



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

**Update prepared by
Climate Prediction Center / NCEP
October 27, 2008**



Outline

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



Overview

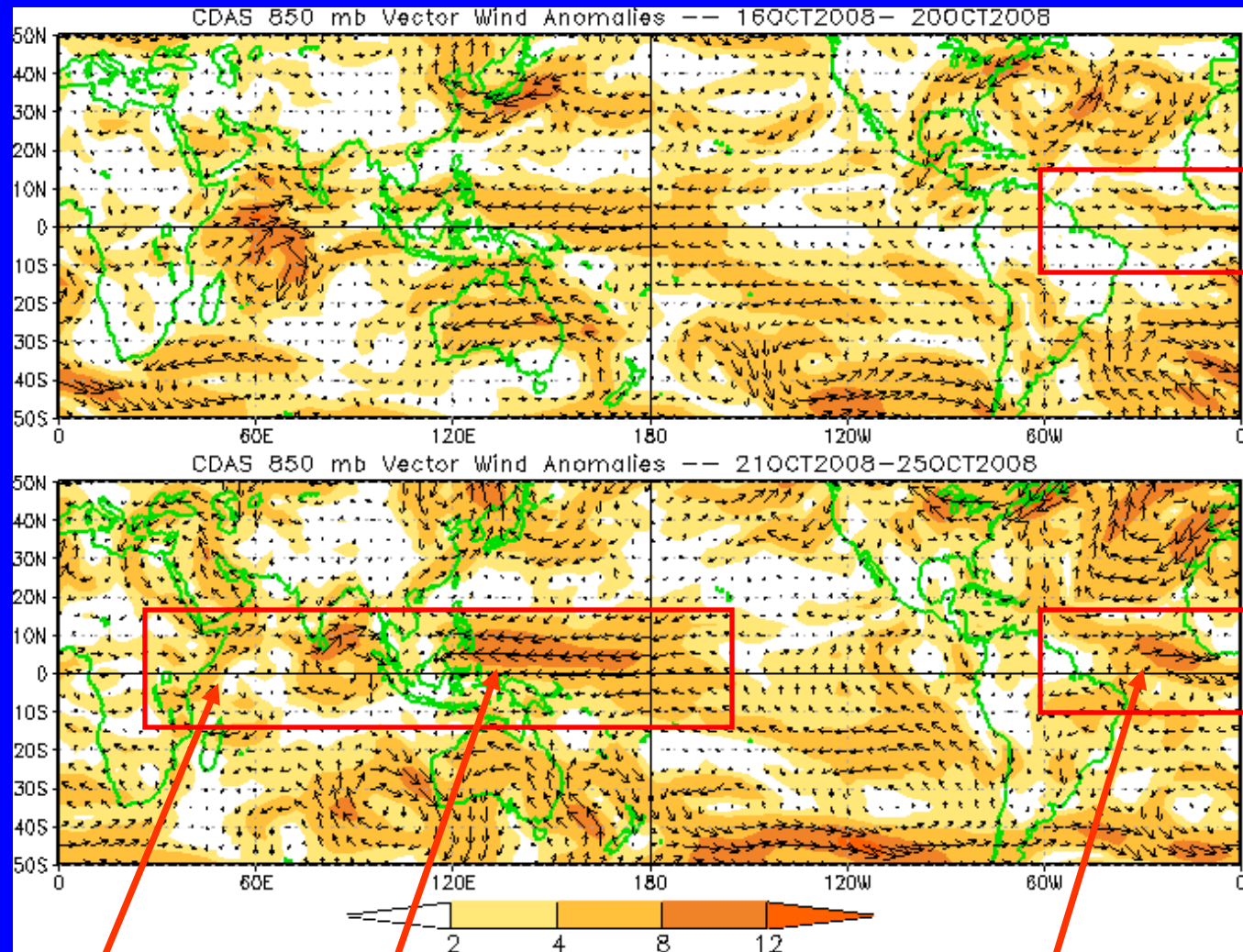
- **MJO activity continues with the enhanced phase centered across the Maritime continent.**
- **Based on the latest observations and model forecasts, moderate to strong MJO activity is expected during the next 1-2 weeks with the enhanced phase expected to shift eastward into the western Pacific.**
- **The MJO is expected to contribute to enhanced rainfall across the Maritime Continent, west Pacific and parts of the SPCZ during much of the period. Suppressed rainfall is expected for interior Brazil and parts of west Africa during Week 1 and also include the equatorial Indian Ocean during Week 2.**
- **The current point in the seasonal cycle makes impacts to the US due to the MJO very uncertain. The likelihood of impacts increases over the course of November so it is more likely that the next cycle of the MJO (mid-Nov-Dec) will affect the US.**

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



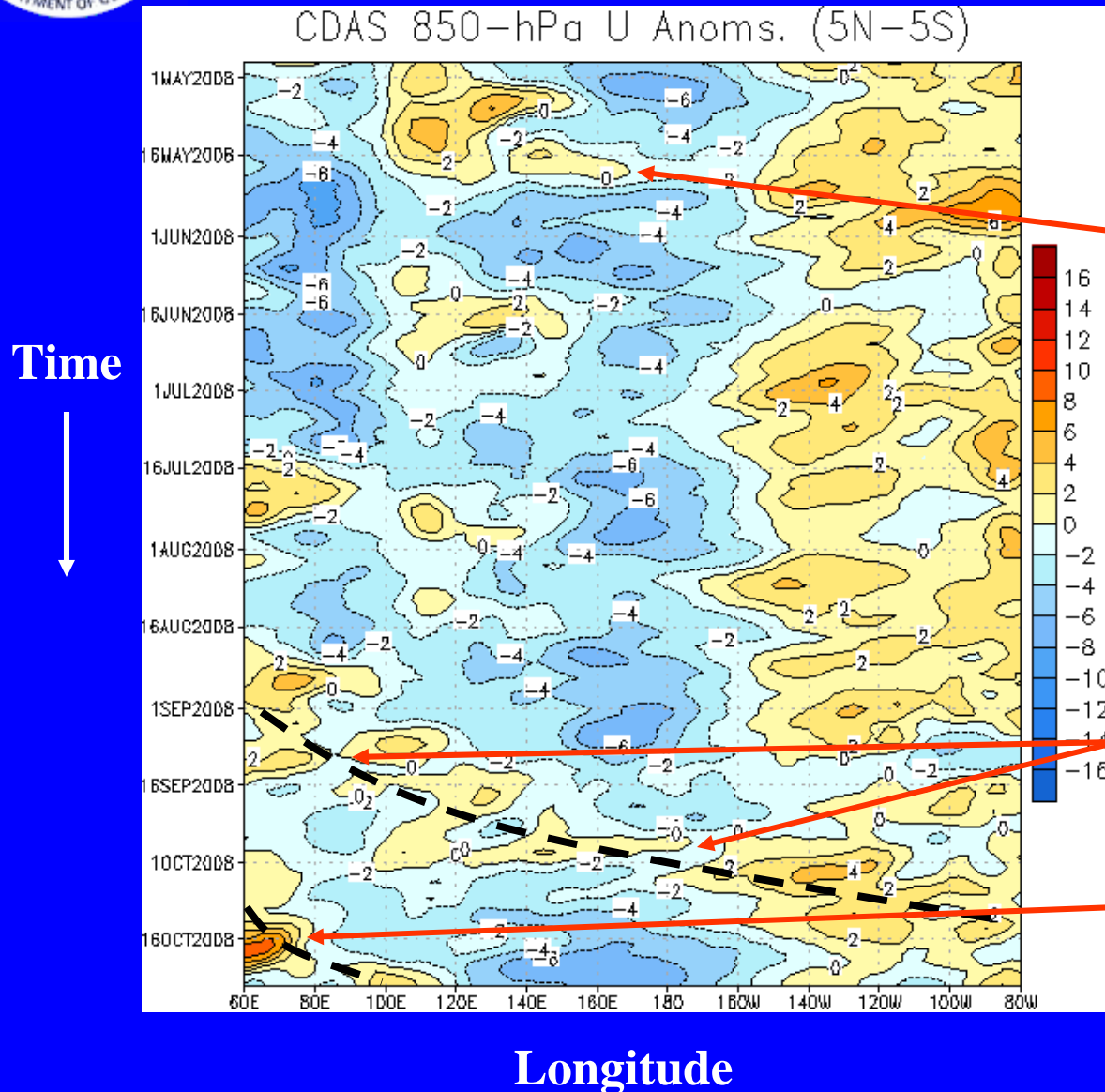
Westerly anomalies have developed in east Africa and the western Indian Ocean.

Easterly anomalies have strengthened in the western Pacific Ocean.

Westerly anomalies have strengthened across the 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

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

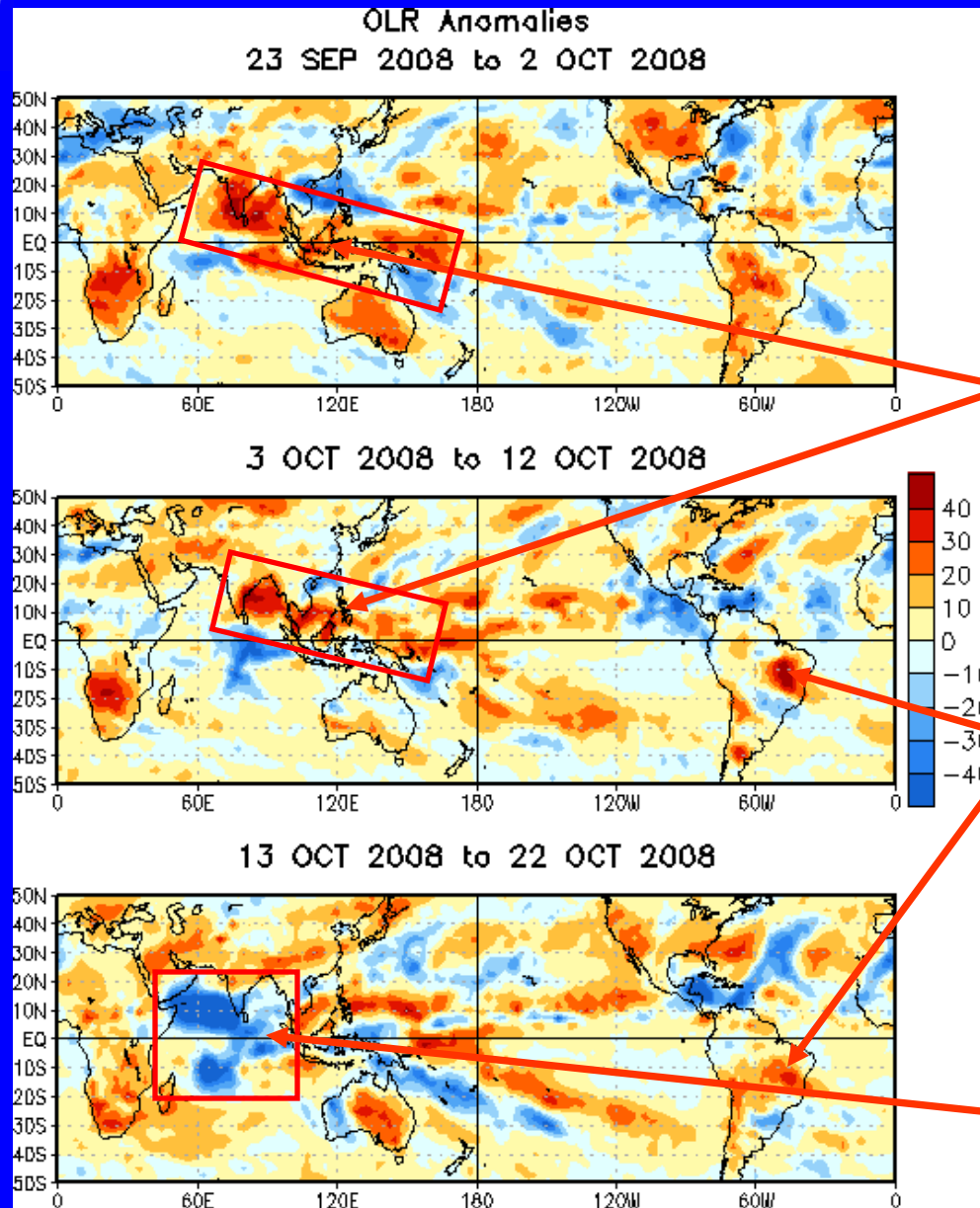
Easterly anomalies prevailed across much of the eastern hemisphere from late May into August.

Beginning in September, anomalous westerlies associated with the current MJO activity shifted from the Indian Ocean across the Pacific.

These westerly anomalies have reentered the Indian Ocean during mid-October while the easterlies have increased 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)

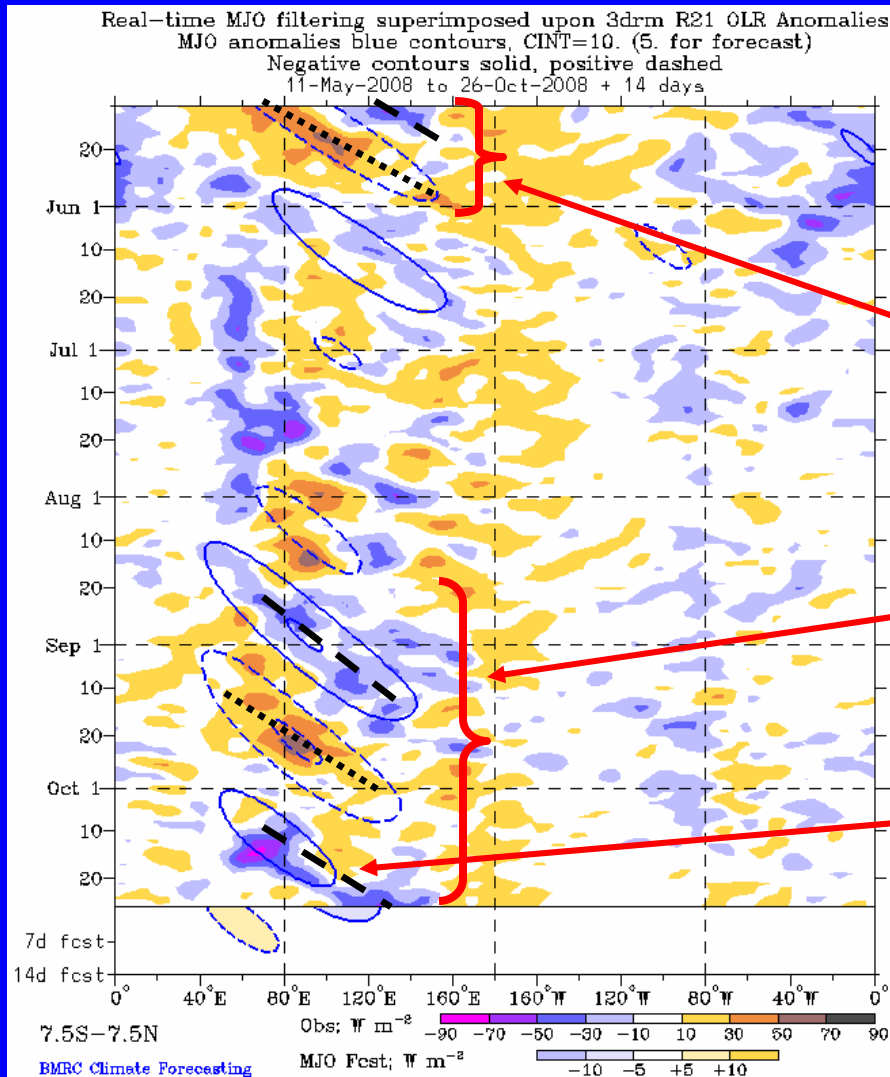
In late September, suppressed convection shifted into India and the Maritime Continent while wet conditions persisted over the eastern Pacific and Central America.

Dry conditions continued across interior Brazil during early-mid October.

In early to mid-October, enhanced convection developed across the equatorial Indian Ocean and Arabian Sea.



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 mid-to-late May as suppressed convection organized across the Indian Ocean and shifted eastward.

Moderate MJO activity initiated in late August as enhanced convection developed across the Indian Ocean and shifted eastward followed by suppressed convection during September.

In early to mid-October, strong convection reinitiated across the Indian Ocean and progressed eastward associated with the renewed enhanced phase of the MJO.

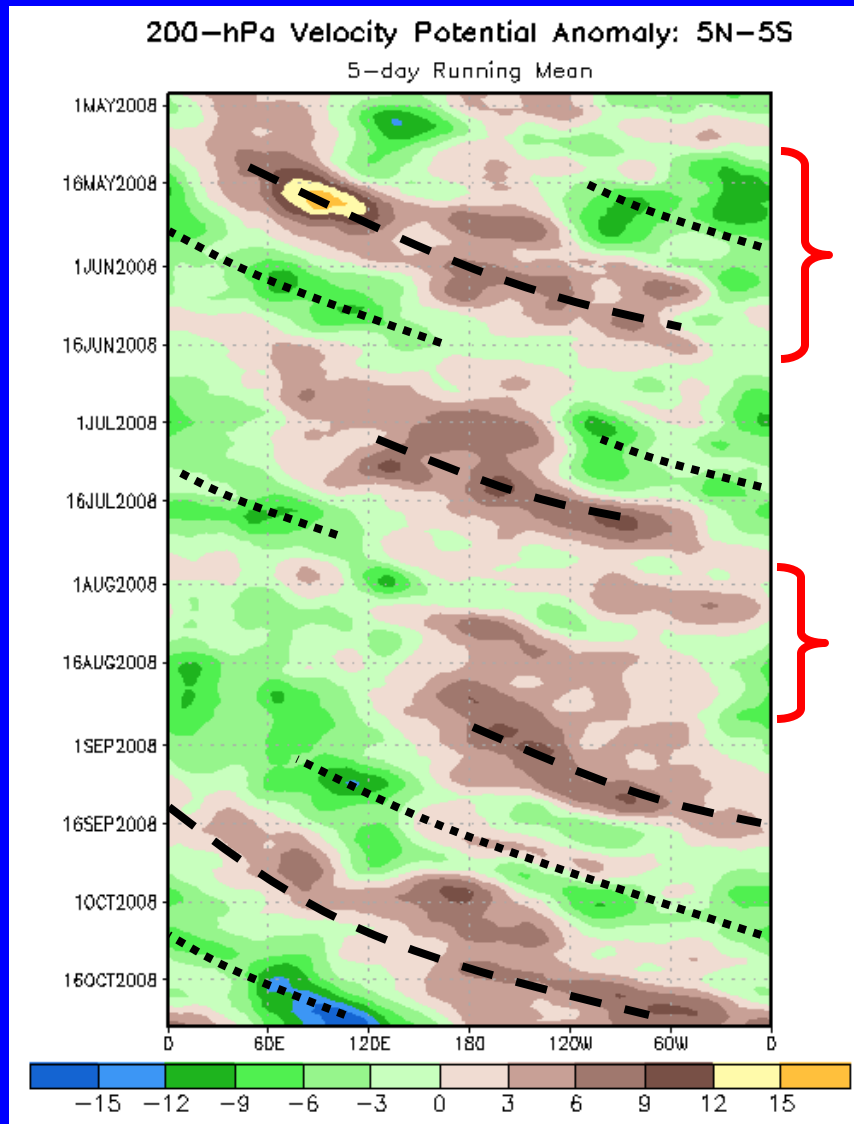


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time



Longitude

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.

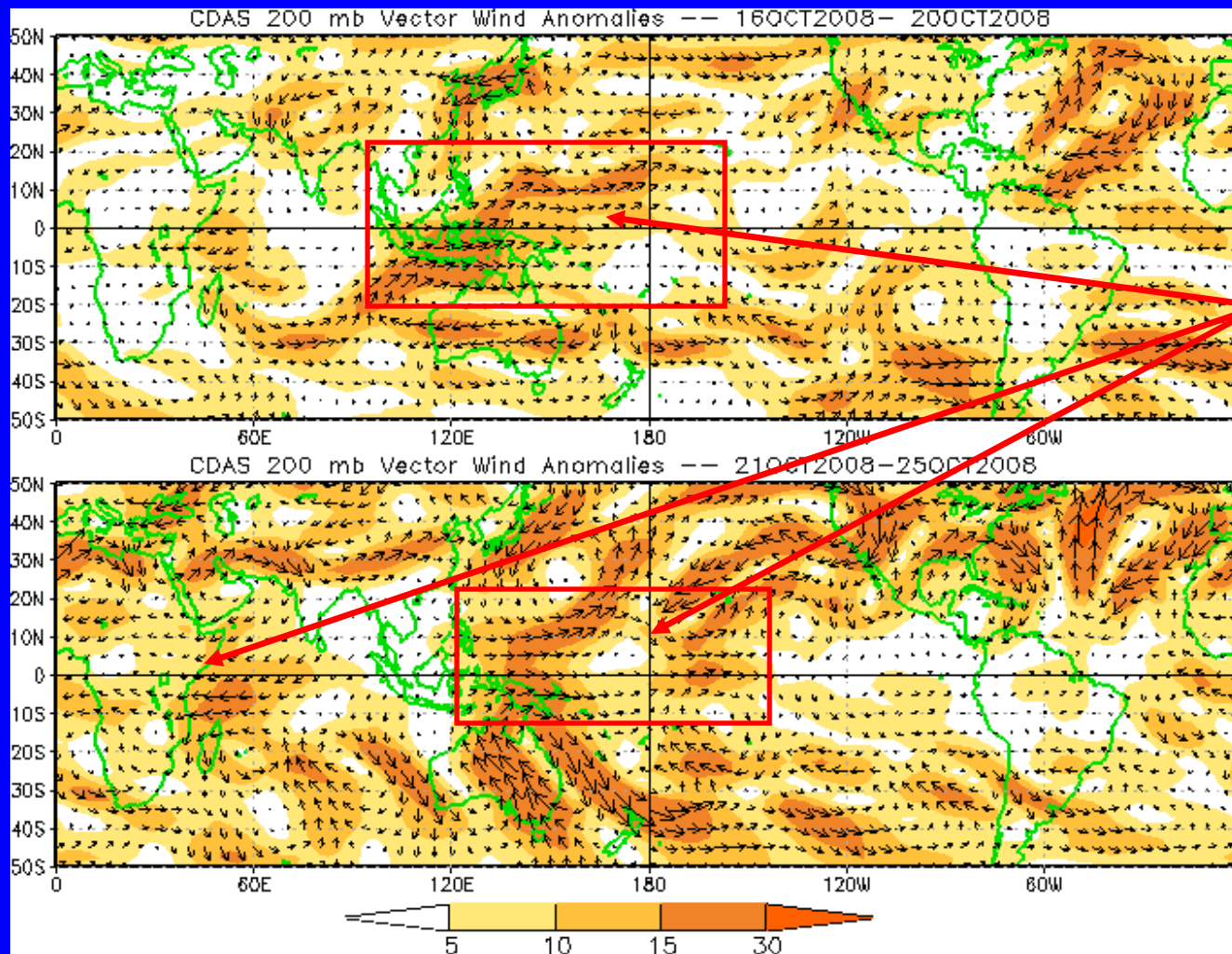
From early-mid August into early September, the MJO was weak as a more stationary pattern was evident.

The MJO strengthened in early September and eastward propagation has been observed from September into late October. The anomalies have increased during the past week.



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

Note that shading denotes the magnitude of anomalous wind vectors



Westerly anomalies have organized across the western Pacific while easterly anomalies have strengthened across the western Indian Ocean.

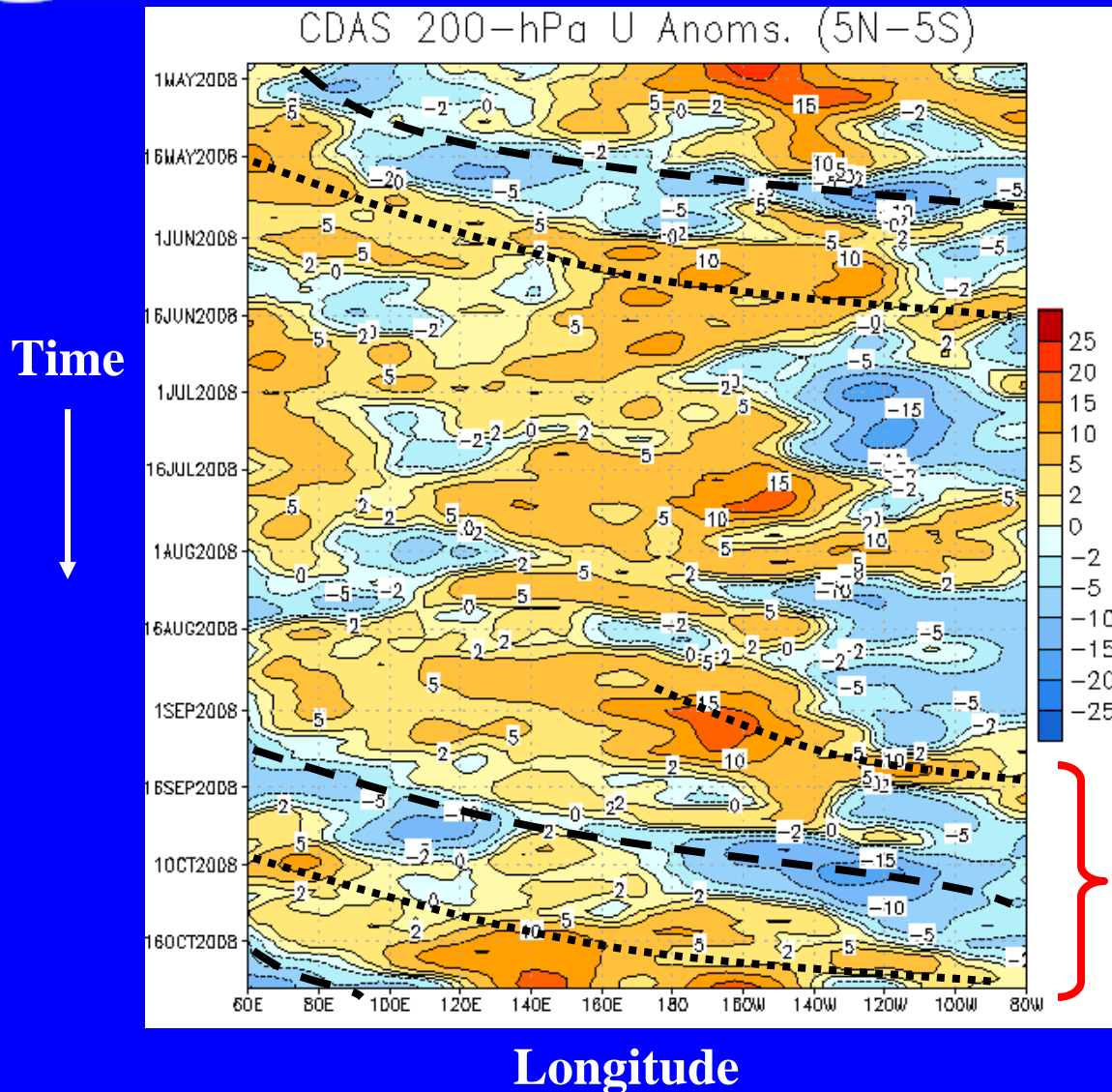
These anomalies are consistent with an MJO centered across Indonesia shifting into the western Pacific.



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

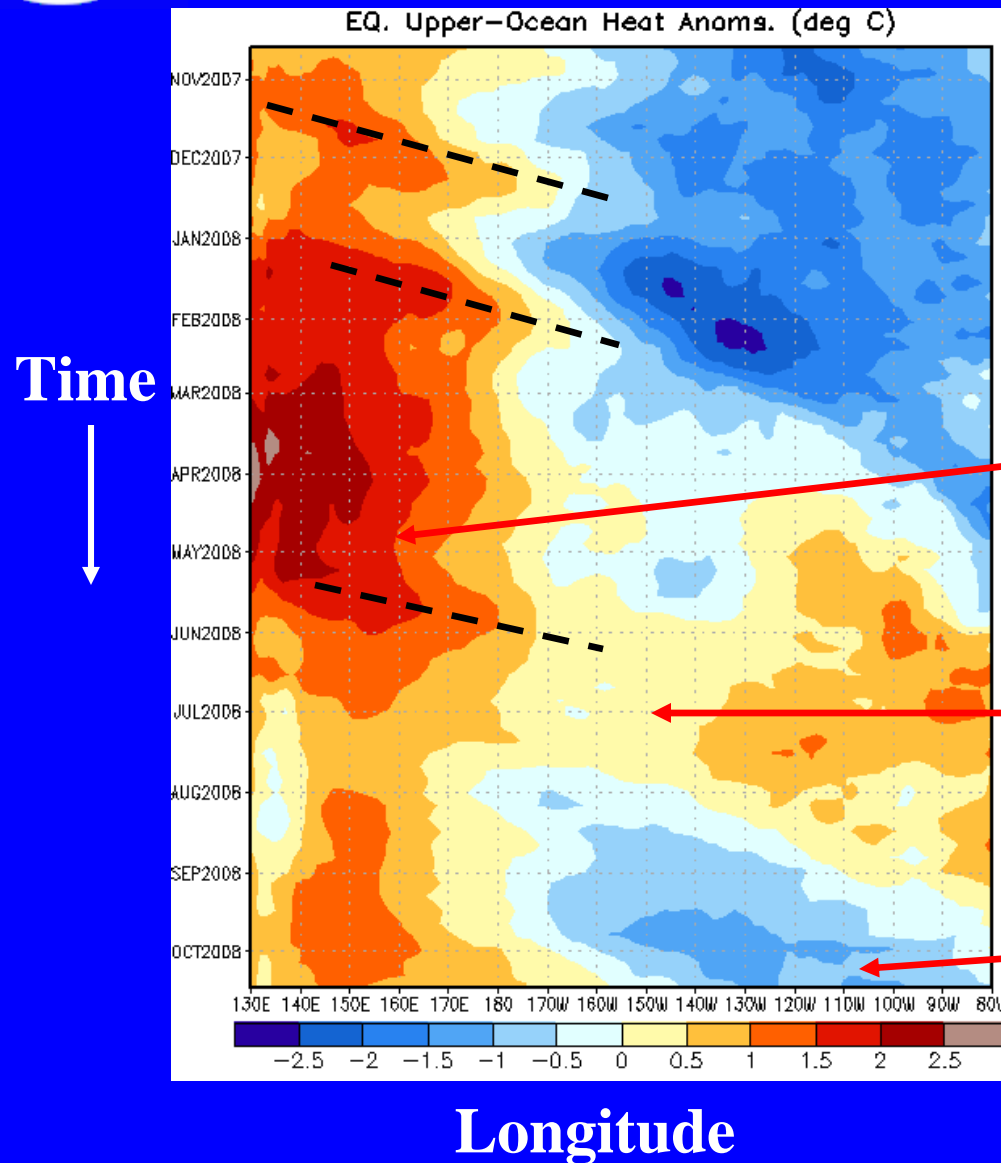


During May and early June, eastward propagation was evident in the upper-level wind field and was associated with the moderate-to-strong MJO activity during this time.

Westerly and easterly anomalies associated with the current MJO activity have shifted eastward during the past two months.



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.

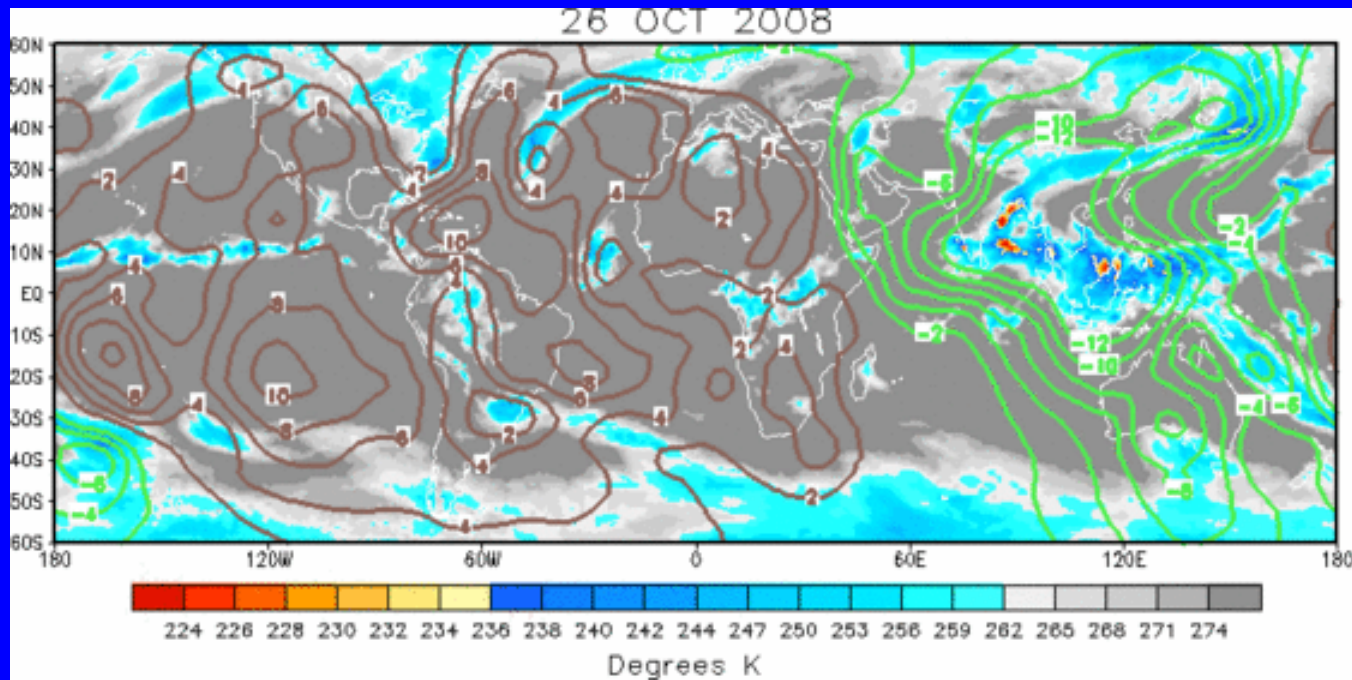
During August 2008, negative anomalies started to develop east of the Date Line and during September and early October the anomalies have increased and expanded eastward.



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 towards the western Pacific while upper-level convergence stretches from the eastern Pacific to Africa.



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).

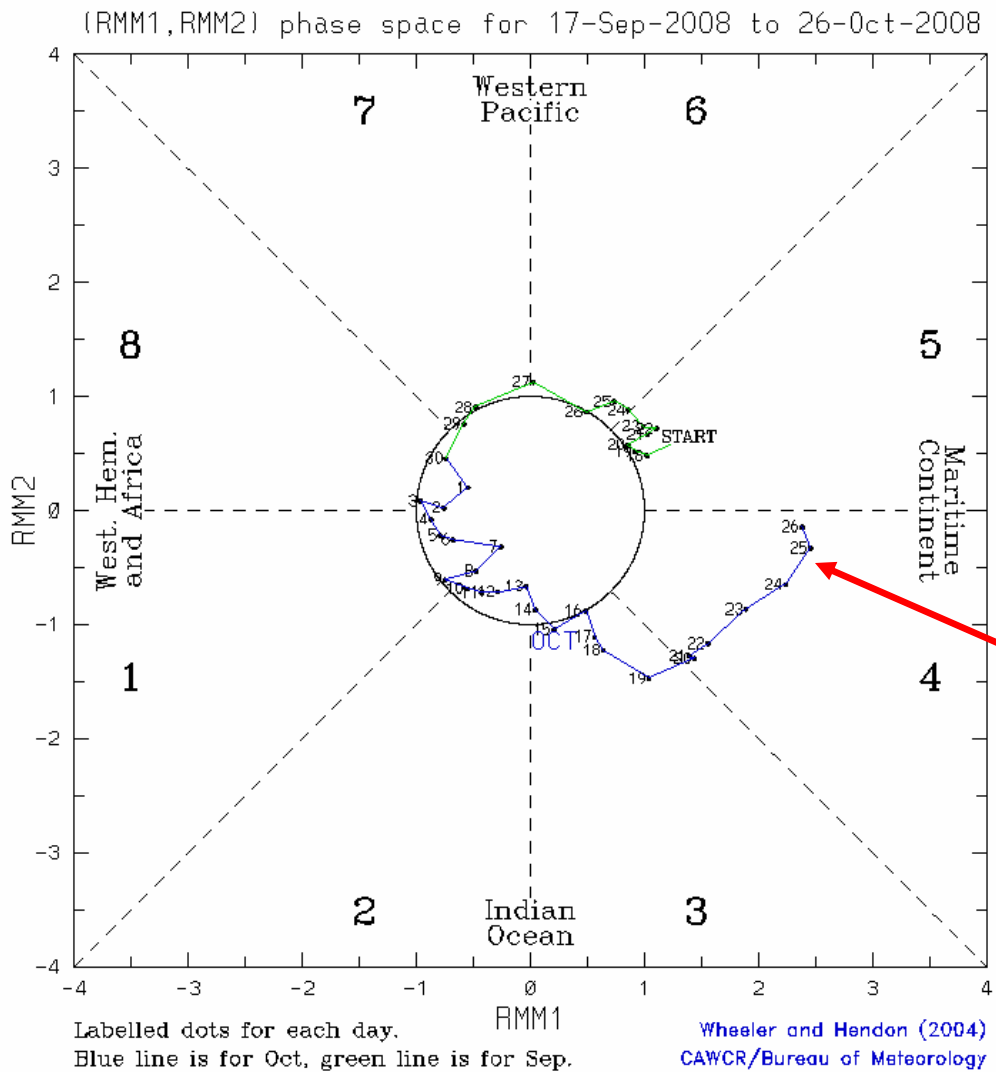
Wheeler M. and H. Hendon, 2004: An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction, *Monthly Weather Review*, 132, 1917-1932.

- 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

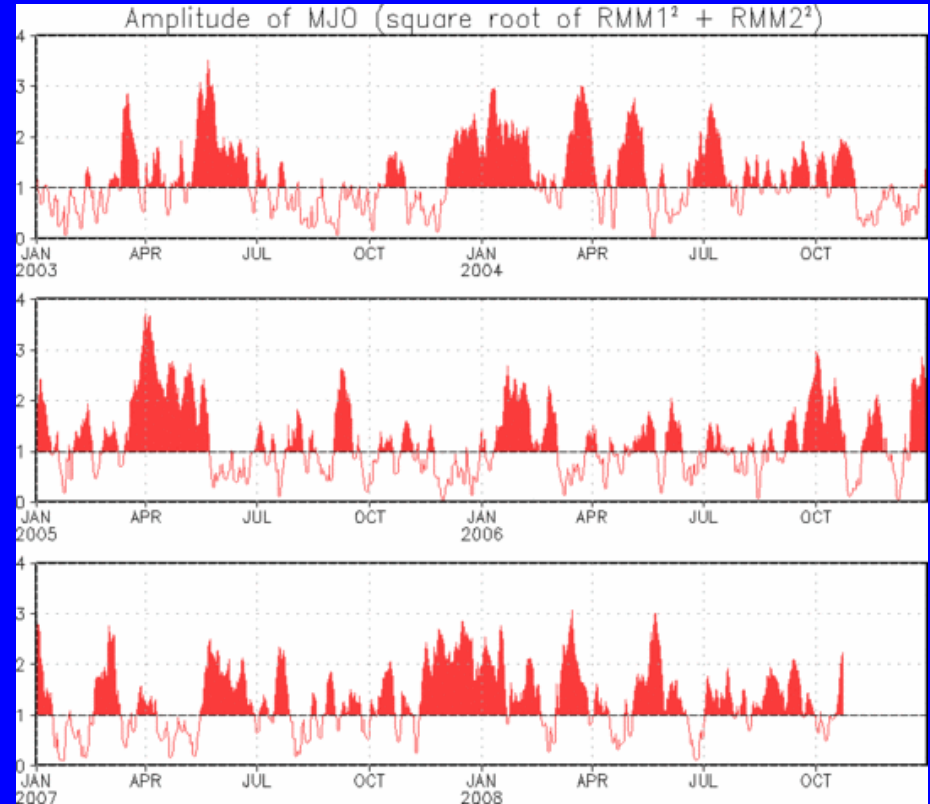
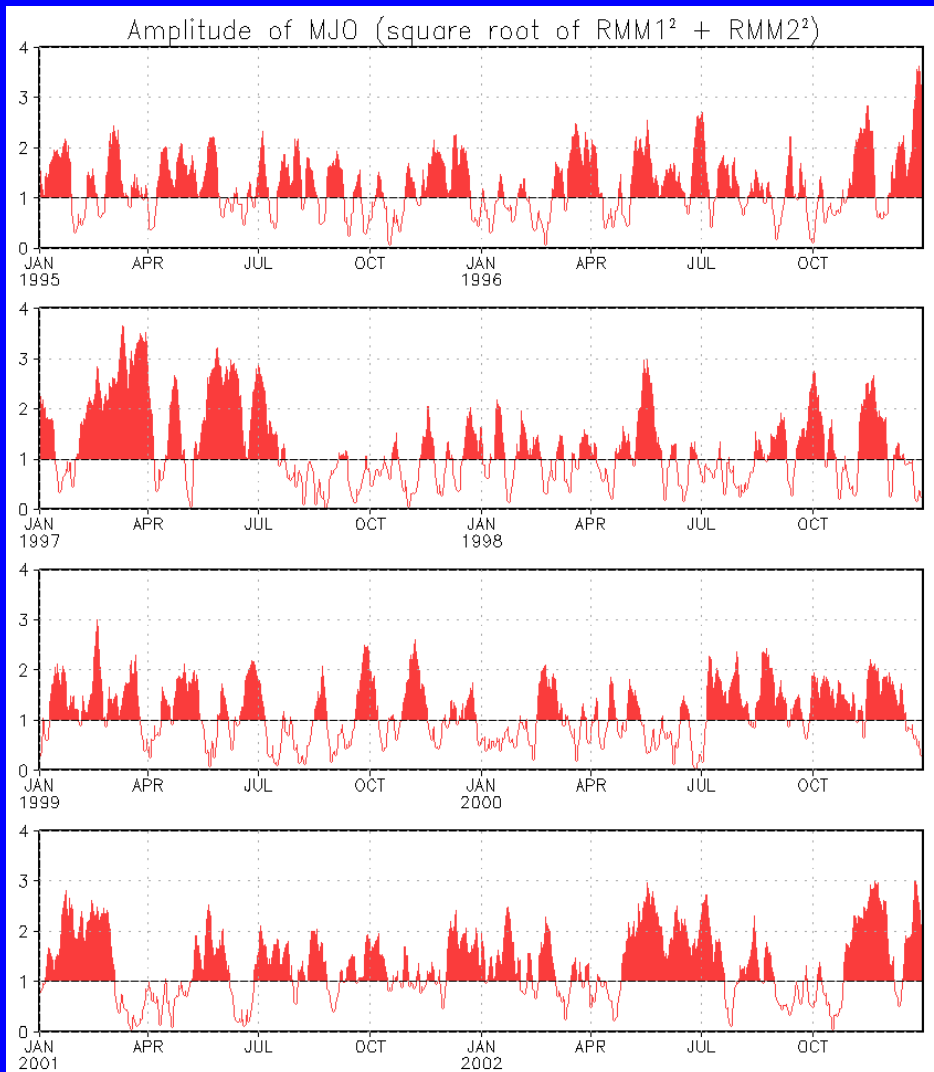
- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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



The MJO index indicates a continued strong MJO signal.



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

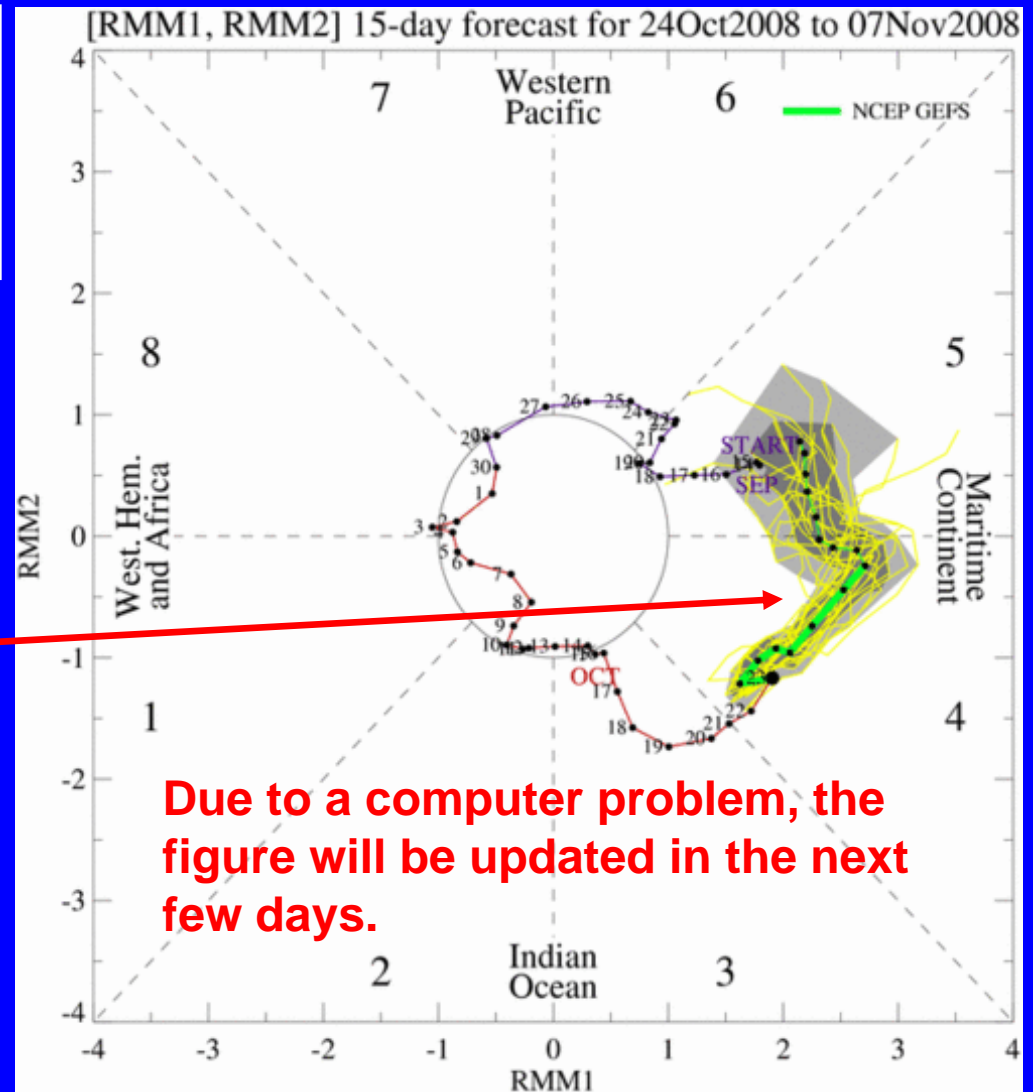
Yellow Lines – 20 Individual Members
Green Line – Ensemble Mean

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 a continued strong MJO during the next two weeks.

Spread is low during much of the period indicating some confidence in MJO strength and propagation.

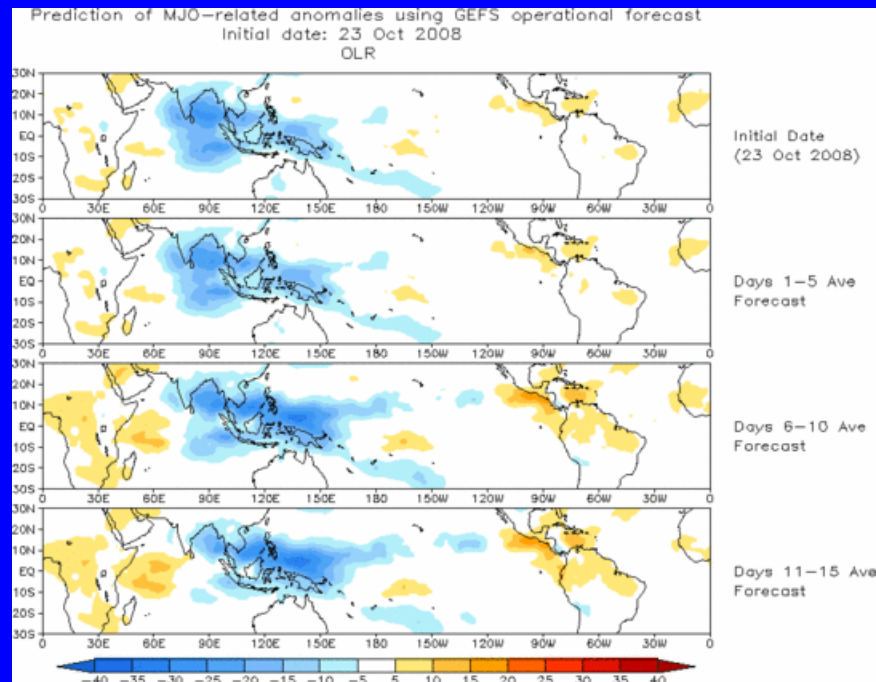




Ensemble Mean GFS MJO Forecast

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)

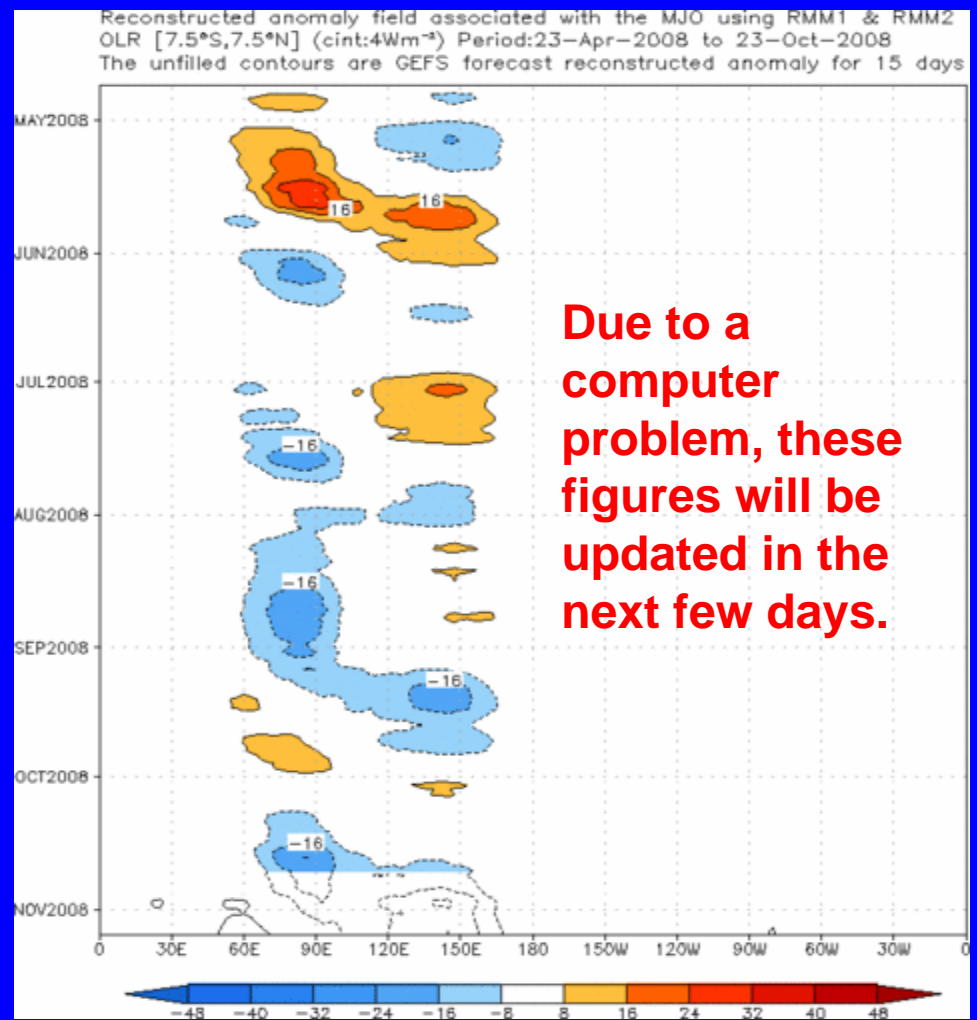
Spatial map of OLR anomalies for the next 15 days



MJO associated enhanced convection is forecast to shift into the west Pacific.

Dry conditions are expected across parts of Central and South America as well as Africa and the western Indian Ocean.

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



Due to a computer problem, these figures will be updated in the next few days.



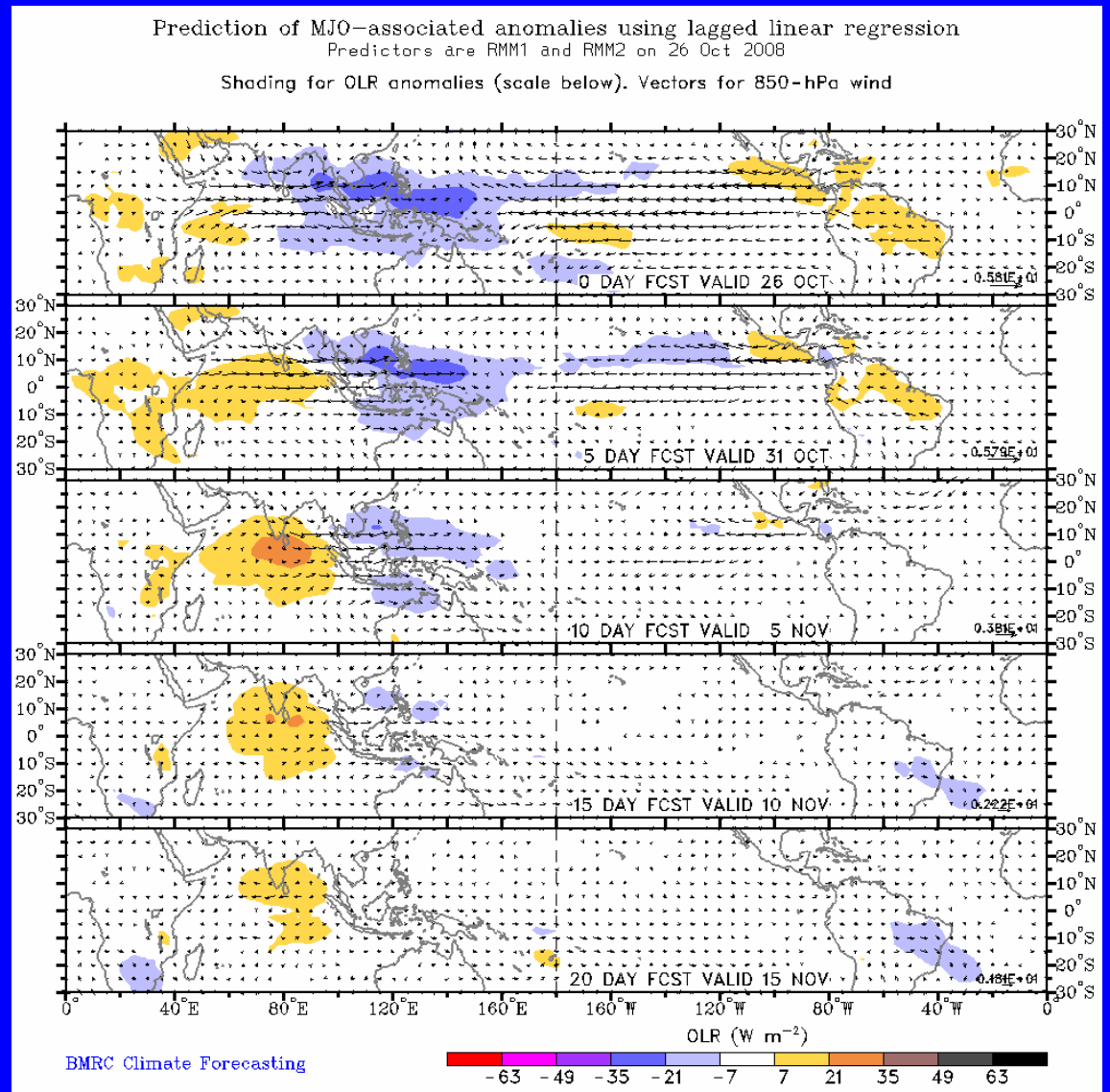
Statistical MJO Forecast

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)

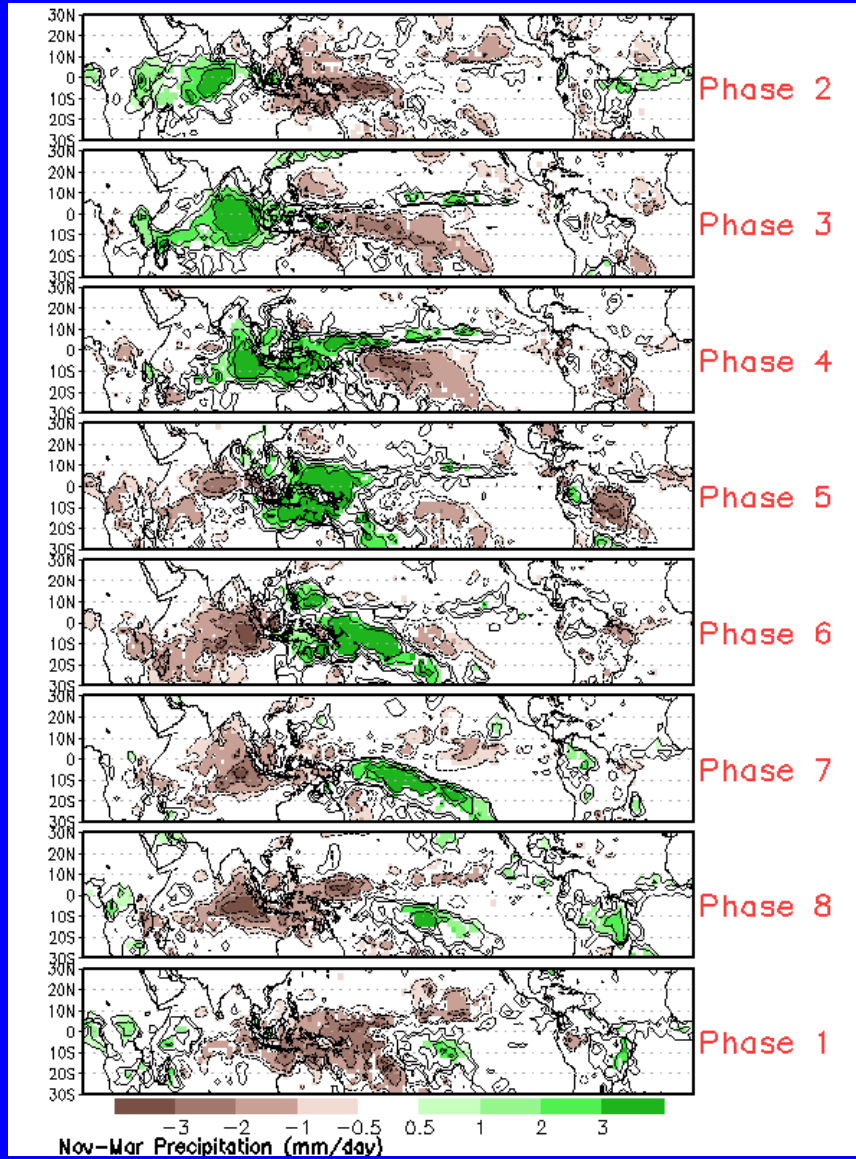
The forecast indicates enhanced convection persisting across the west Pacific while suppressed convection develops across Africa and the Indian Ocean.





MJO Composites – Global Tropics

Precipitation Anomalies (Nov-Mar)



850-hPa Wind Anomalies (Nov-Mar)

