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

Update prepared by
Climate Prediction Center / NCEP
August 25, 2008

Outline

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

Overview

- The MJO signal has become better organized during the past week but has shown little eastward propagation during the past few days.

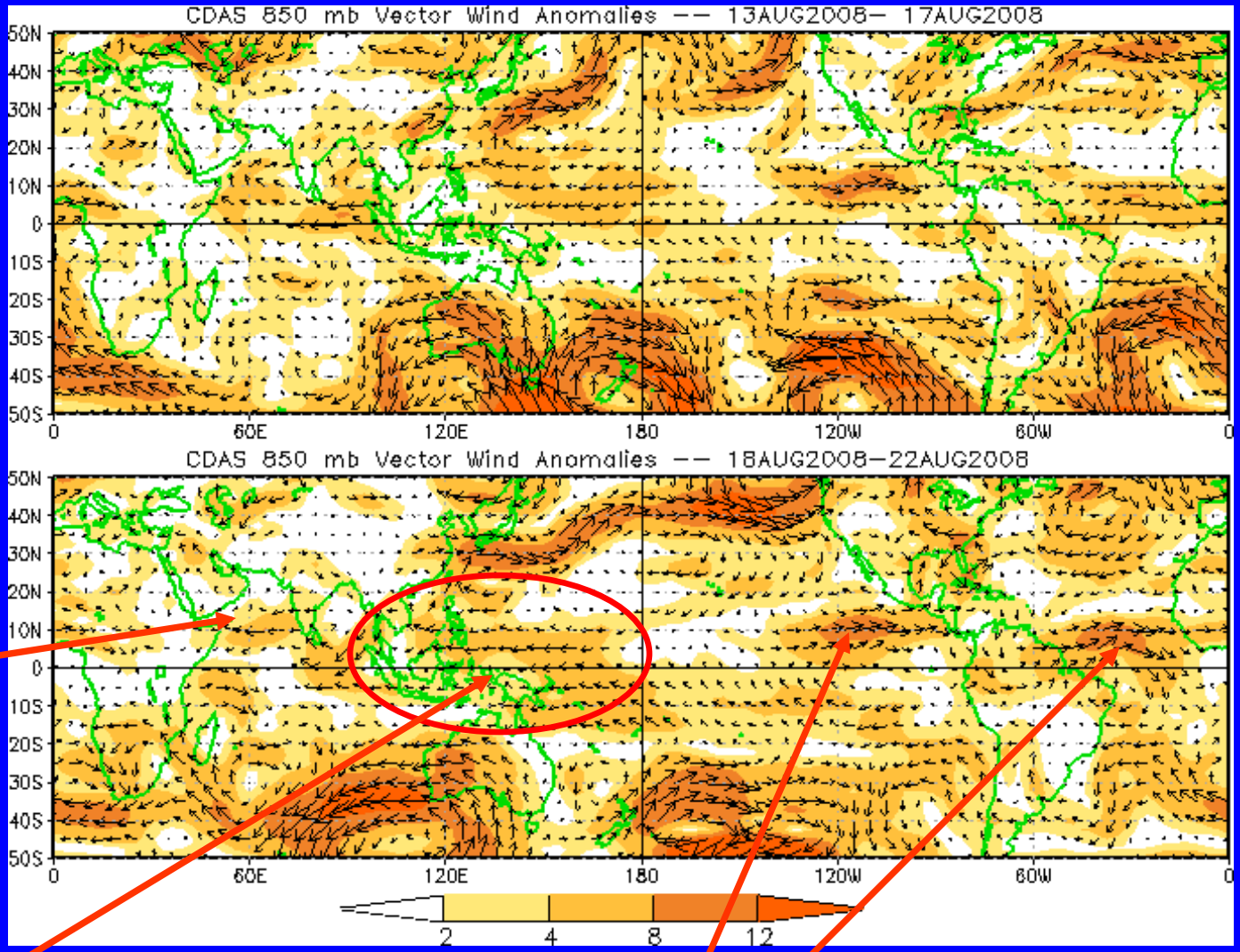
- Model forecasts at the current time do not indicate a strengthening MJO during the upcoming period. The current phase of the MJO, however, is in an area where model forecasts often are unable to accurately capture its evolution.

- Based on the most recent observations and above guidance, the MJO may further strengthen and slowly propagate eastward 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 (m s^{-1})

Note that shading denotes the magnitude of anomalous wind vectors



Low-level easterly anomalies across the Arabian Sea, India and the Bay of Bengal have weakened during the last five days.

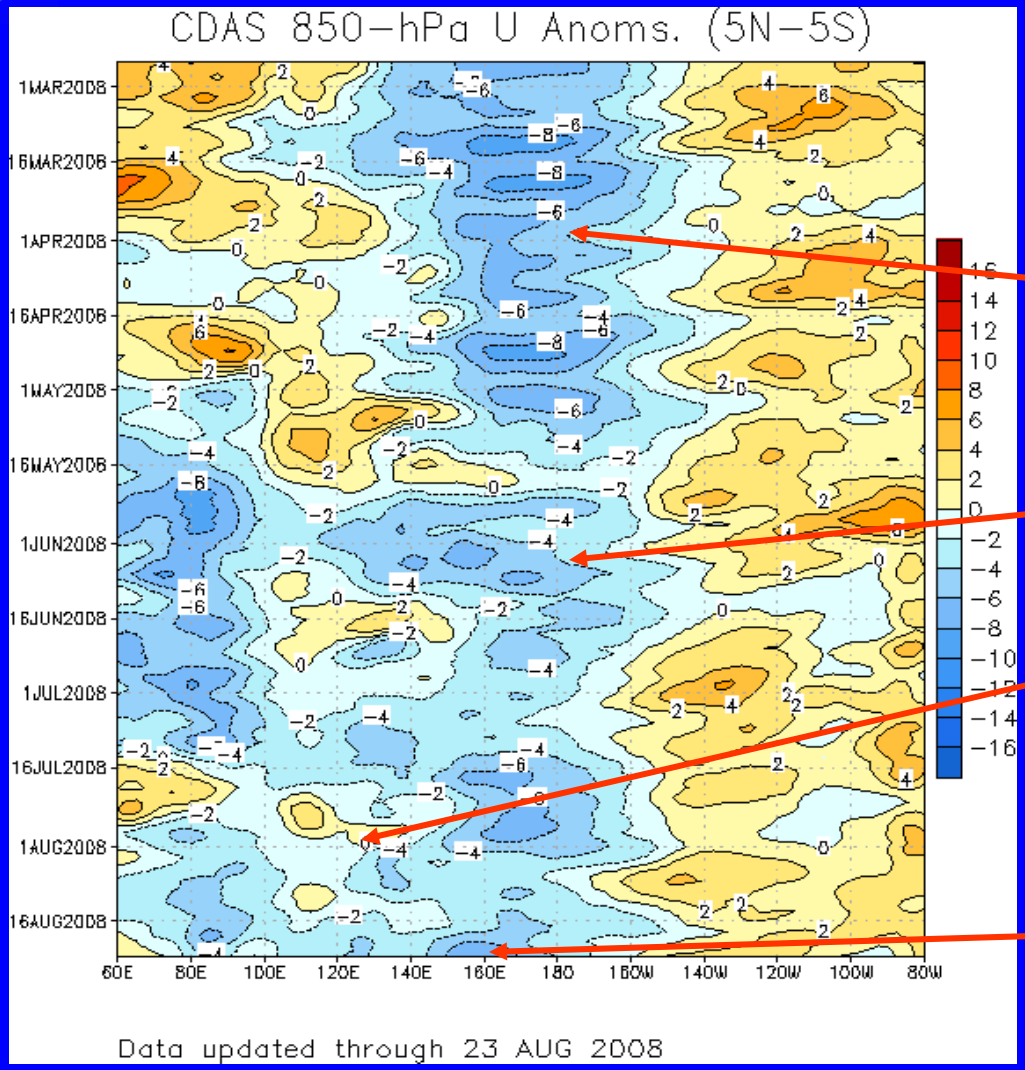
Low-level easterly anomalies continue across the western Pacific.

Westerly anomalies strengthened across the eastern Pacific. Equatorial westerly anomalies also have increased across the Atlantic and Africa.

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

MJO activity was weak during much of March and April with strong anomalous easterlies continuing near the Date Line.

During mid-May, easterlies weakened across the western Pacific associated with moderate MJO activity.

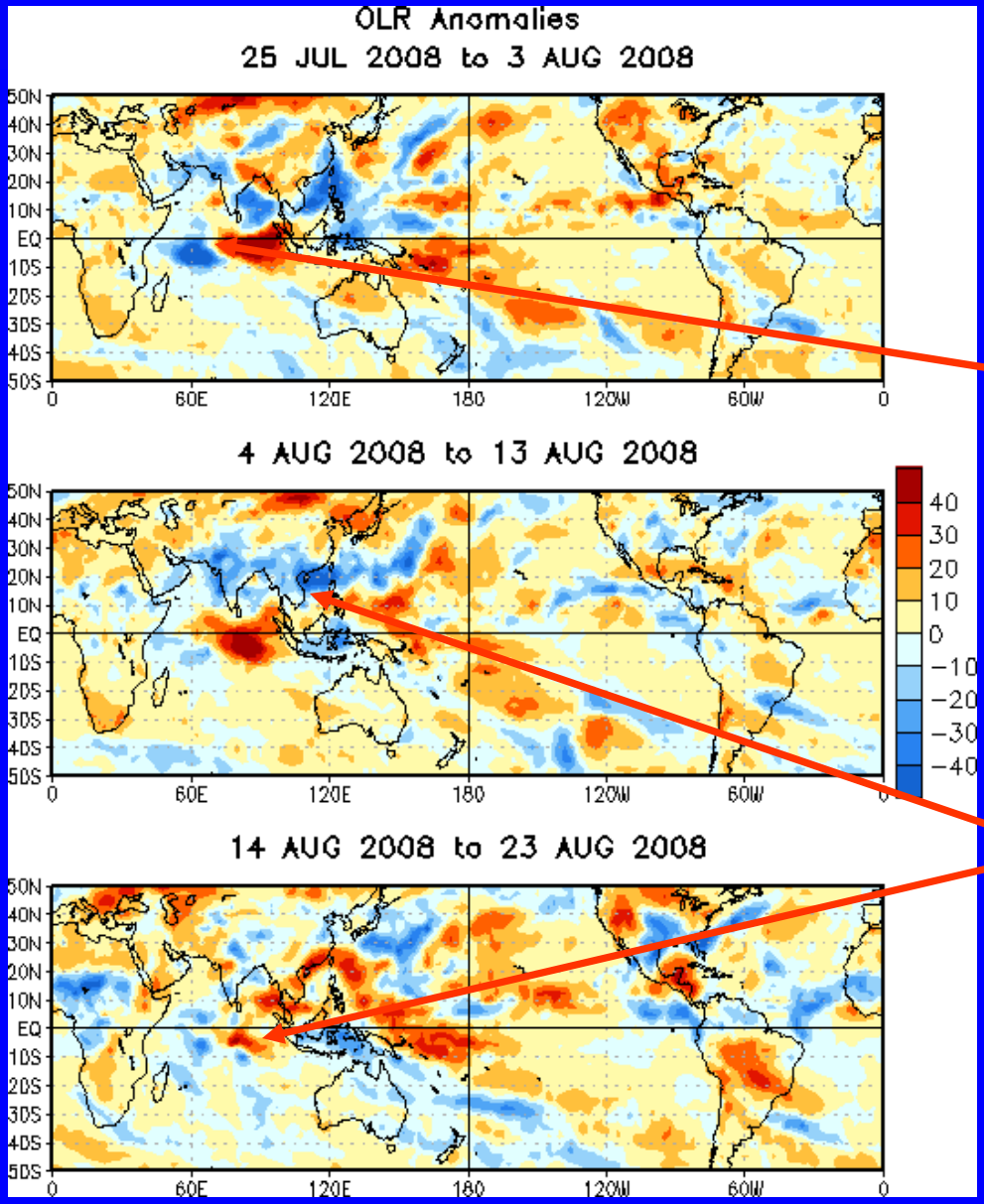
Easterly anomalies have prevailed across much of the eastern hemisphere since late May. Westerly anomalies were evident across parts of the Indian Ocean and Indonesia during the second half of July associated with the most recent MJO activity.

Easterly anomalies continued to strengthen in the west-central Pacific.

OLR Anomalies: Last 30 days

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

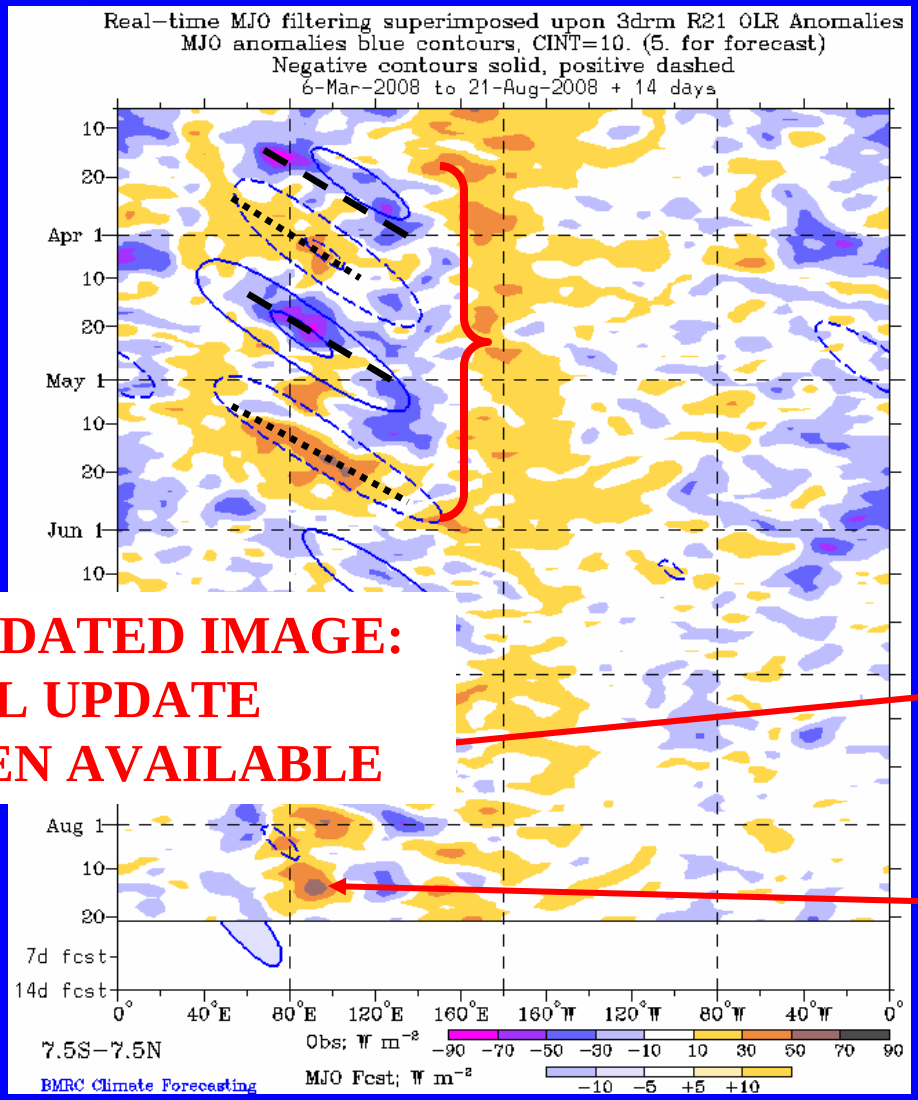
Wetter-than-normal conditions, negative OLR anomalies (blue shading)



Enhanced convection persisted across the central Indian Ocean from mid through early August.

Northeast propagation of enhanced convection from the Indian Ocean to southern Asia and the development of drier-than-average conditions in the eastern Indian Ocean are evident during late-July and mid-August.

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



Time

Longitude

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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)

MJO activity was evident from mid-March into early June 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.

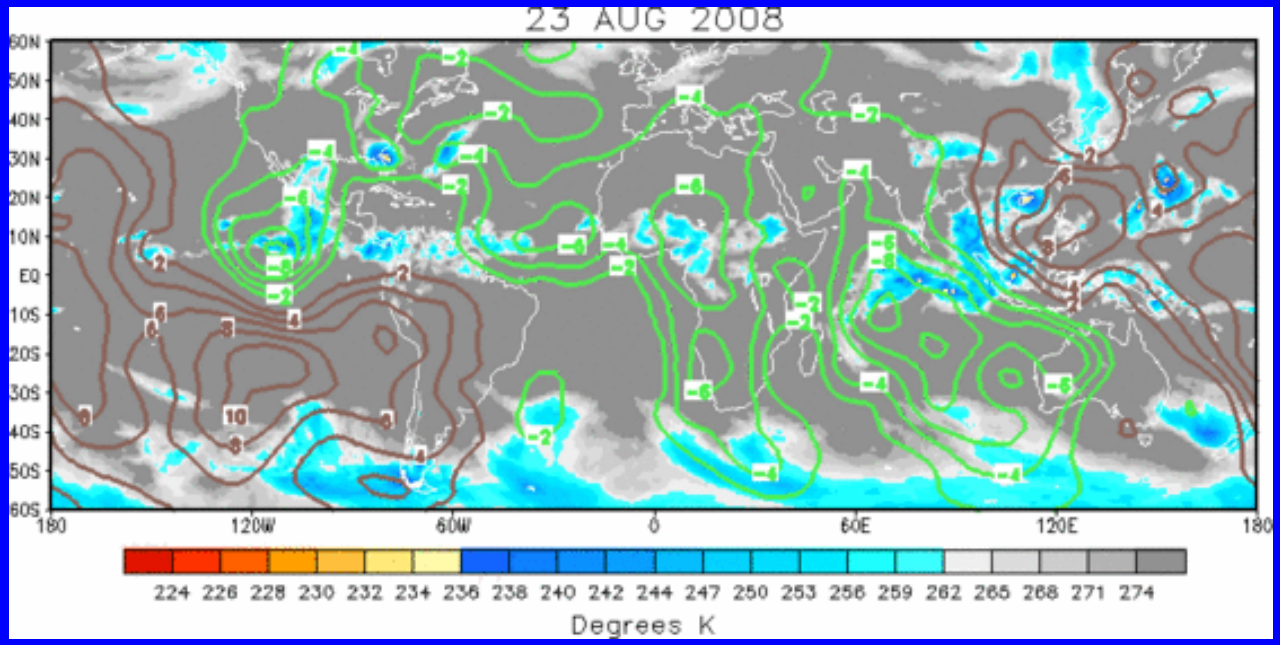
Persistent enhanced convection was evident across the western Indian Ocean from mid-June to early August.

During early August, suppressed convection was evident across the equatorial Indian Ocean and western Indonesia but most recently anomalies have become closer to average.

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

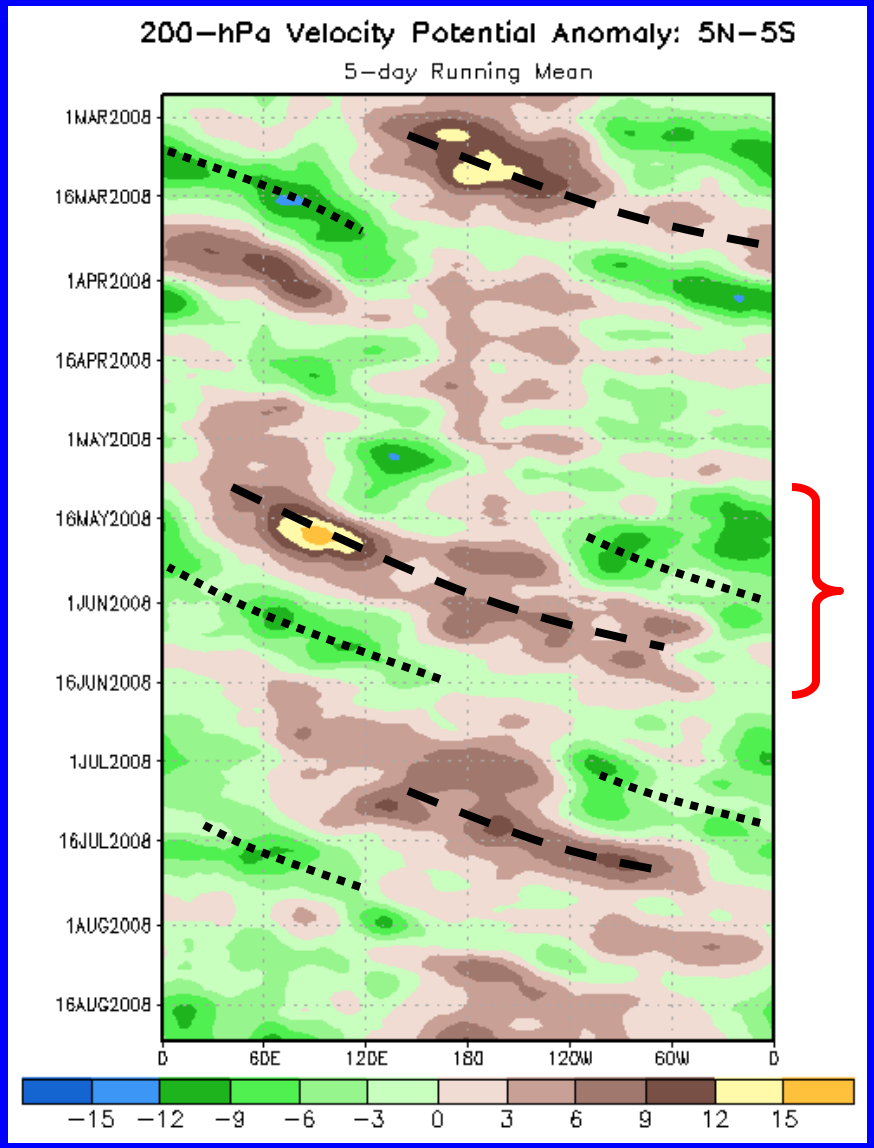


Upper-level divergence strengthened across Africa, the Atlantic Ocean, and the equatorial eastern Pacific. Upper-level convergence continues across the western and central Pacific Ocean.

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

Longitude

Weak-to-moderate MJO activity was evident during March.

The MJO was largely incoherent during the month of April.

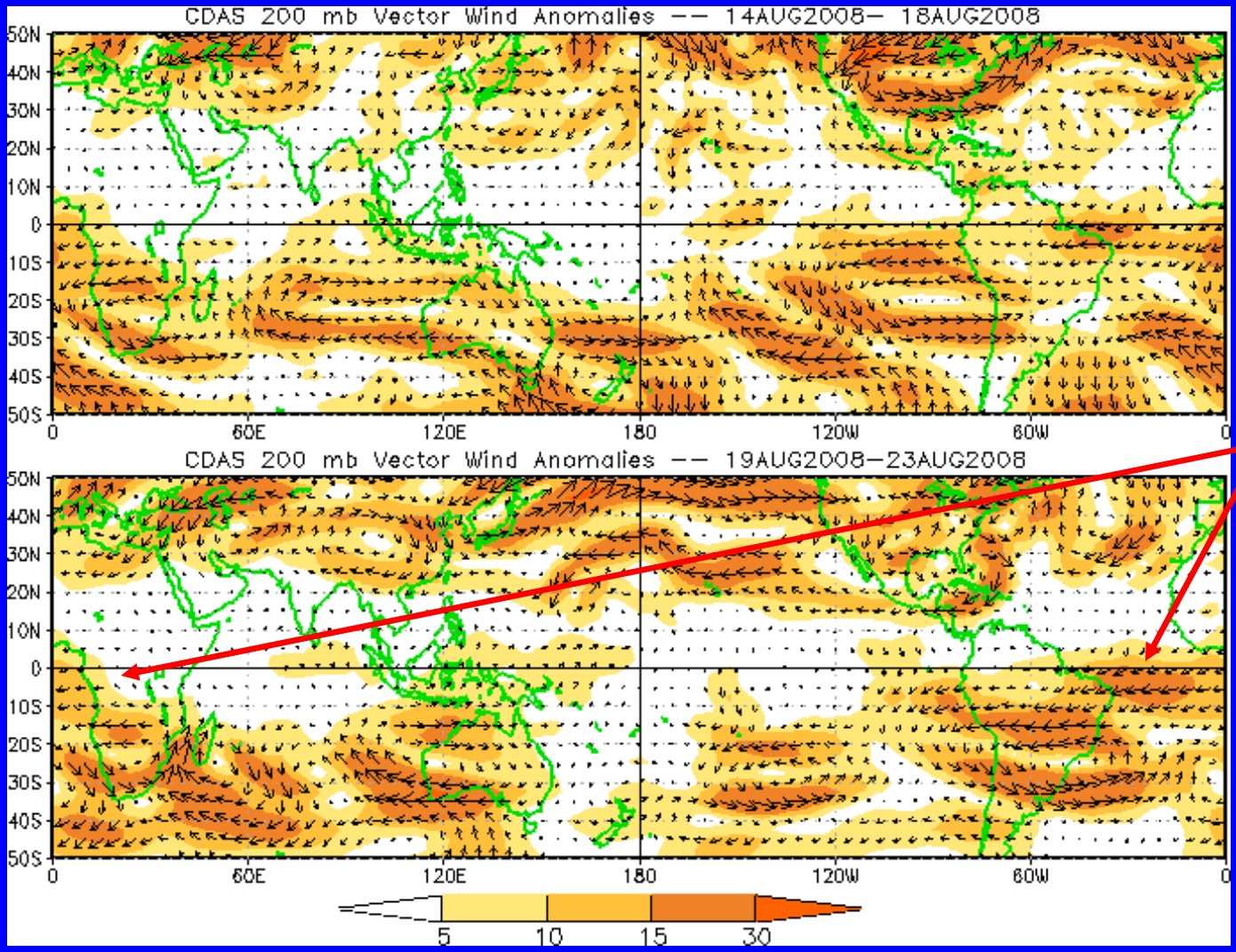
A moderate-to-strong MJO was observed from mid-May through mid-June as eastward propagation was more coherent and longer-lived.

After weakening in late June, the MJO strengthened during mid-July.

The MJO weakened in early August but may be showing signs of strengthening.

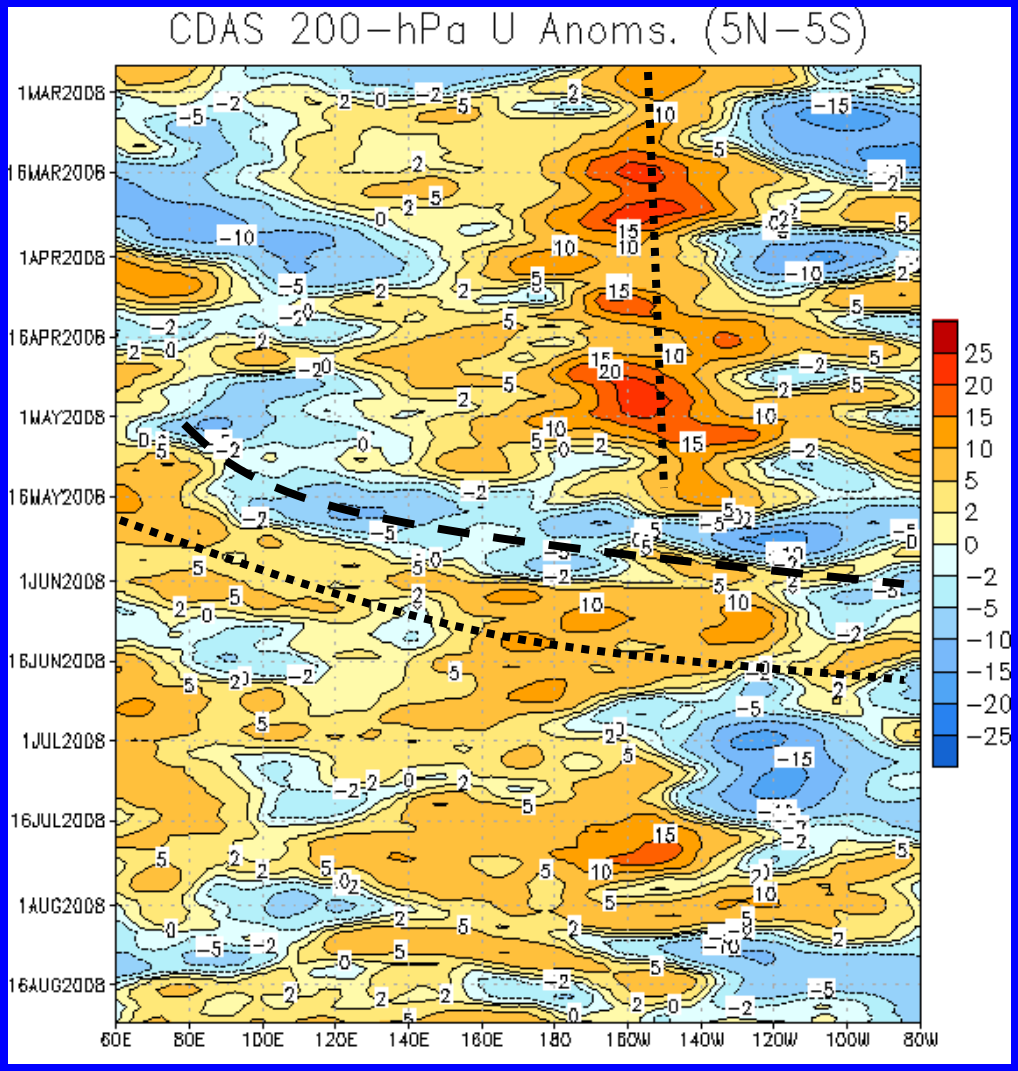
200-hPa Vector Wind Anomalies (m s^{-1})

Note that shading denotes the magnitude of anomalous wind vectors



Upper-level easterly anomalies across equatorial Africa and the Atlantic strengthened. during the last five days.

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



Time

Longitude

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

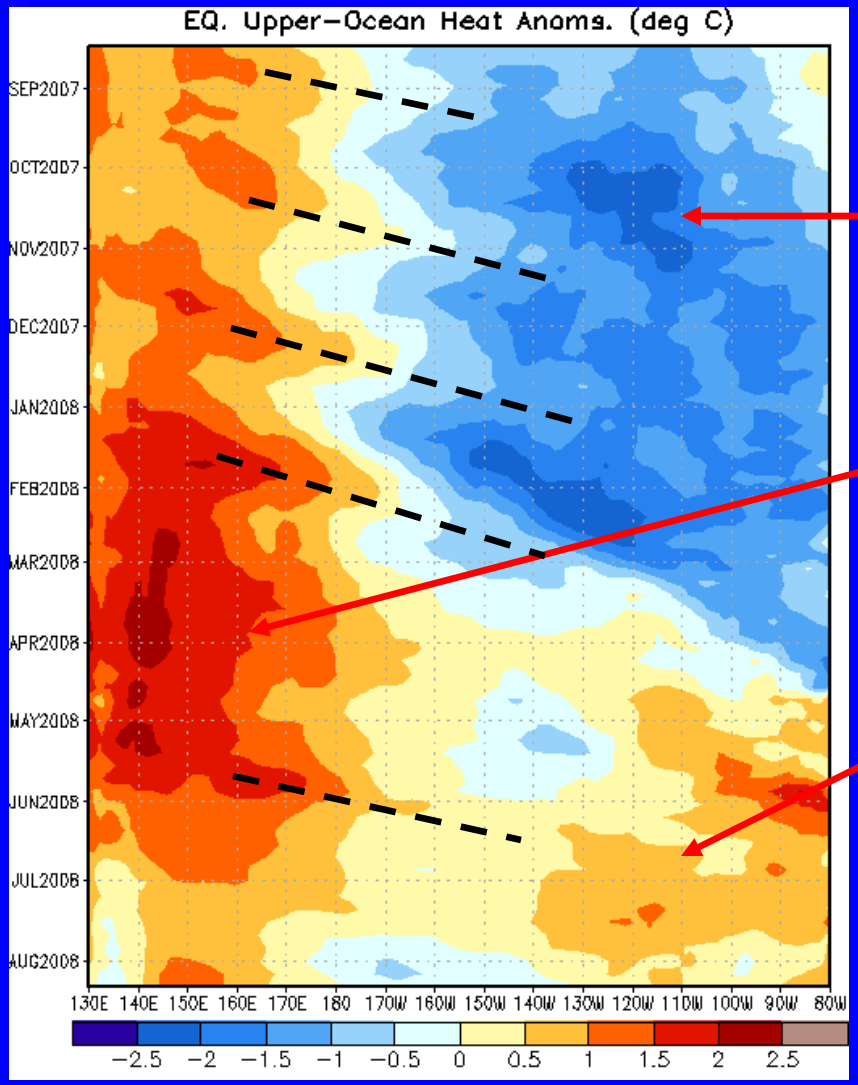
Easterly anomalies (blue shading) represent anomalous east-to-west flow

The MJO was weak or incoherent for much of the period from mid-February through April and upper-level winds indicate generally strong and persistent westerly anomalies near and east of the Date Line.

During May and early June, eastward propagation was evident in the upper-level wind field and was associated with the moderate-to-strong MJO activity during this time.

Easterly anomalies across the eastern Pacific have weakened, while westerly anomalies returned over the Indian Ocean and Indonesia.

Weekly Heat Content Evolution in the Equatorial Pacific



Time

Longitude

During September and October, negative heat content anomalies increased markedly across the eastern Pacific Ocean and continued until February 2008.

Beginning in February, increasingly positive anomalies developed across parts of the western and central Pacific but have since decreased.

During June and July 2008, positive heat content anomalies encompassed much of the Pacific basin in part associated with a Kelvin wave initiated during May 2008.

During early August 2008, negative anomalies started to develop near and east of the Date Line in response to enhanced easterly surface winds.

MJO Index -- Information

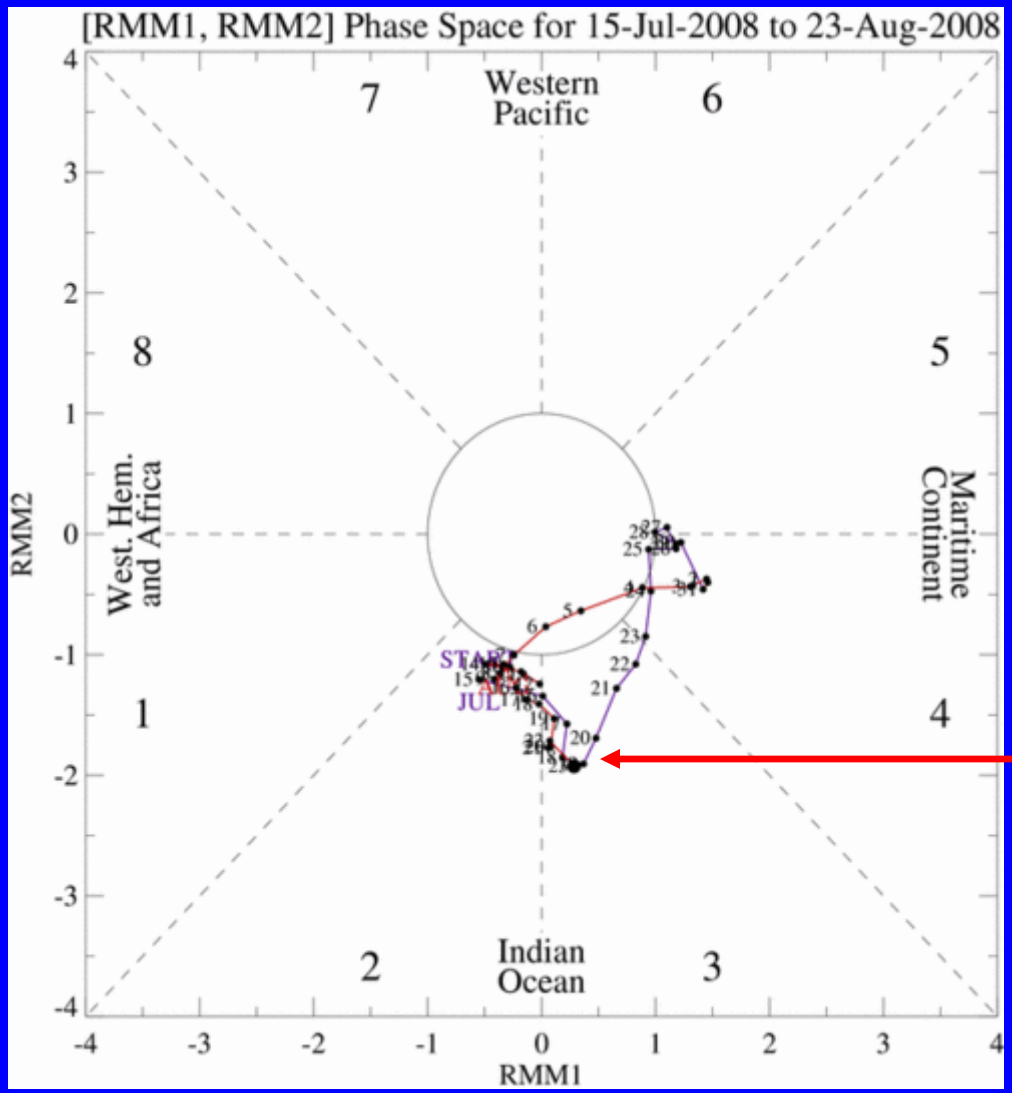
- **The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).**

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

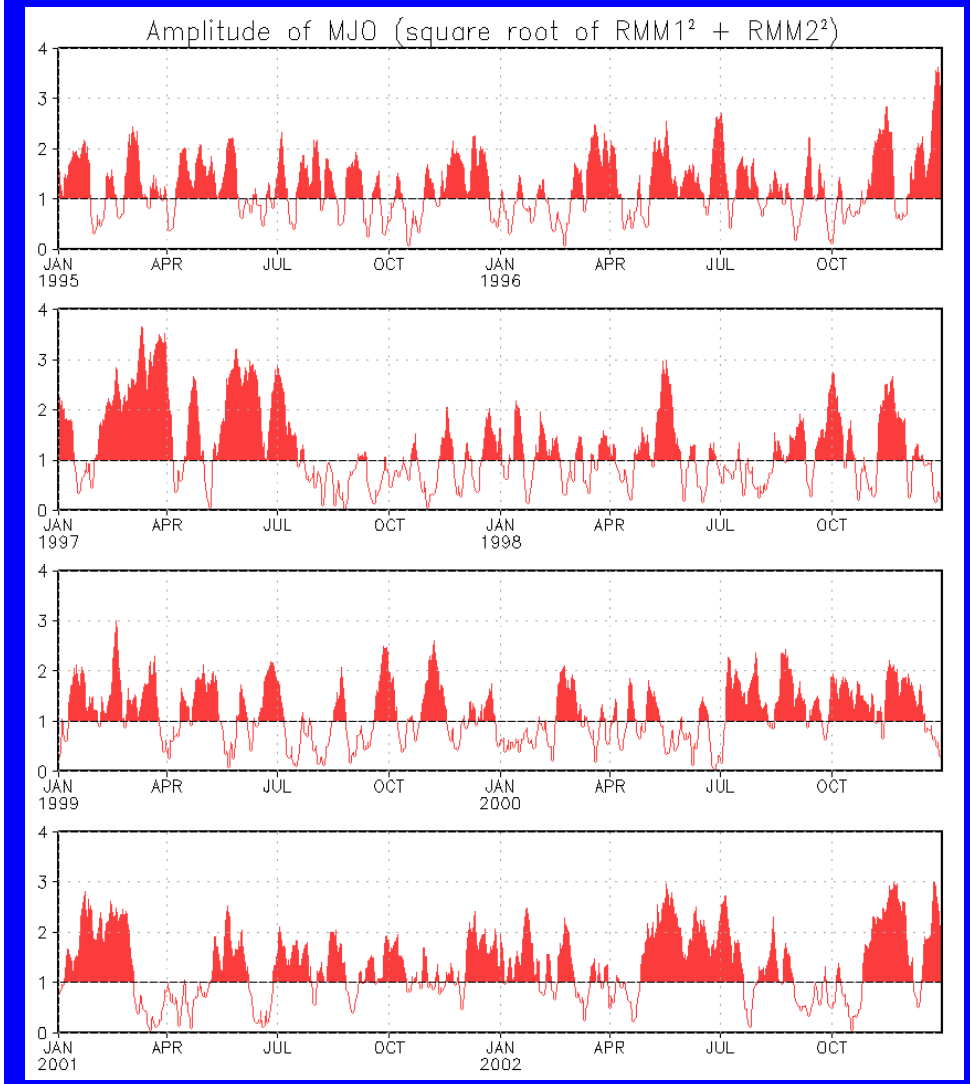


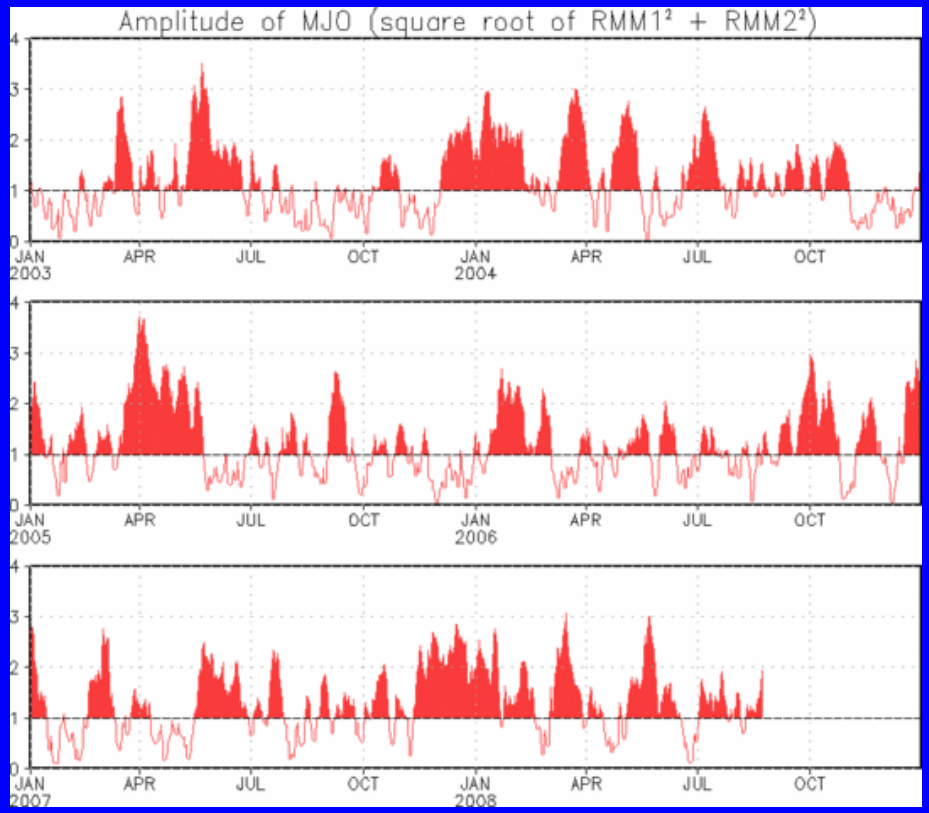
- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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

The MJO has become better organized.

While the amplitude has increased in recent days, little eastward propagation is evident.

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

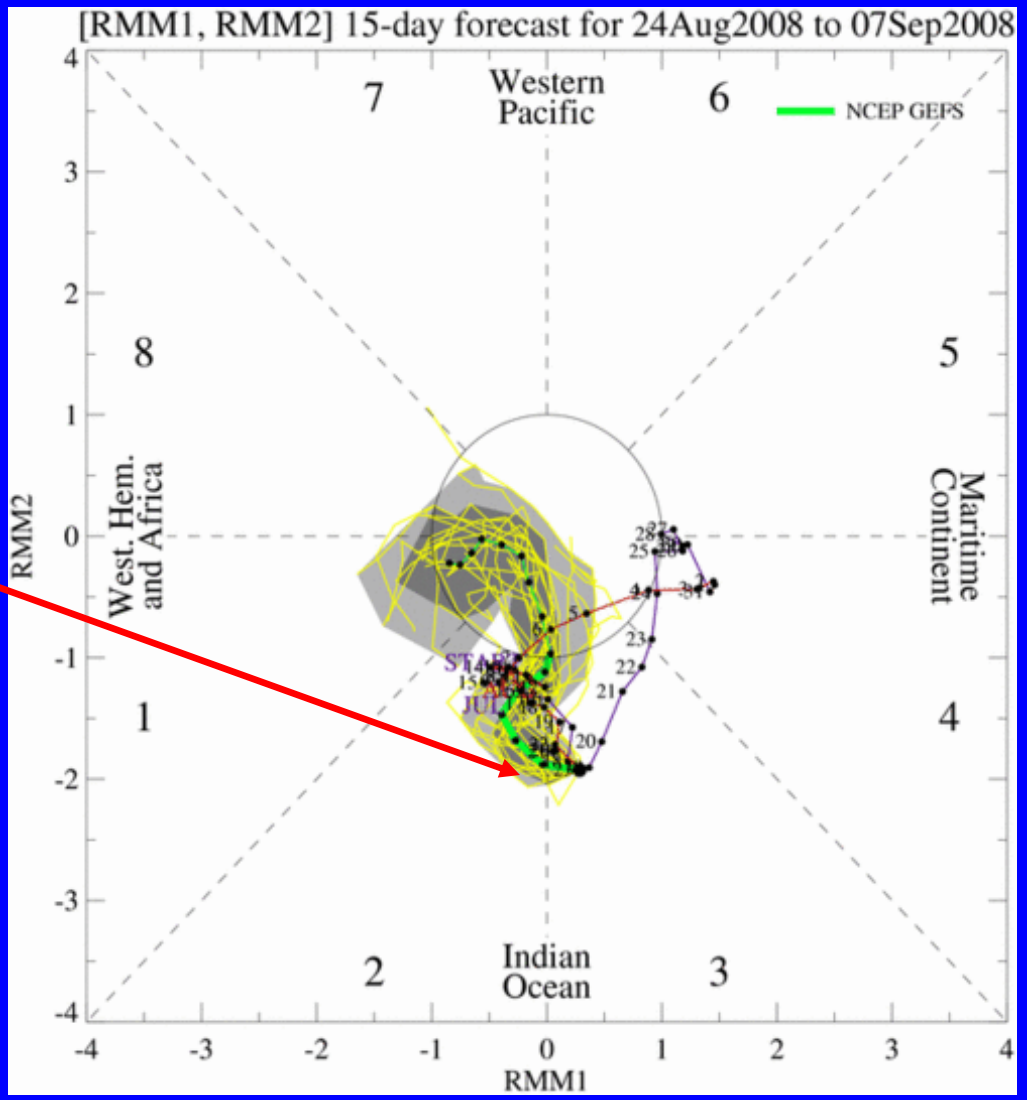
Ensemble GFS MJO Forecasts

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

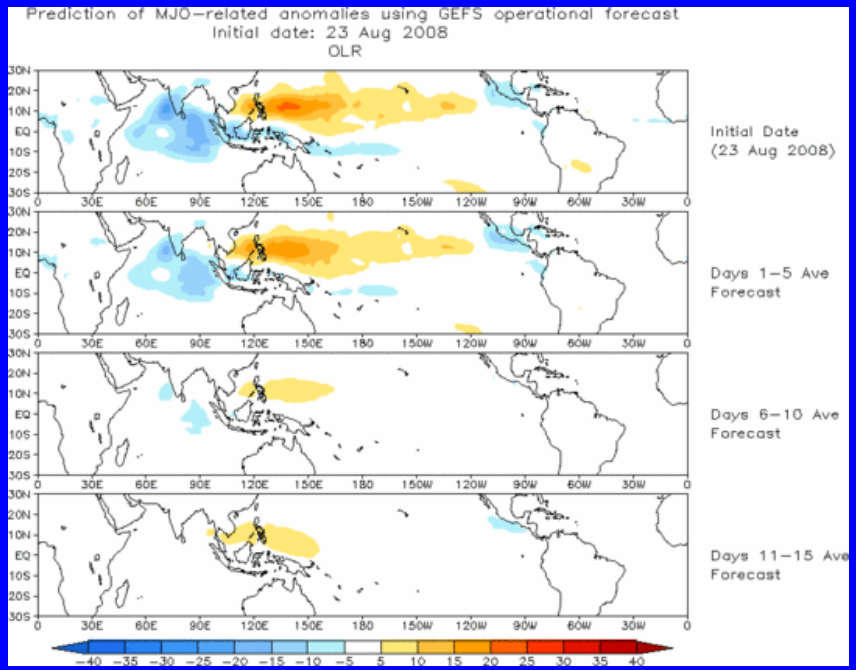
The GEFS predicts weak MJO activity during the period.



Ensemble Mean GFS MJO Forecast

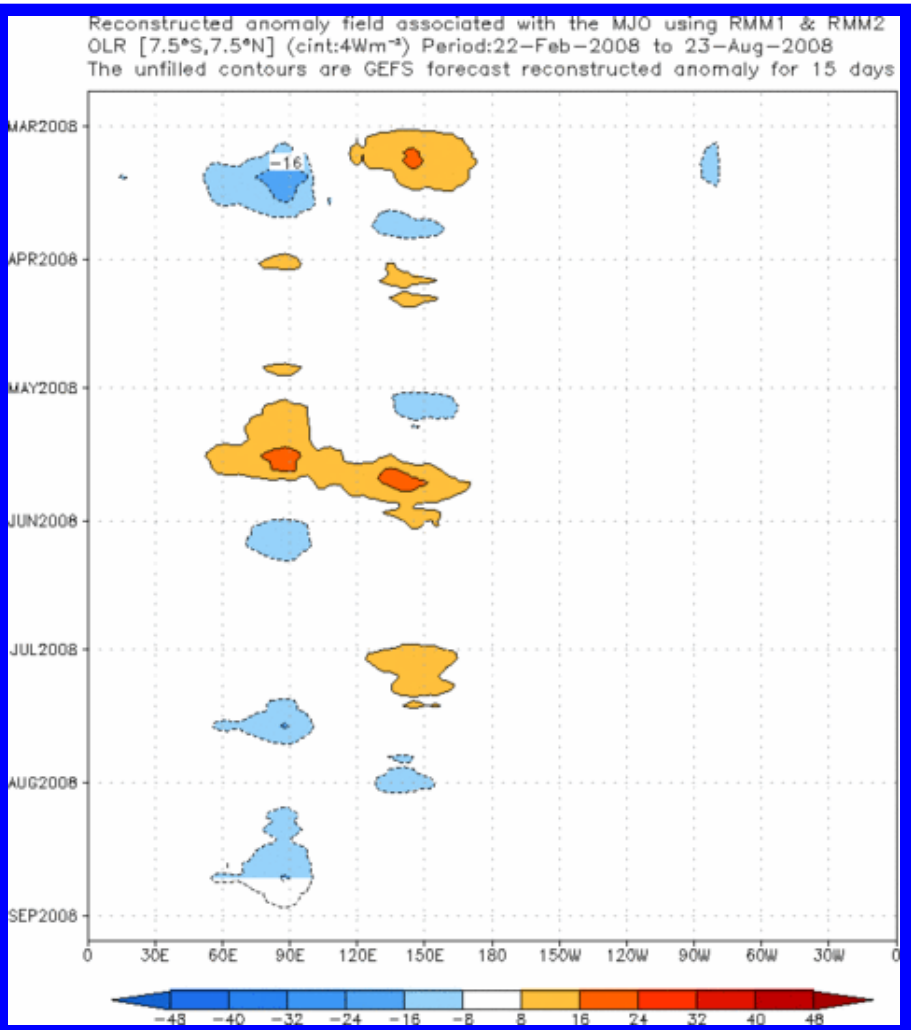
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



The forecast indicates MJO-associated enhanced (suppressed) convection across the Indian (western Pacific) Oceans early during the period. Only small anomalies are forecast thereafter.

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

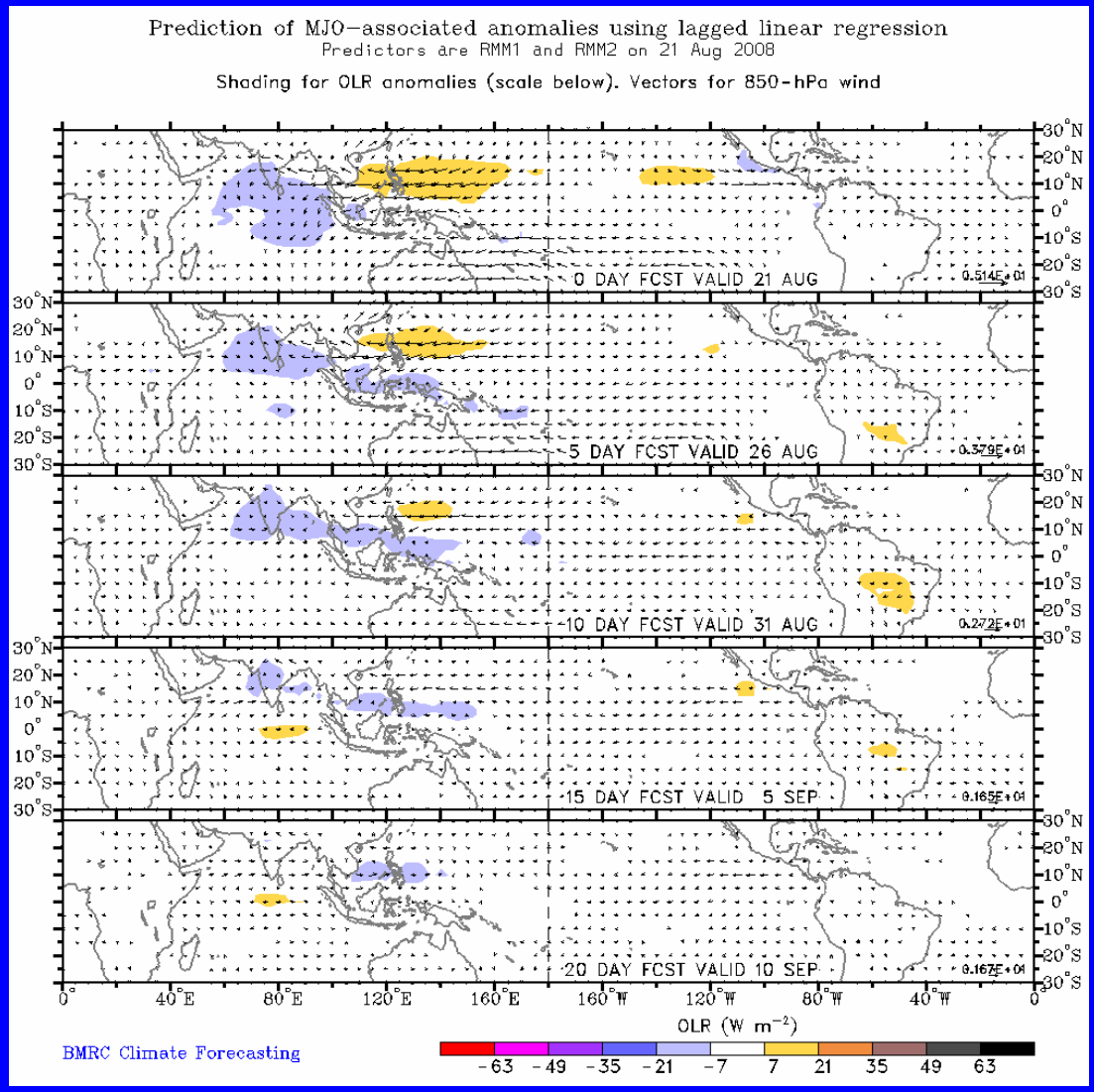


Statistical MJO Forecast

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-to-moderate MJO activity is forecast during the next two weeks with enhanced convection slowly shifting northeast from the Indian Ocean into southern Asia.

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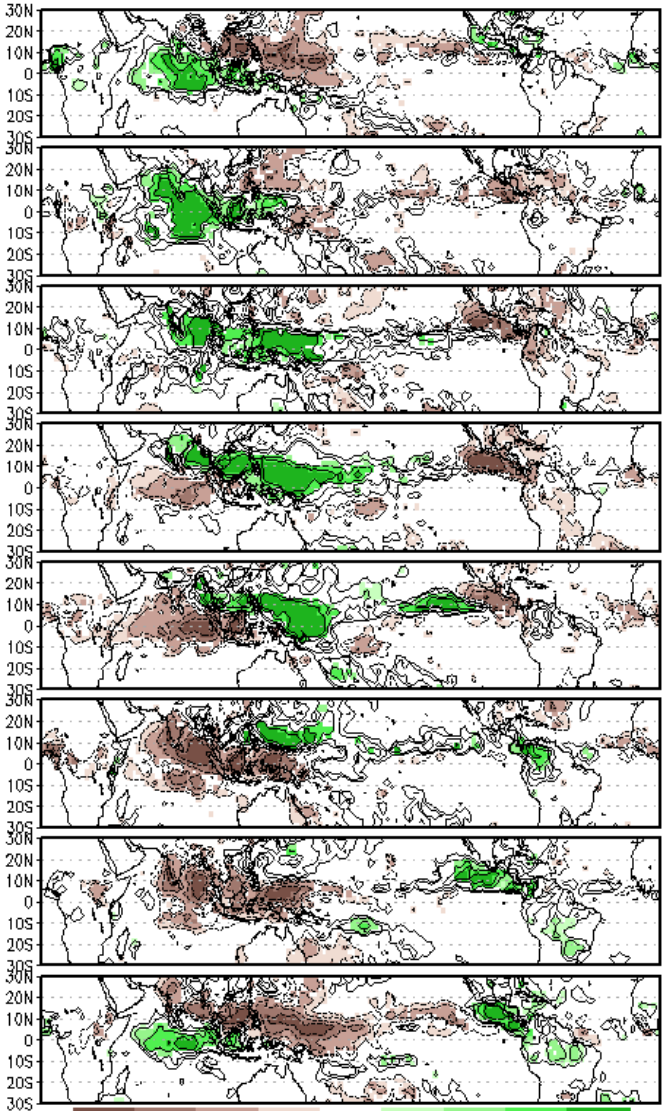
MJO Composites – Global Tropics

Precipitation Anomalies (May-Sep)



850-hPa Wind Anomalies (May-Sep)