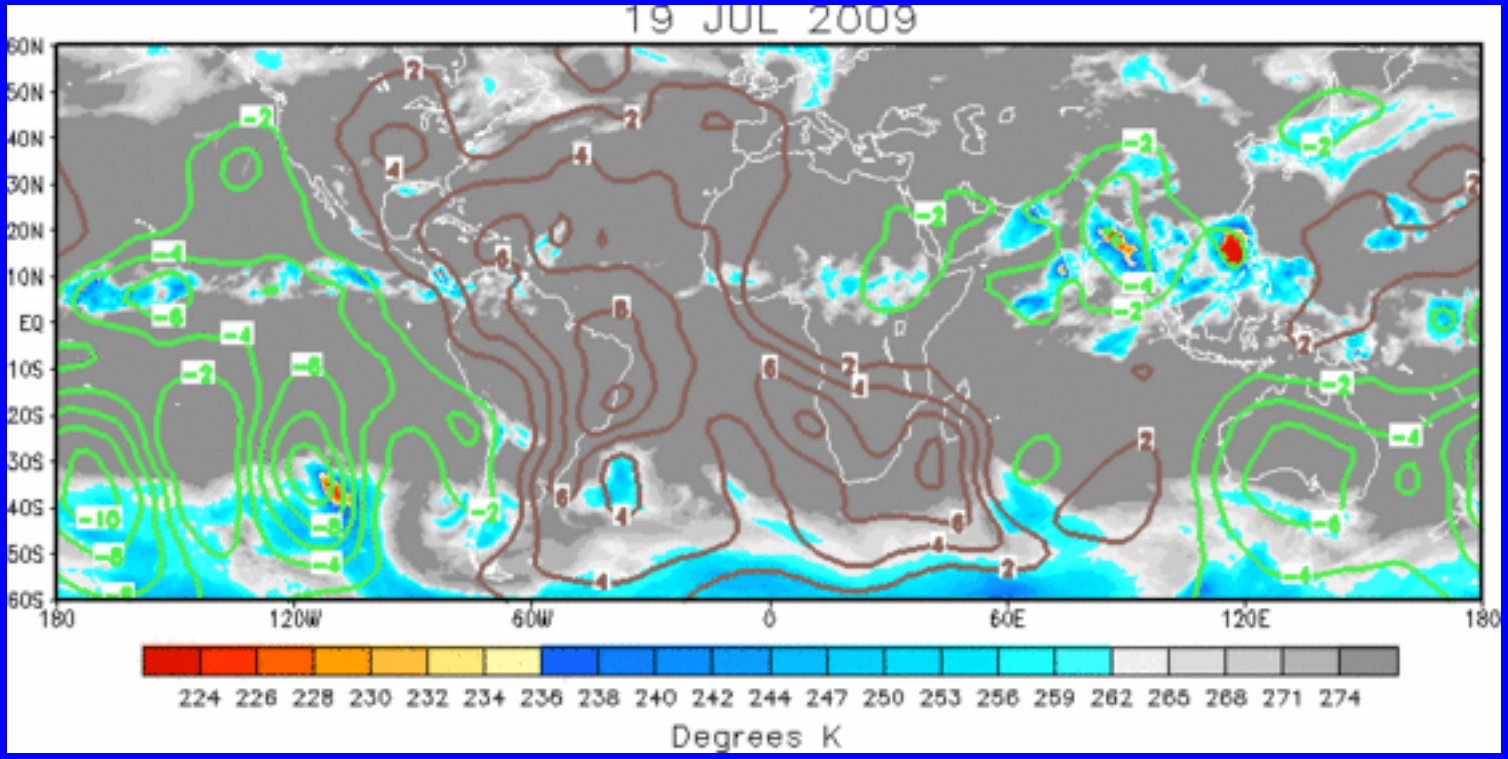
The MJO weakened in May.

Velocity potential anomalies increased in early June with some eastward propagation evident. However, in early July, anomalies have become weaker.

IR Temperatures (K) / 200-hPa Velocity Potential Anomalies

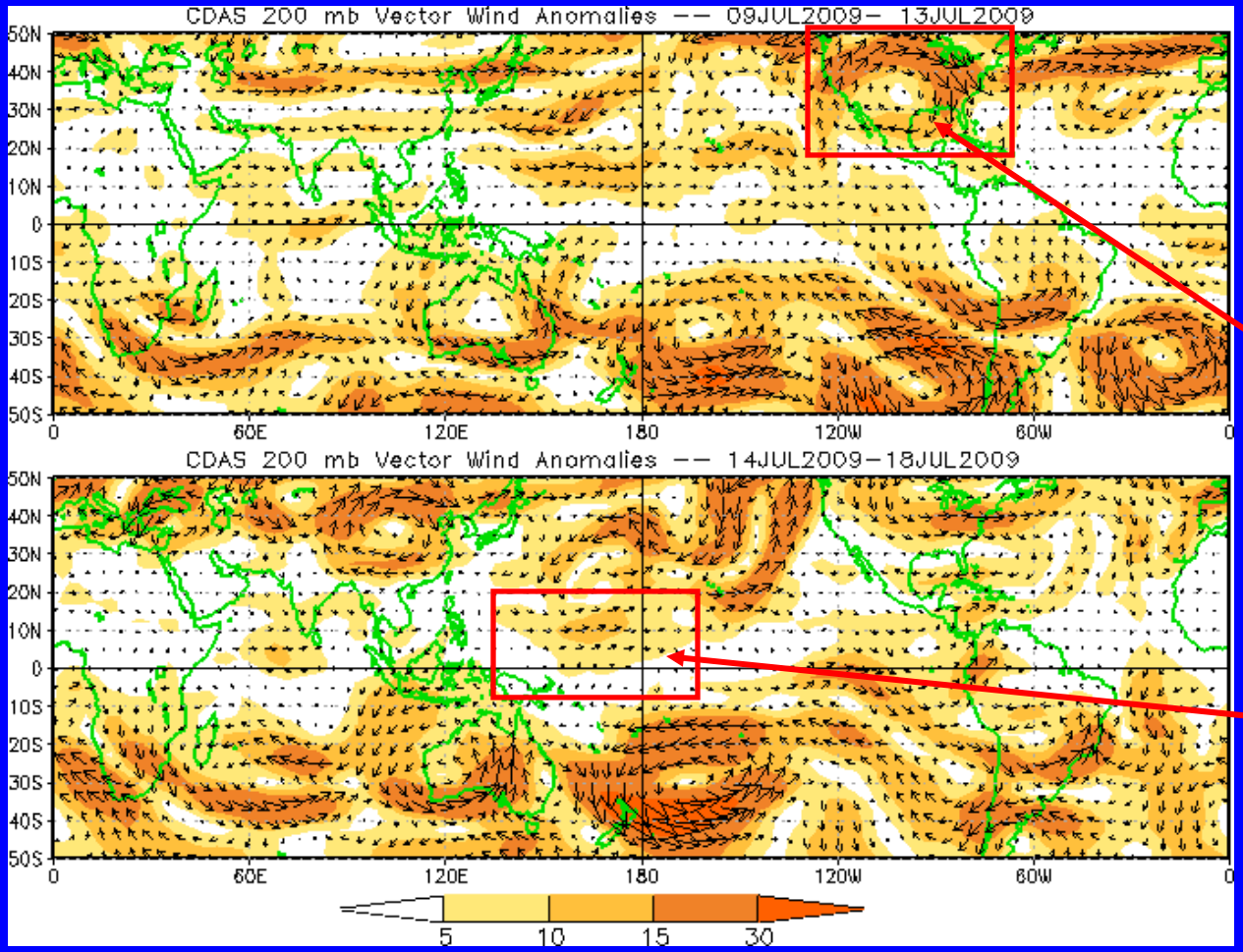
Positive anomalies (brown contours) indicate unfavorable conditions for precipitation

Negative anomalies (green contours) indicate favorable conditions for precipitation



The latest velocity potential anomalies indicate upper-level divergence in the vicinity of the Bay of Bengal through the Philippines and also the eastern half of the Pacific Ocean. Upper-level convergence is strong across the Americas and the Atlantic Ocean.

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



Note that shading denotes the magnitude of anomalous wind vectors

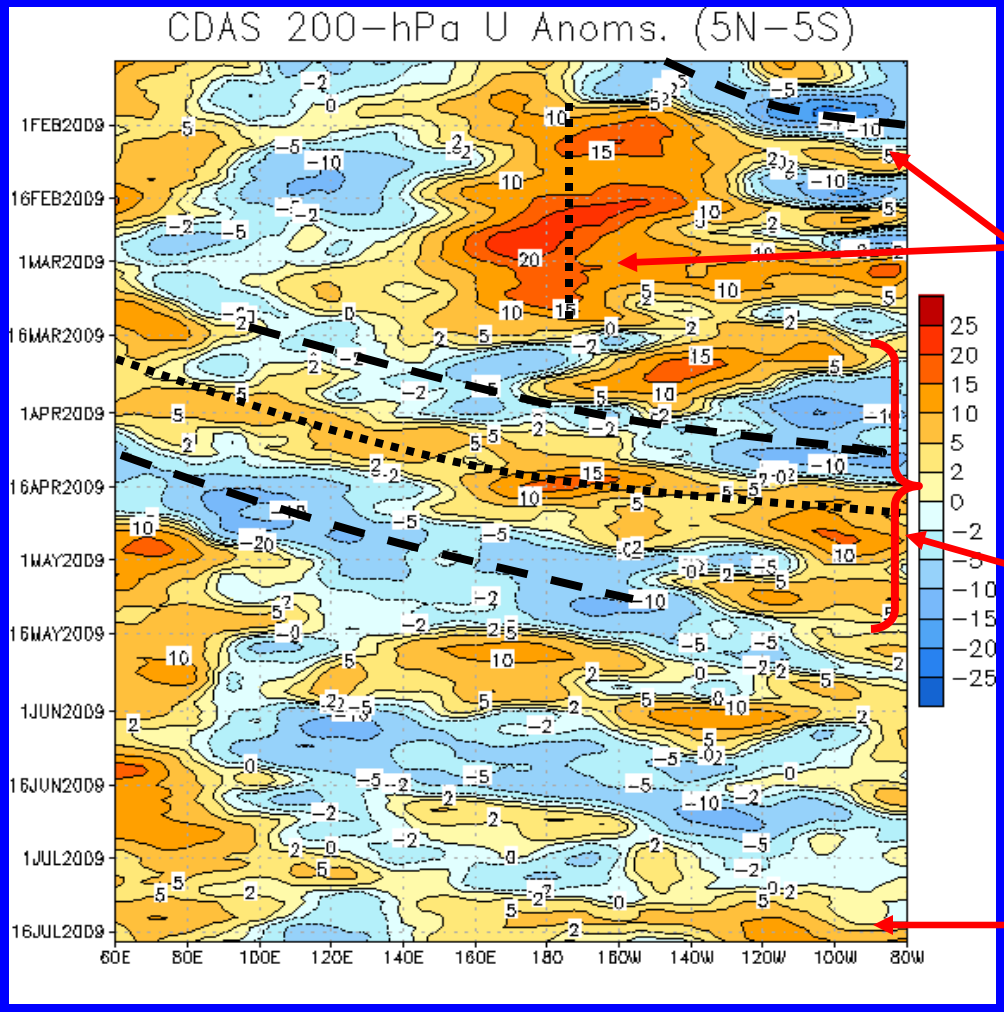
Anomalous ridge is indicated across the south-central US during the earlier five day period.

Westerly anomalies have increased near the central and western Pacific (mainly north of the equator) 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



Time

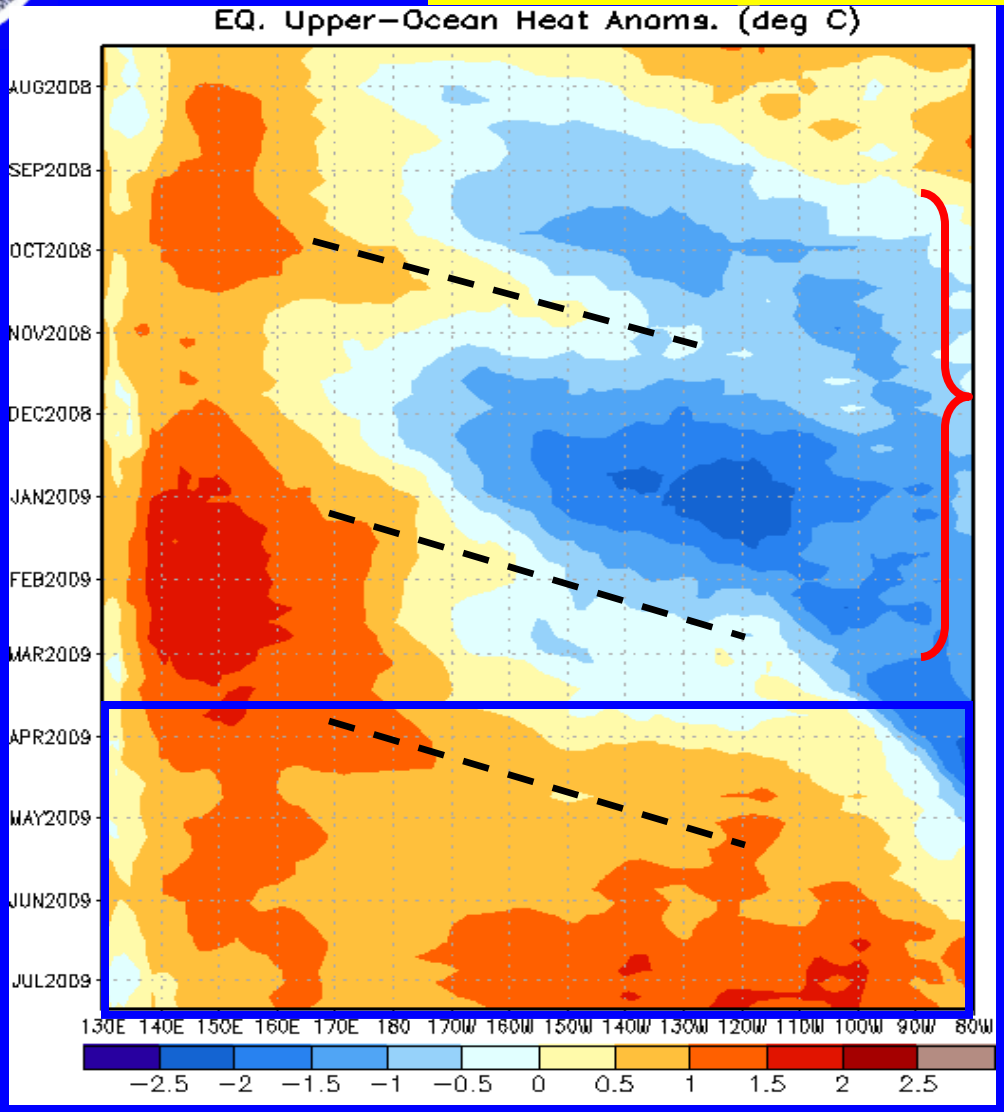
Longitude

Westerly anomalies continued near the Date Line 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.

Over the past week, westerly anomalies persist across parts of the Indian Ocean while at the same time westerly anomalies have rapidly developed across the Pacific.

Weekly Heat Content Evolution in the Equatorial Pacific



Time

Longitude

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 (blue box).

MJO Index -- Information

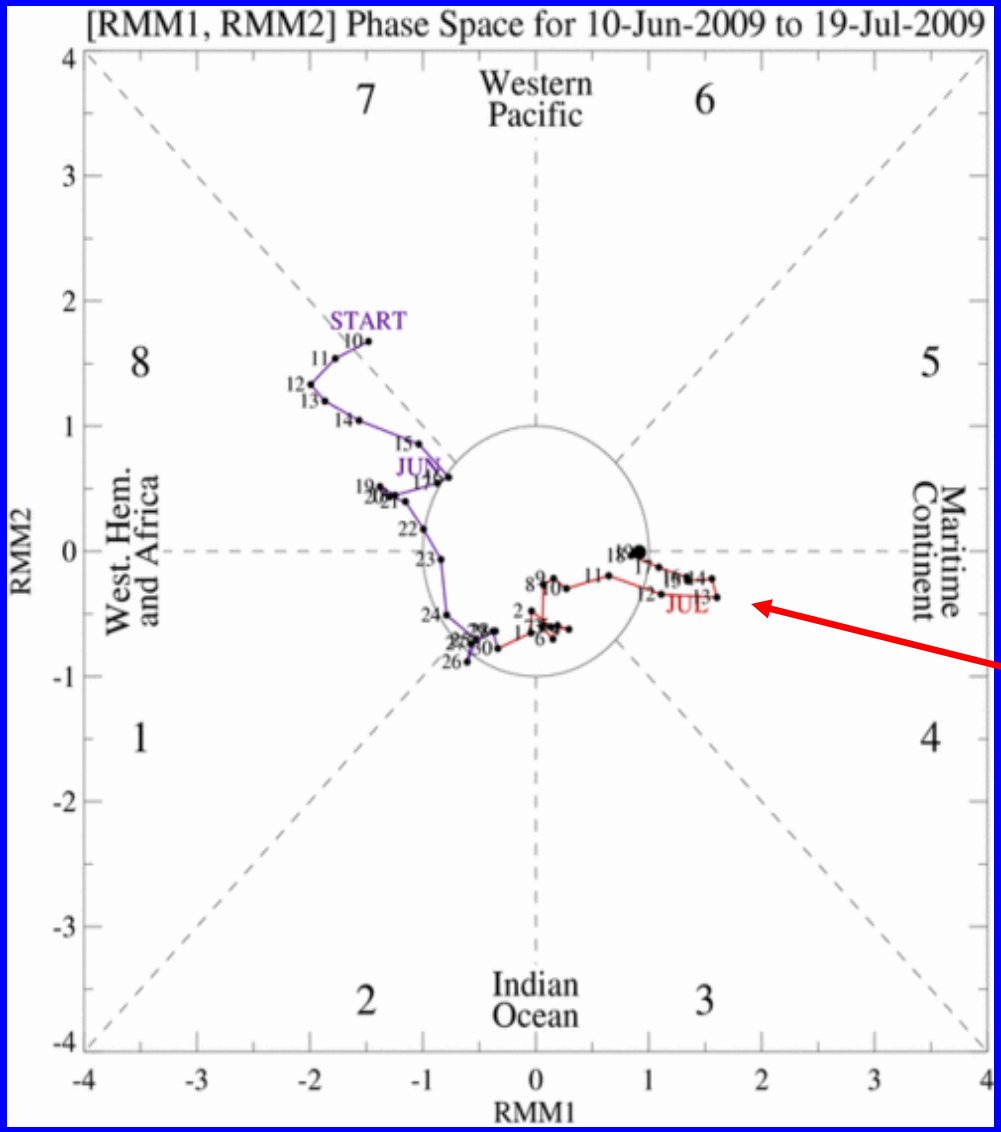
- **The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).**

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).**

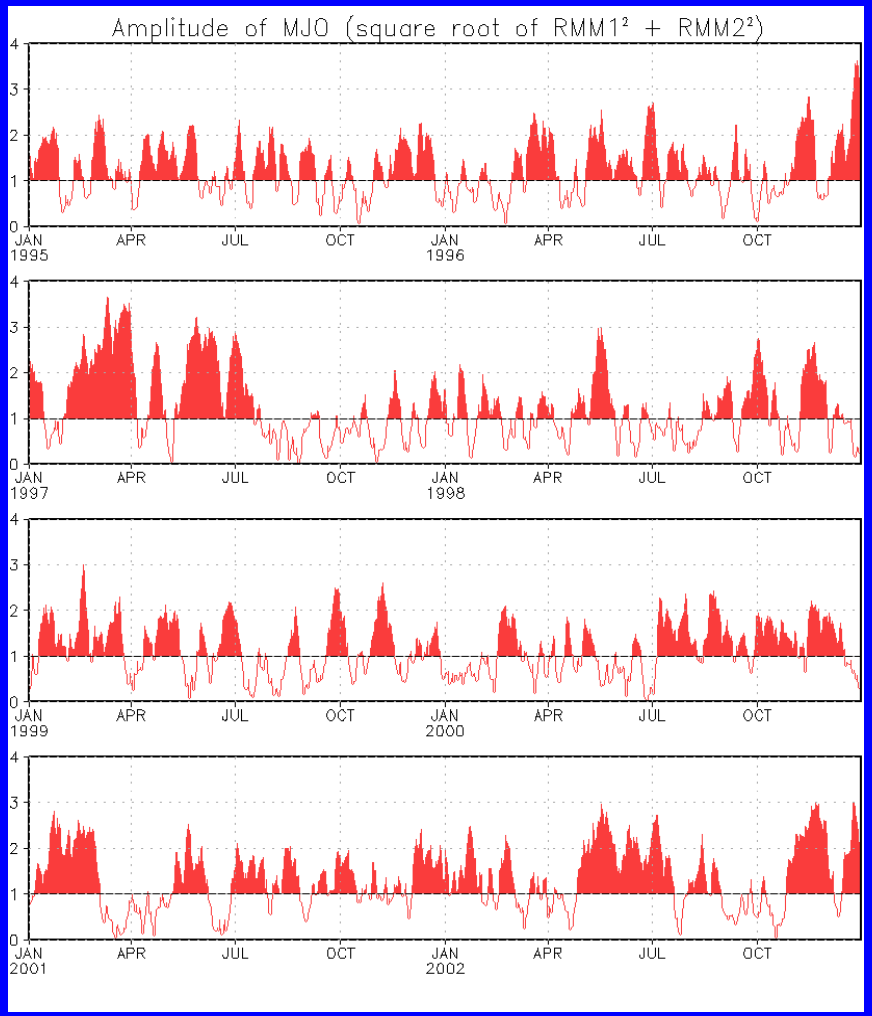
MJO Index -- Recent Evolution

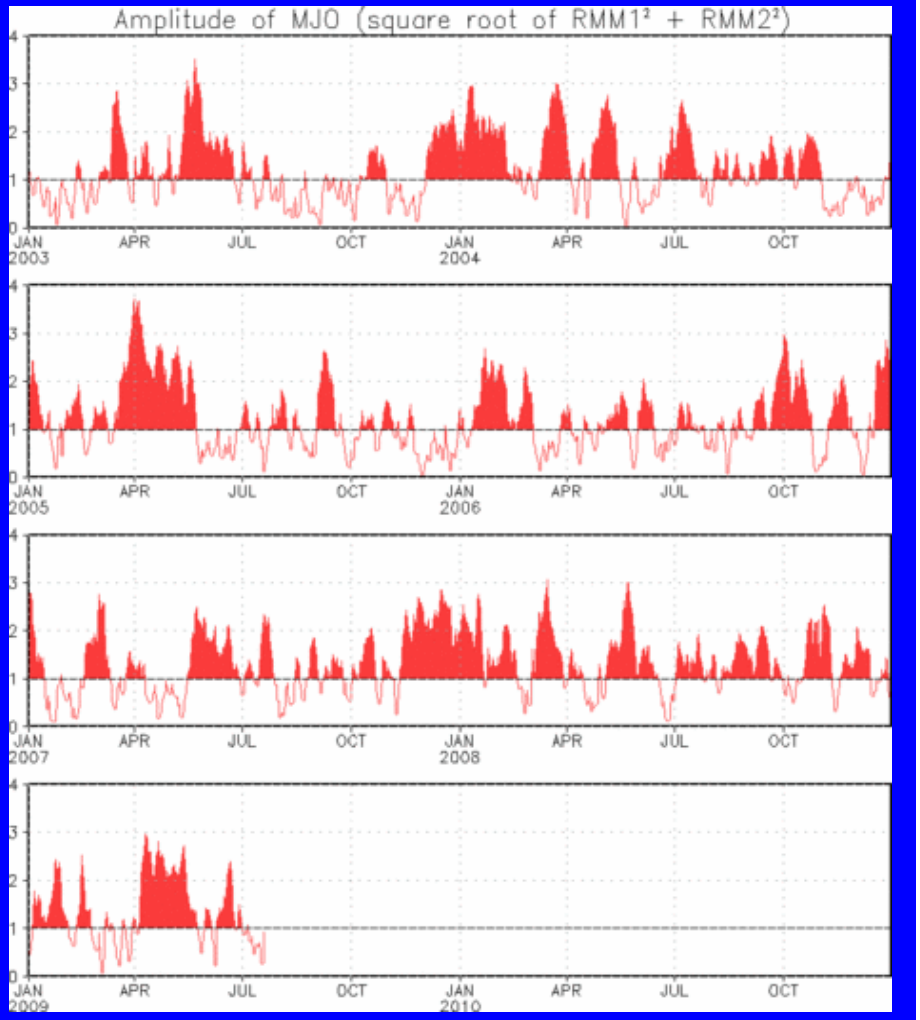


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the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

During the past week, the MJO index generally increased in amplitude, but has recently weakened.

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.

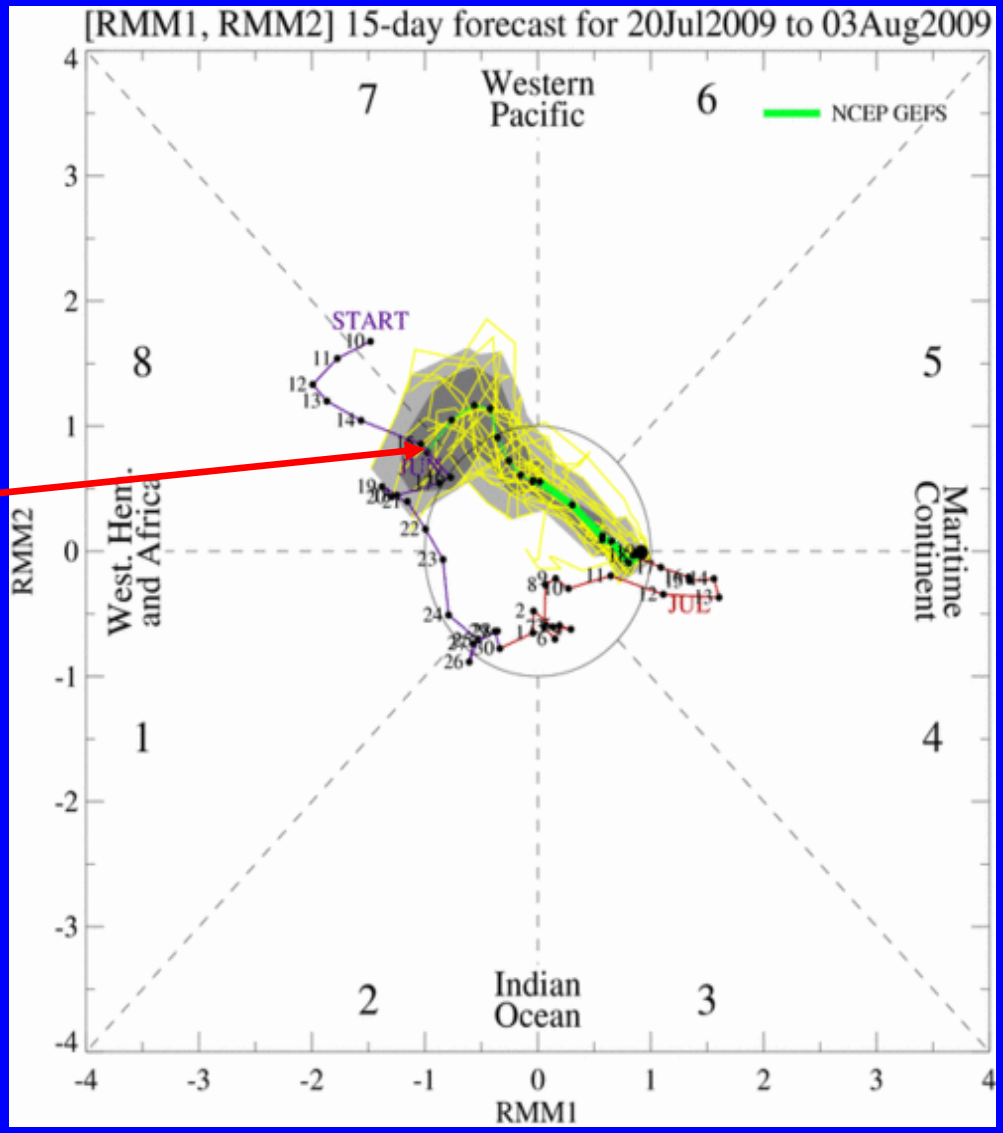
Ensemble GFS (GEFS) MJO Forecast

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

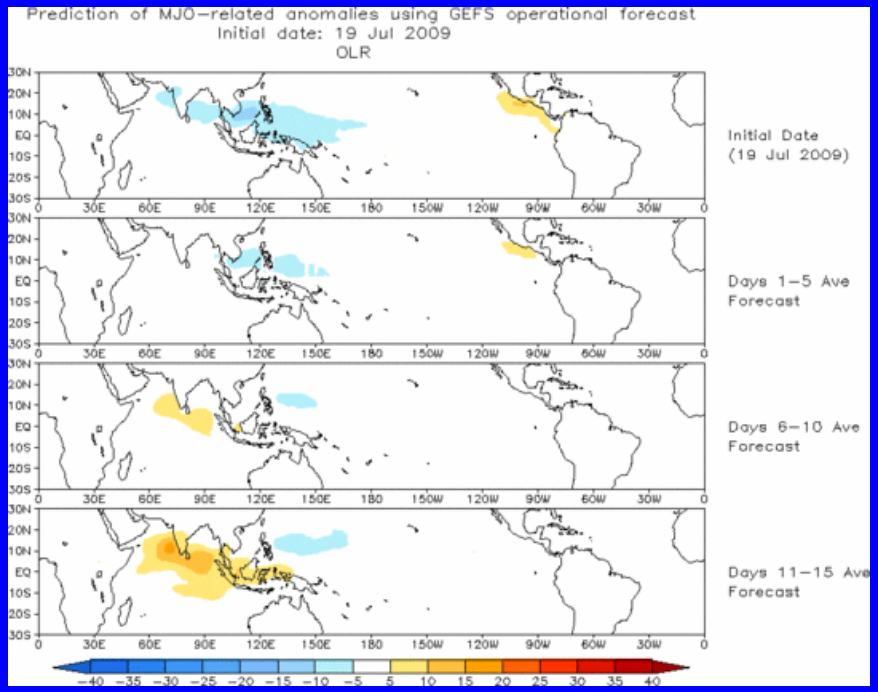
The GEFS forecasts an incoherent signal during Week-1 with an increase in amplitude during the Week-2 period.



Ensemble Mean GFS MJO Forecast

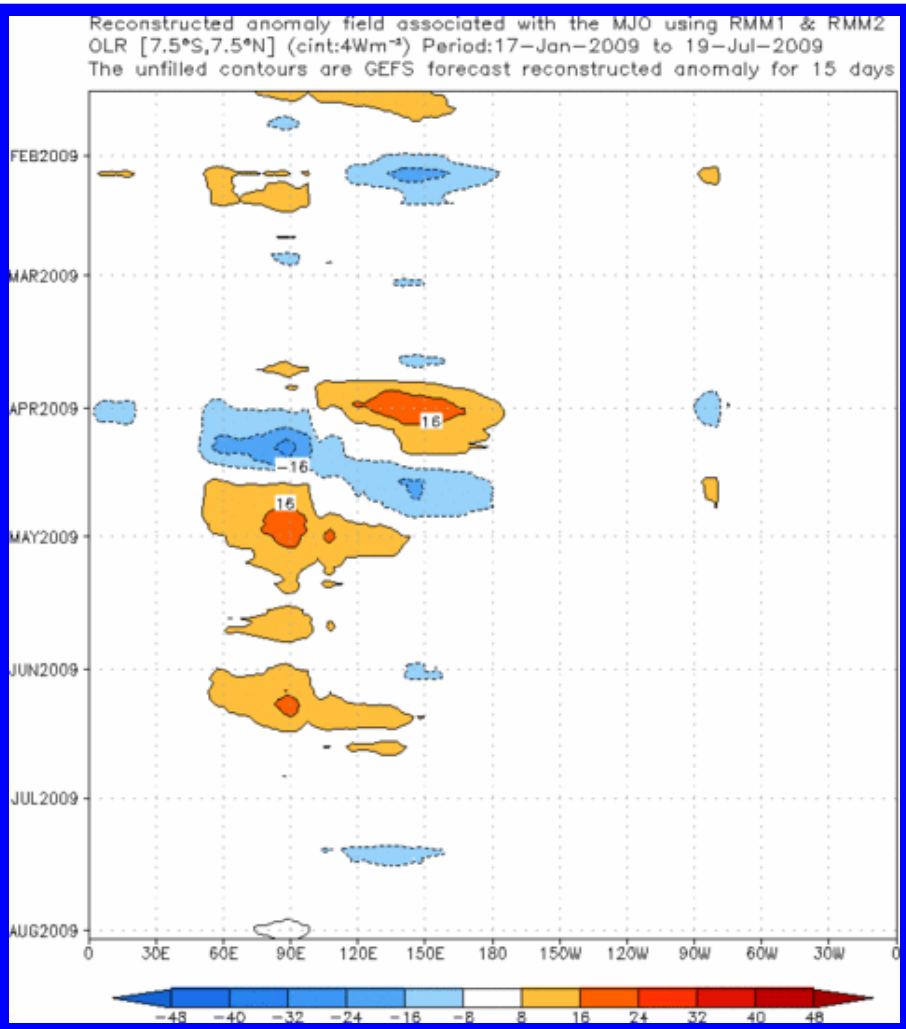
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



The GEFS ensemble mean forecasts weak suppressed convection over southern India through the western Maritime Continent during 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



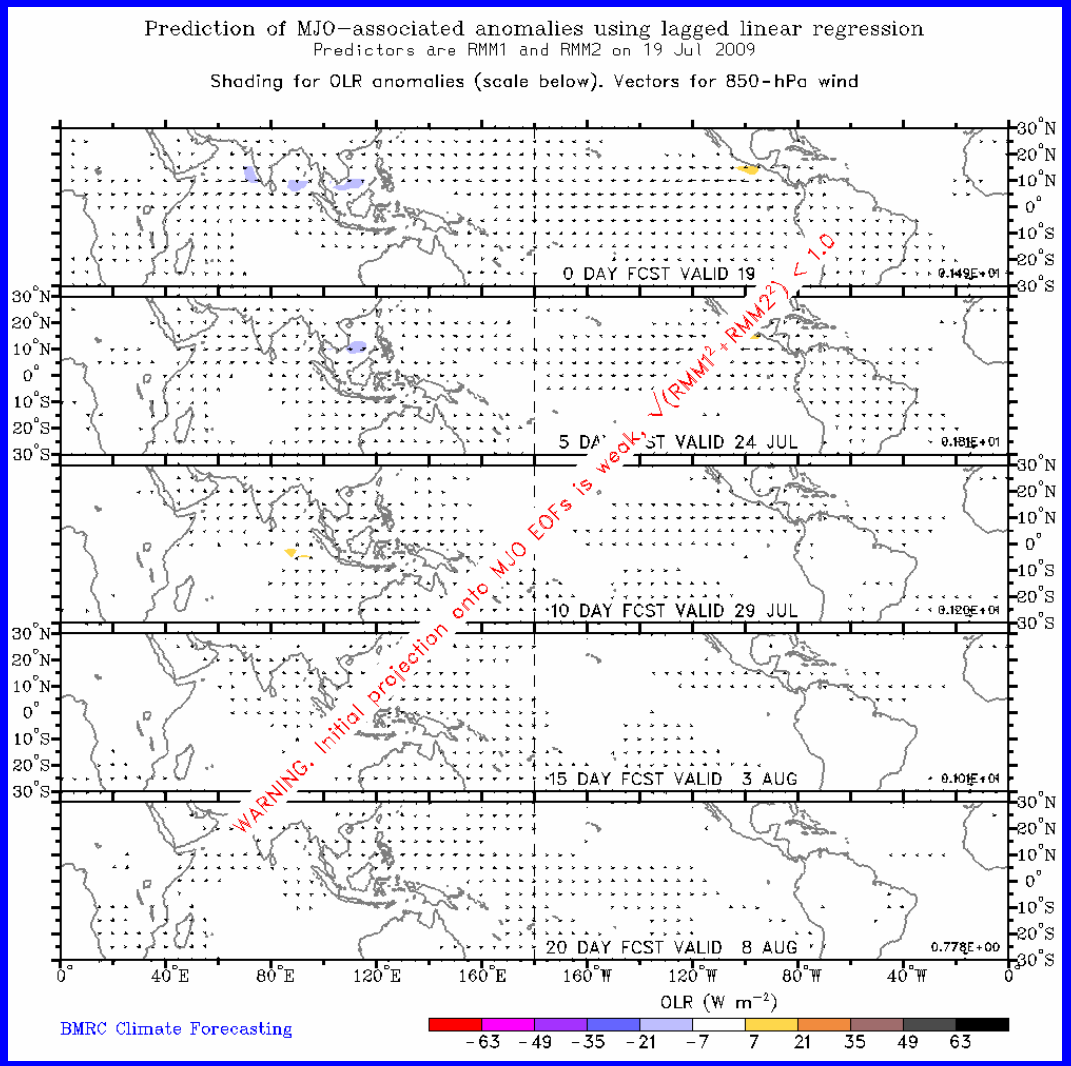
Statistical MJO Forecast

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 vectors for the next 20 days

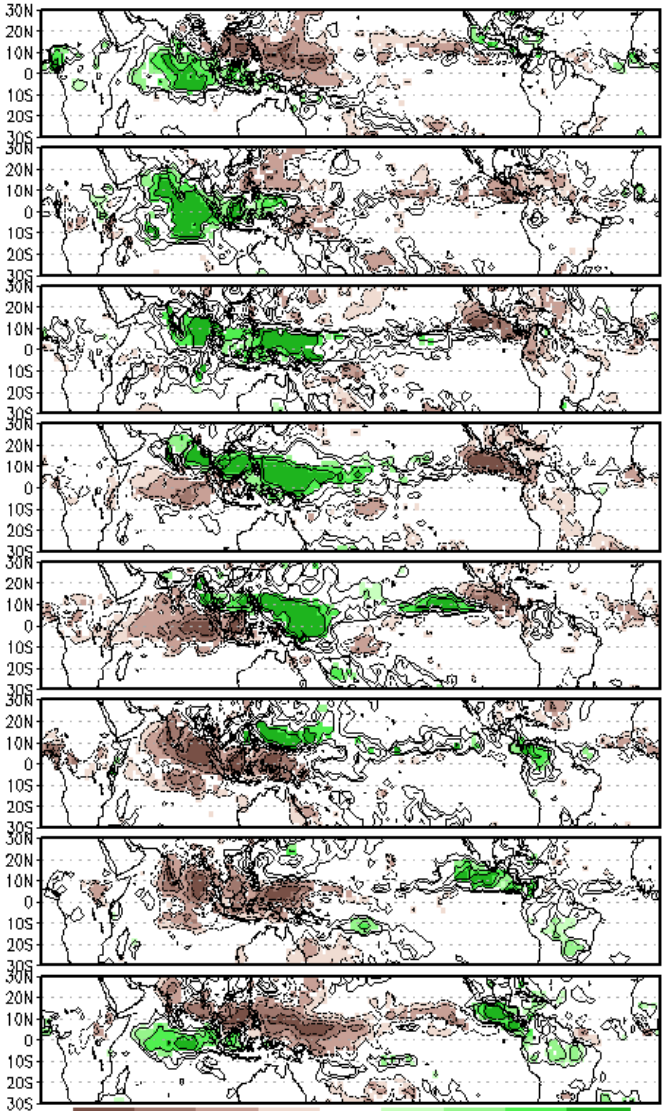
(Courtesy of the Bureau of Meteorology Research Centre - Australia)

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)