



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

**Update prepared by
Climate Prediction Center / NCEP
December 29, 2008**



Outline

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



Overview

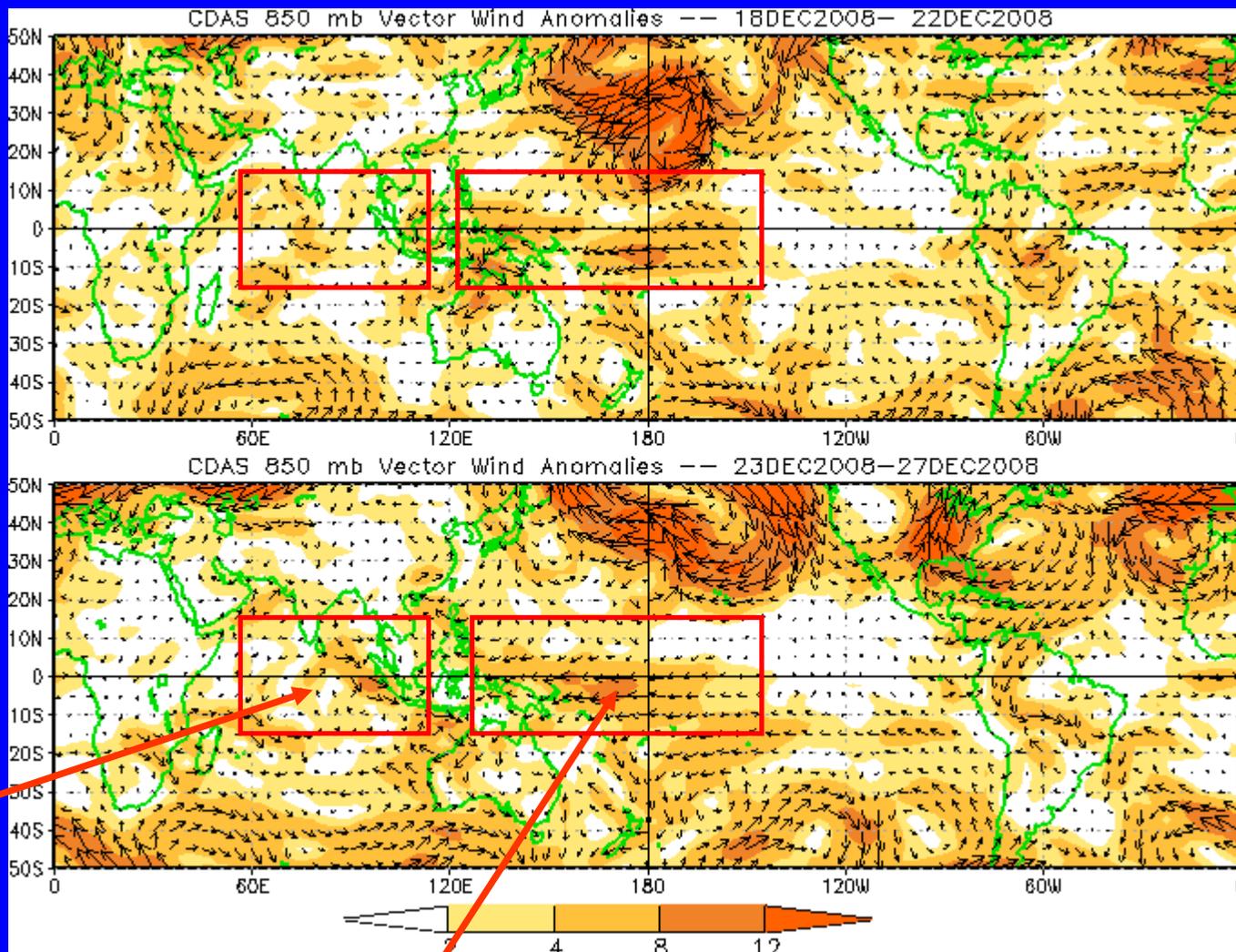
- **The MJO remained weak during the past week.**
- **Based on the most recent observations, it is expected that the MJO will remain weak during the next 1-2 weeks even though some model forecasts indicate eastward progression during this period.**
- **At the current time, minimal impacts from the MJO are expected 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



Westerly anomalies strengthened across the eastern Indian Ocean during the last five days.

The easterly anomalies have expanded across much of the tropical Pacific during the last five to ten days.

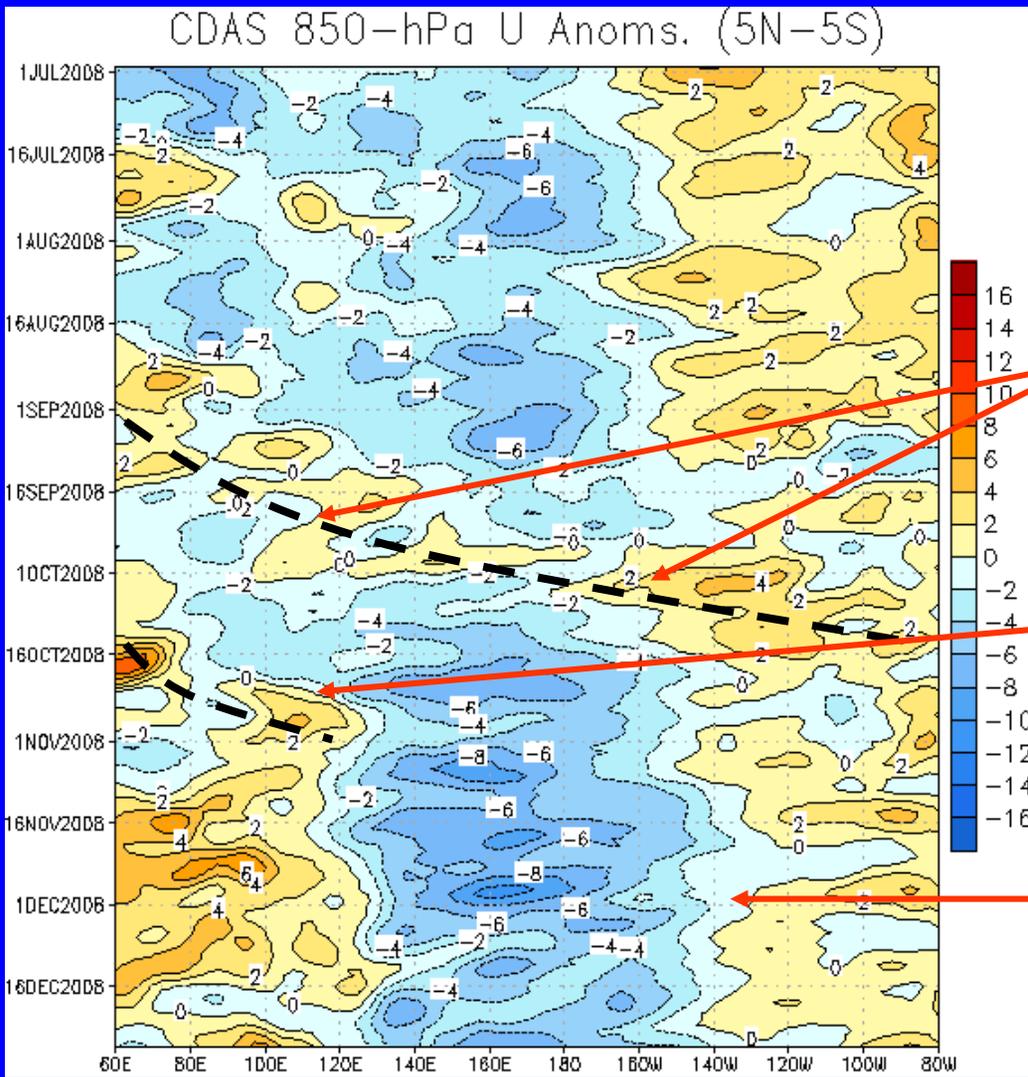


850-hPa Zonal Wind Anomalies (m s^{-1})

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

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

Time
↓



Longitude

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.

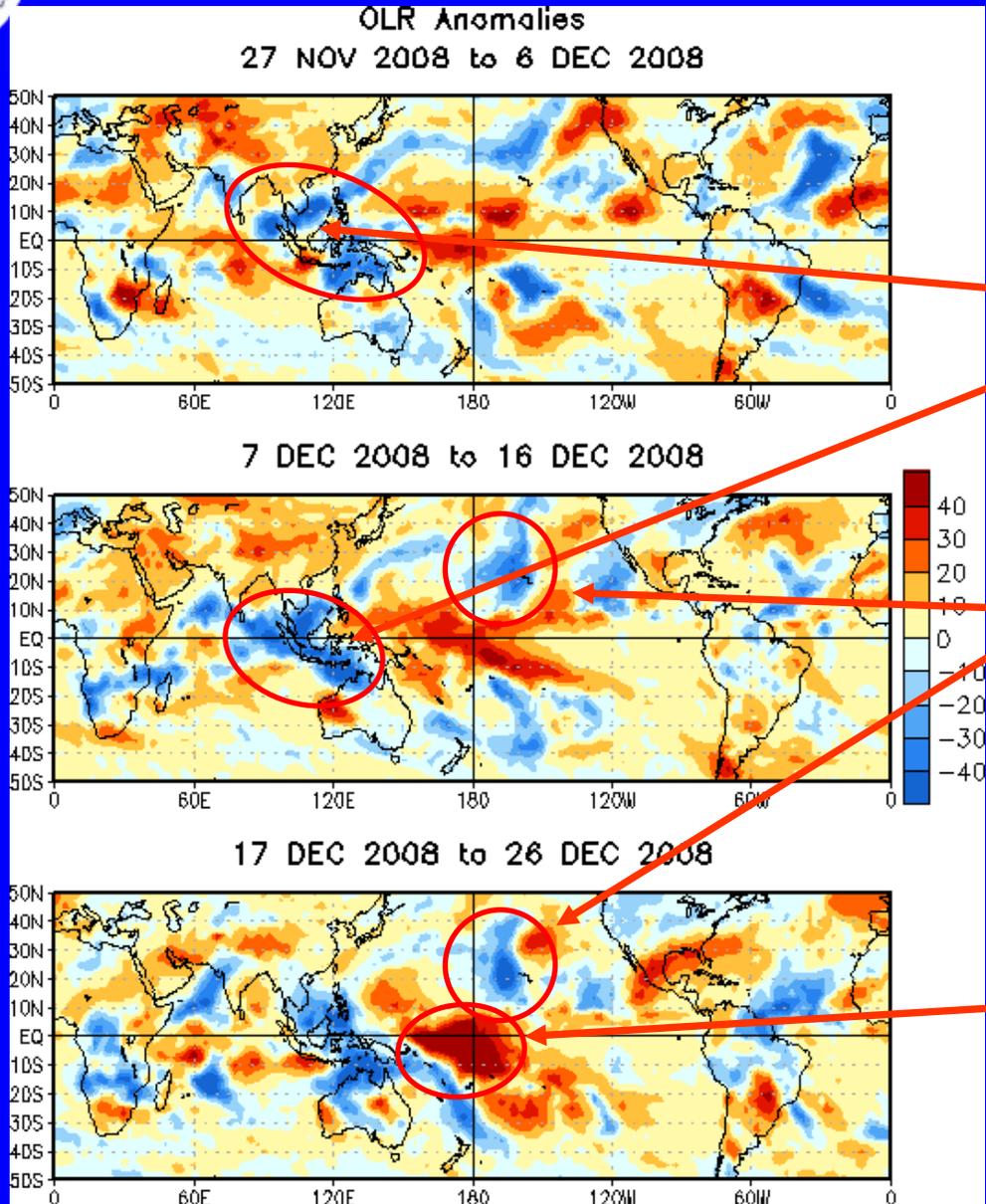
These westerly anomalies reentered the Maritime Continent during late October but eastward progress stalled.

A persistent pattern of westerly (easterly) anomalies in the Indian (western Pacific) Oceans continued since November.



OLR Anomalies: Last 30 days

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



During late November to mid December, enhanced convection was mainly confined to the Maritime Continent and far eastern Indian Ocean.

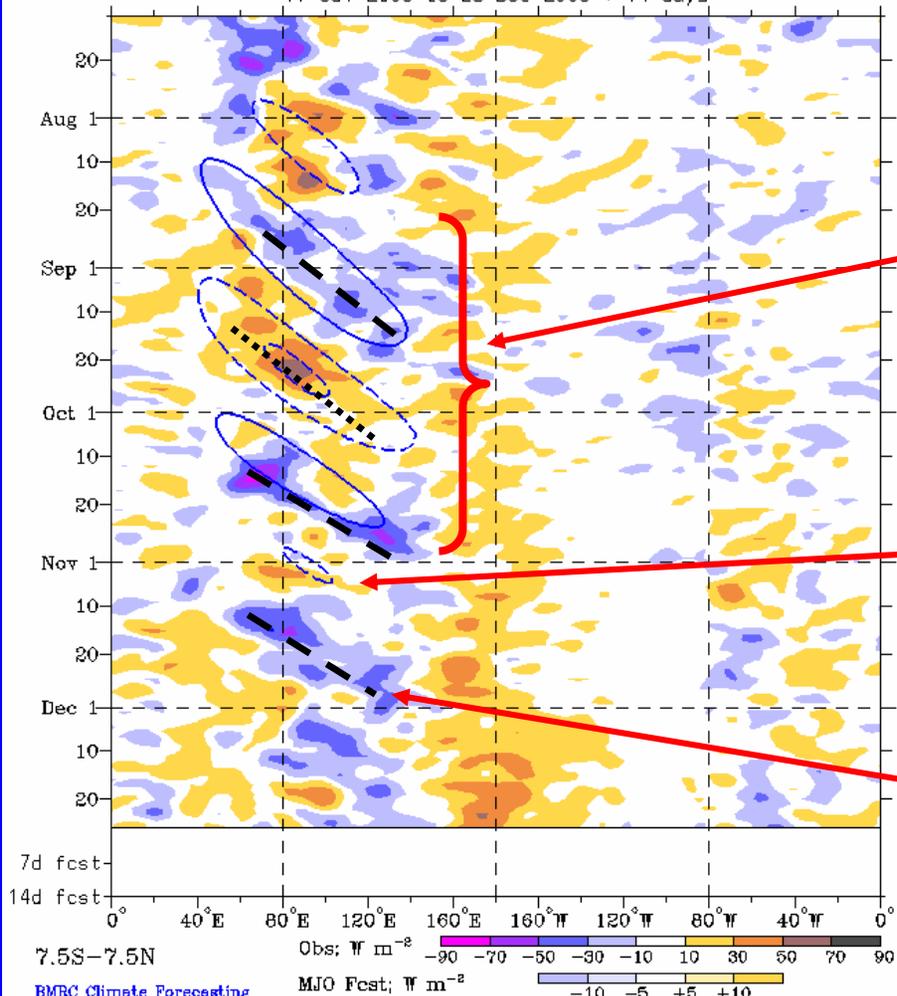
Enhanced convection has been evident near Hawaii since early December.

Suppressed convection has been observed during the entire period near the Date Line.



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

Real-time MJO filtering superimposed upon 3drn R21 OLR Anomalies
MJO anomalies blue contours, CINT=10. (5. for forecast)
Negative contours solid, positive dashed
11-Jul-2008 to 26-Dec-2008 + 14 days



Time
↓

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 was most evident from late August to early November as enhanced (suppressed) convection developed across the Indian Ocean and shifted eastward during the period.

The suppressed phase during the second MJO cycle in late October and early November was not as strong.

During late-November, enhanced convection shifted across the Maritime Continent before the MJO weakened and has remained weak.

Longitude

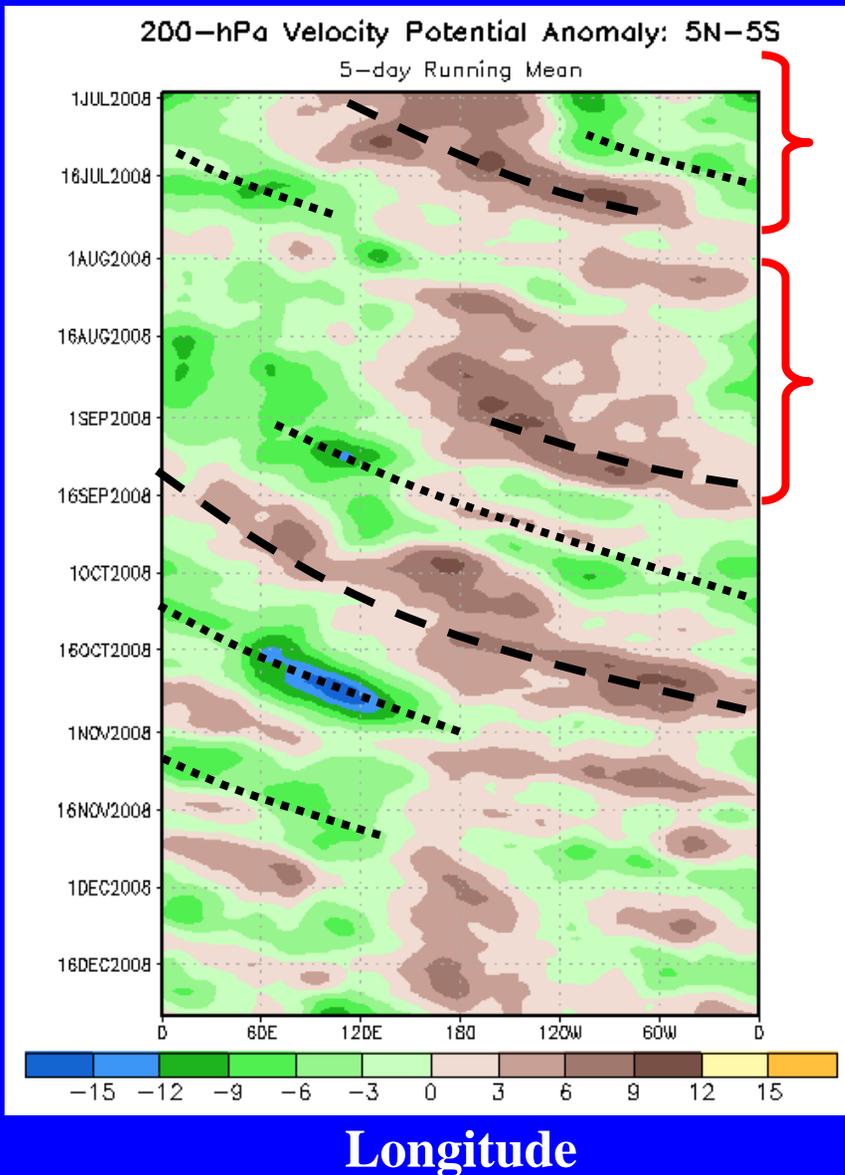


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time
↓



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

From late August through October, 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 October.

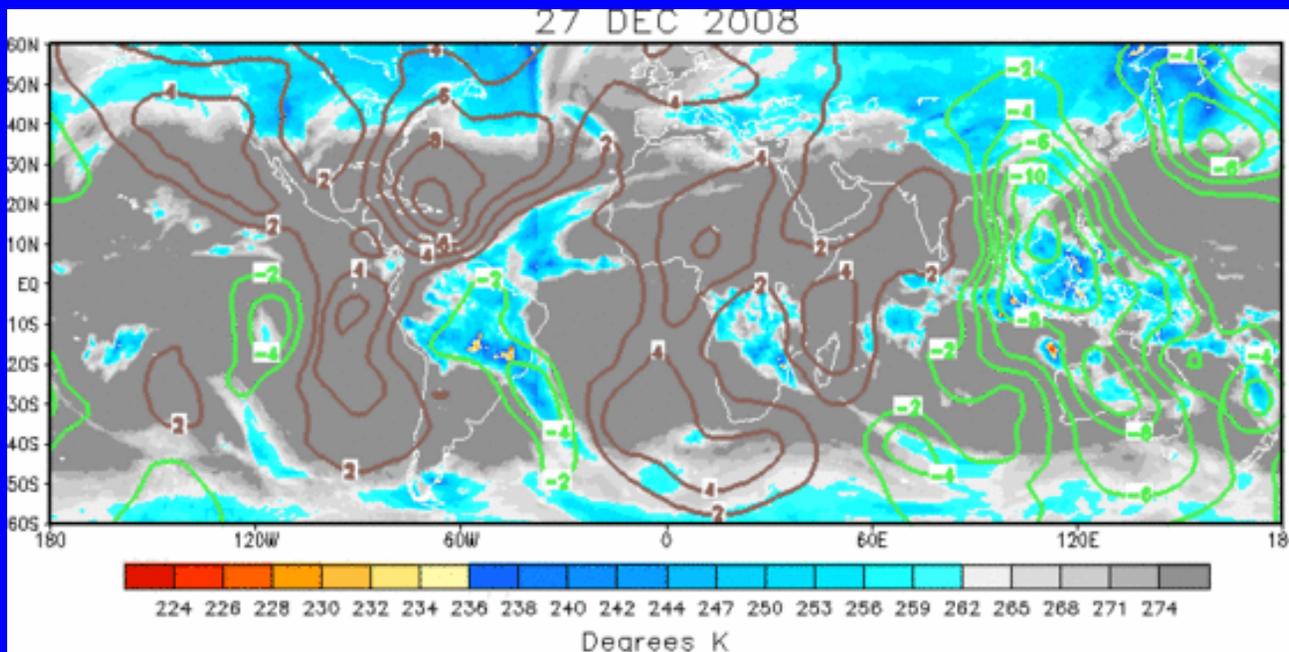
Since mid November, the subseasonal activity has been organizing on a faster time scale.



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

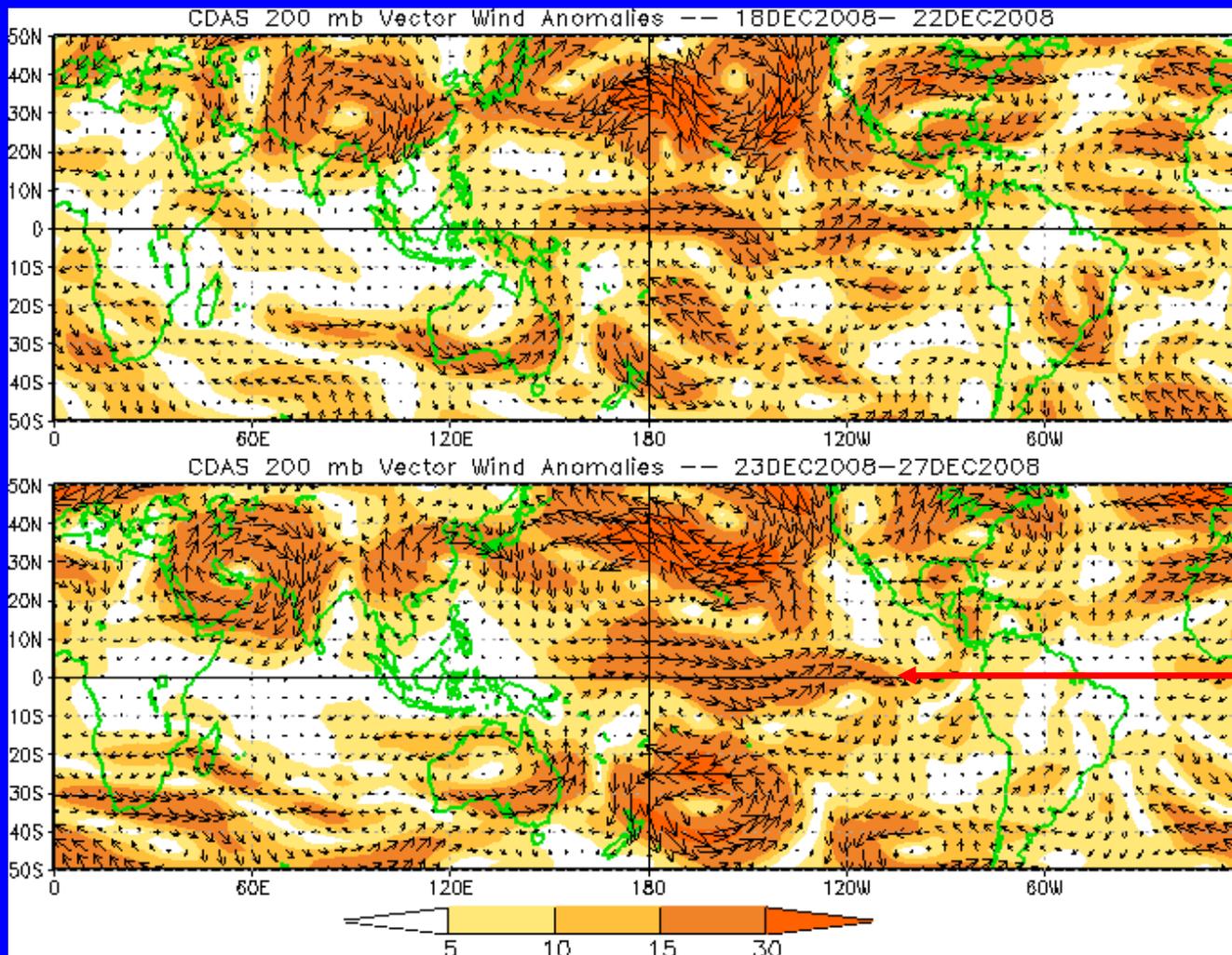


The velocity potential pattern has become more organized with upper level divergence centered over the Maritime Continent.



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

Note that shading denotes the magnitude of anomalous wind vectors



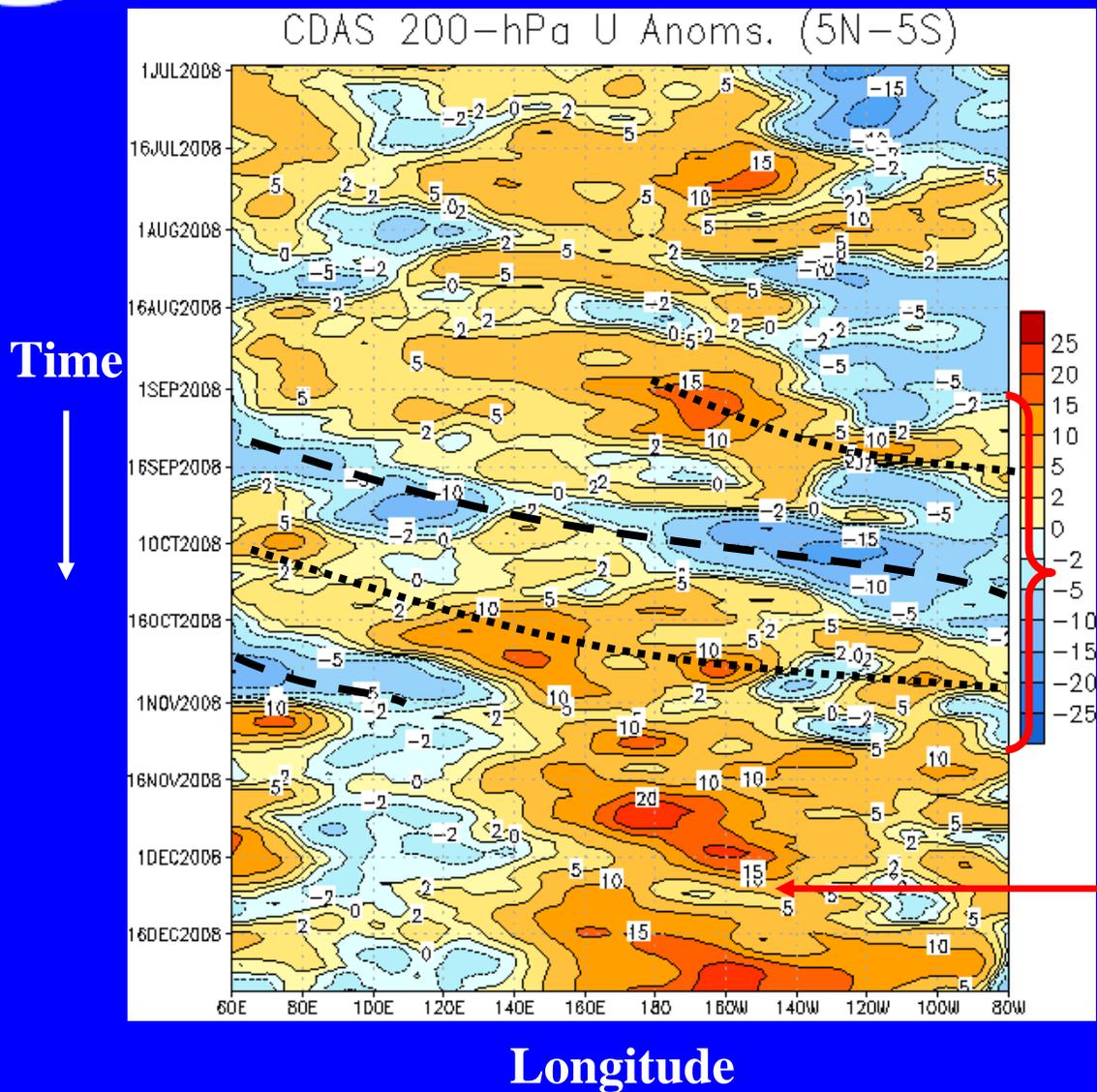
Westerly anomalies have strengthened over the central Pacific Ocean.



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



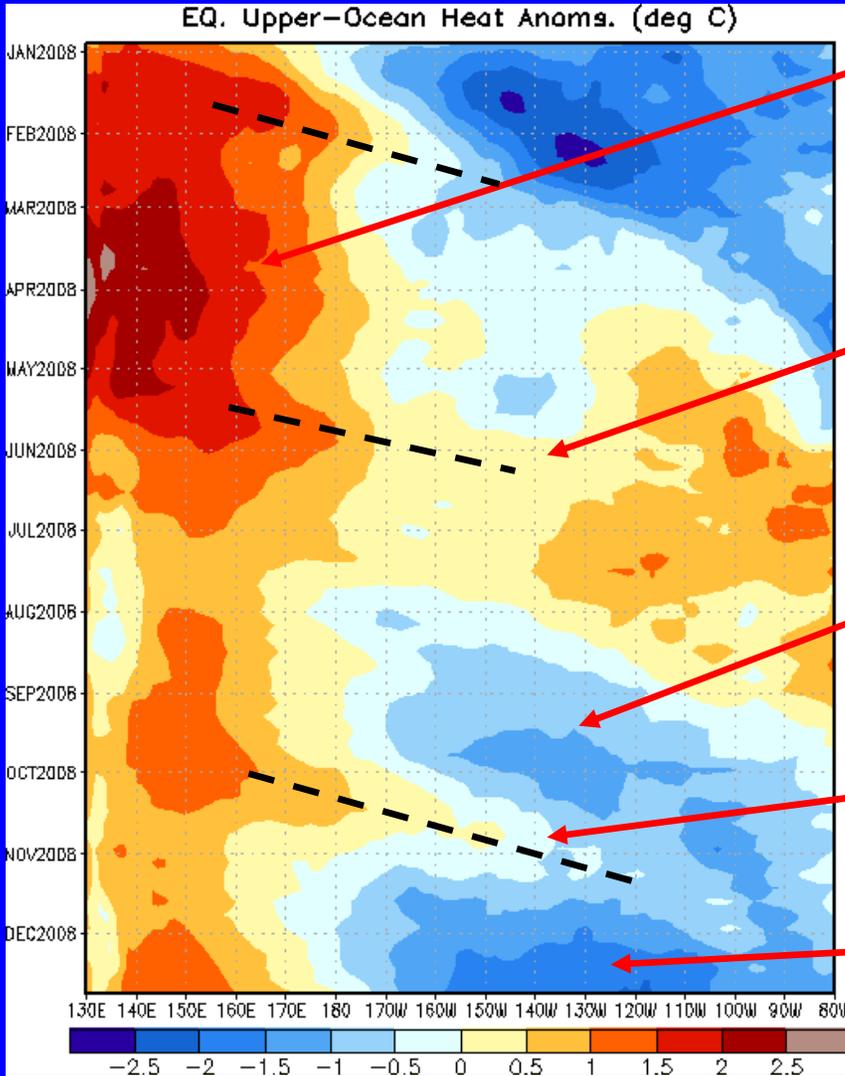
Westerly and easterly anomalies associated with the MJO activity shifted eastward during September and October.

Westerly anomalies strengthened markedly in mid-November near the Date Line and have persisted into December.



Weekly Heat Content Evolution in the Equatorial Pacific

Time
↓



Longitude

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).

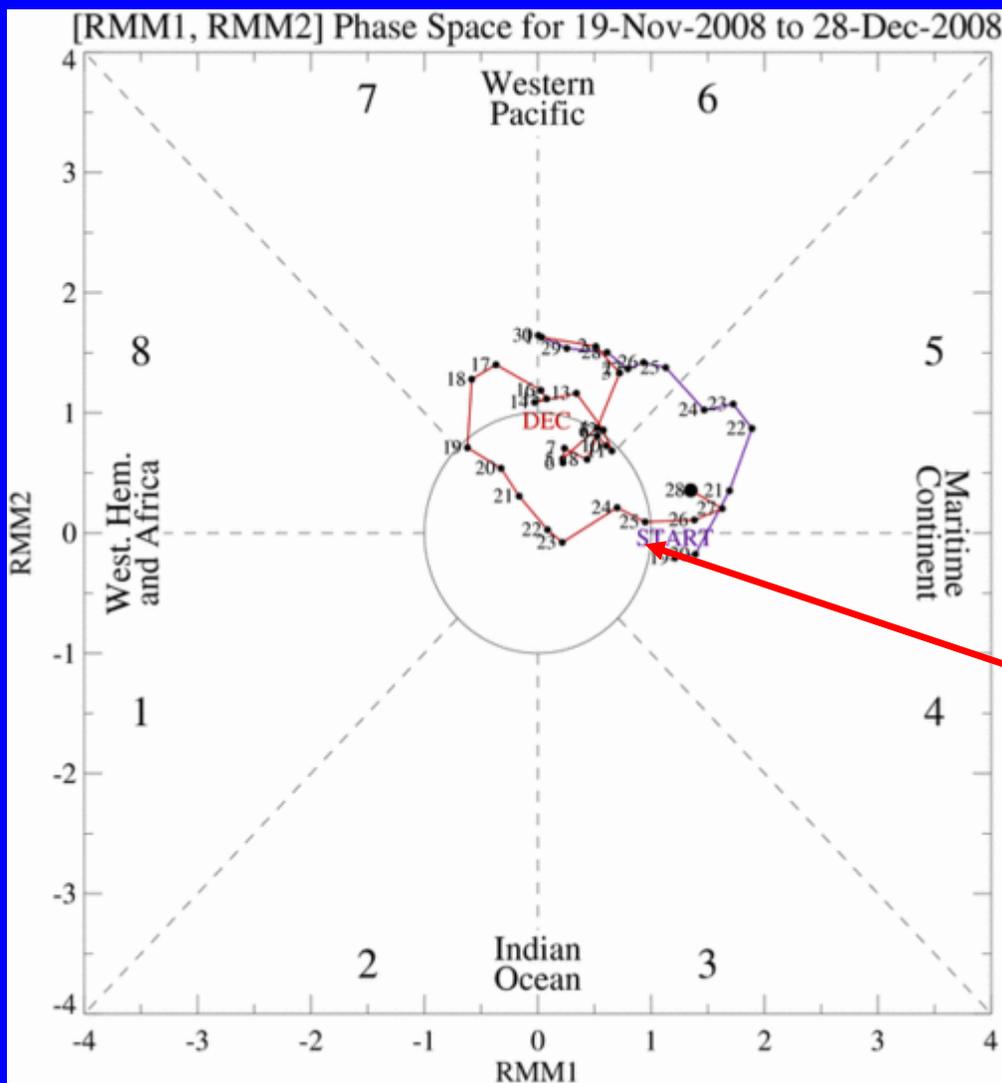
Wheeler M. and H. Hendon, 2004: An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction, *Monthly Weather Review*, 132, 1917-1932.

- 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

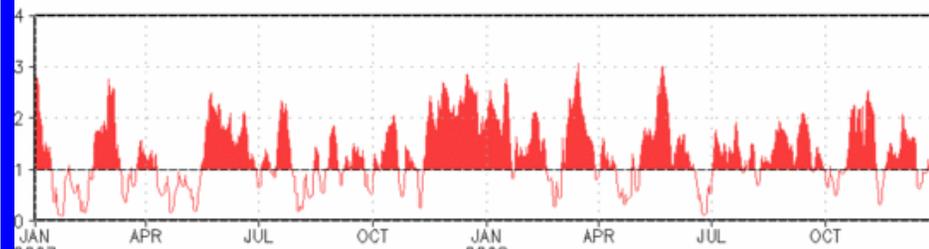
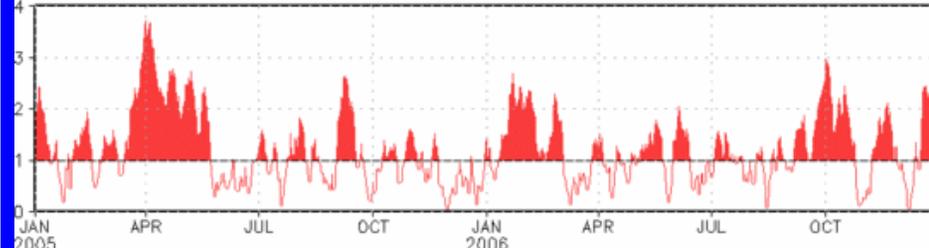
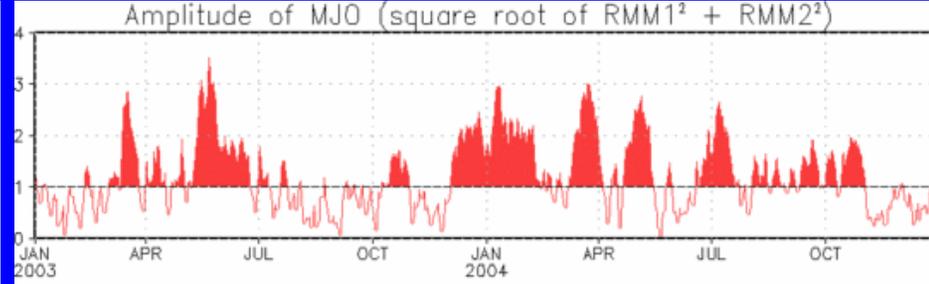
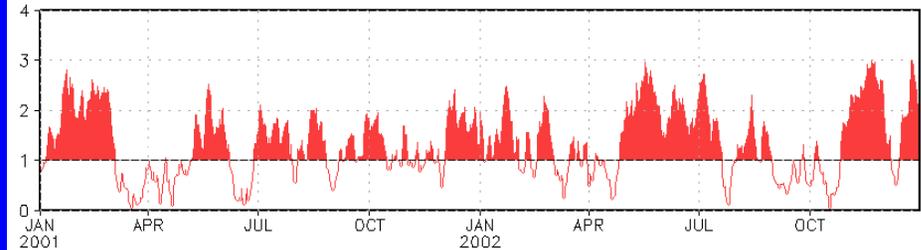
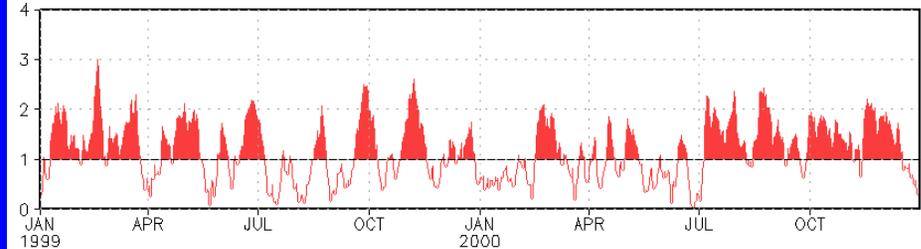
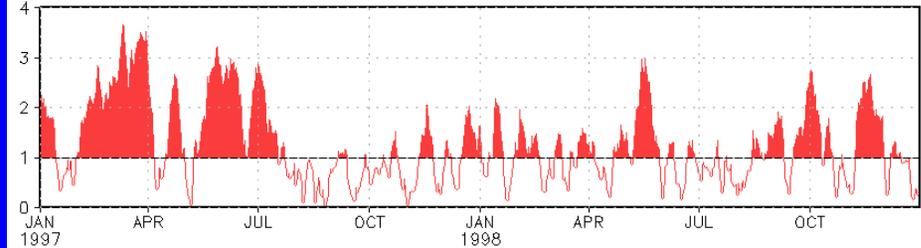
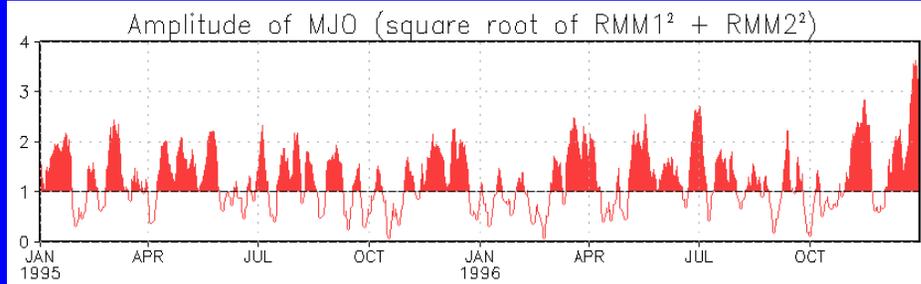
- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation
- Distance from the origin is proportional to MJO strength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



The MJO index indicates weak activity during the last week.



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



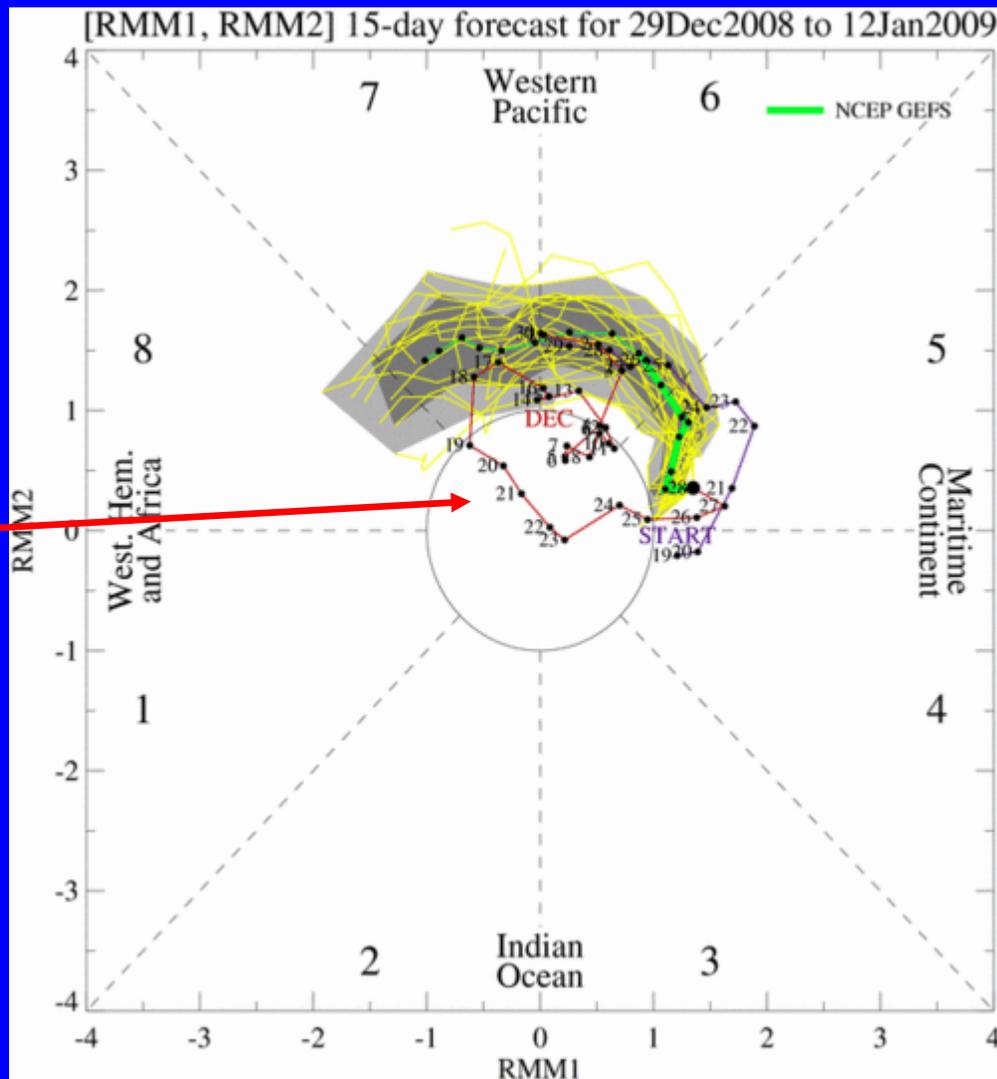
Ensemble GFS (GEFS) MJO Forecast

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 a moderate MJO to shift eastward from the Maritime Continent to the Western Pacific during weeks 1 and 2.

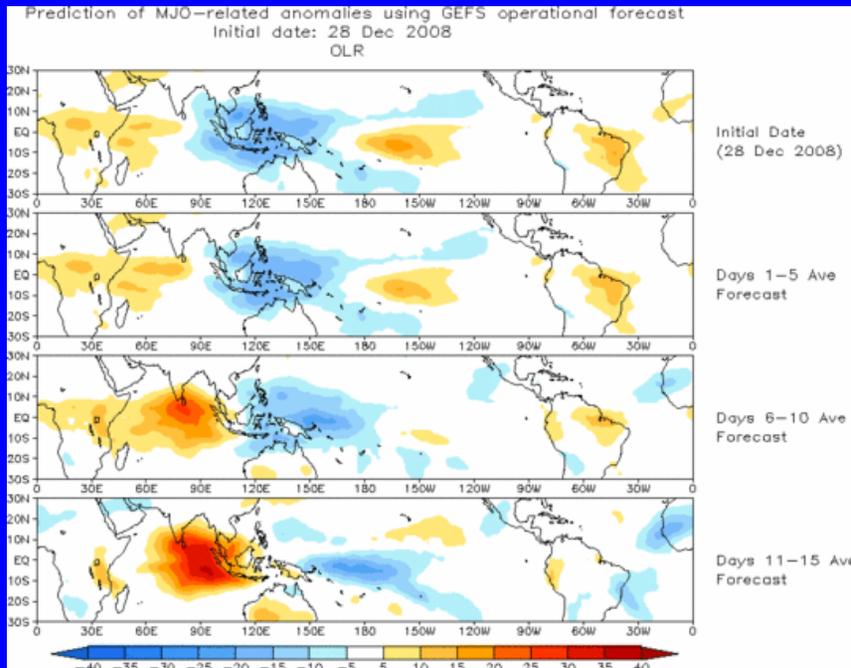




Ensemble Mean GFS MJO Forecast

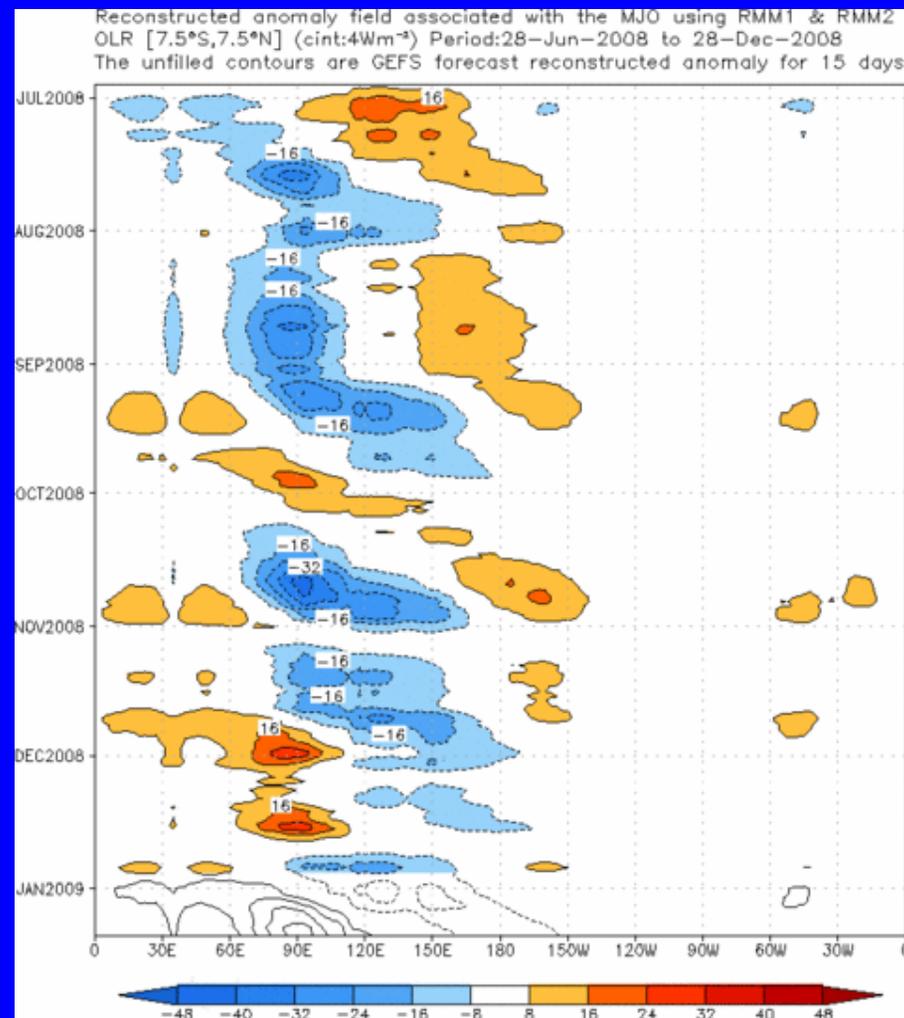
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days



MJO-related enhanced convection is forecast across the Maritime Continent during week 1 and western Pacific during week 2. Suppressed convection is forecast for the eastern Indian Ocean during week 2

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





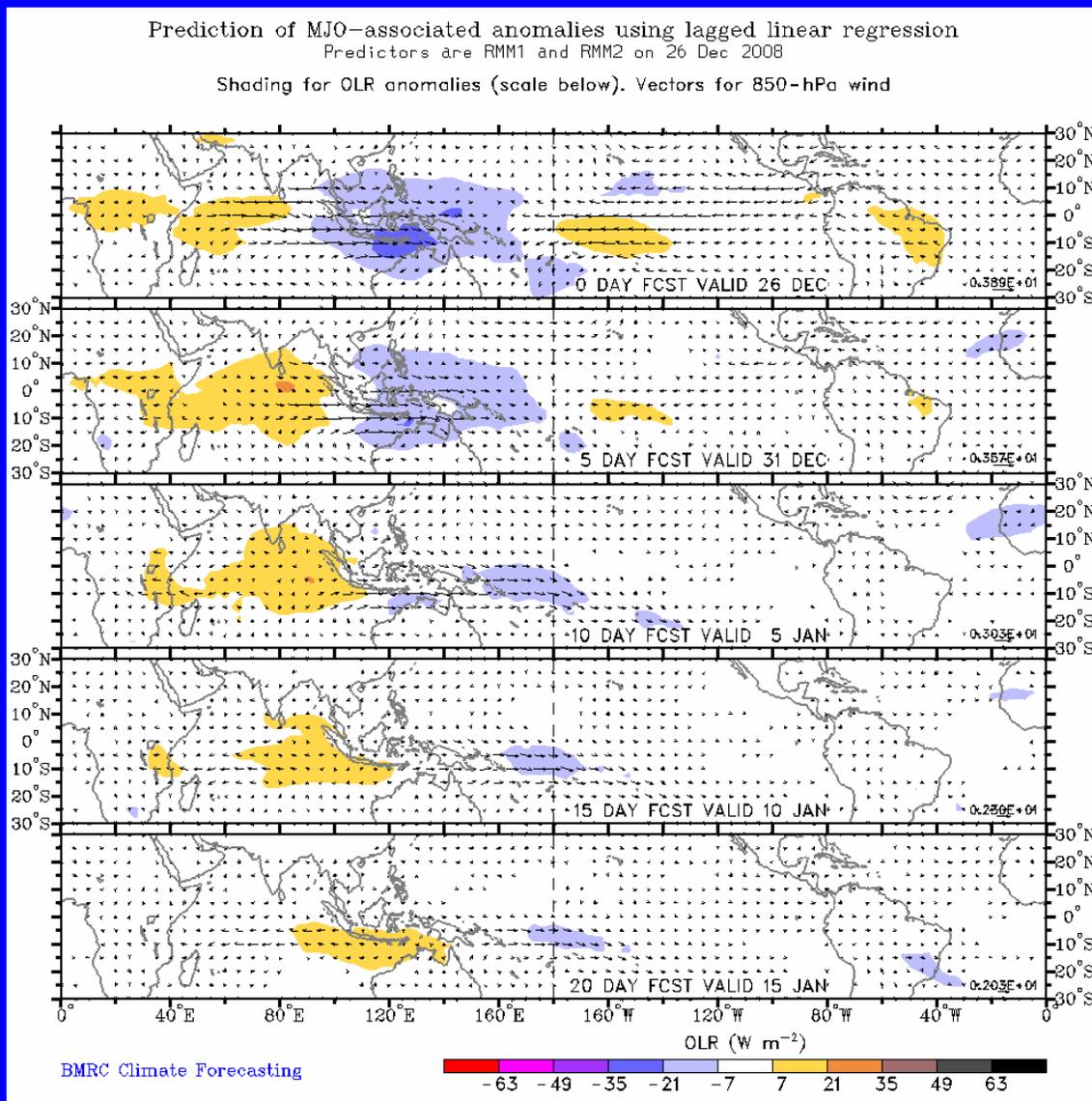
Statistical MJO Forecast

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)

Enhanced convection associated with the MJO is predicted to shift eastward from the Maritime Continent towards the dateline as it weakens. Suppressed convection is predicted to develop over the Indian Ocean





MJO Composites – Global Tropics

Precipitation Anomalies (Nov-Mar)

850-hPa Wind Anomalies (Nov-Mar)

