



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

**Update prepared by
Climate Prediction Center / NCEP
October 14, 2008**



Outline

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



Overview

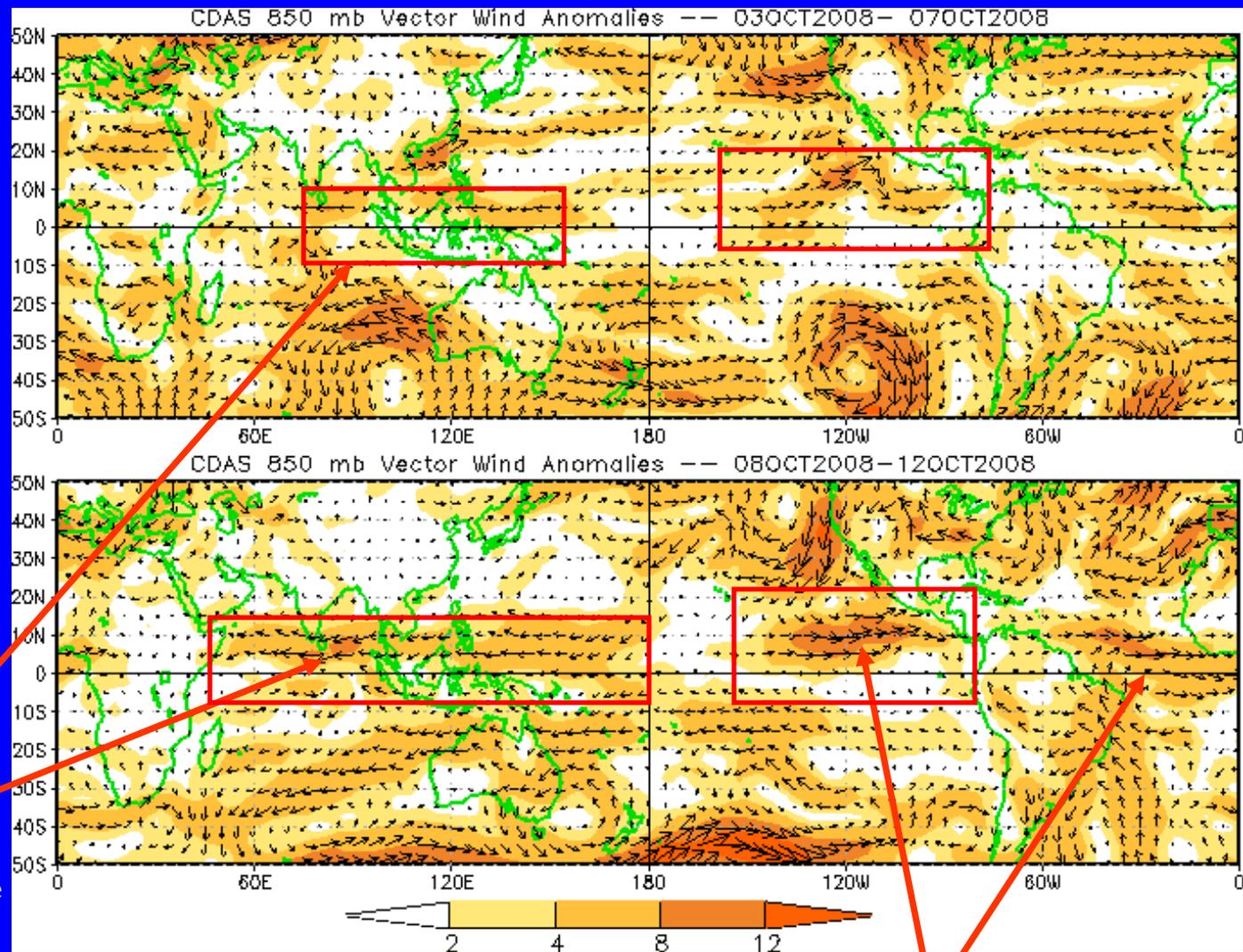
- **MJO activity continues with the enhanced phase located across the Indian Ocean.**
- **Based on the latest observations and most forecast tools, moderate MJO activity is expected to continue during the next 1-2 weeks.**
- **During Week 1, the MJO is expected to contribute to enhanced rainfall across the Indian Ocean and dry conditions across parts of Southeast Asia and the Philippines. Enhanced rainfall is expected to shift towards the Maritime Continent during Week 2.**
- **The current MJO increases the likelihood for tropical cyclone development across the Caribbean Sea and southwest Indian Ocean during Week 1. An increasing threat for tropical cyclone development is expected during Week 2 for the Bay of Bengal.**

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



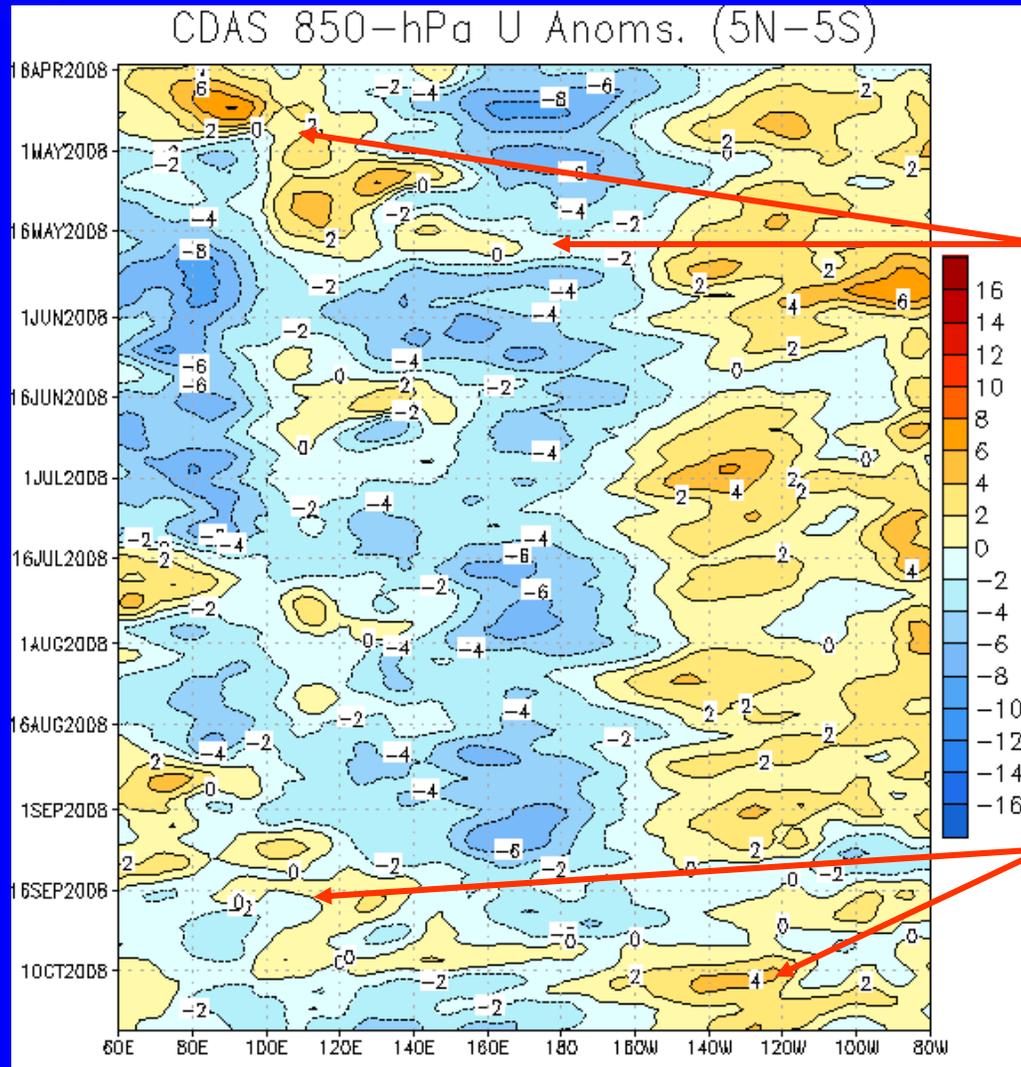
Easterly anomalies have strengthened during the last five days across the Indian Ocean, Maritime Continent, and the western Pacific.

Westerly anomalies persist across the east Pacific and Atlantic.



850-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

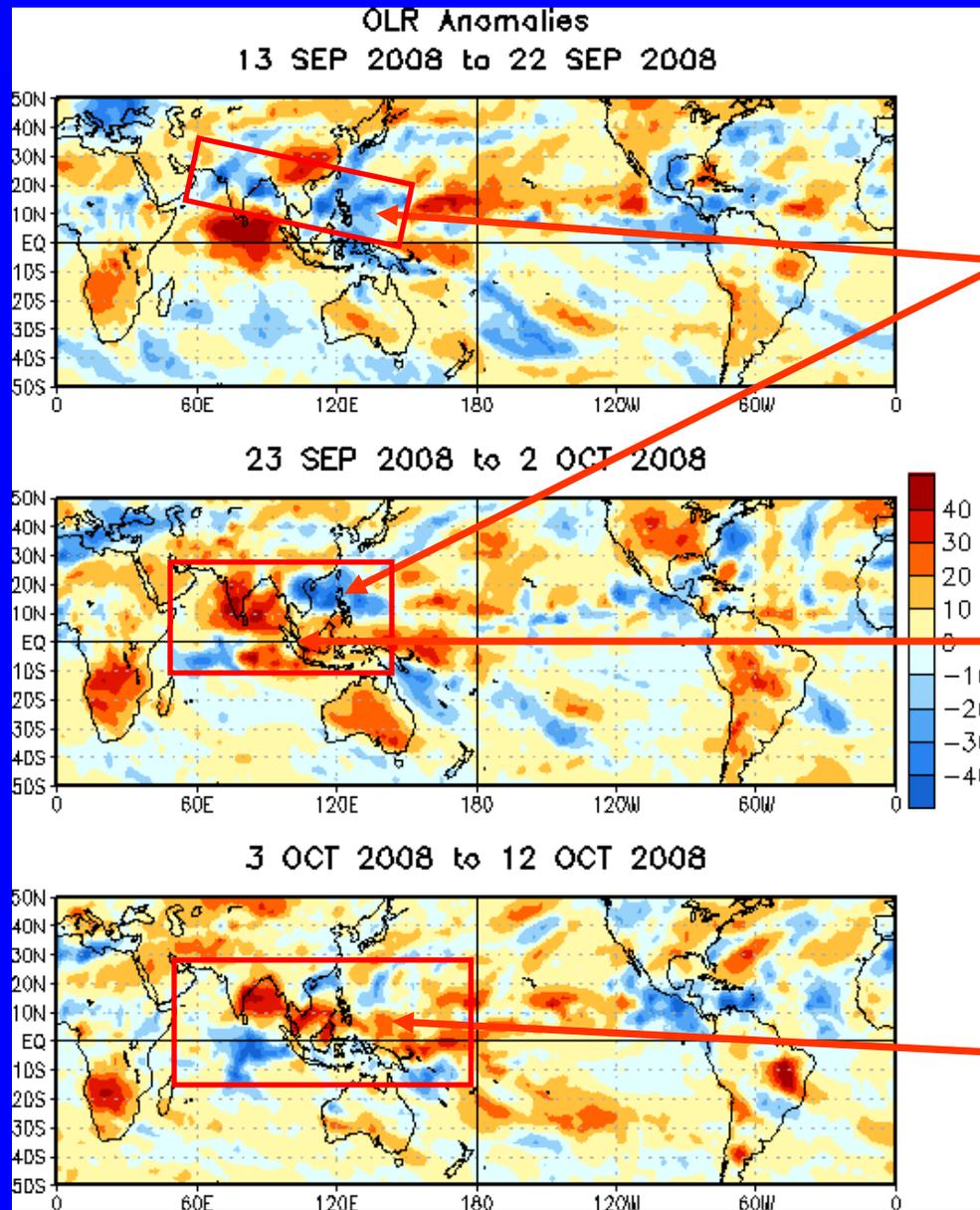
During mid-May, easterlies weakened across the western Pacific associated with moderate MJO activity.

Easterly anomalies prevailed across much of the eastern hemisphere from late May into August.

From mid-August to late-September, westerly anomalies associated with the current MJO activity propagated eastward from the Indian Ocean across the 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)

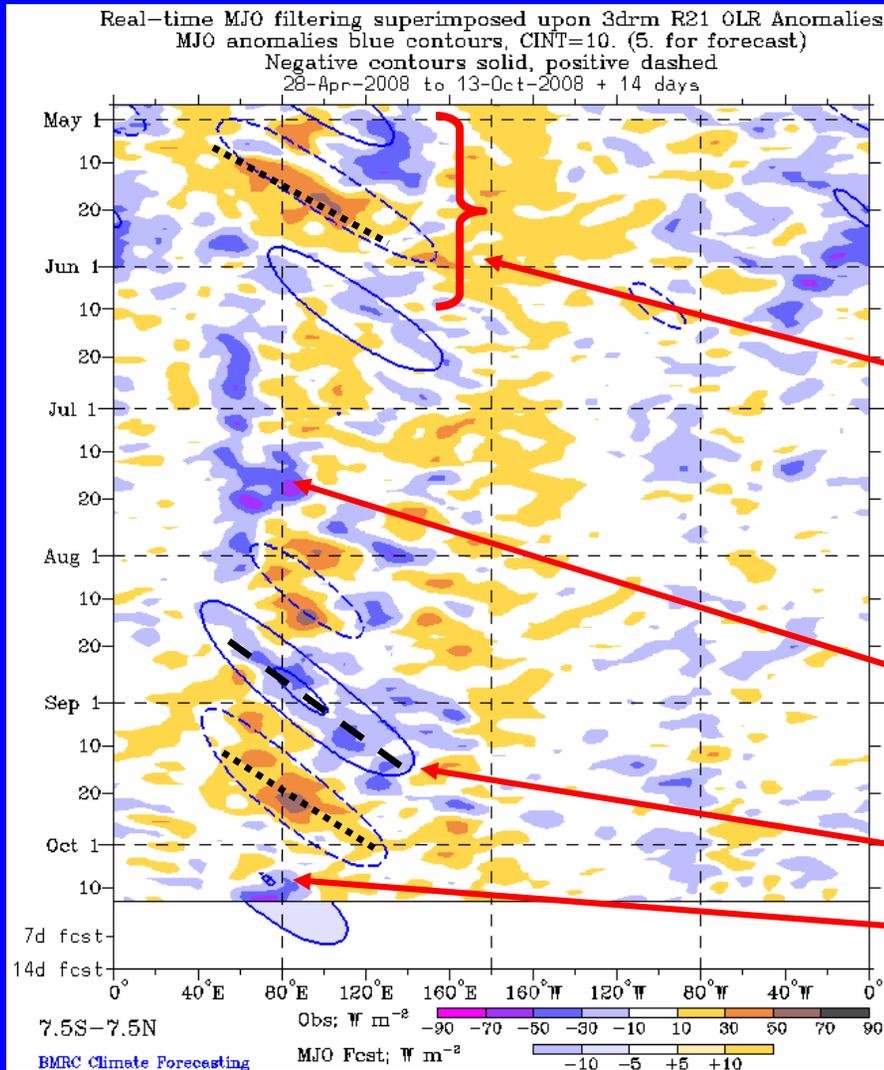
In mid-September, enhanced convection shifted northeast to southern Asia, Indonesia and the western Pacific. The Atlantic Ocean experienced wet conditions during the period.

In late September, suppressed convection shifted to India and the Maritime Continent while wet conditions persisted over the eastern Pacific, Central America and Mexico.

In early-mid October, dry conditions continued to shift northeast while wet conditions developed across the equatorial Indian Ocean.



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)

MJO activity was evident during May into early June. 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.

Moderate MJO activity is evident since late August as anomalous convection developed across the Indian Ocean and shifted eastward.

Recently, enhanced convection has developed across the Indian Ocean.

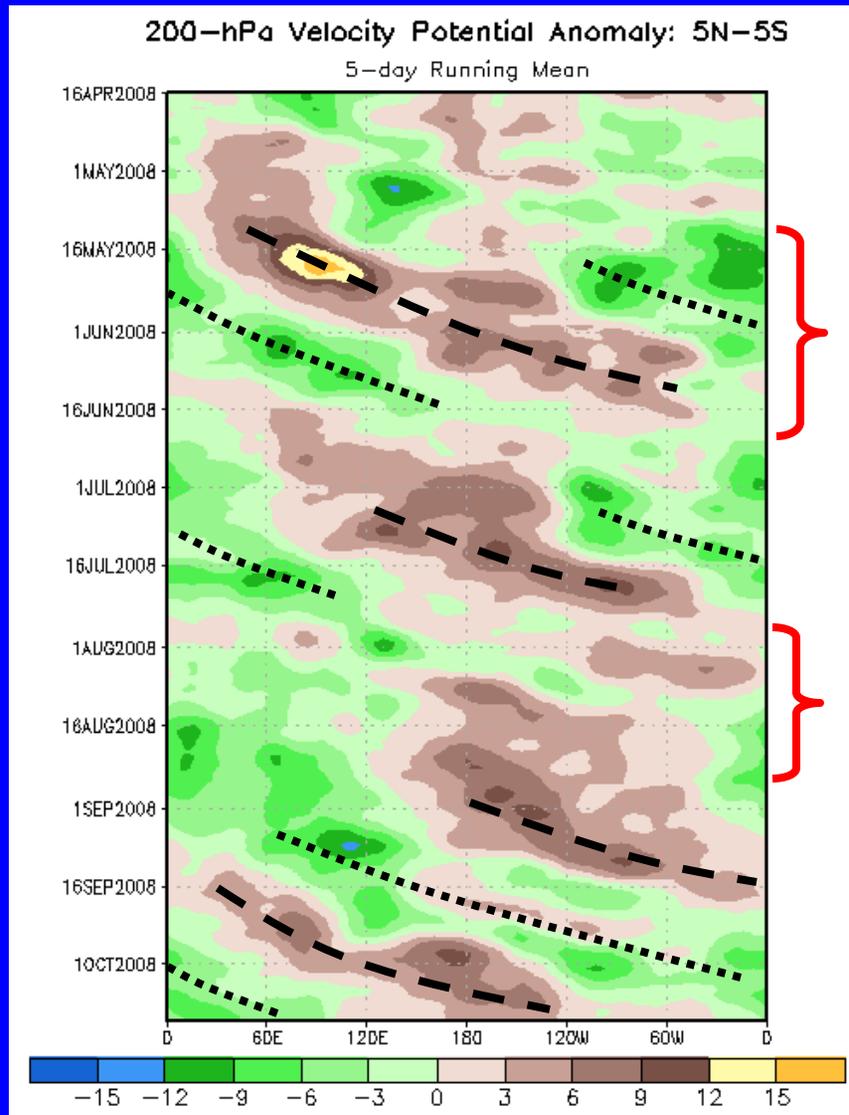


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time



Longitude

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.

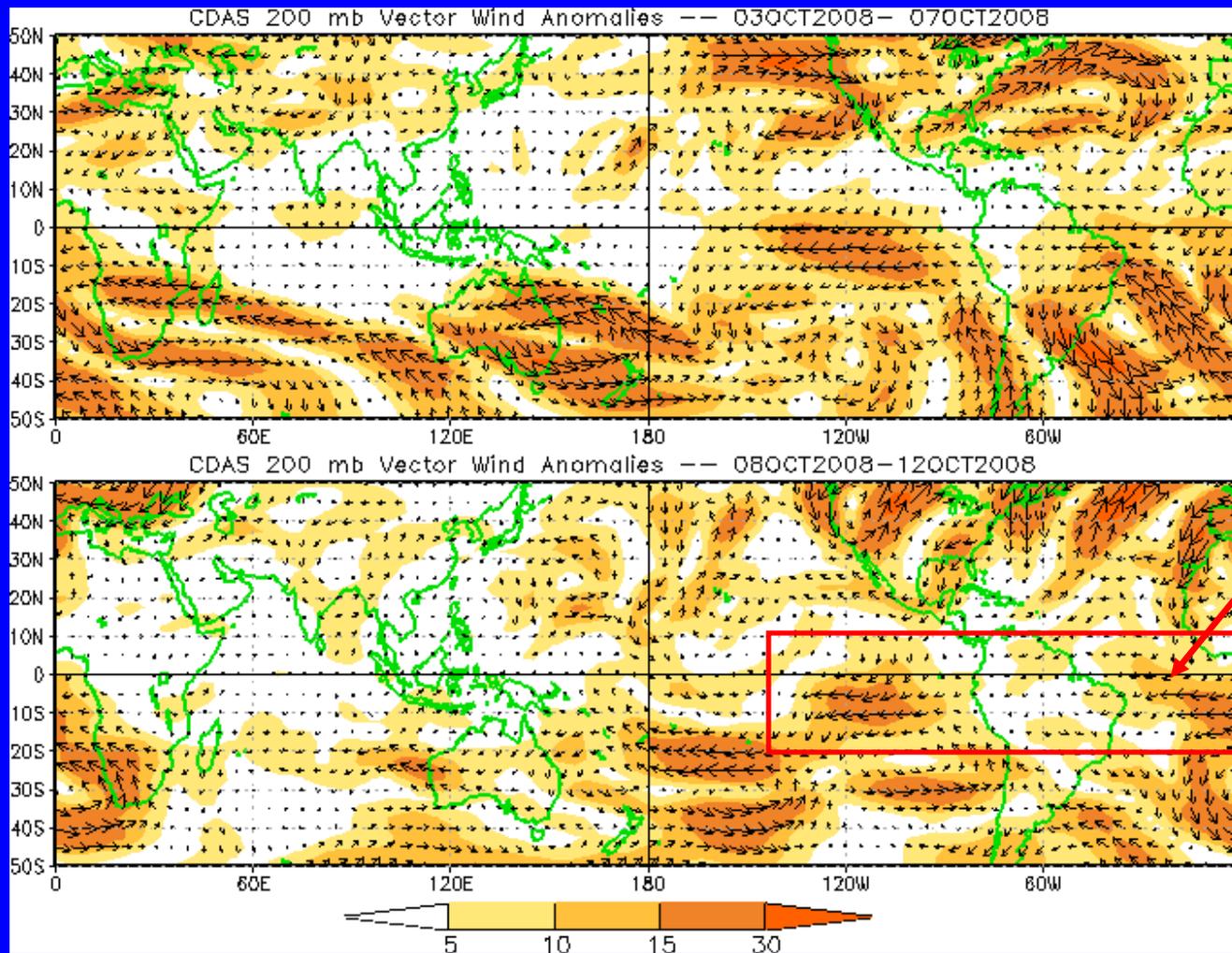
From early-mid August into early September, the MJO was weak as a more stationary pattern was evident.

The MJO strengthened in early September and eastward propagation has been observed from September into early October.



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

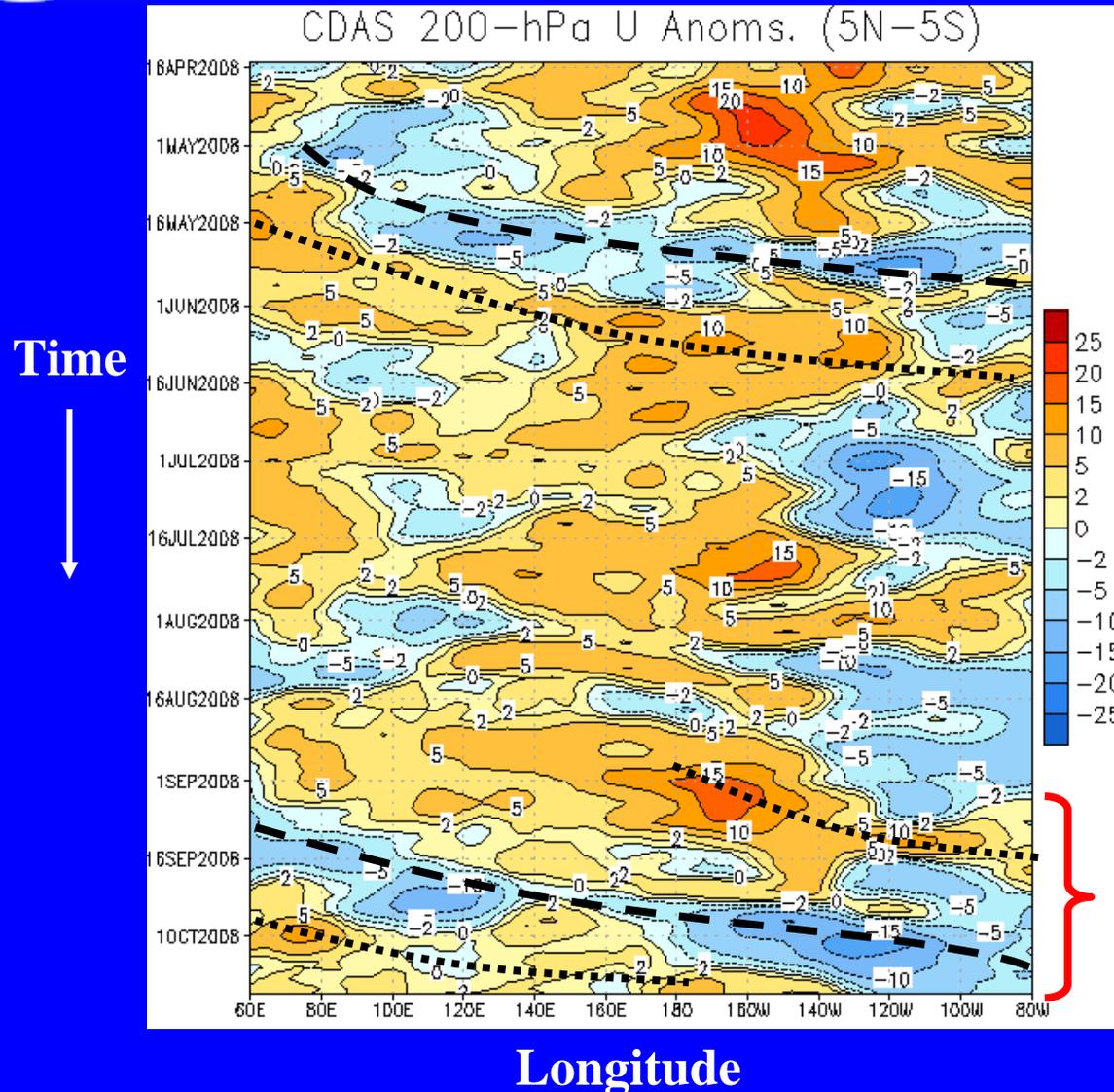
Note that shading denotes the magnitude of anomalous wind vectors



Easterly anomalies prevail across the western hemisphere and stretch from the east Pacific to Africa.



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



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

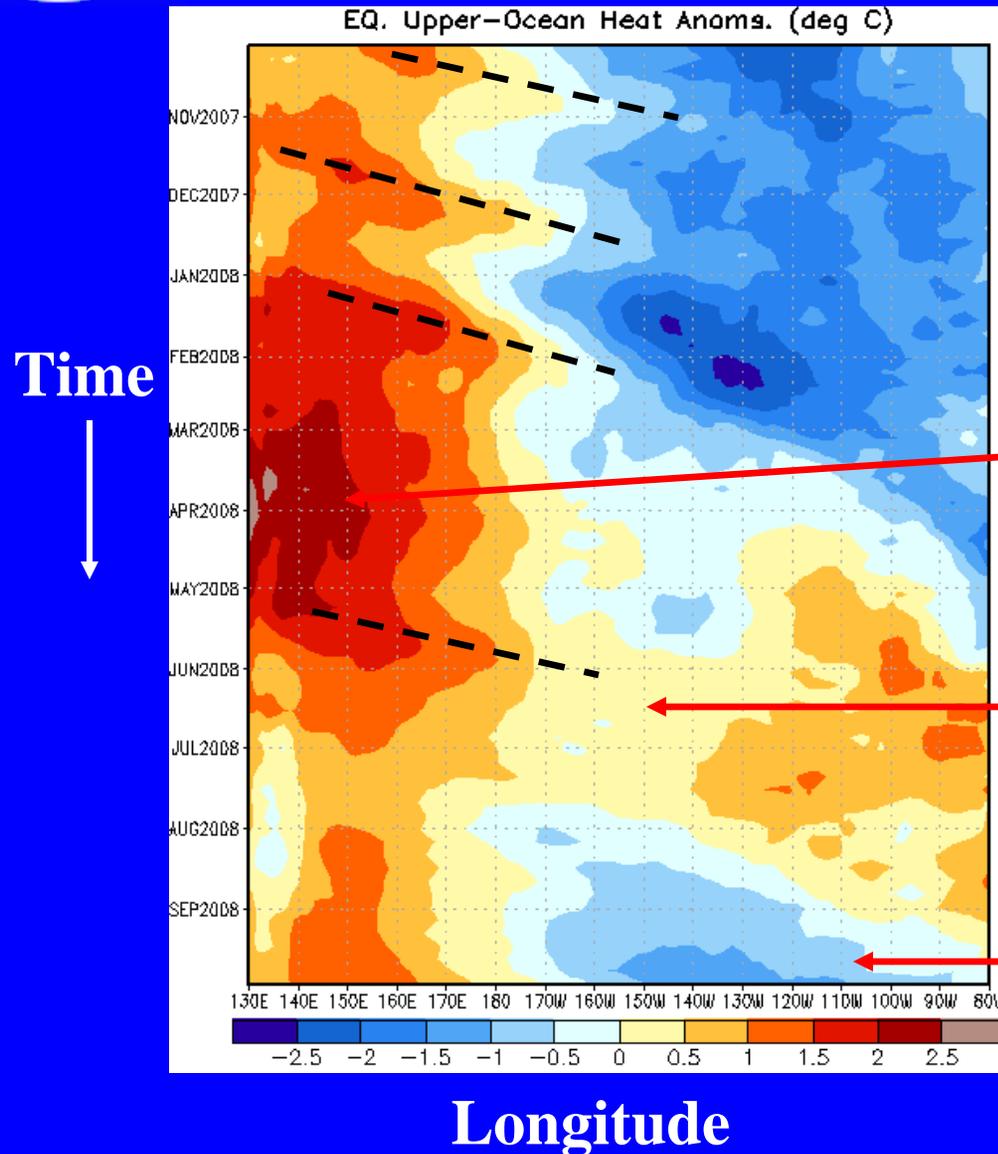
Easterly anomalies (blue shading) represent anomalous east-to-west flow

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.

Westerly and easterly anomalies associated with the current MJO activity have shifted eastward since approximately late August.



Weekly Heat Content Evolution in the Equatorial Pacific



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.

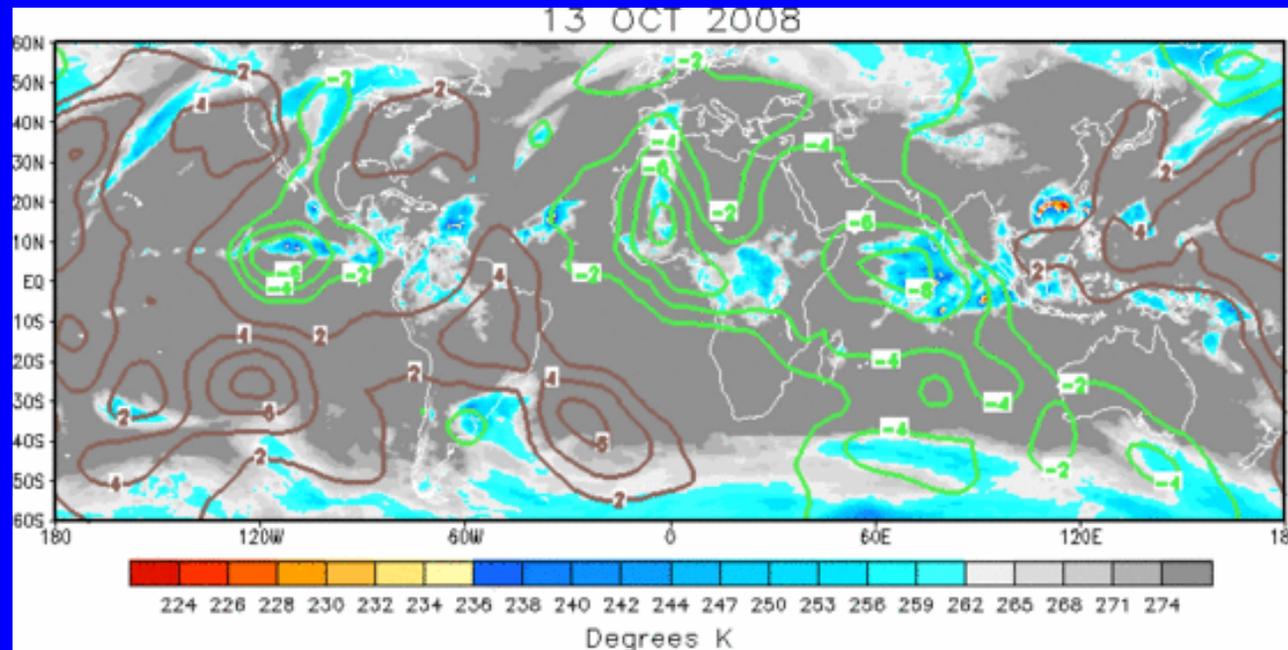
During August 2008, negative anomalies started to develop east of the Date Line and during September the anomalies have increased and expanded eastward.



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



During the past week, upper-level divergence has progressed slowly east into the eastern hemisphere, while upper-level convergence has shifted east into the west and central 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).

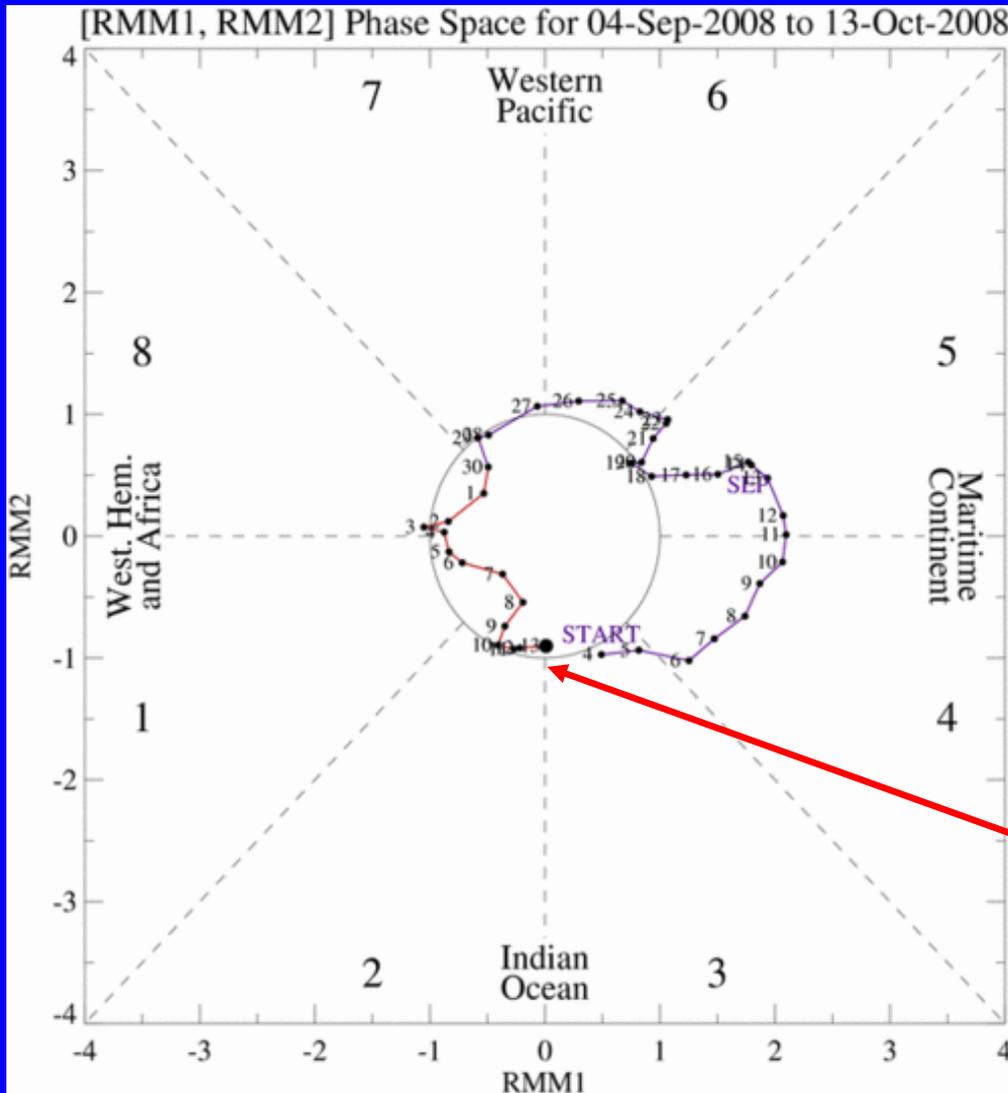
Wheeler M. and H. Hendon, 2004: An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction, *Monthly Weather Review*, 132, 1917-1932.

- 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

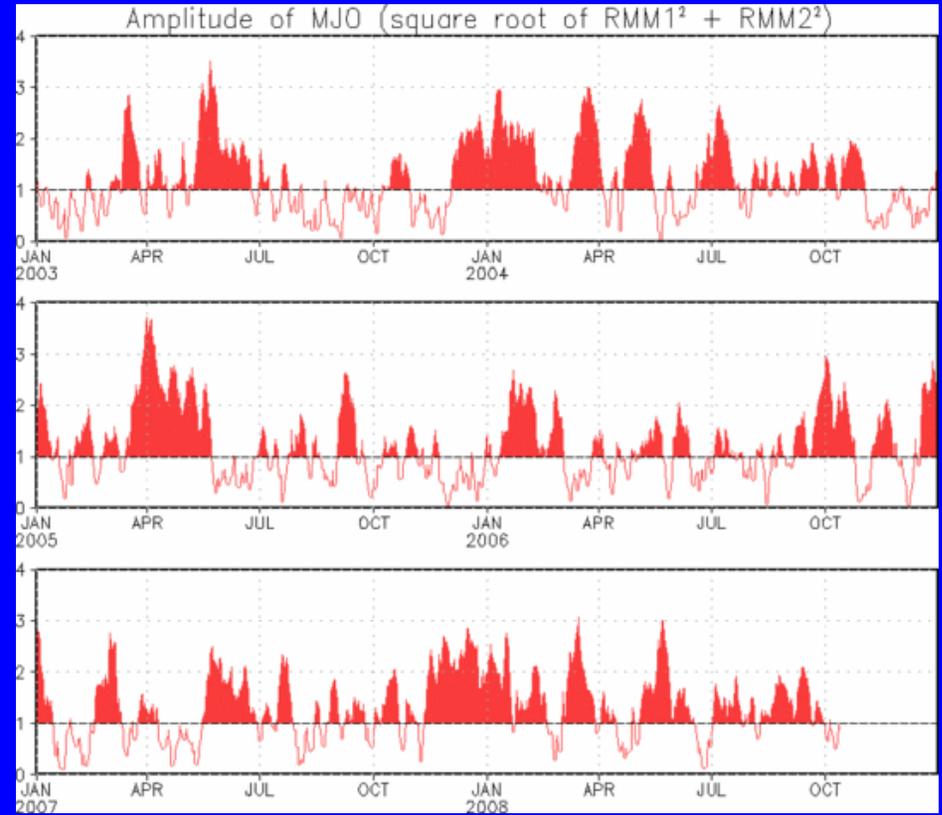
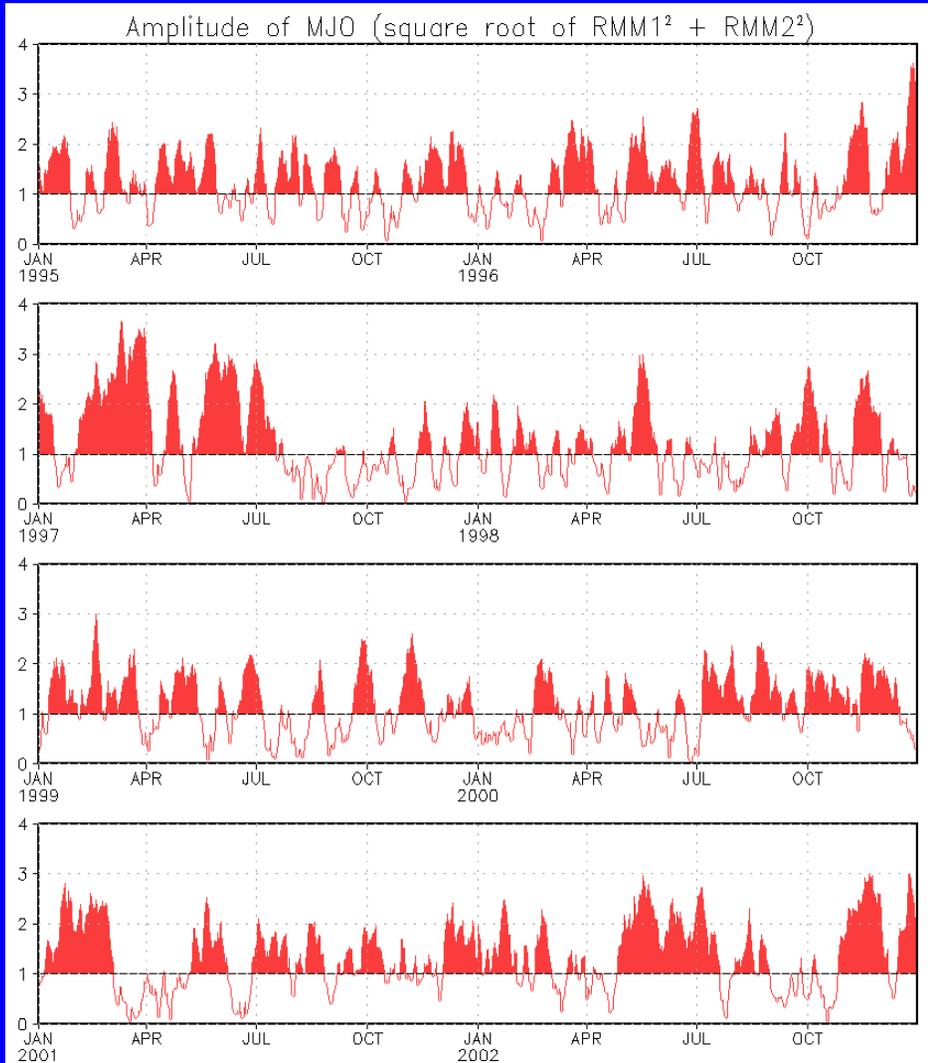
- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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



The MJO index indicates continued MJO activity with the enhanced phase entering the Indian Ocean.



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



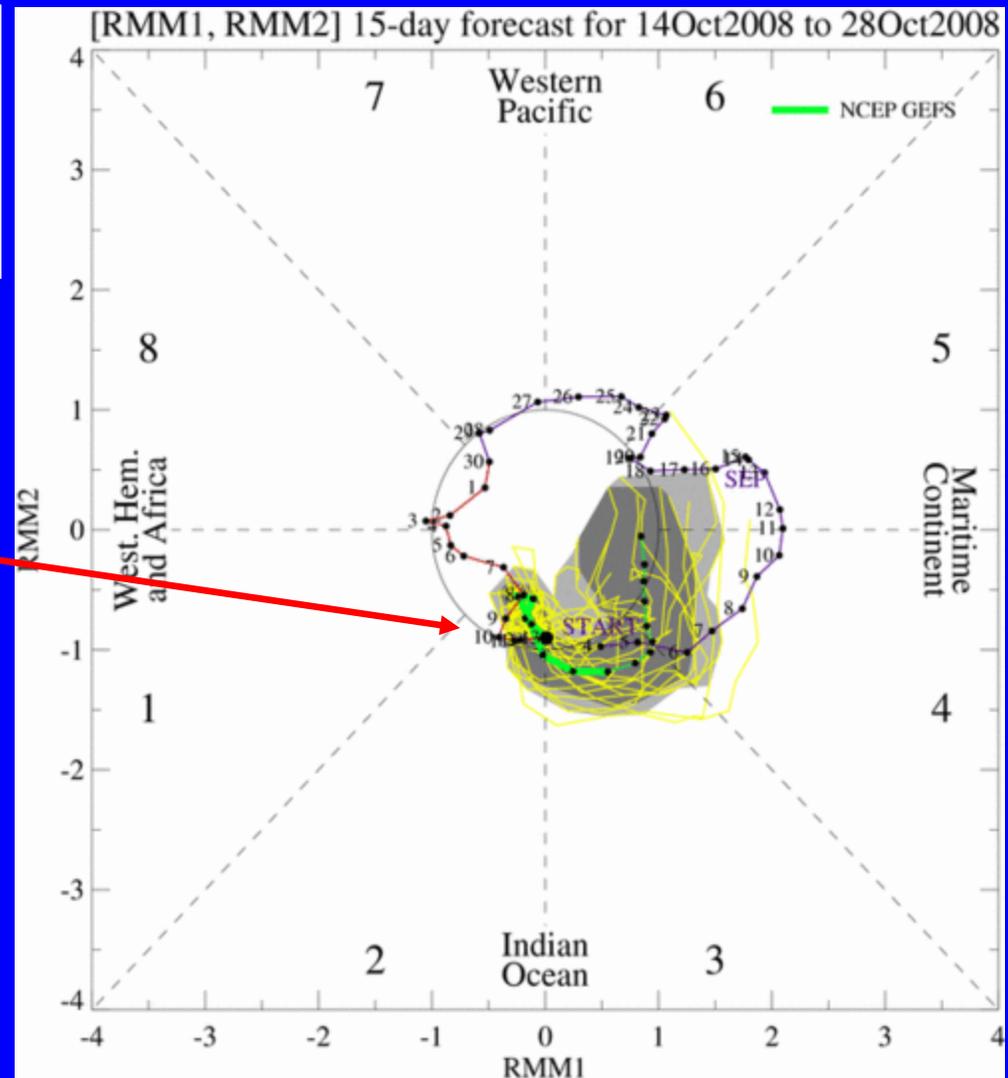
Ensemble GFS (GEFS) MJO Forecast

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 continued MJO activity during the next two weeks.

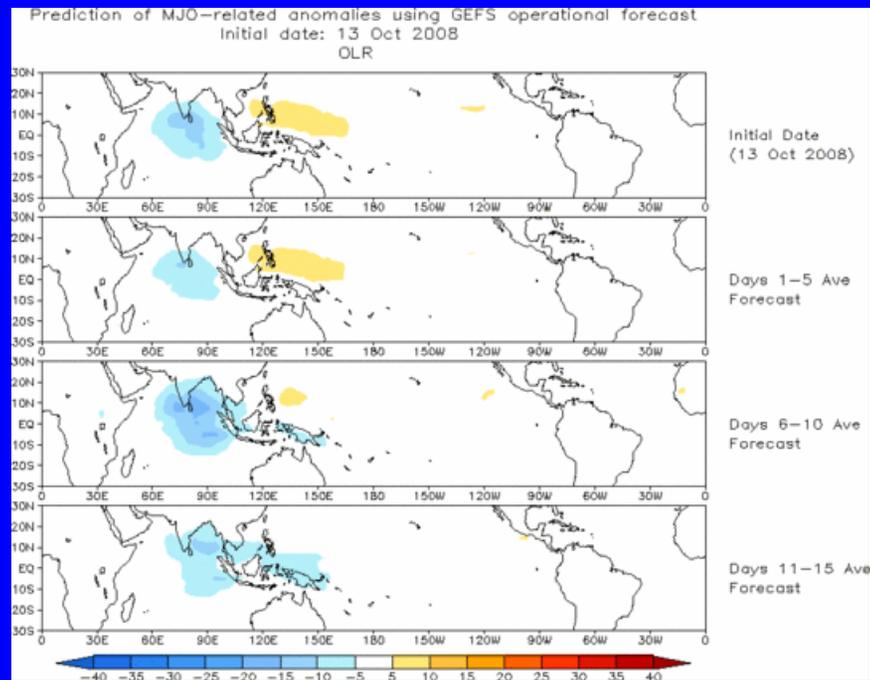




Ensemble Mean GFS MJO Forecast

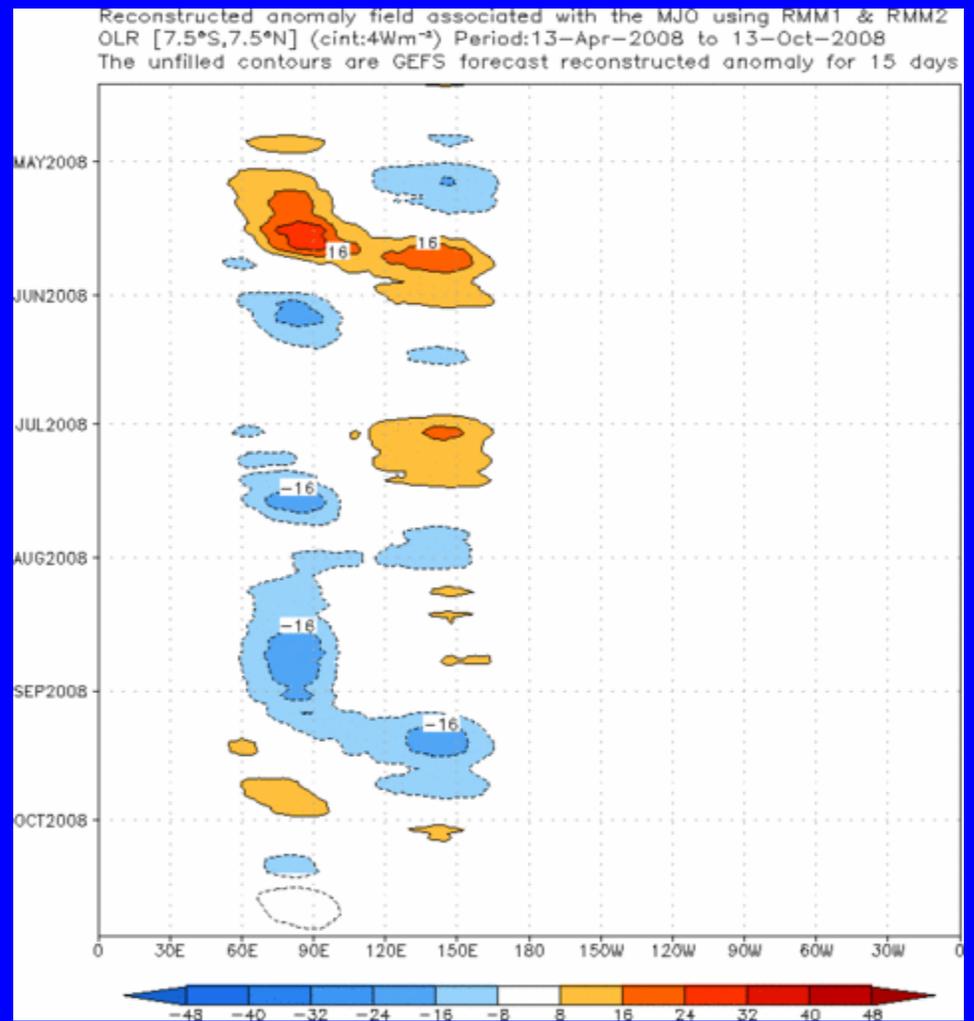
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



MJO associated enhanced convection is forecast to slowly shift northeast from the Indian Ocean to parts of Indonesia and southern Asia.

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



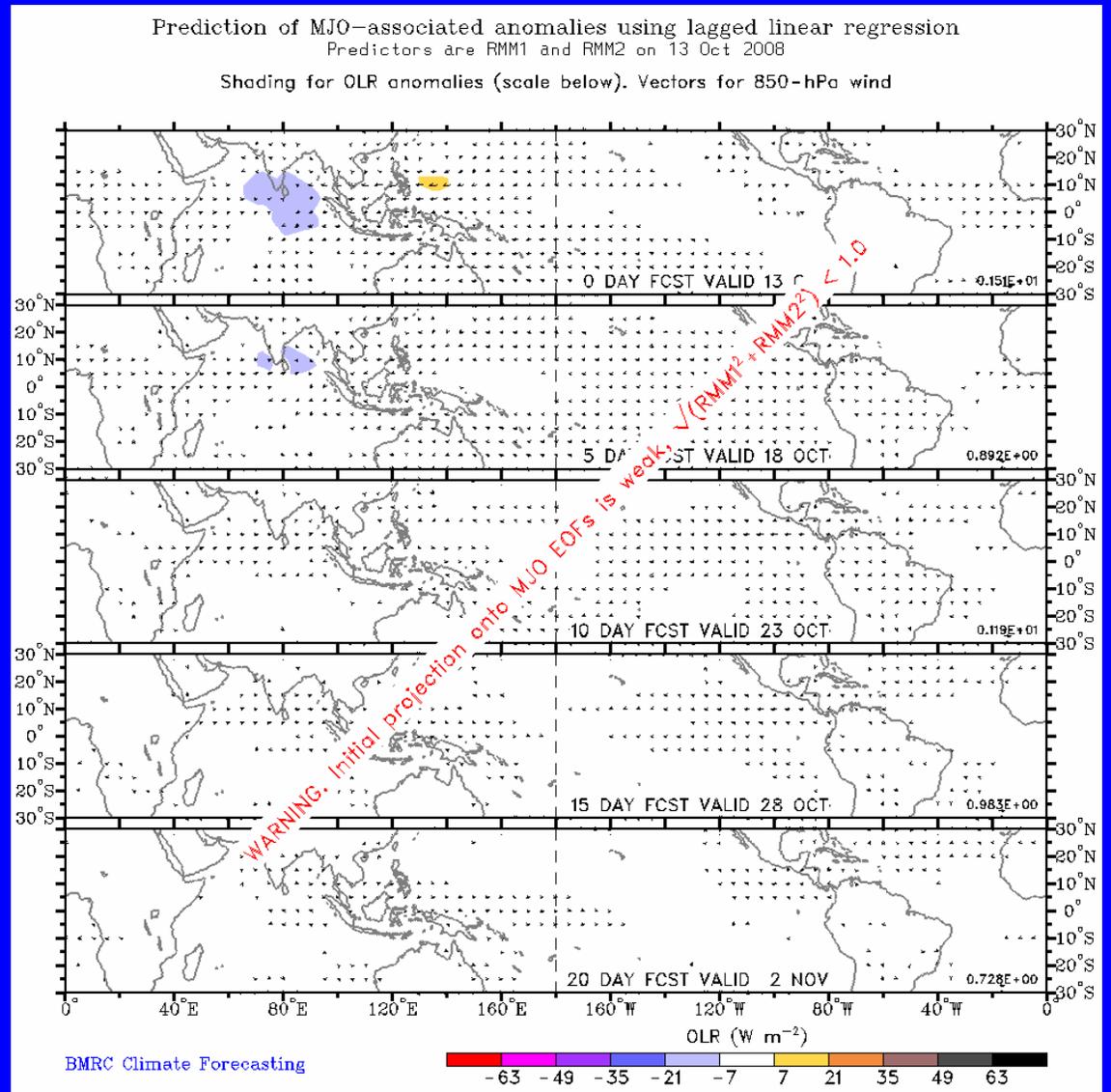


Statistical MJO Forecast

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)

The 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)

