



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

**Update prepared by
Climate Prediction Center / NCEP
April 21, 2008**



Outline

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



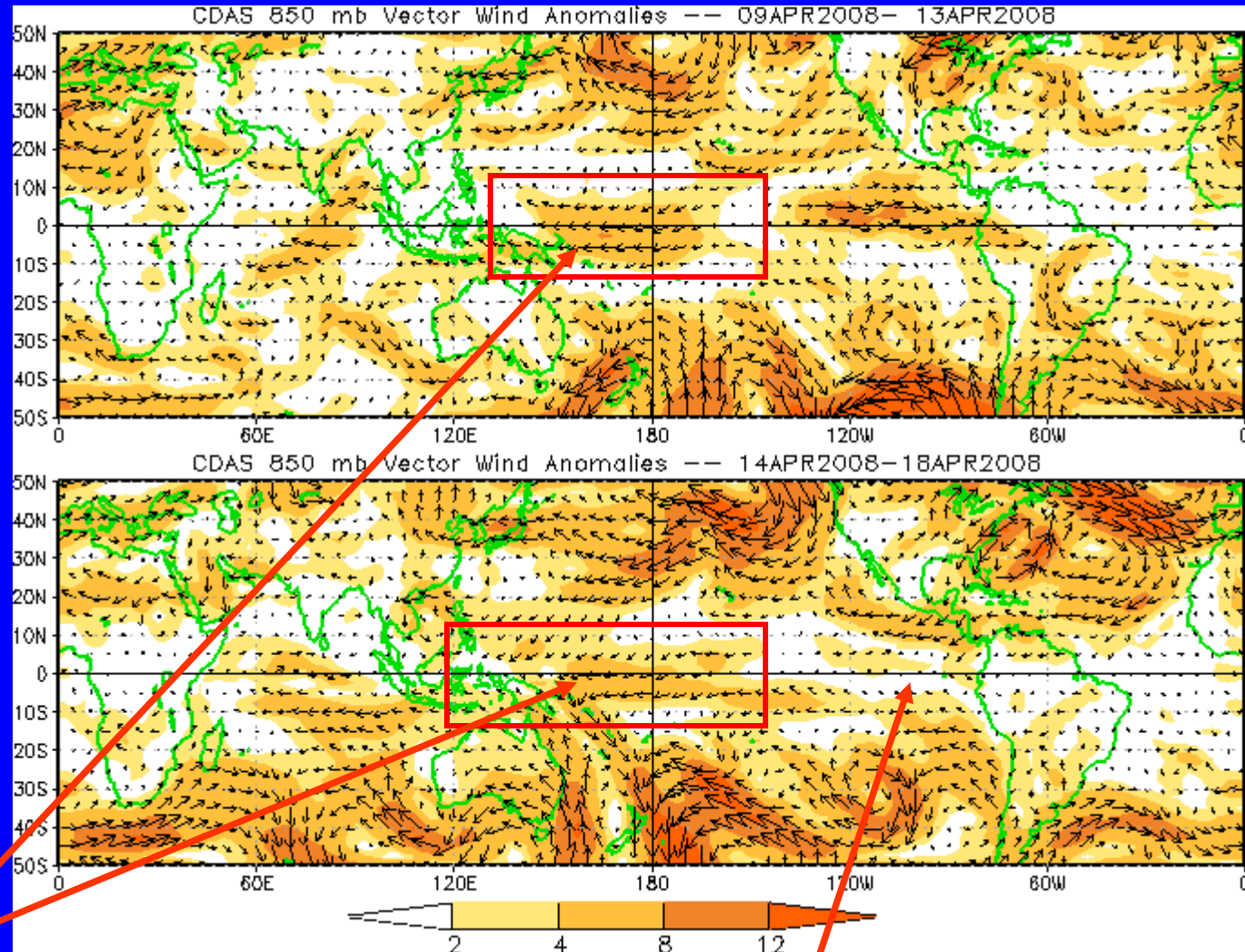
Overview

- **The MJO signal is currently weak.**
- **Continued weak MJO activity is expected during the next 1-2 weeks although some potential exists for enhanced convection to shift slightly eastward.**
- **It is currently unclear how much the MJO will contribute to the patterns of tropical rainfall during the next two weeks.**



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

Note that shading denotes the magnitude of anomalous wind vectors



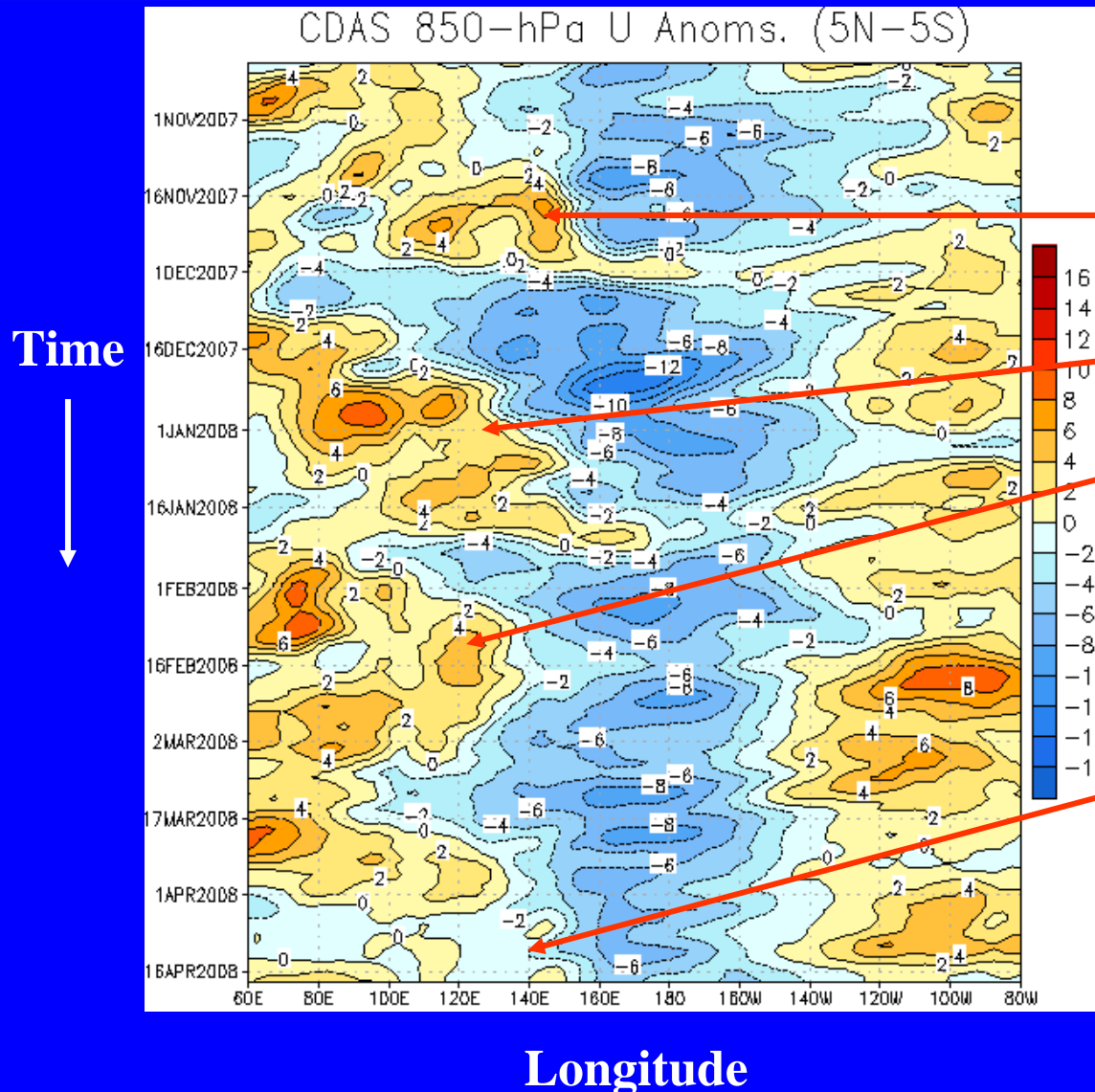
Easterly anomalies continue across the western Pacific.

Westerly anomalies across the eastern Pacific have decreased 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



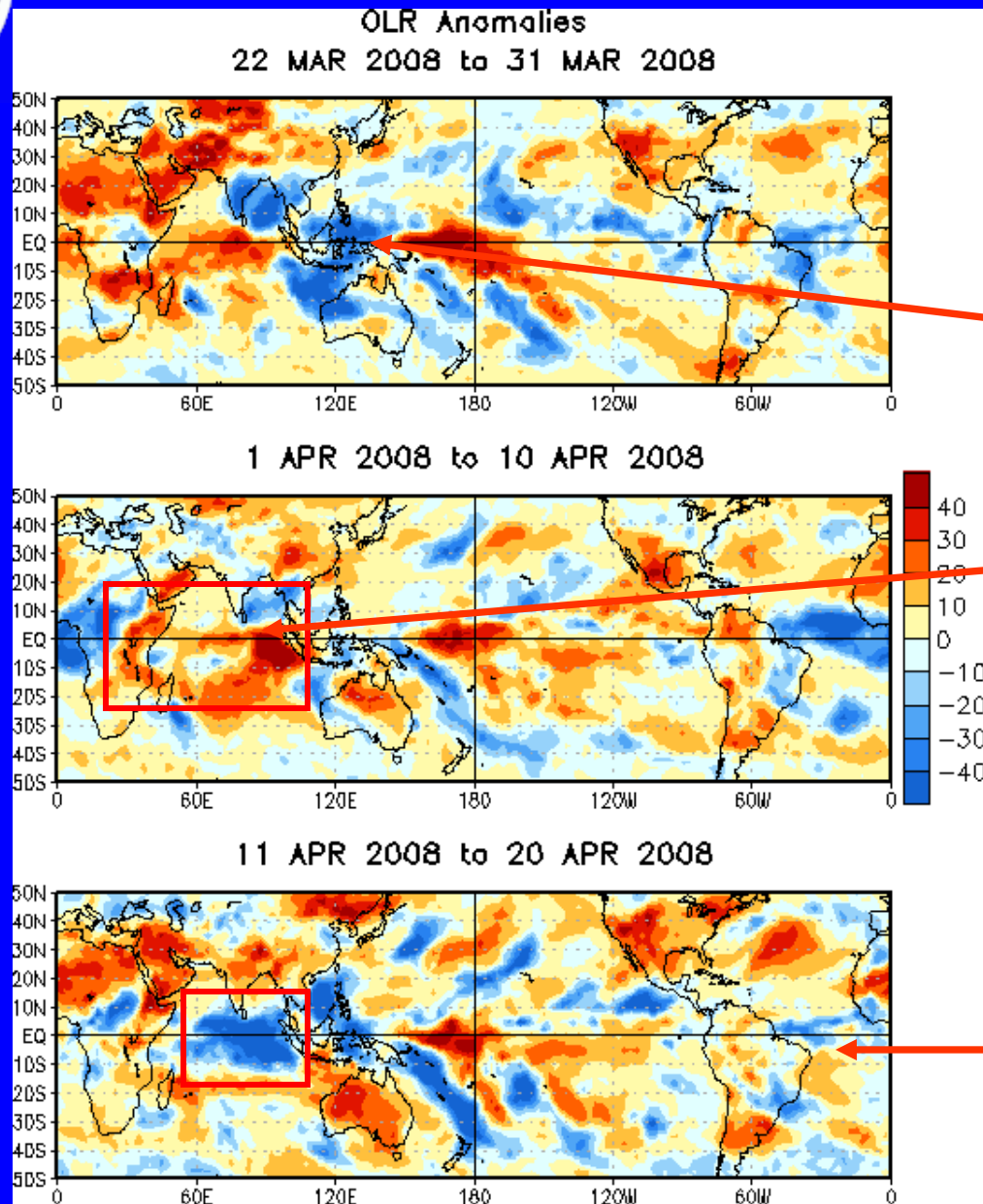
Moderate-to-strong MJO activity was evident from late October to mid-late February as shown by westerly anomalies shifting eastward from the Indian Ocean across Indonesia and a weakening of the easterlies at the Date Line during early December, mid-January and mid-February.

During April, winds across the Indian Ocean and Indonesia have been near average.

Easterly anomalies continue near the Date Line.



OLR Anomalies: Last 30 days



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

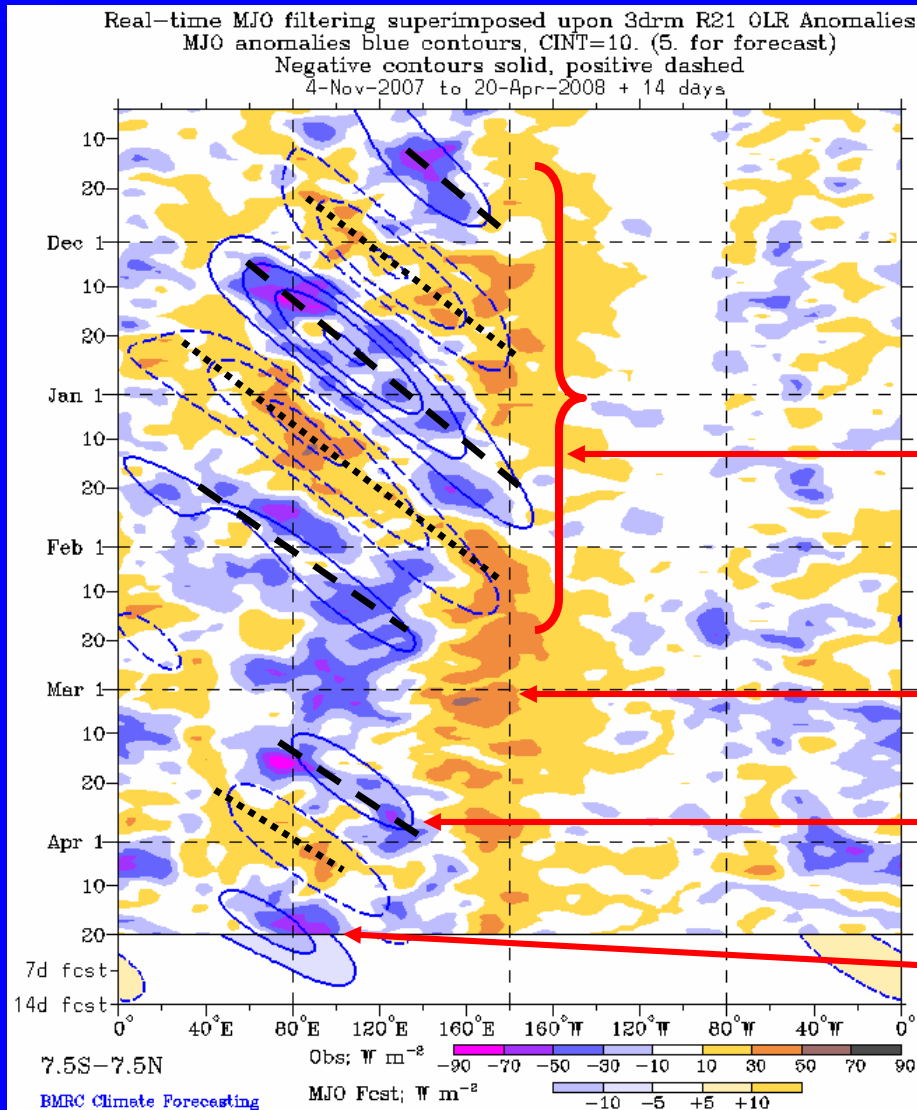
In part associated with the MJO, enhanced convection shifted eastward to the Maritime continent during late March.

During early April, dry conditions were observed across parts of eastern Africa and the Indian Ocean while wet conditions developed across portions of the Atlantic Ocean, South America, and Africa.

Tropical convection became less organized during early-mid April, although in recent days convection has become quite active across the Indian Ocean.



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



Time
↓

Longitude

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

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

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

Moderate-to-strong MJO activity was evident from mid-November to mid-February with coherent eastward propagation of enhanced (suppressed) convection indicated by the dashed (dotted) lines.

From mid-February to early-mid March, a more stationary pattern of anomalous convection was evident.

Weak MJO activity was evident during mid-late March as enhanced convection shifted east across the Indian Ocean.

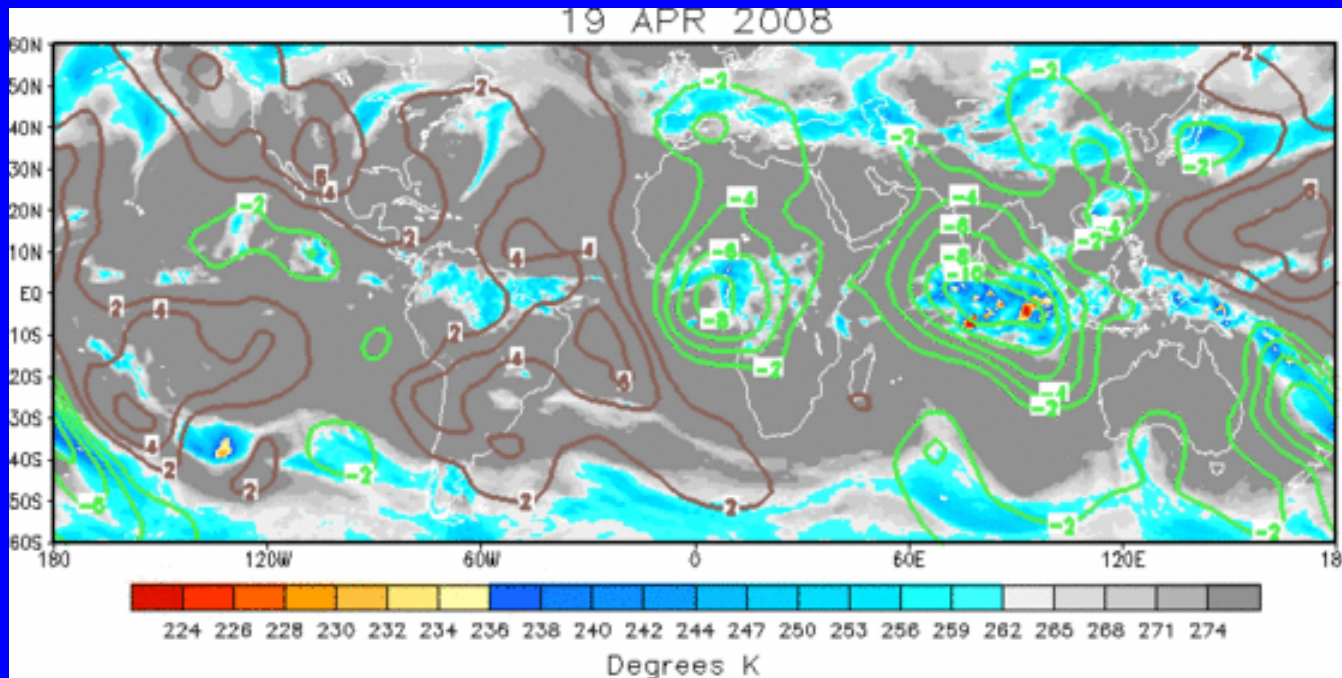
Convection has become enhanced in the Indian Ocean during the past several days.



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 current velocity potential anomalies indicate large-scale divergence over parts of Africa and the Indian Ocean with areas of generally large-scale subsidence across much of the western hemisphere.

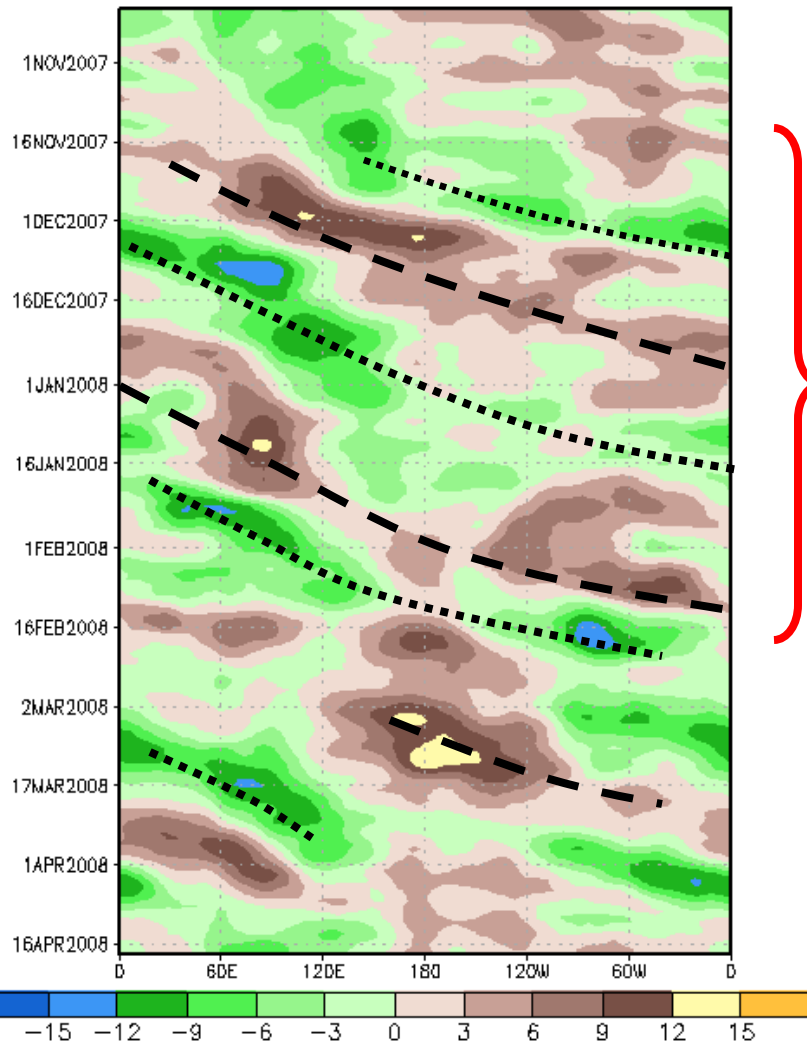


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



Moderate-to-strong MJO activity developed in mid-November and continued into mid-February.

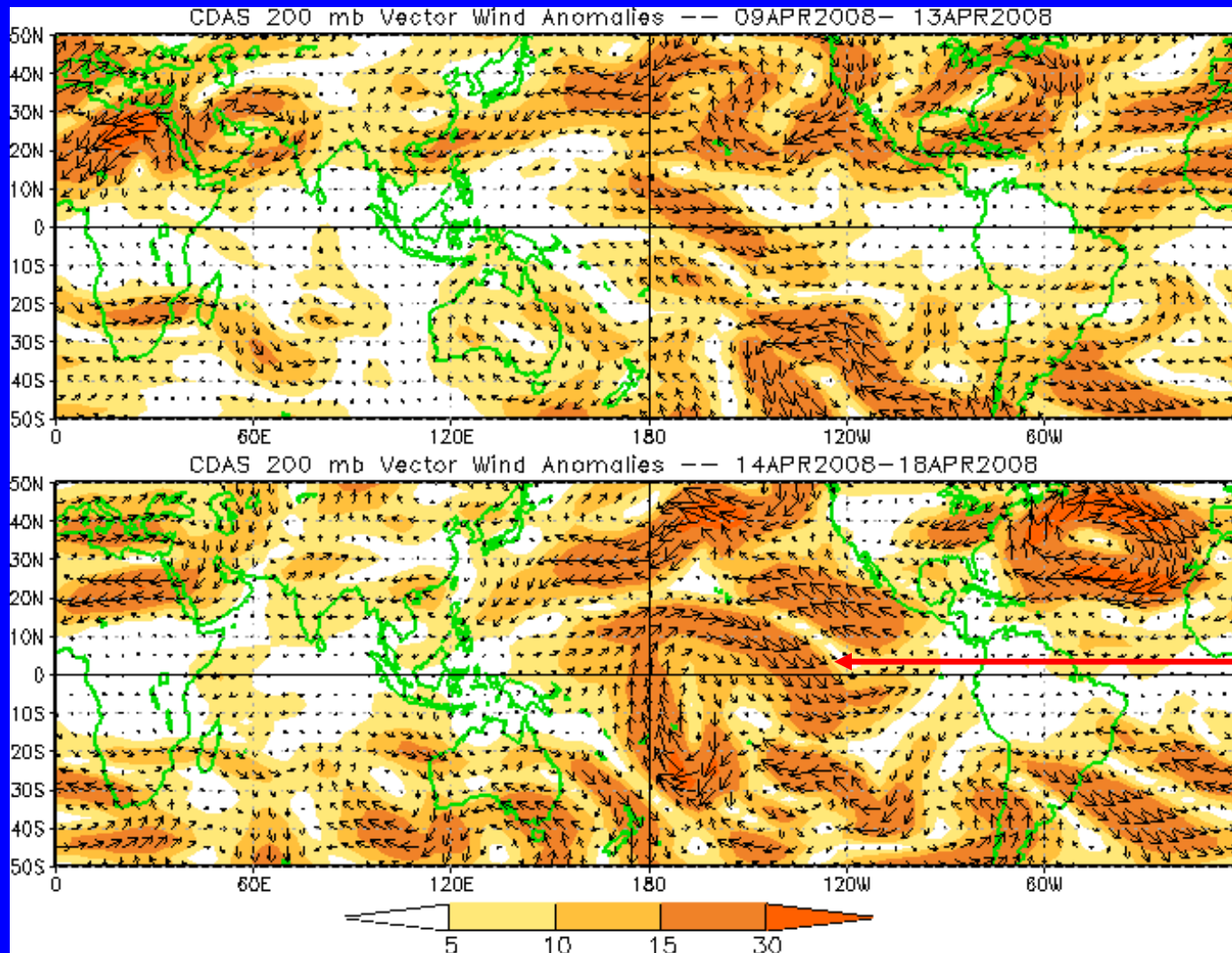
The MJO weakened during the second half of February.

During March, velocity potential anomalies increased and some eastward propagation was evident but recently the MJO has again weakened.



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

Note that shading denotes the magnitude of anomalous wind vectors

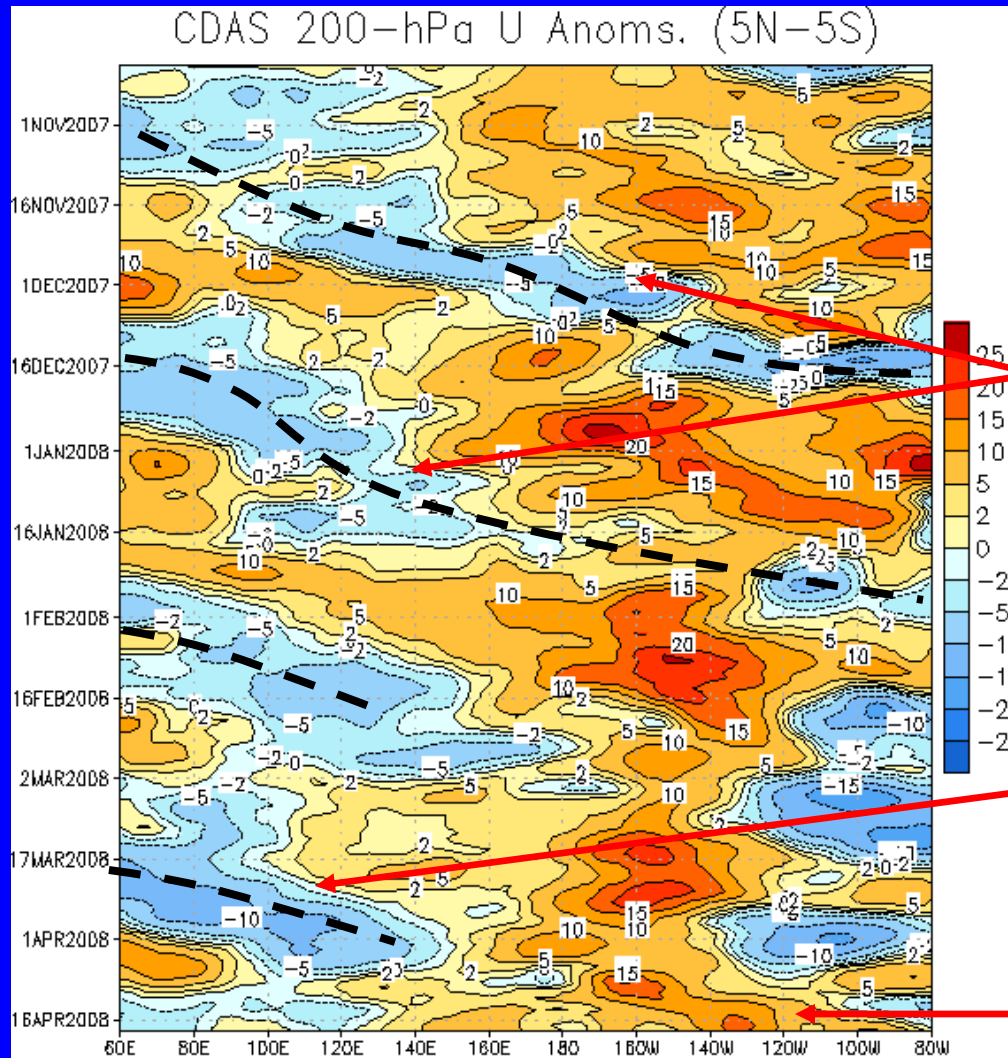


Westerly anomalies continue across the Pacific Ocean with strong cross-equatorial flow near the Date Line during the last five days.



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

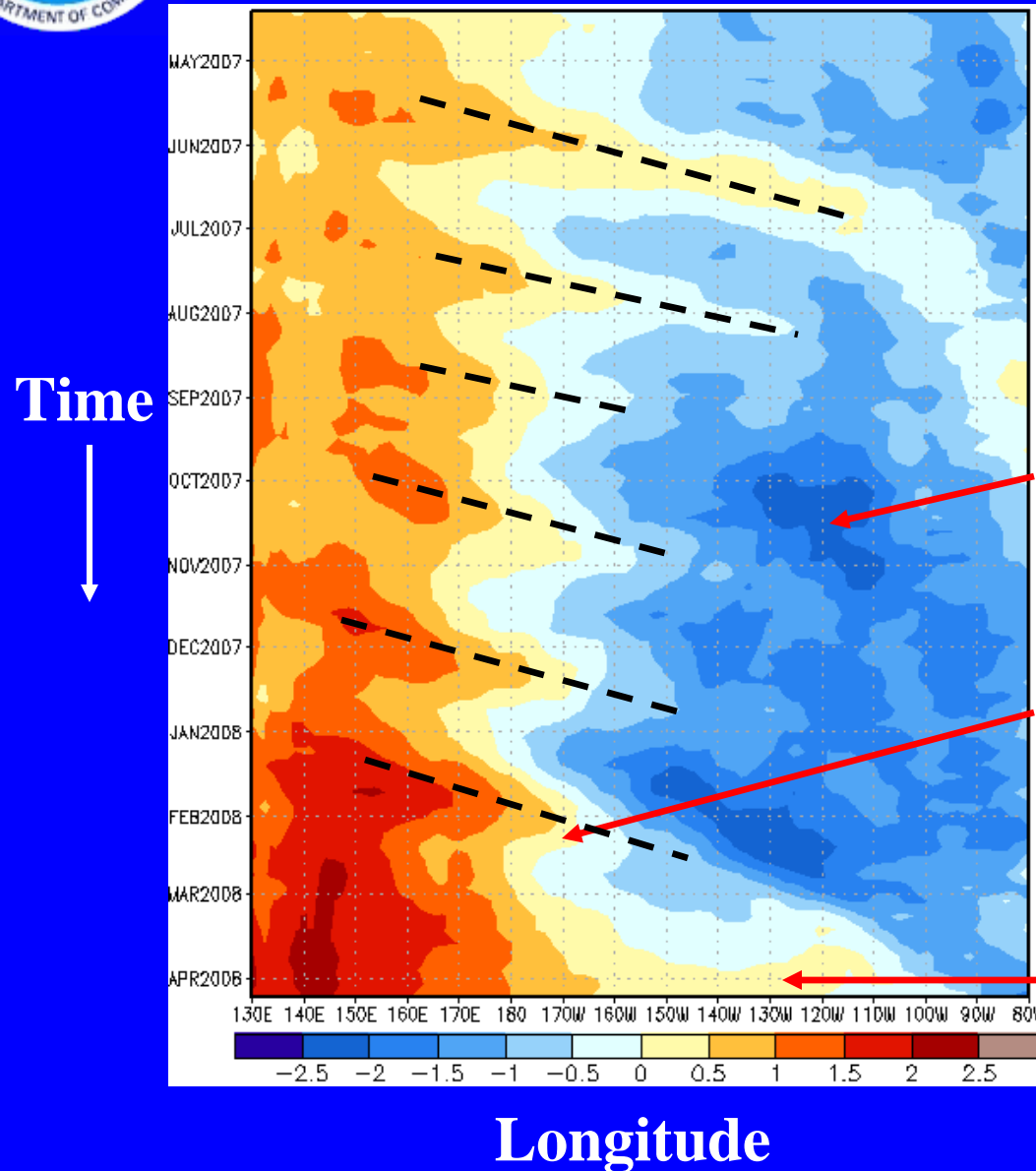
MJO activity is evident in the upper-levels by eastward propagation of easterly anomalies (dashed lines) globally from early November to mid-February.

During March, easterly anomalies propagated quickly eastward from the western hemisphere to the Maritime continent region.

Currently, westerly anomalies stretch across much of the Pacific Ocean.



Weekly Heat Content Evolution in the Equatorial Pacific



Kelvin wave activity (downwelling phases indicated by dashed lines) has been observed since May and has affected the sub-surface temperature departures at varying degrees across the Pacific Ocean. The strongest wave occurred during May and June.

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

From late January into early February, increasingly positive anomalies developed across the western Pacific and shifted eastward associated with the latest downwelling Kelvin wave.

Positive anomalies have started to develop during the last few weeks across the central and eastern 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).

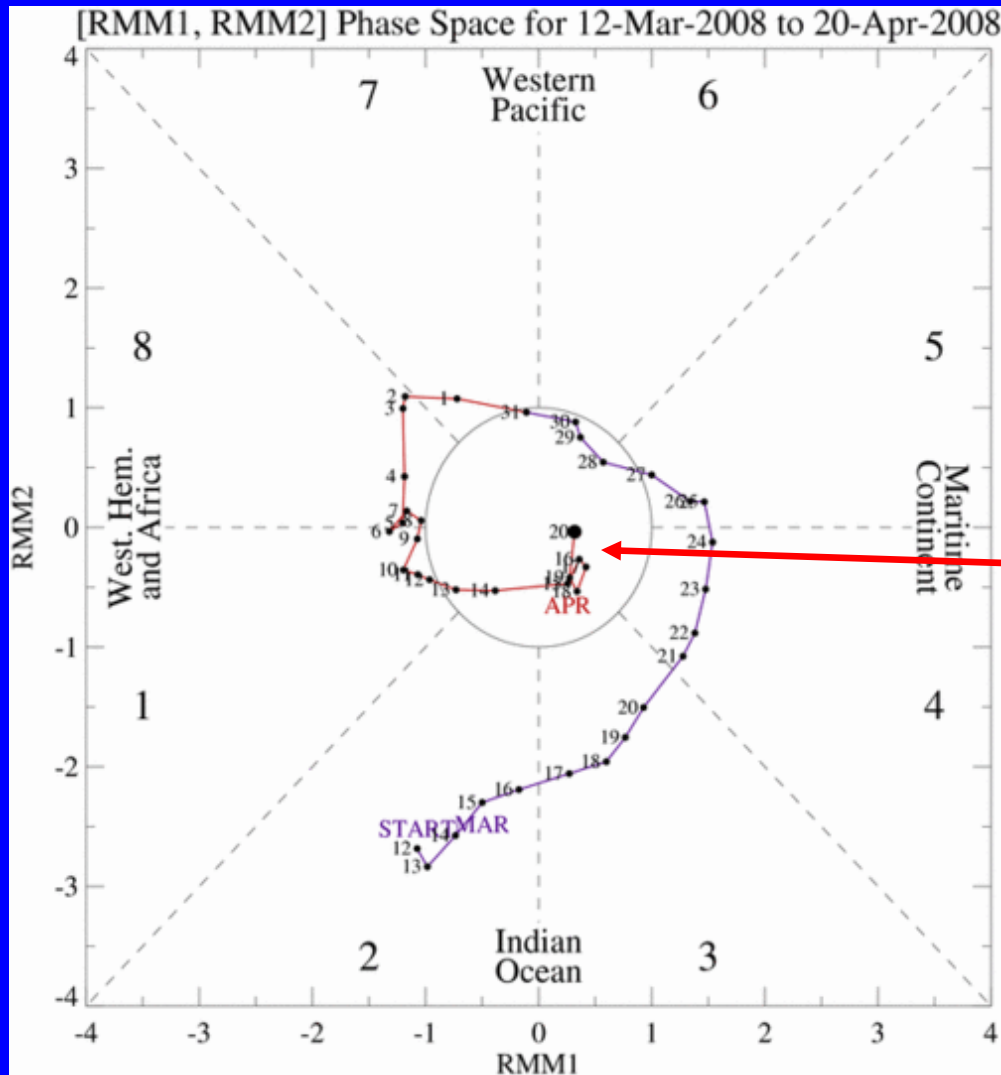
Wheeler M. and H. Hendon, 2004: An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction, *Monthly Weather Review*, 132, 1917-1932.

- 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

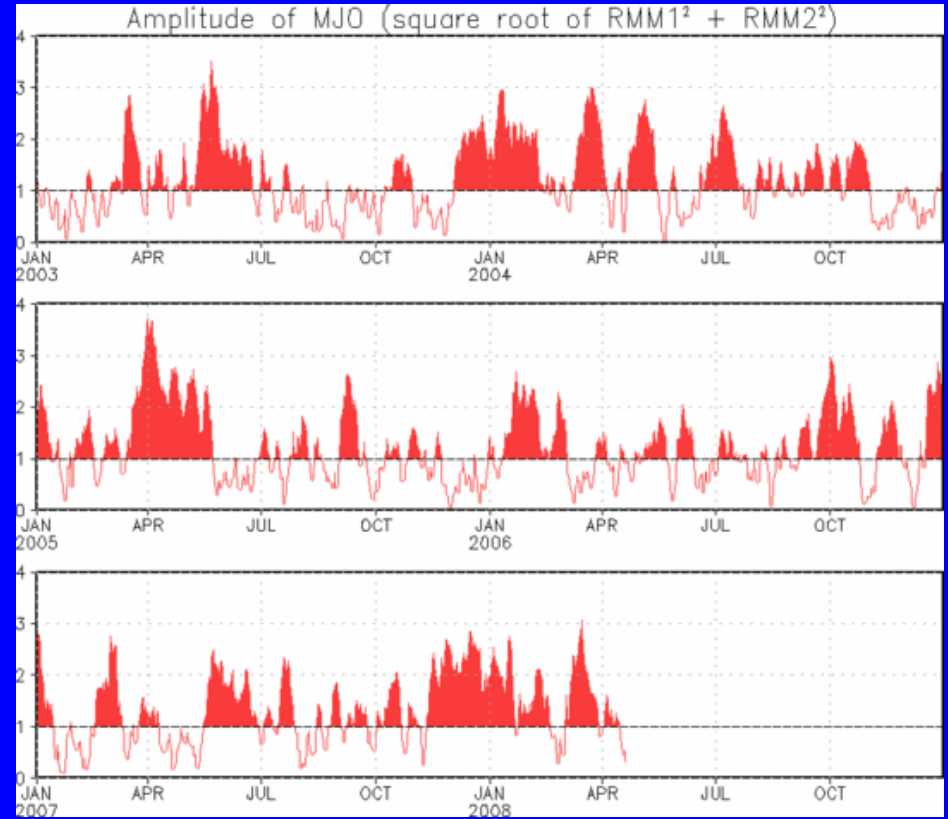
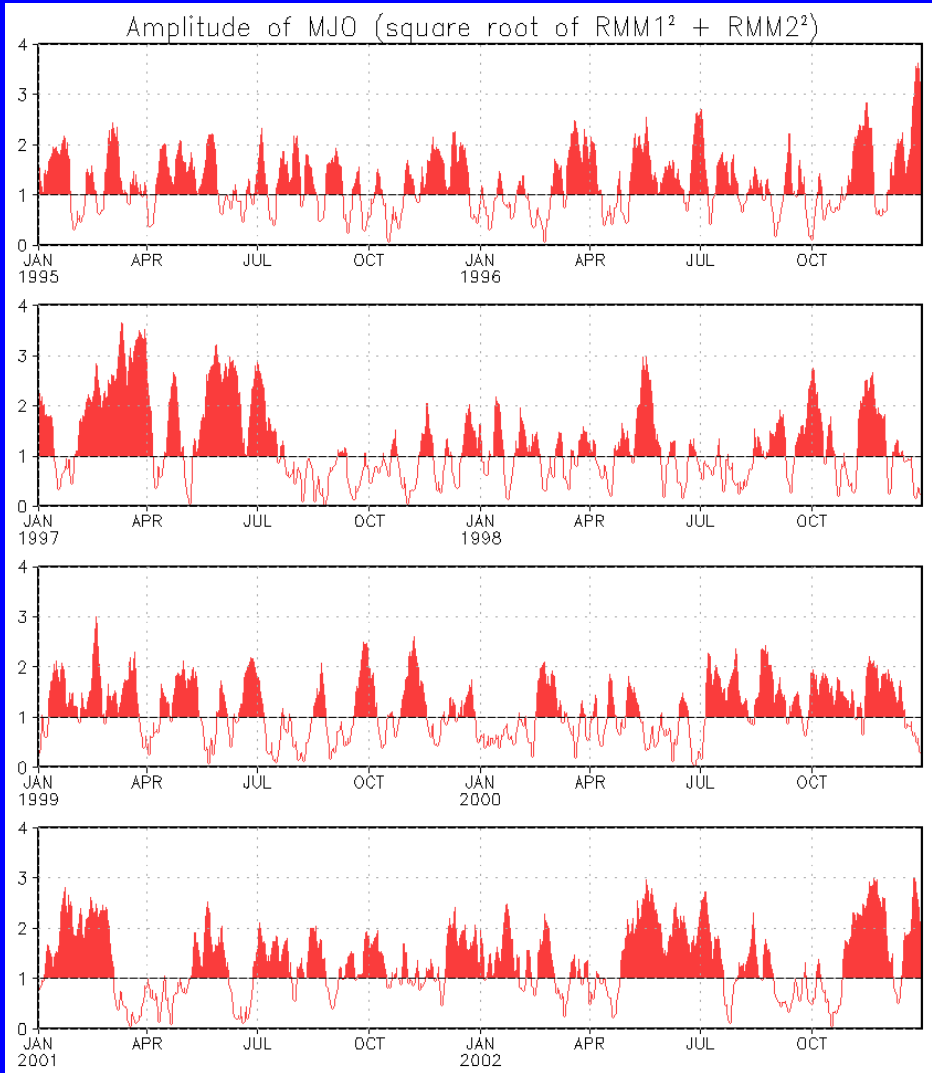
- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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



The MJO signal has continued to weaken in recent 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



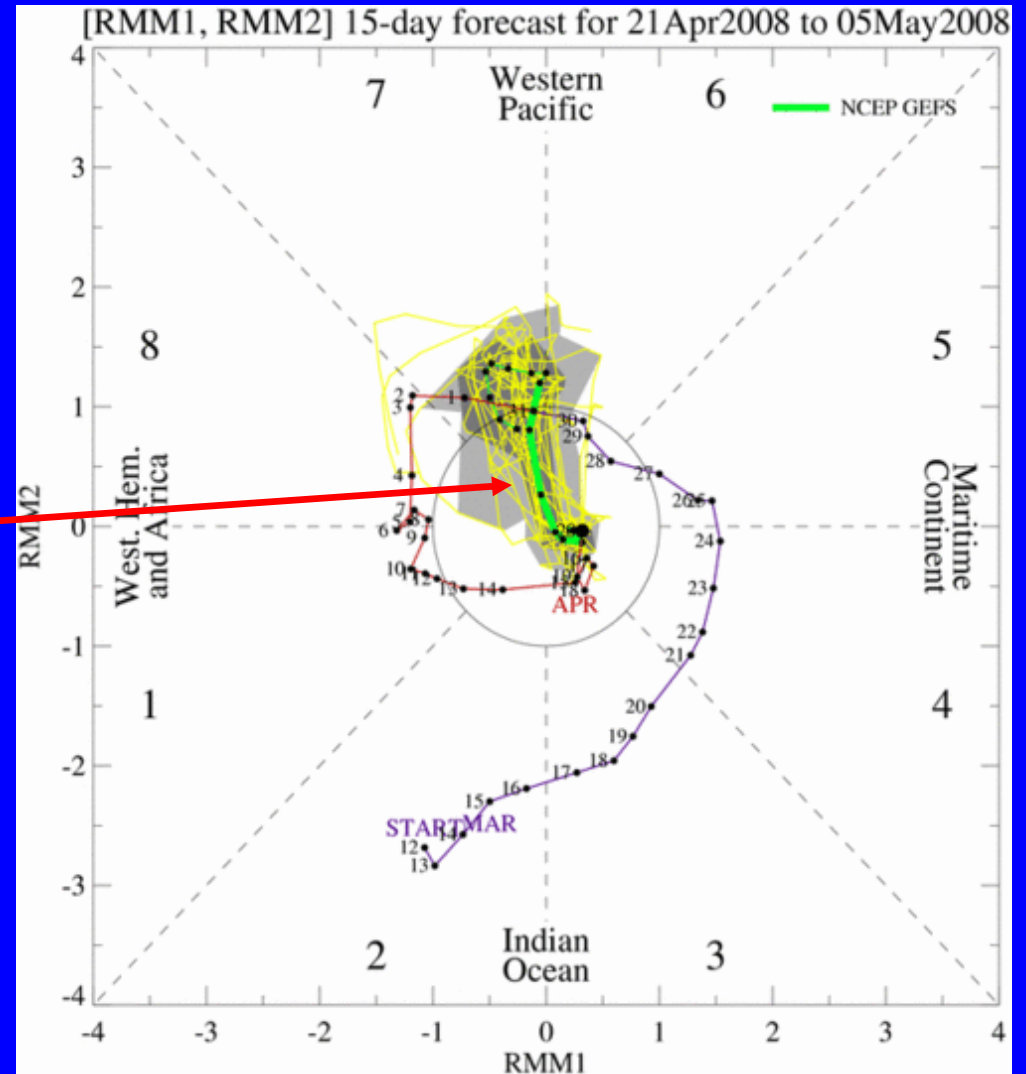
Ensemble GFS MJO Forecasts

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 (GFS) for the next 15 days

light gray shading: 90% of forecasts
dark gray shading: 50% of forecasts

The GEFS predicts a generally weak MJO signal during the next two weeks.

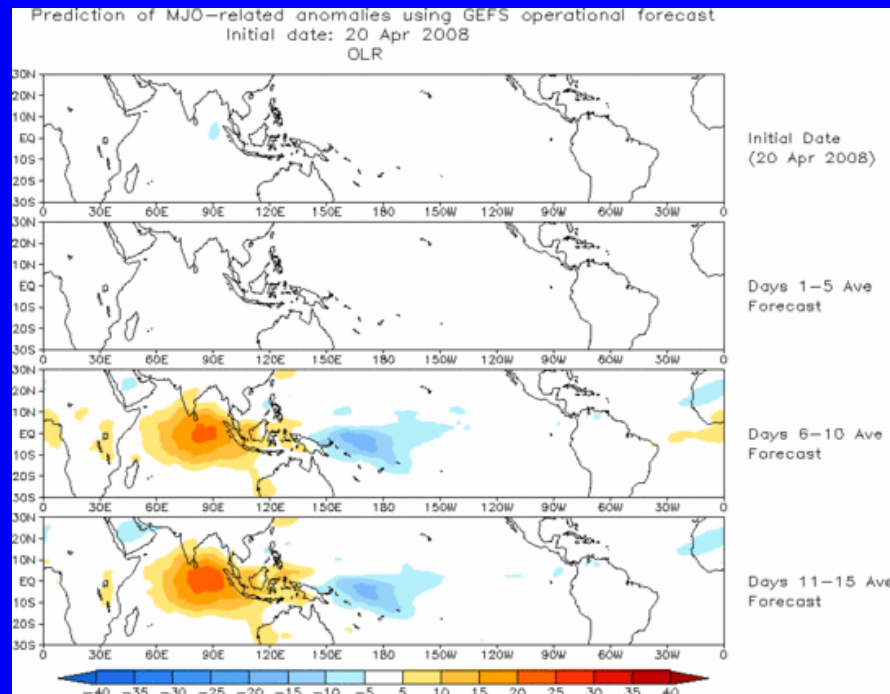




Ensemble Mean GFS MJO Forecast

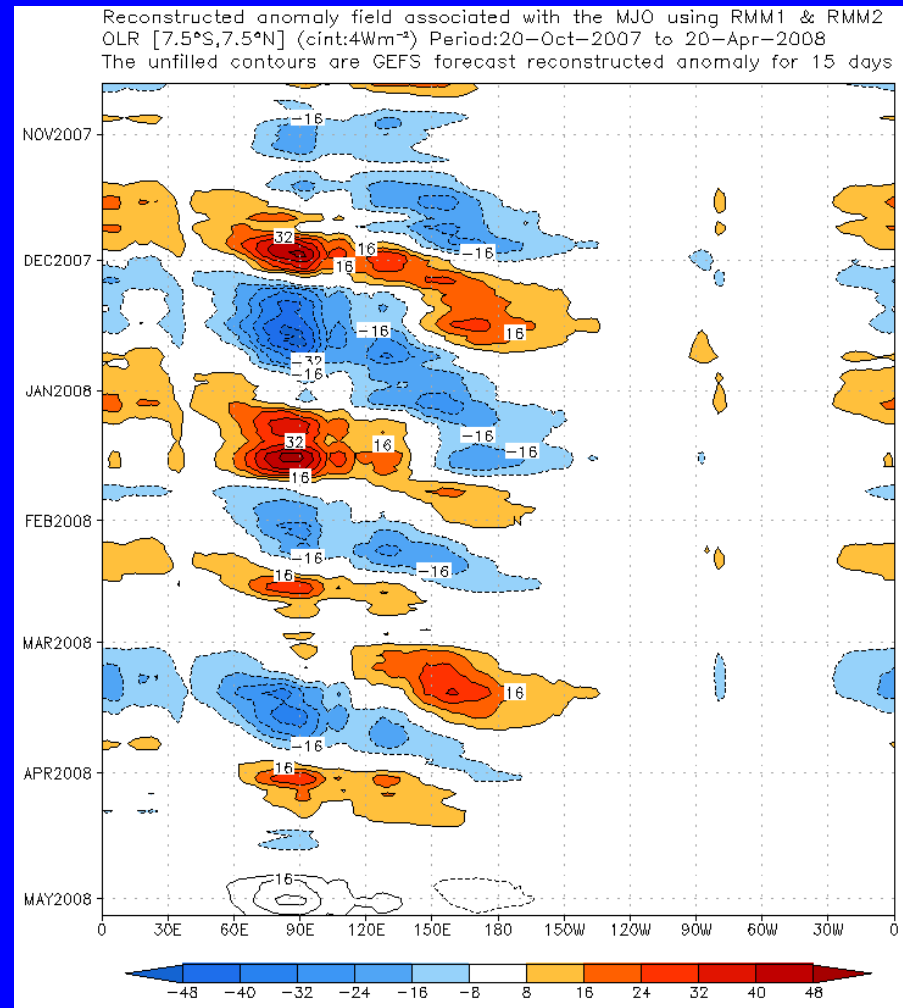
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



MJO-related convection is expected to be small early during the period.

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



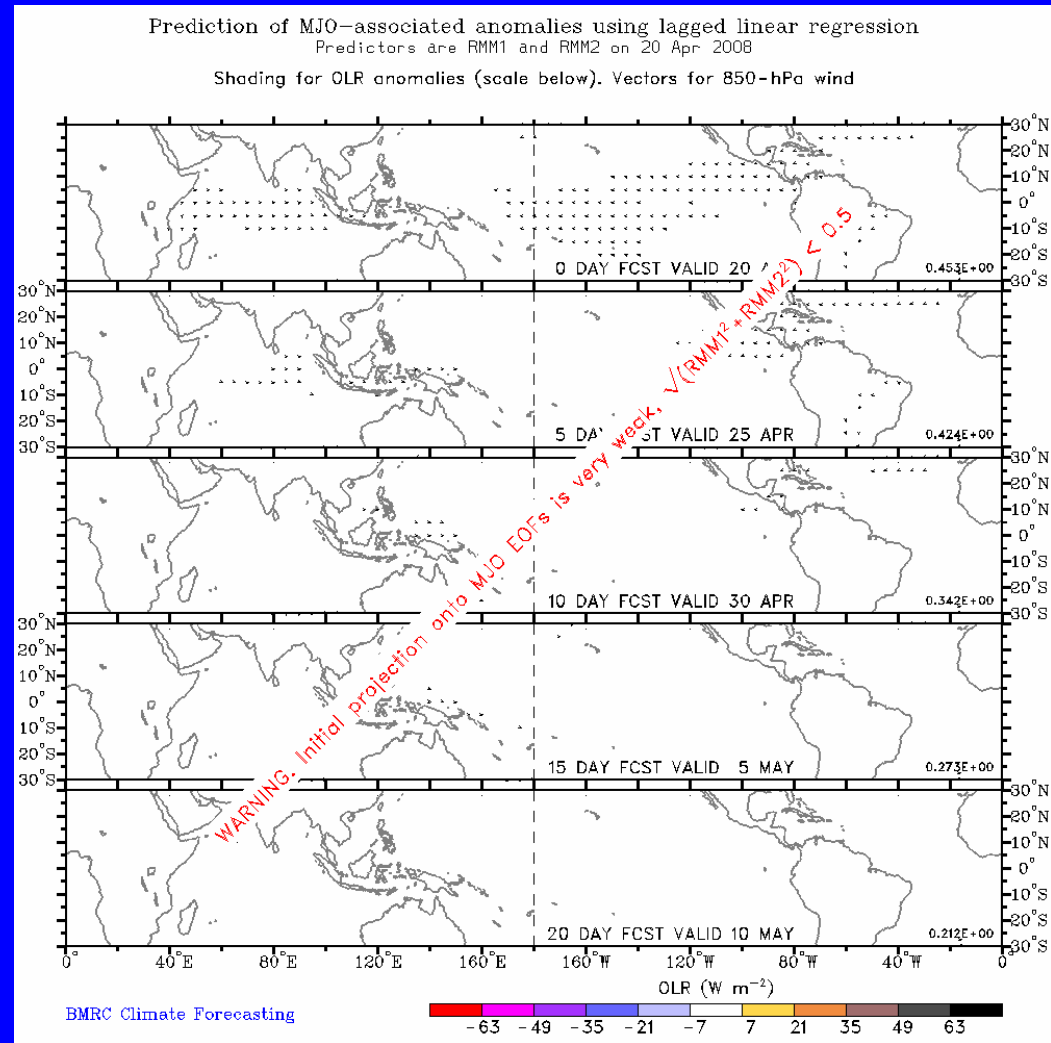


Statistical MJO Forecast

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)

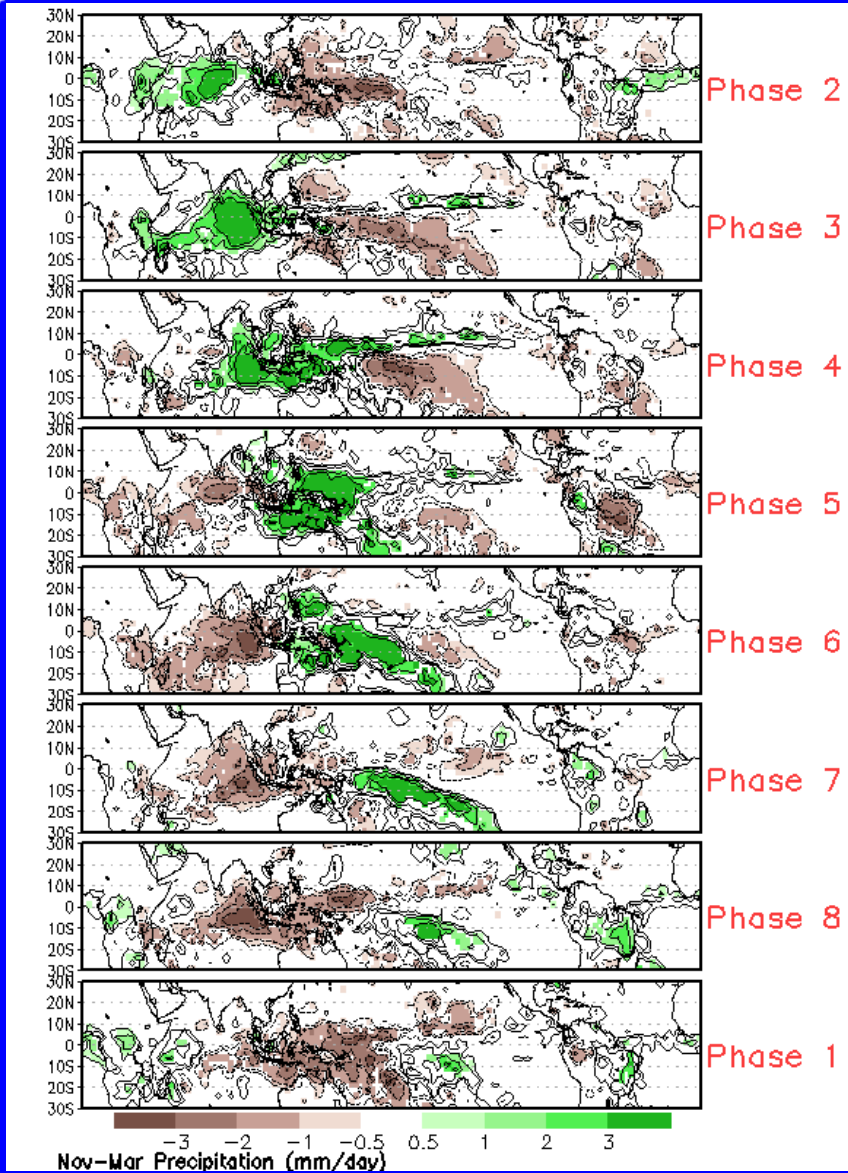
Weak MJO activity is forecast.





MJO Composites – Global Tropics

Precipitation Anomalies



850-hPa Wind Anomalies

