



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

**Update prepared by
Climate Prediction Center / NCEP
November 24, 2008**



Outline

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



Overview

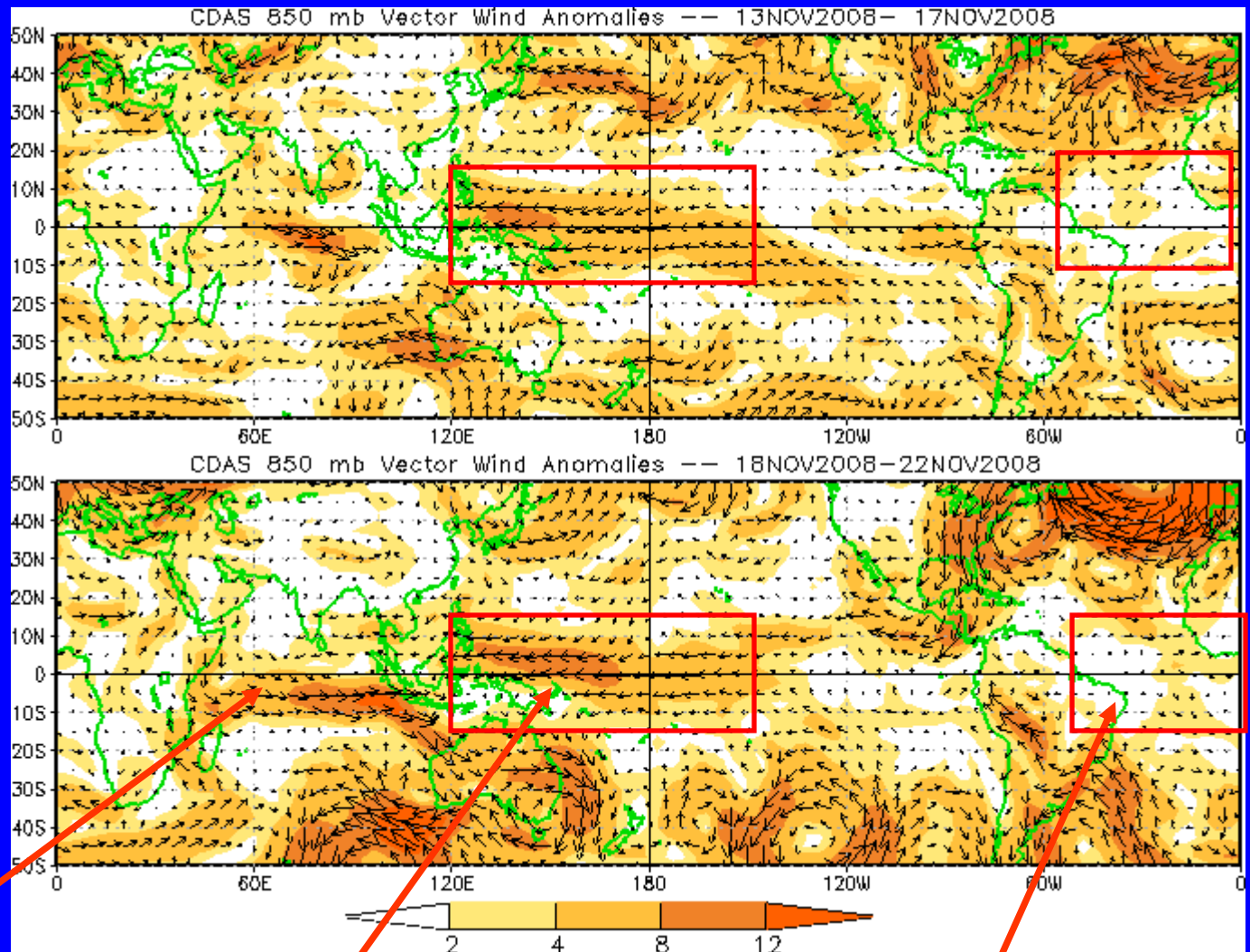
- **The MJO signal during the past week is consistent with the enhanced phase centered over Indonesia.**
- **Recent observations and model guidance indicate the MJO will shift eastward during the upcoming week. There is considerable uncertainty, however, for the expected evolution of the MJO during Week-2.**
- **During Week-1, the MJO is expected to contribute to enhanced convection from Sri Lanka extending eastward across Indonesia toward Papua New Guinea and favorable conditions for tropical cyclogenesis for the Bay of Bengal. Enhanced convection is expected to shift eastward to the SPCZ region during Week-2.**
- **The uncertainty in the future strength and evolution of the MJO makes the designation of specific impacts for the US unclear at the current time.**

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 strengthened over the central and eastern Indian Ocean during the last five days.

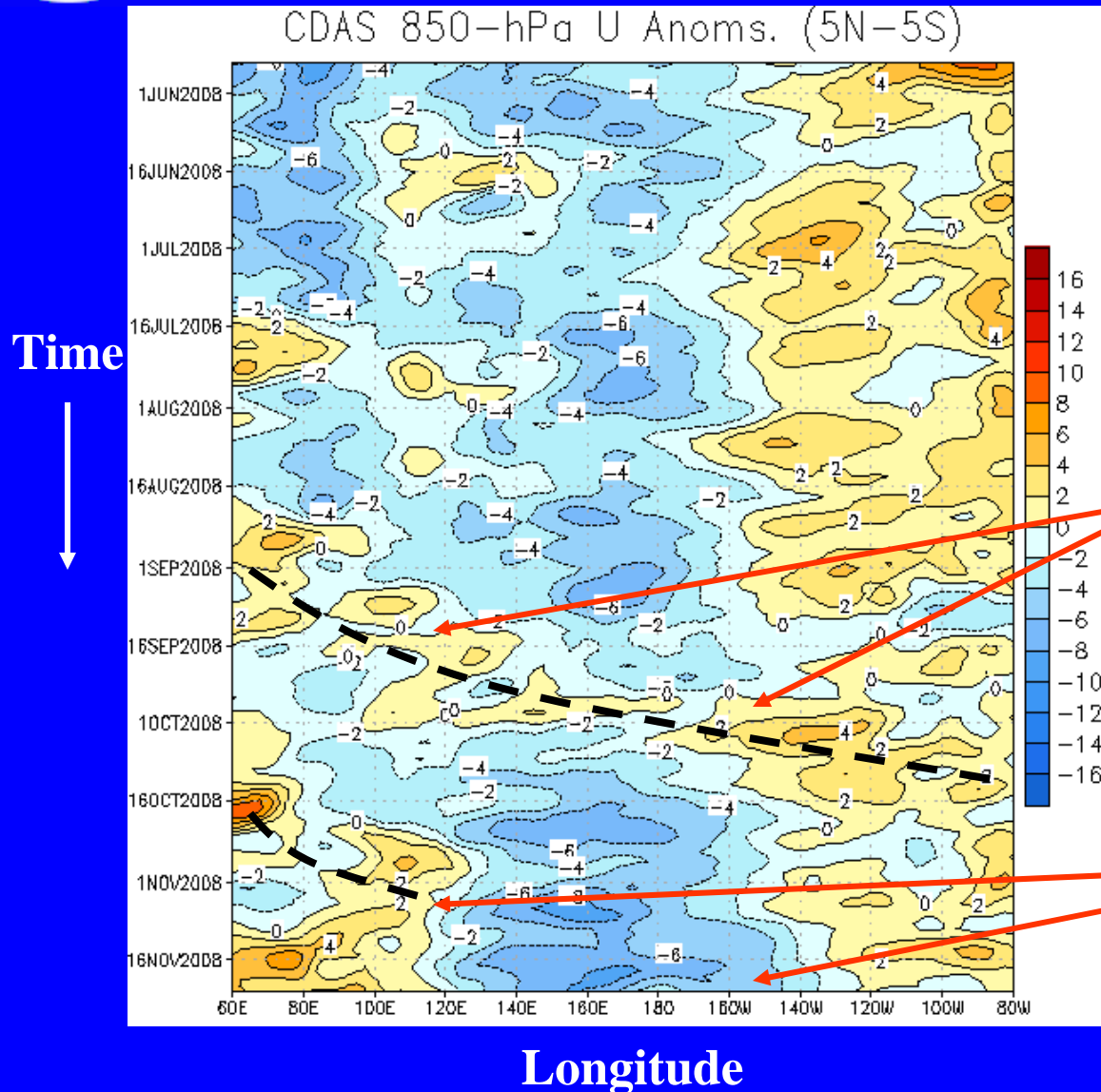
Easterly anomalies have increased in the western and central Pacific Ocean.

Westerly anomalies have decreased across the Atlantic during the last five to ten 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



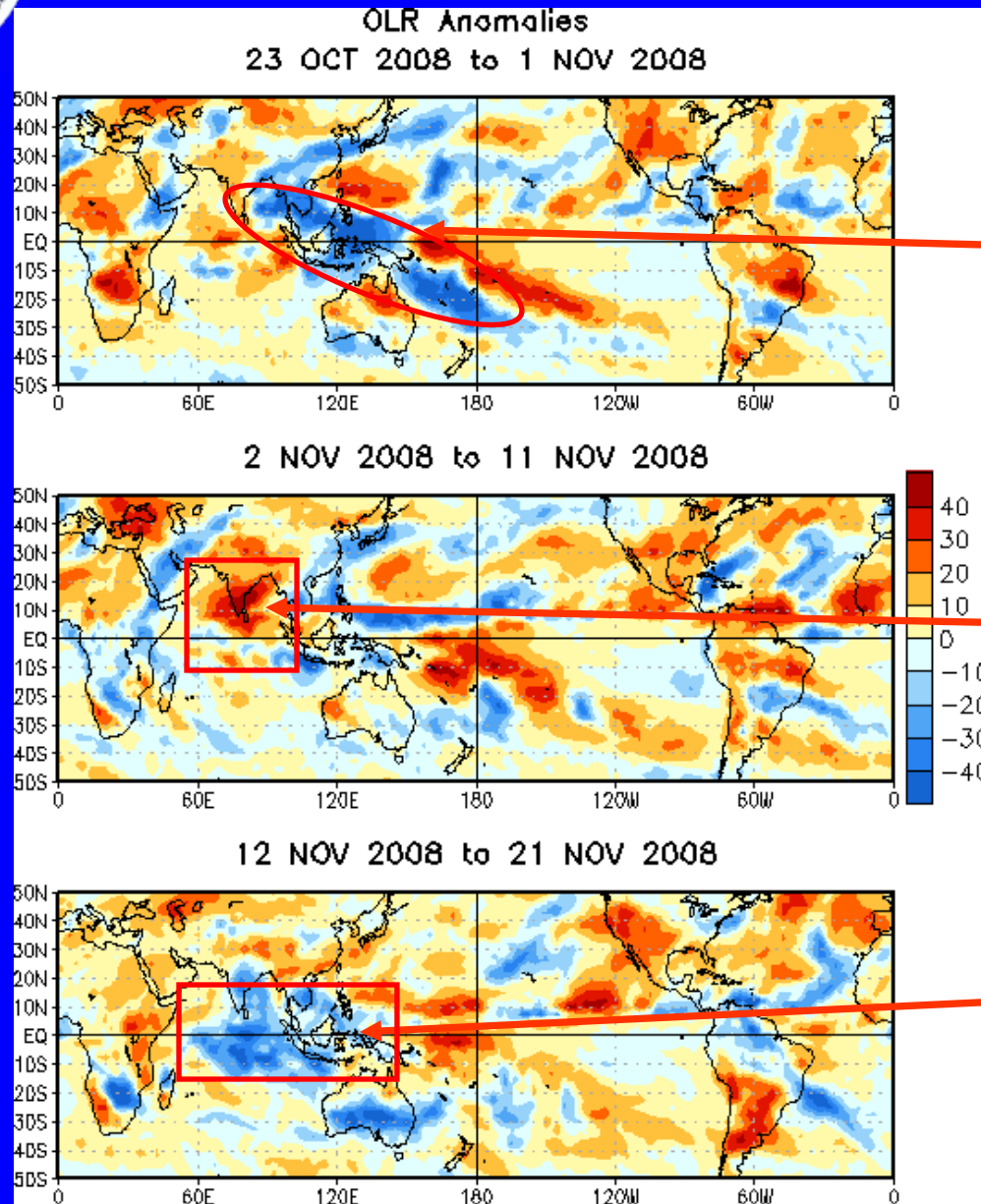
Easterly anomalies prevailed across much of the eastern hemisphere from late May into August.

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

These westerly anomalies reentered the Maritime Continent during late October, but its eastward progress stalled. The pattern of easterly anomalies over the Pacific has strengthened.



OLR Anomalies: Last 30 days



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

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

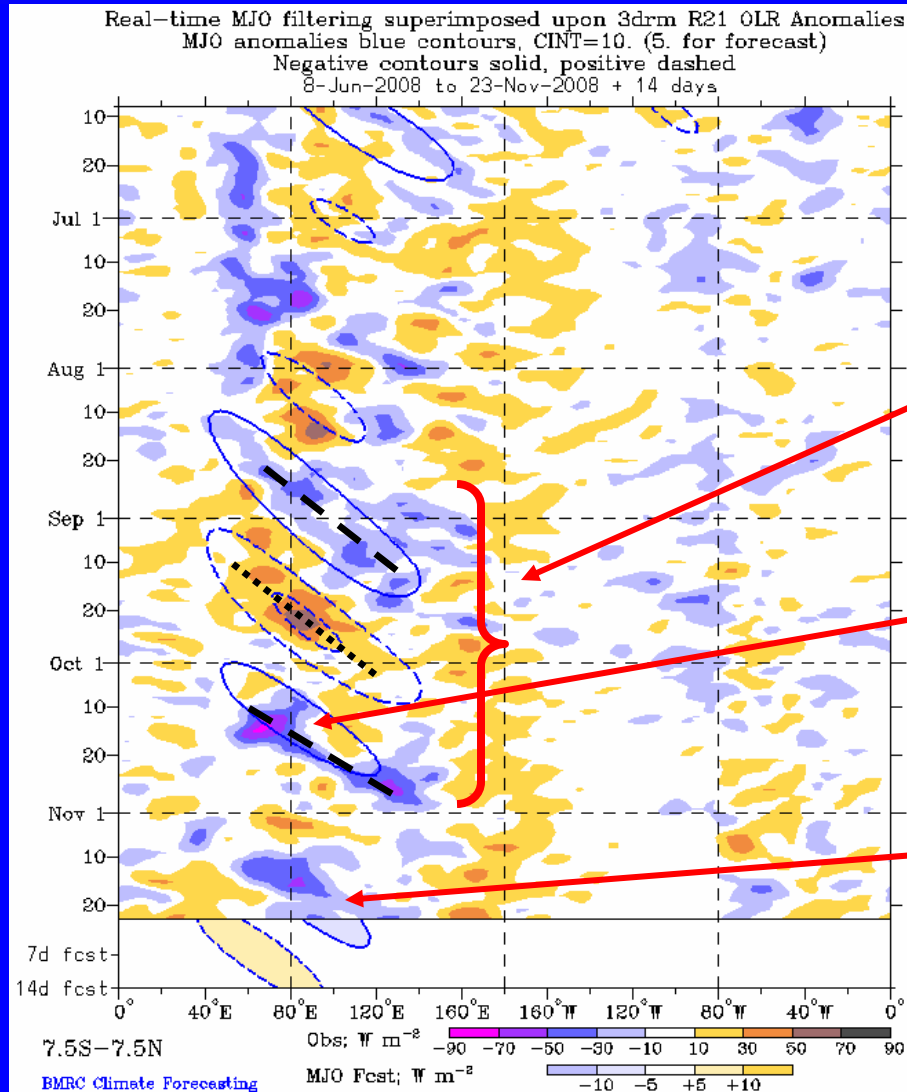
In late October, enhanced convection extended eastward from the Bay of Bengal to the South Pacific Convergence Zone (SPCZ) region (southeast of Papua New Guinea).

During early-mid November, anomalous convection became less coherent over the Eastern Hemisphere. Strong anomalous suppression developed over India.

Enhanced convection again developed across the equatorial Indian Ocean, parts of Southeast Asia and the Maritime continent during mid November.



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)

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

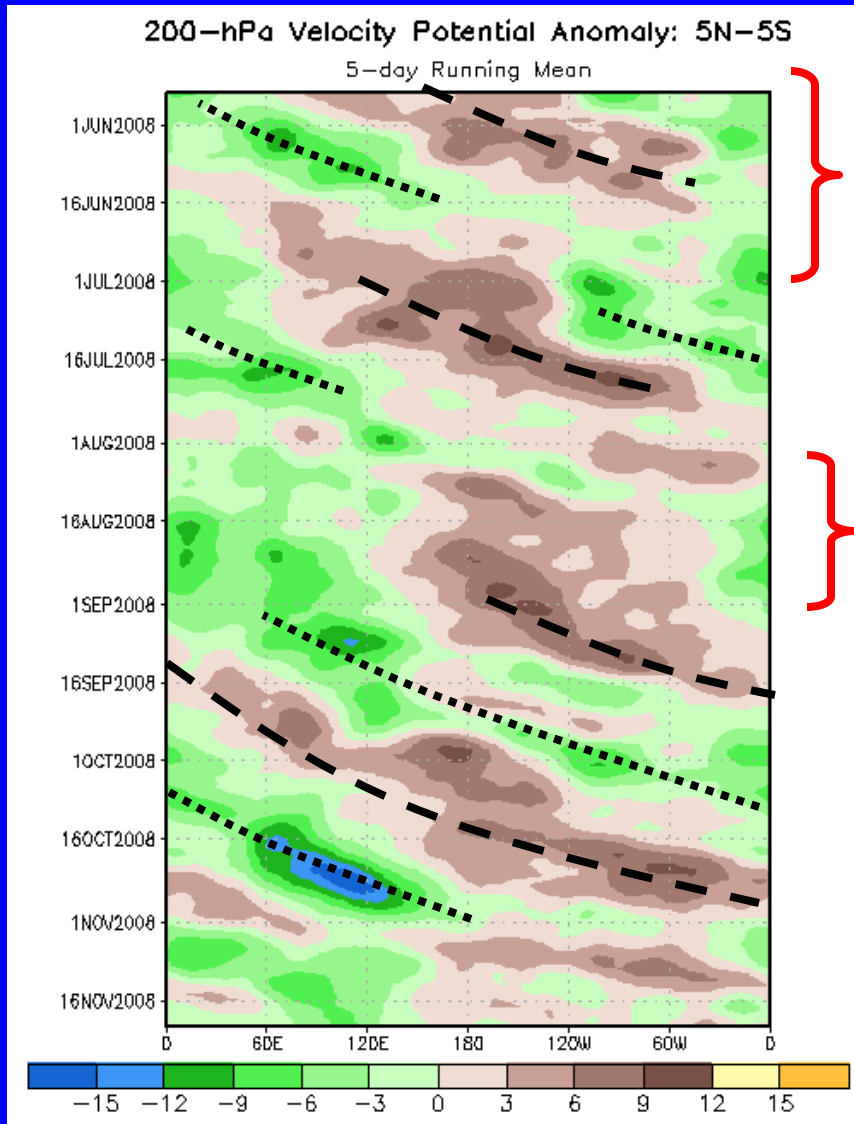
In October, strong convection reinitiated across the Indian Ocean and progressed eastward to the Maritime Continent.

During mid November, enhanced convection is once again evident across the equatorial Indian Ocean. The preceding suppressed phase of the MJO was less defined in this region.



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



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 was observed from September through mid-October.

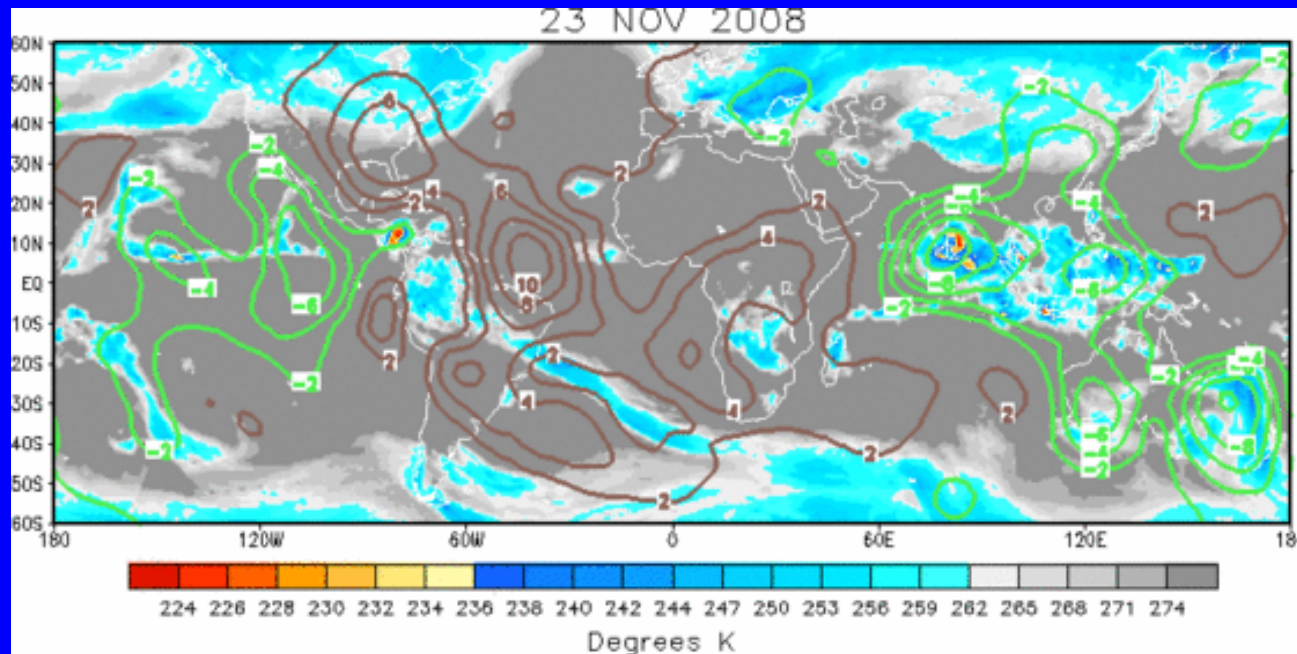
The MJO became less coherent during November but some eastward movement continues.



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

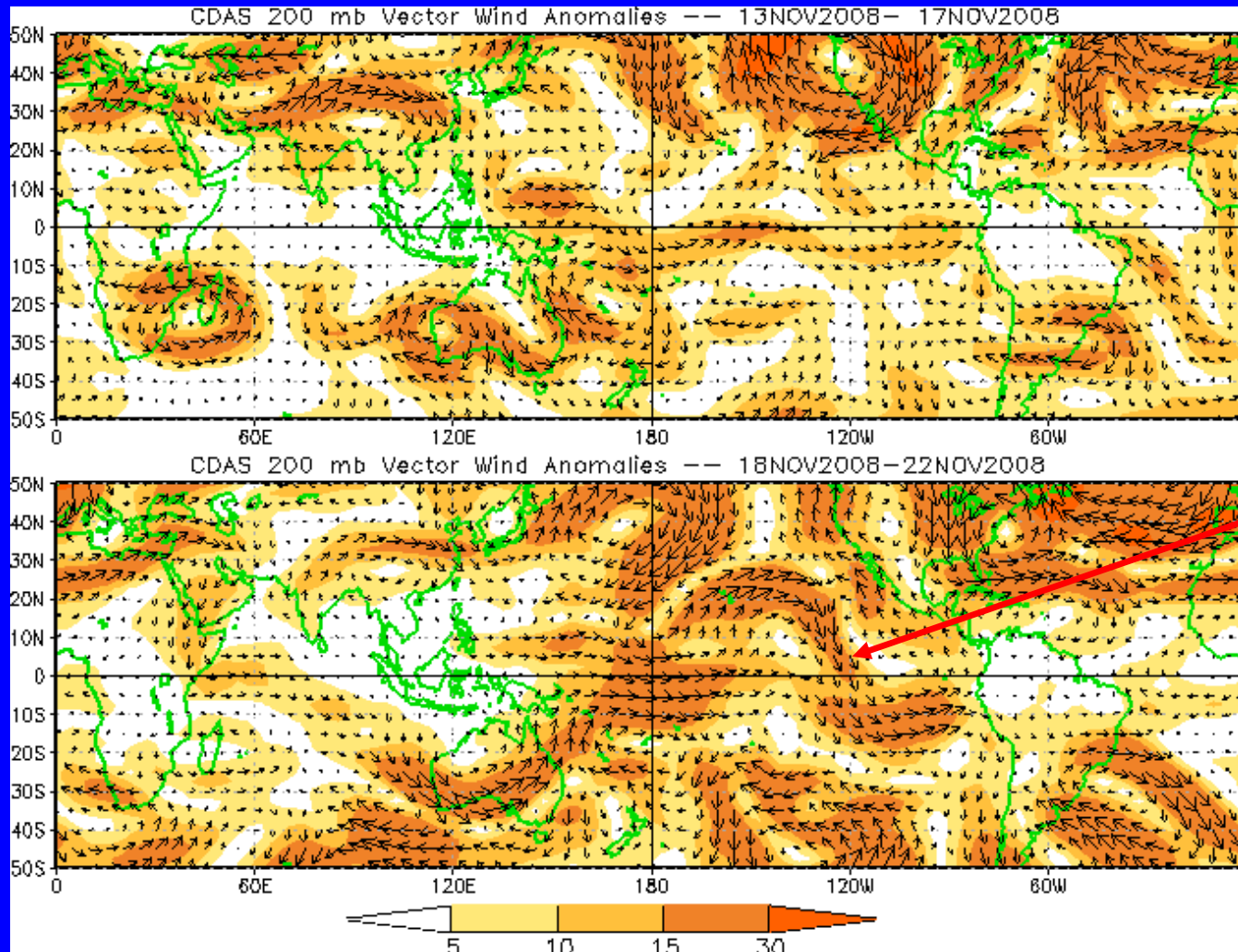


The velocity potential pattern shows upper-level convergence over the Atlantic Ocean and parts of Africa with strong upper-level divergence over the eastern Indian Ocean and Maritime Continent.



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

Note that shading denotes the magnitude of anomalous wind vectors

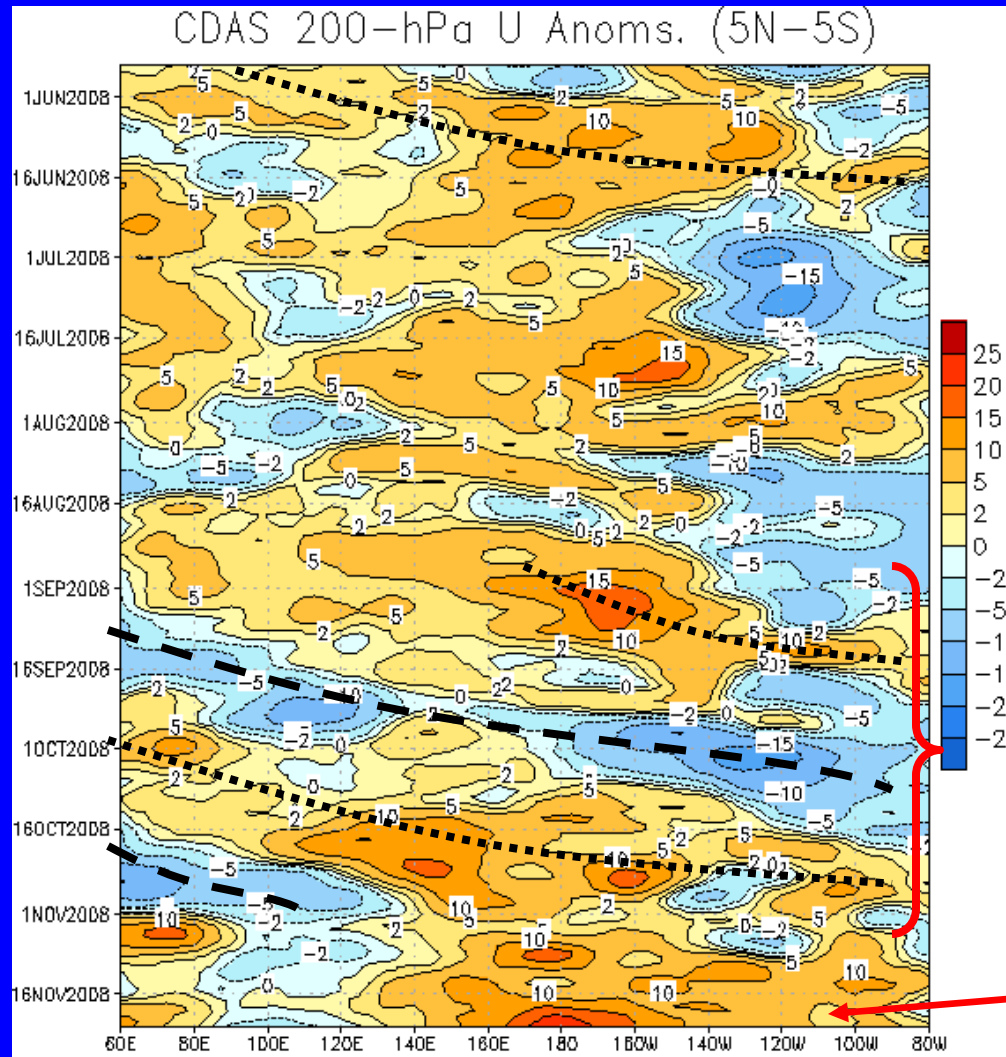


Westerly anomalies have strengthened over the equatorial Pacific Ocean during the last five days.



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

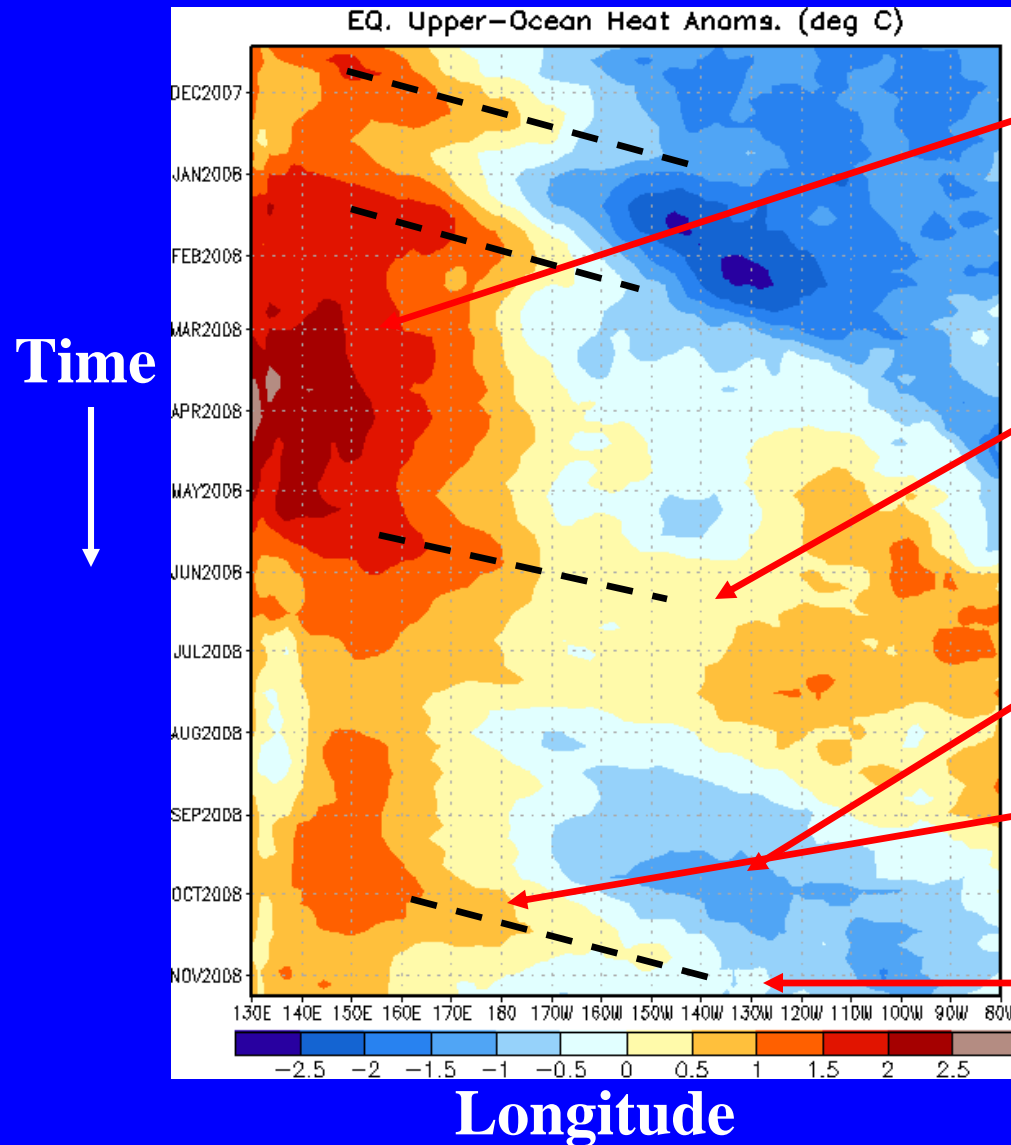
During May and early June, eastward propagation was evident in the upper-level wind field and was associated with the moderate-to-strong MJO activity during this time.

Westerly and easterly anomalies associated with the MJO activity shifted eastward during September and October.

More recently, westerly anomalies have remained more stationary over the Pacific Ocean and increased in strength.



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.

During late September, positive anomalies shifted eastward in associated with a Kelvin wave that was initiated during September 2008.

During November, negative anomalies reappeared east of the Date Line.



MJO Index -- Information

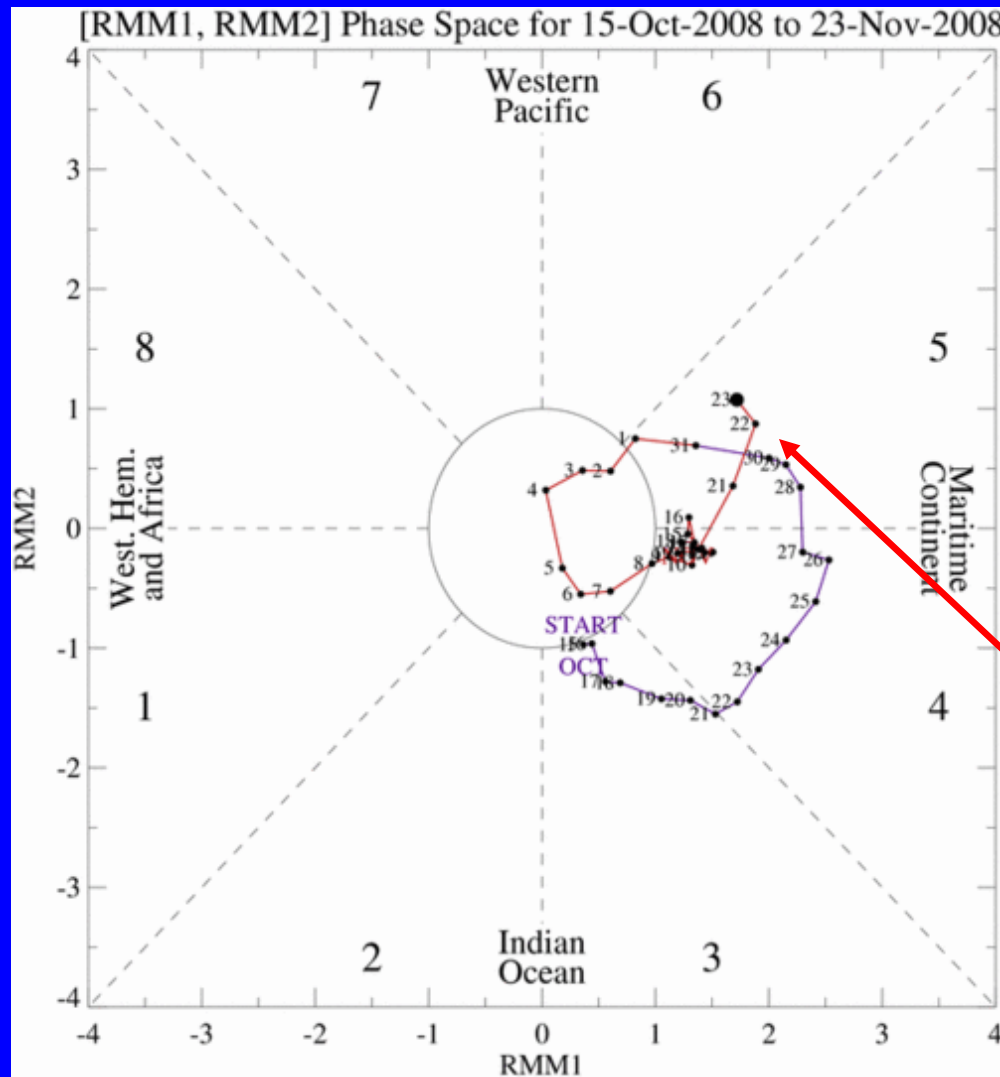
- The MJO index illustrated on the next several slides is the CPC version of the Wheeler and Hendon index (2004, hereafter WH2004).

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

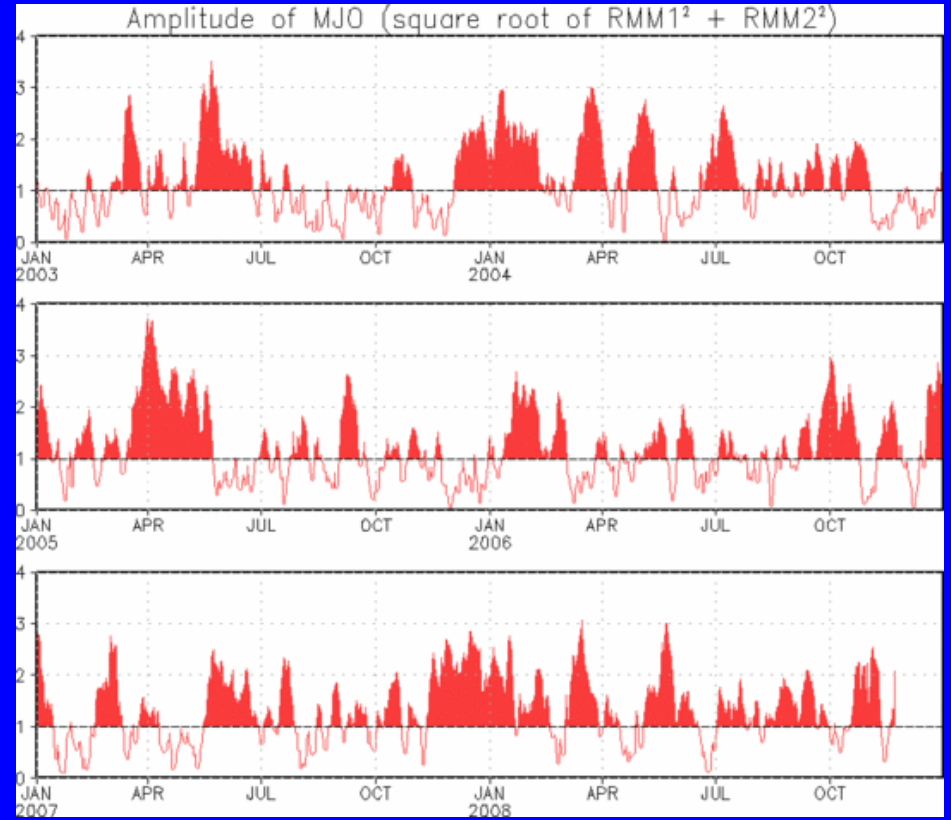
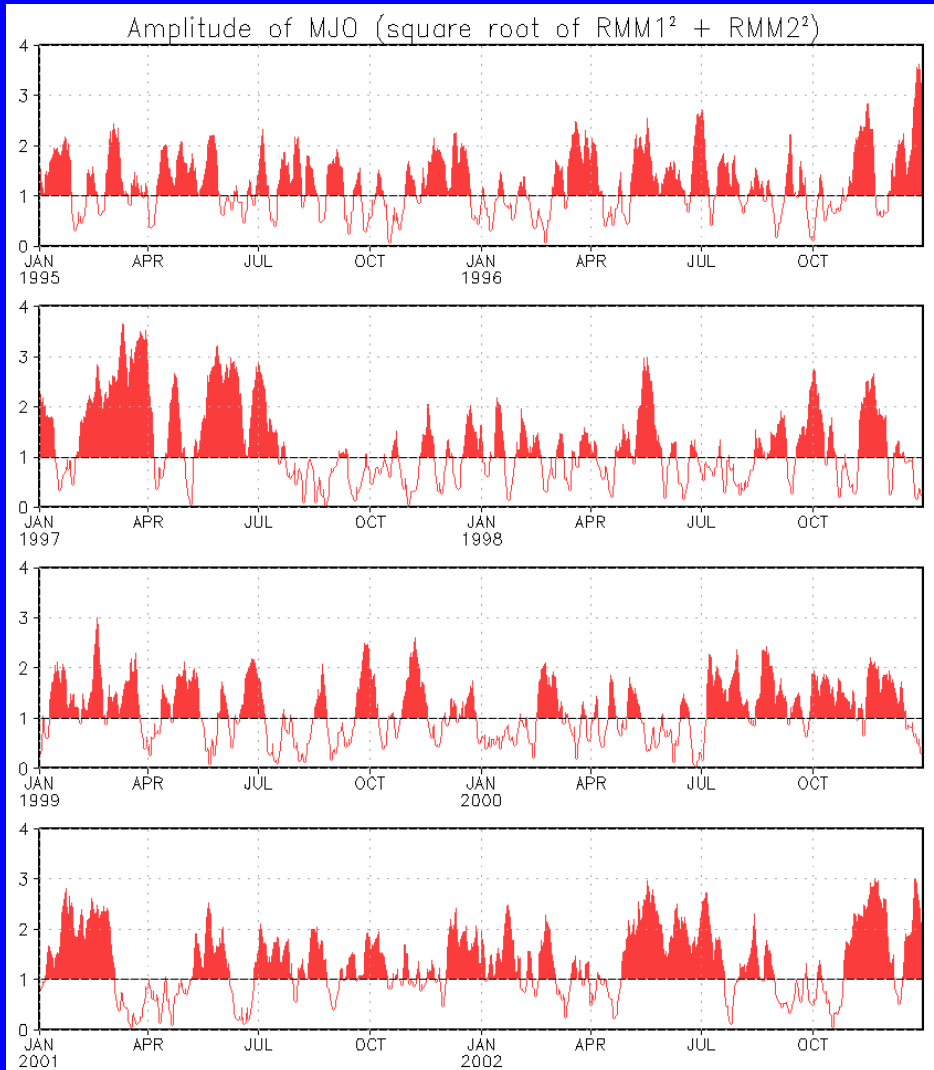


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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

The MJO signal has strengthened over the past several days.



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



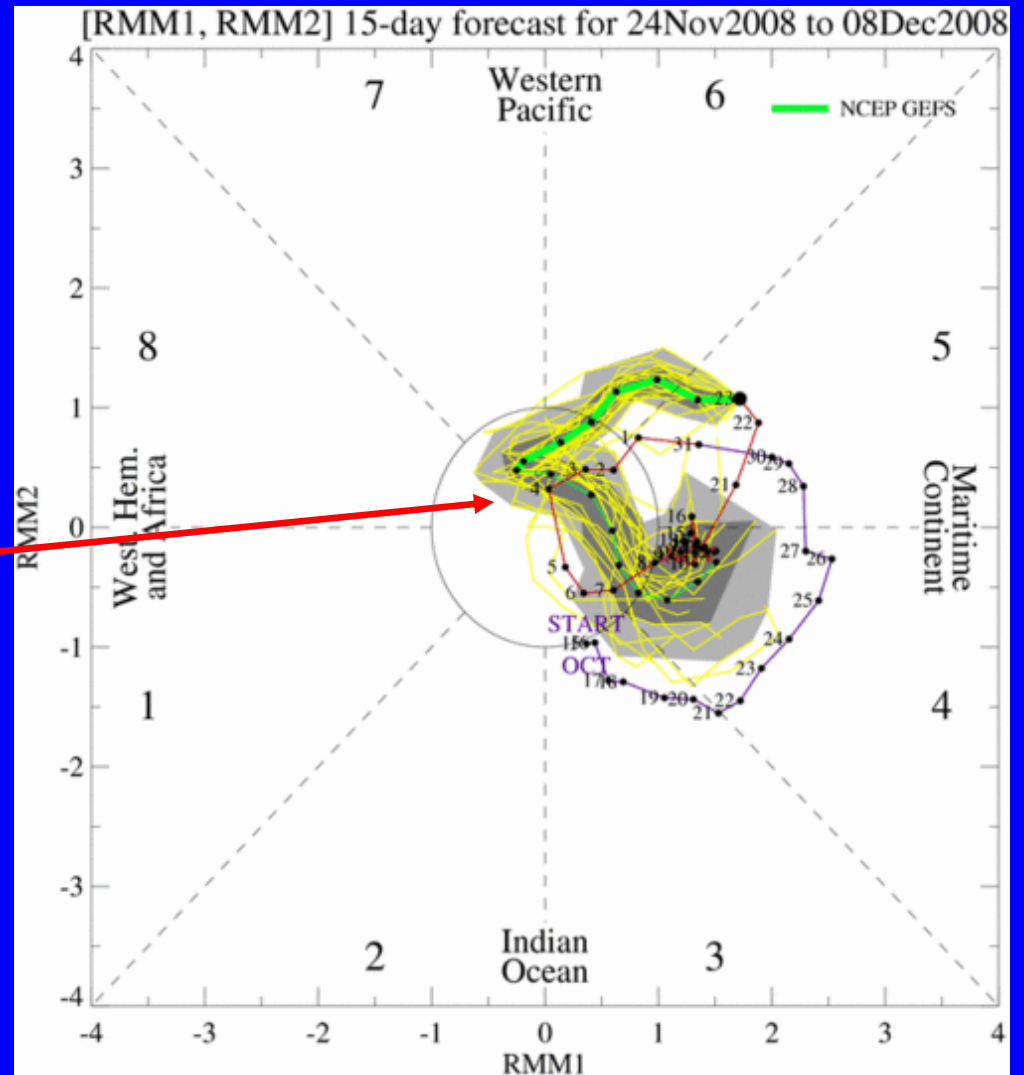
Ensemble GFS (GEFS) MJO Forecast

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 predict the MJO index to shift eastward during the upcoming week with a decreasing amplitude.

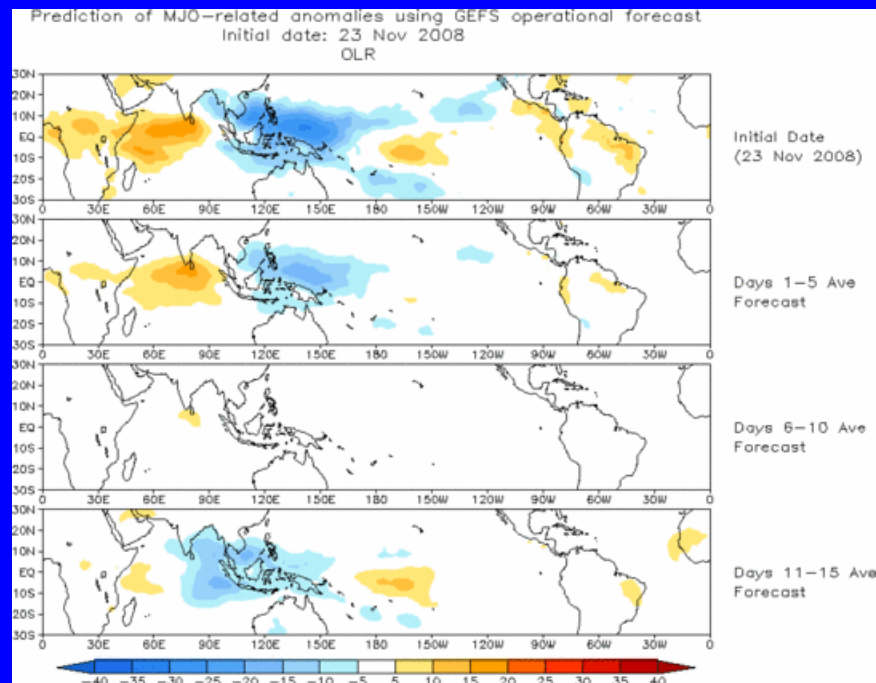




Ensemble Mean GFS MJO Forecast

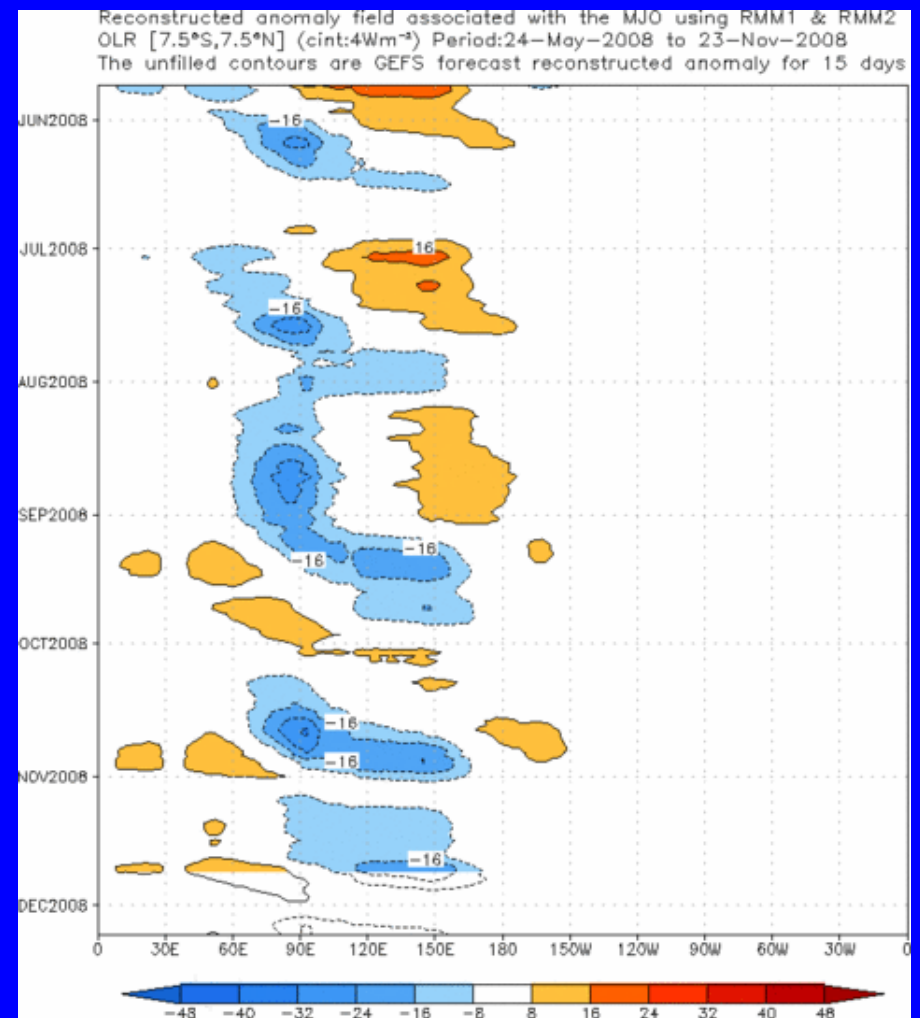
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



MJO associated enhanced convection is forecast over the Maritime Continent during the early part of the period while weak suppressed convection is predicted across the 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





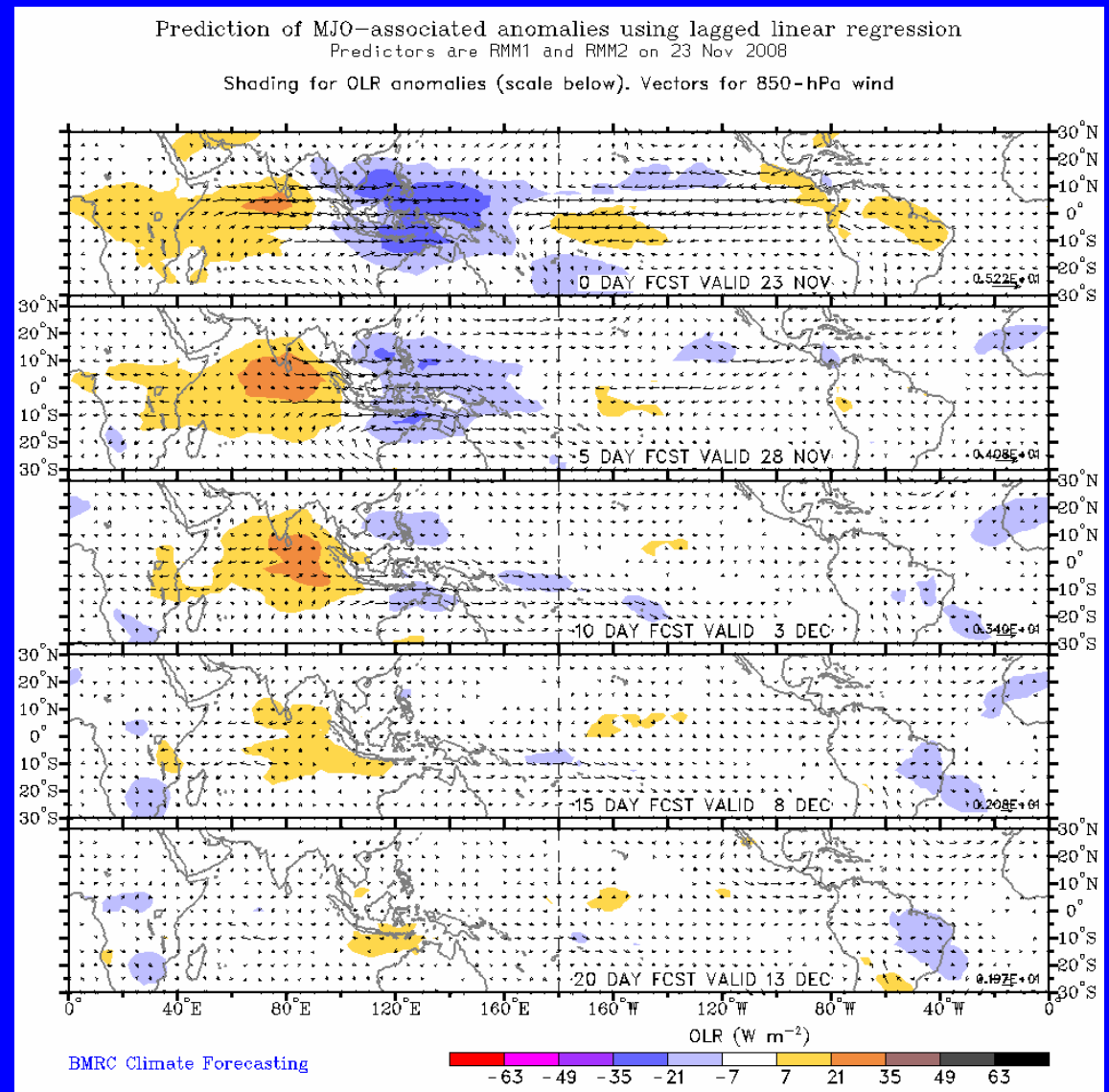
Statistical MJO Forecast

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 is for moderate MJO activity.

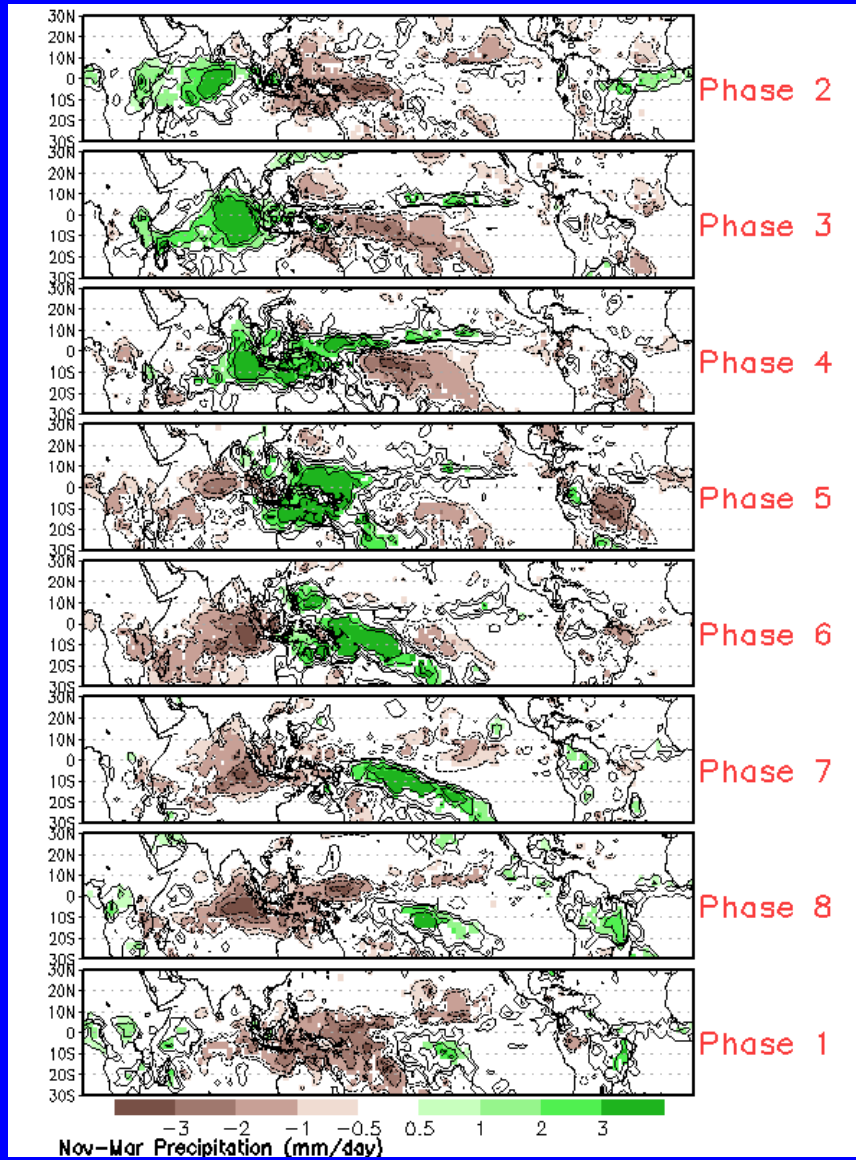
Decreasing enhanced convection across the Maritime continent is expected during the period with dry conditions over the Indian Ocean shifting slightly eastward.





MJO Composites – Global Tropics

Precipitation Anomalies (Nov-Mar)



850-hPa Wind Anomalies (Nov-Mar)

