



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

**Update prepared by
Climate Prediction Center / NCEP
September 20, 2010**



Outline

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



Overview

- The MJO signal remained weak during the past week.
- All dynamical model MJO index forecasts indicate weak or incoherent MJO activity during the upcoming period with large spread across these solutions.
- Based on recent observations, statistical MJO forecasts, and MJO dynamical forecast tools, the MJO is expected to remain weak 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>

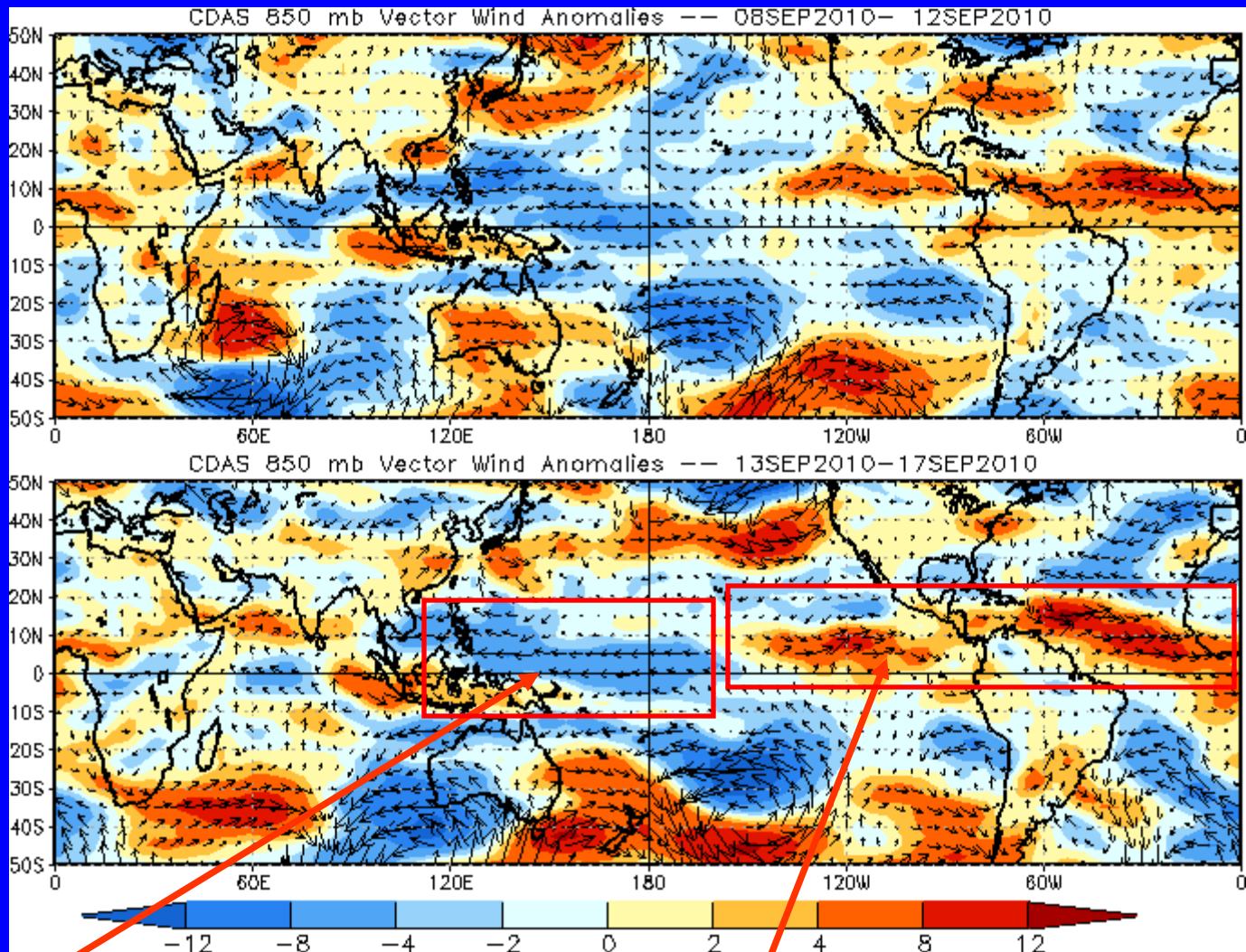


850-hPa Vector Wind Anomalies (m s^{-1})

Note that shading denotes the zonal wind anomaly

Blue shades: Easterly anomalies

Red shades: Westerly anomalies



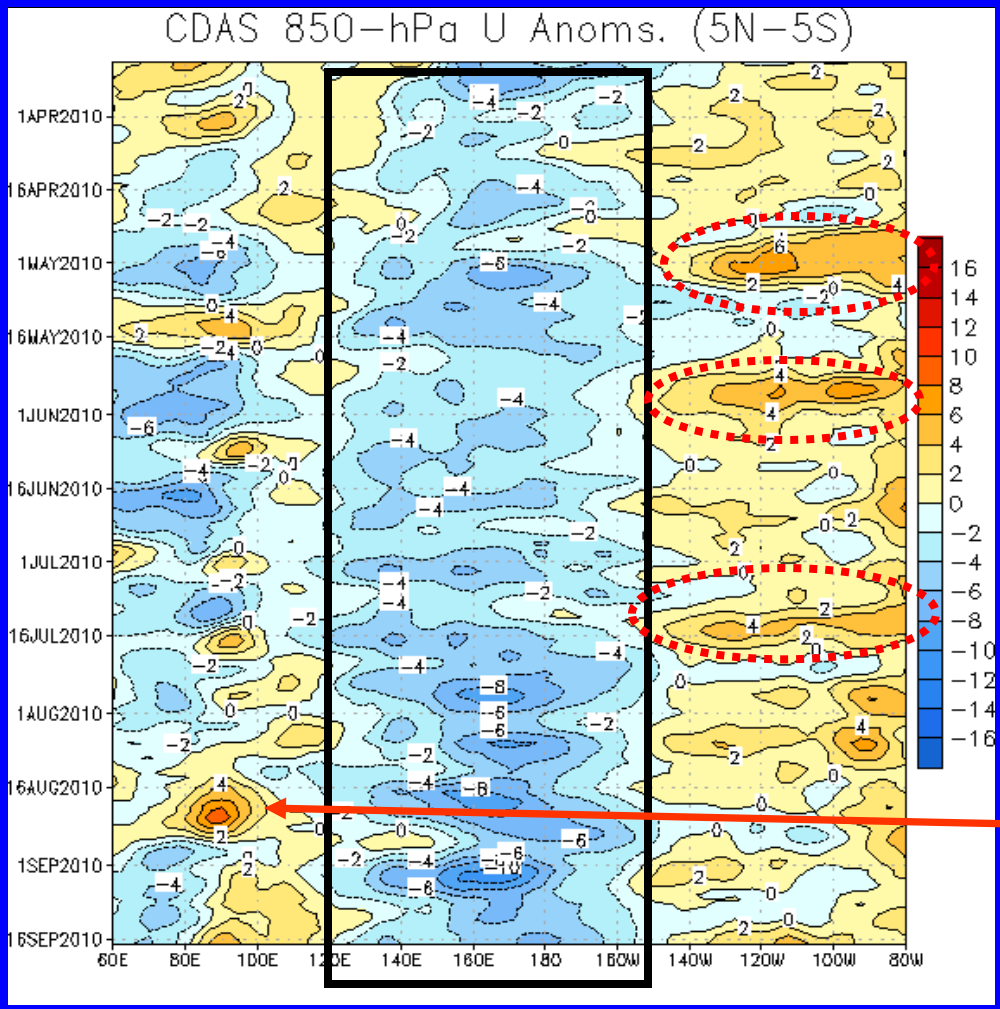
Easterly anomalies persisted across the western Pacific during the last five to ten days.

Westerly anomalies continued from the eastern Pacific across the Atlantic to west Africa.



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 have persisted in the west-central Pacific since mid-March (black box) consistent with the development of La Nina conditions.

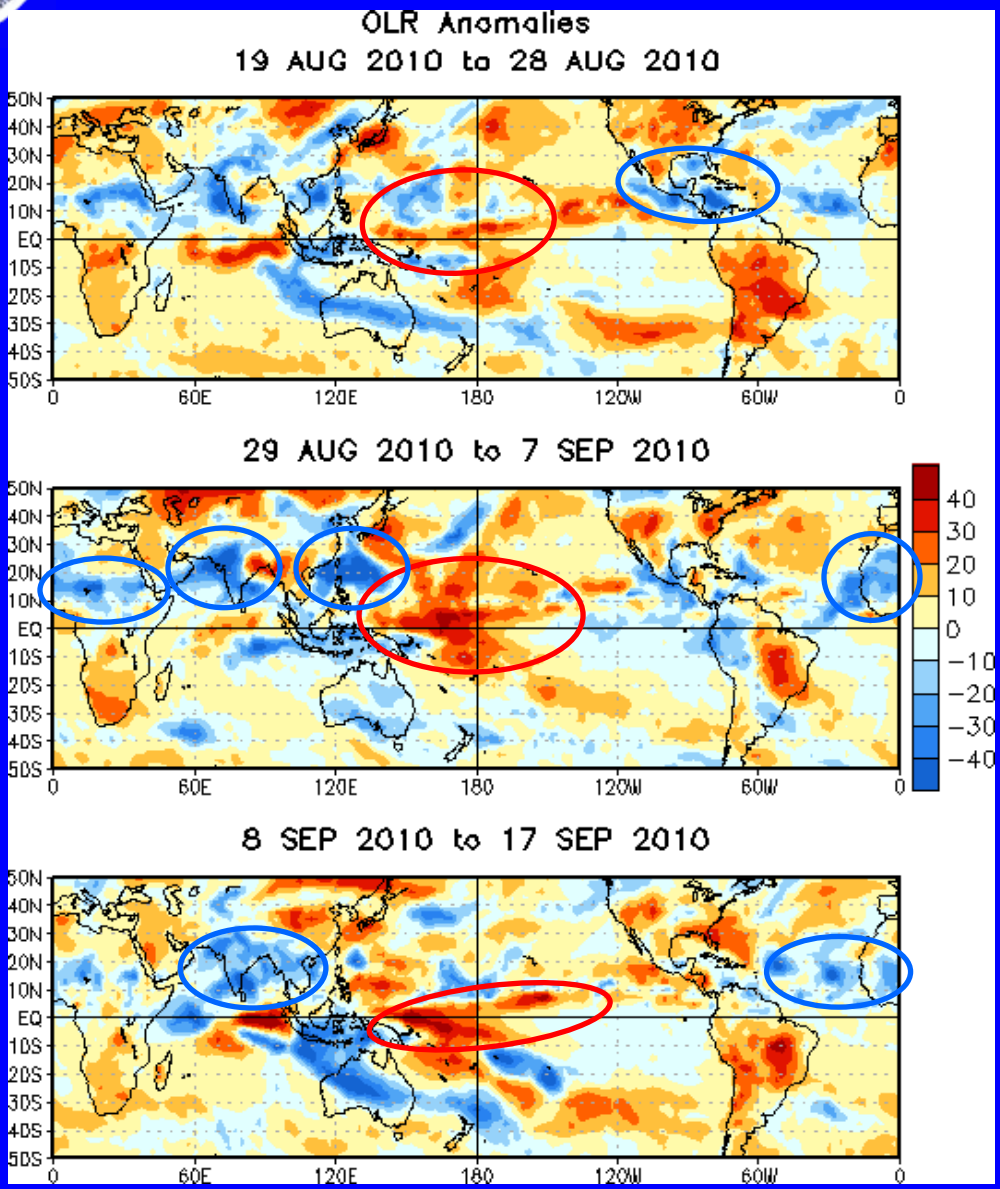
Enhanced westerly anomalies (red dotted ovals) occurred across the eastern Pacific on separate occasions during late April, late May and early-to-mid July and these were in part associated with MJO activity.

During mid-August, westerly anomalies strengthened at 90E, enhancing low-level convergence over the western Maritime Continent.



OLR Anomalies – Past 30 days

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



During mid-to-late August, convection (red oval) near the Date Line and in the western Pacific became less suppressed with areas of enhanced convection evident. Also, enhanced convection was evident across Central America and the Atlantic (blue ovals).

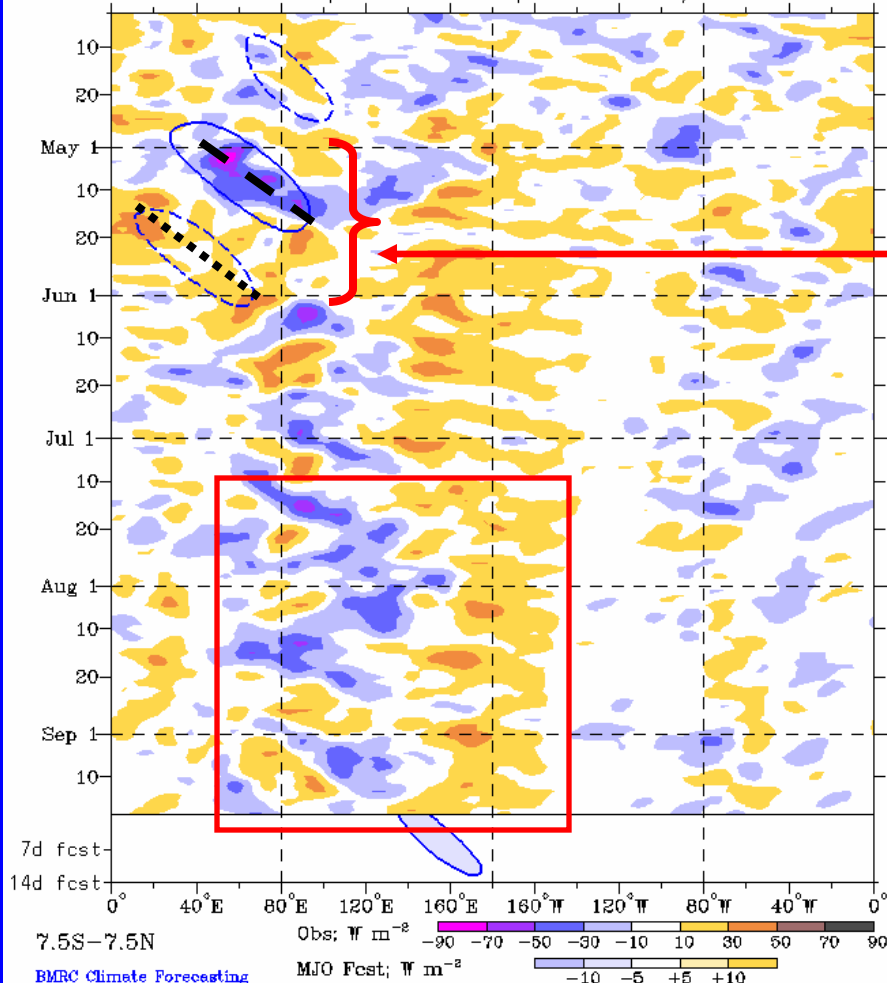
In late August to early September, wetter-than-average conditions continued across parts of southern Asia, Indonesia and the far western Pacific. Enhanced convection developed over most of Africa.

Enhanced convection continued over west Africa and the Atlantic during mid September with suppressed convection continuing across the west-central Pacific. Enhanced rainfall was also evident across much of southern Asia.



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

Real-time MJO filtering superimposed upon 3drm R21 OLR Anomalies
MJO anomalies blue contours, CINT=10. (5. for forecast)
Negative contours solid, positive dashed
3-Apr-2010 to 18-Sep-2010 + 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 (BOM) - Australia)

Enhanced convection, in part associated with the MJO, developed across the Indian Ocean in early May and shifted eastward. Suppressed convection developed across much of Africa in its wake.

Since mid-July, generally enhanced (suppressed) convection has prevailed across the western Maritime continent (Date Line) (red box). Considerable intraseasonal variability is evident during the period as enhanced convection has shifted both eastward and westward in this area during the period.

Longitude

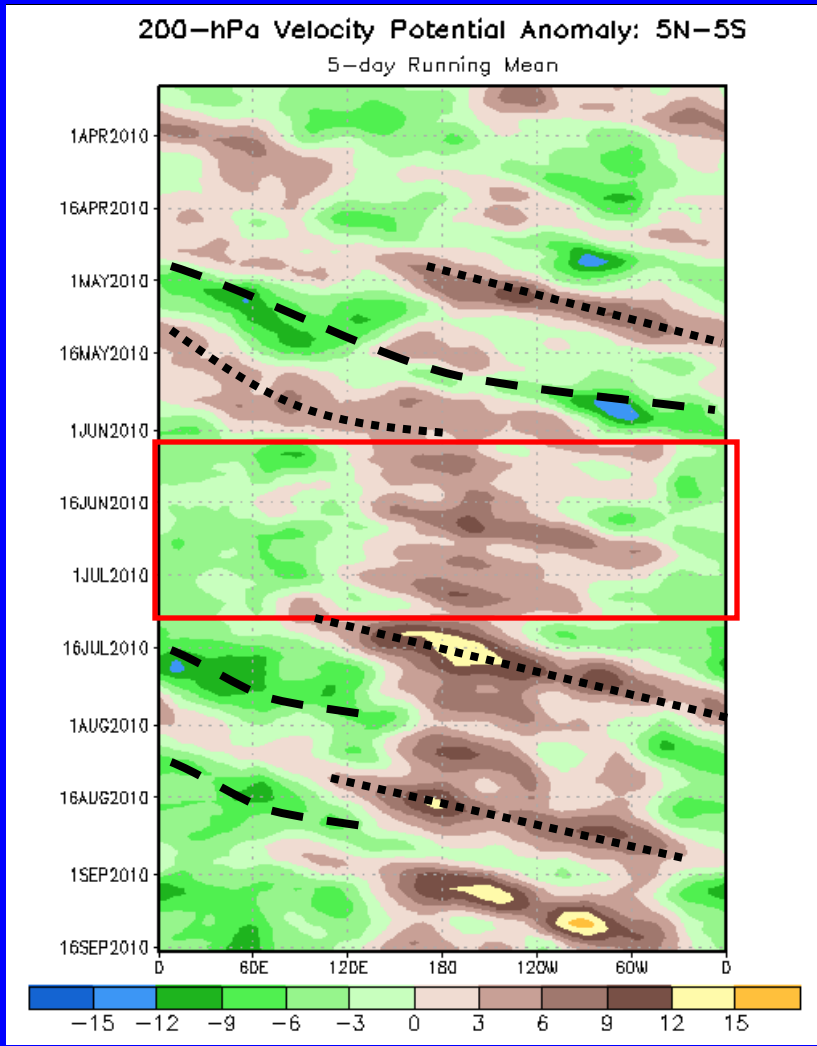


200-hPa Velocity Potential Anomalies (5°S-5°N)

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation

Negative anomalies (green shading) indicate favorable conditions for precipitation

Time
↓



In late April and into May, anomalies increased and eastward propagation was evident, coincident with the MJO.

From early June to early July, anomalies became more stationary in nature (red box) with upper-level convergence primarily located across the central Pacific and divergence stretching from the Atlantic to the Indian Ocean.

Eastward propagation was evident during mid-July and mid-August.

Eastward propagation in September has mainly been associated with higher frequency coherent tropical variability rather than the MJO.

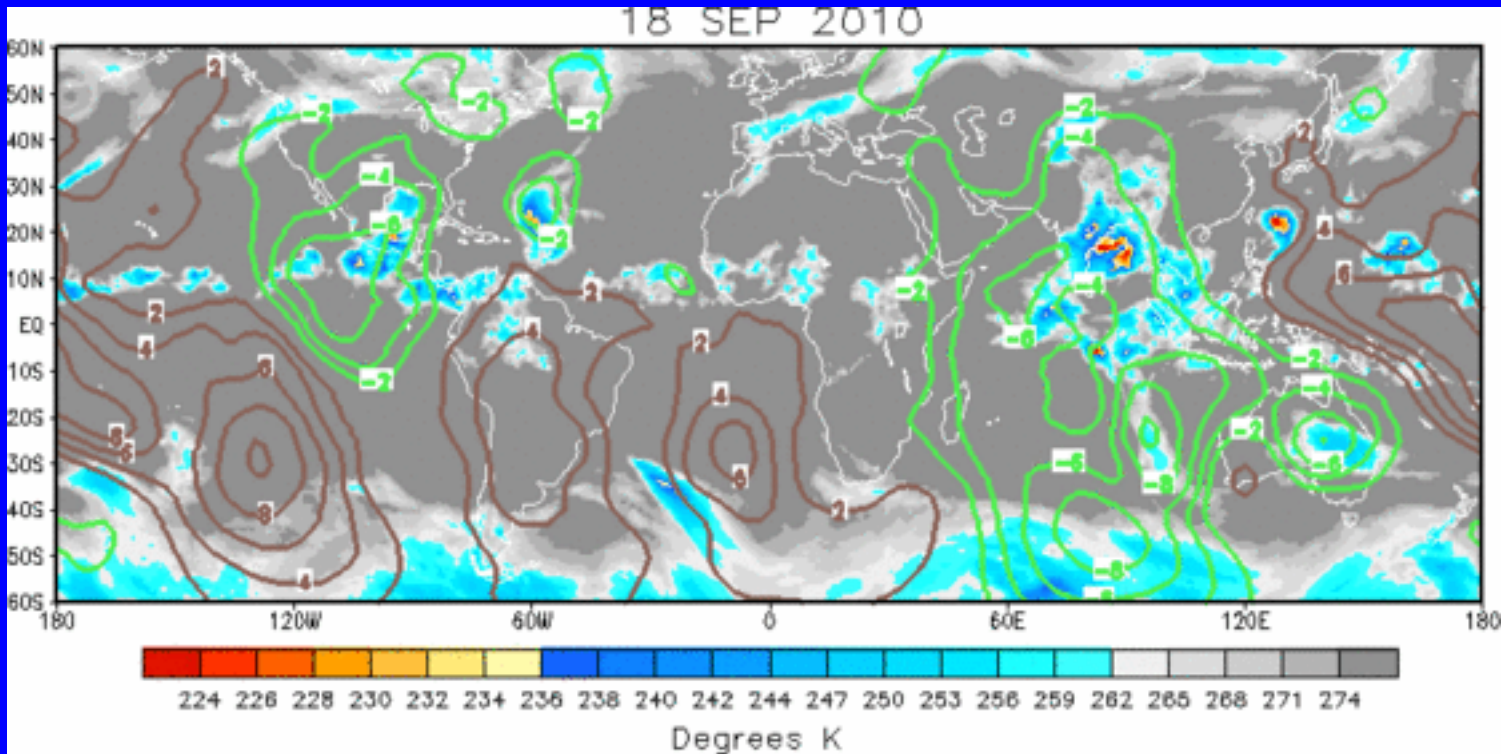
Longitude



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 anomalous velocity potential pattern shows upper-level divergence mainly evident across the eastern Pacific and Maritime Continent and upper-level convergence across the western and central Pacific.

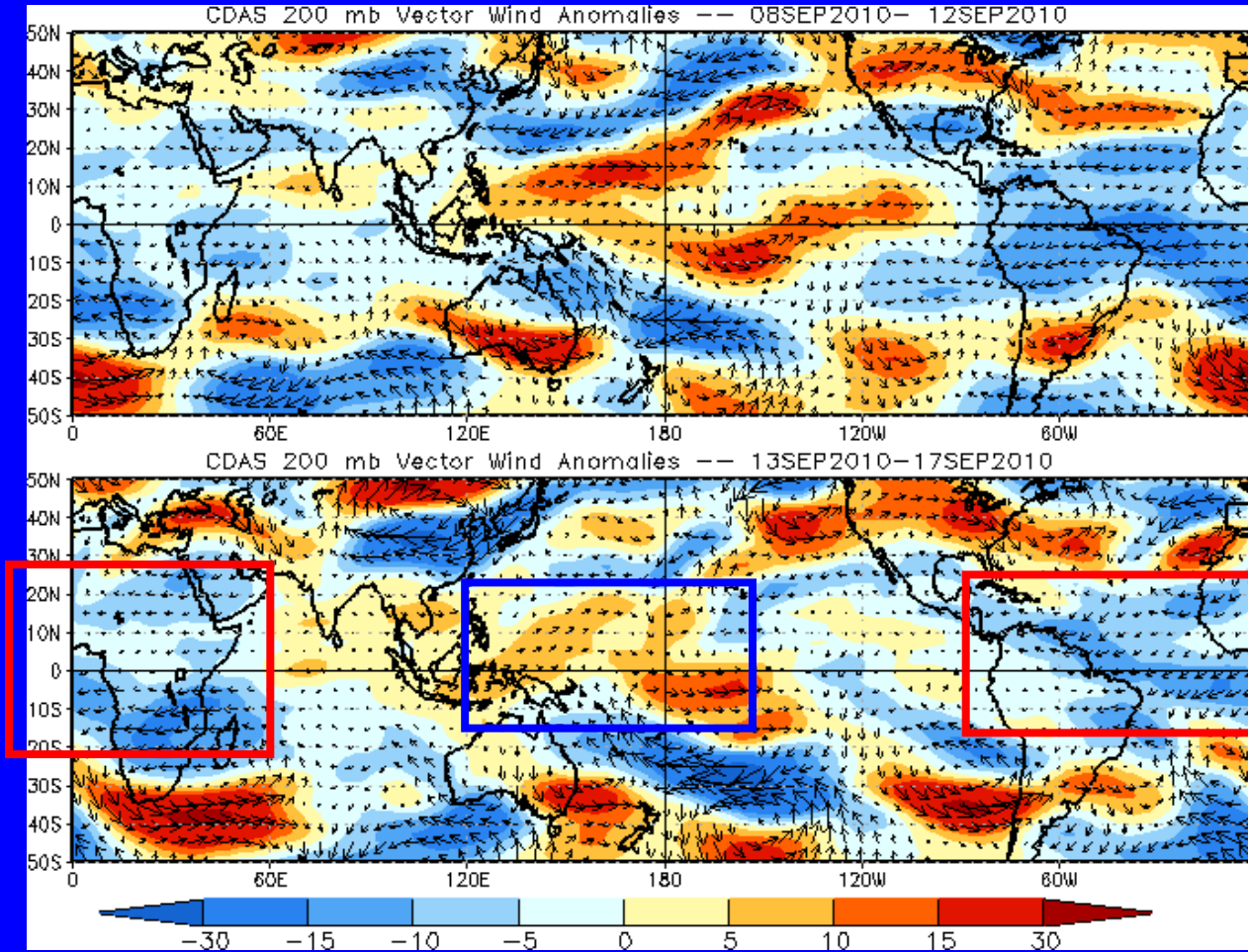


200-hPa Vector Wind Anomalies (m s^{-1})

Note that shading denotes the zonal wind anomaly

Blue shades: Easterly anomalies

Red shades: Westerly anomalies



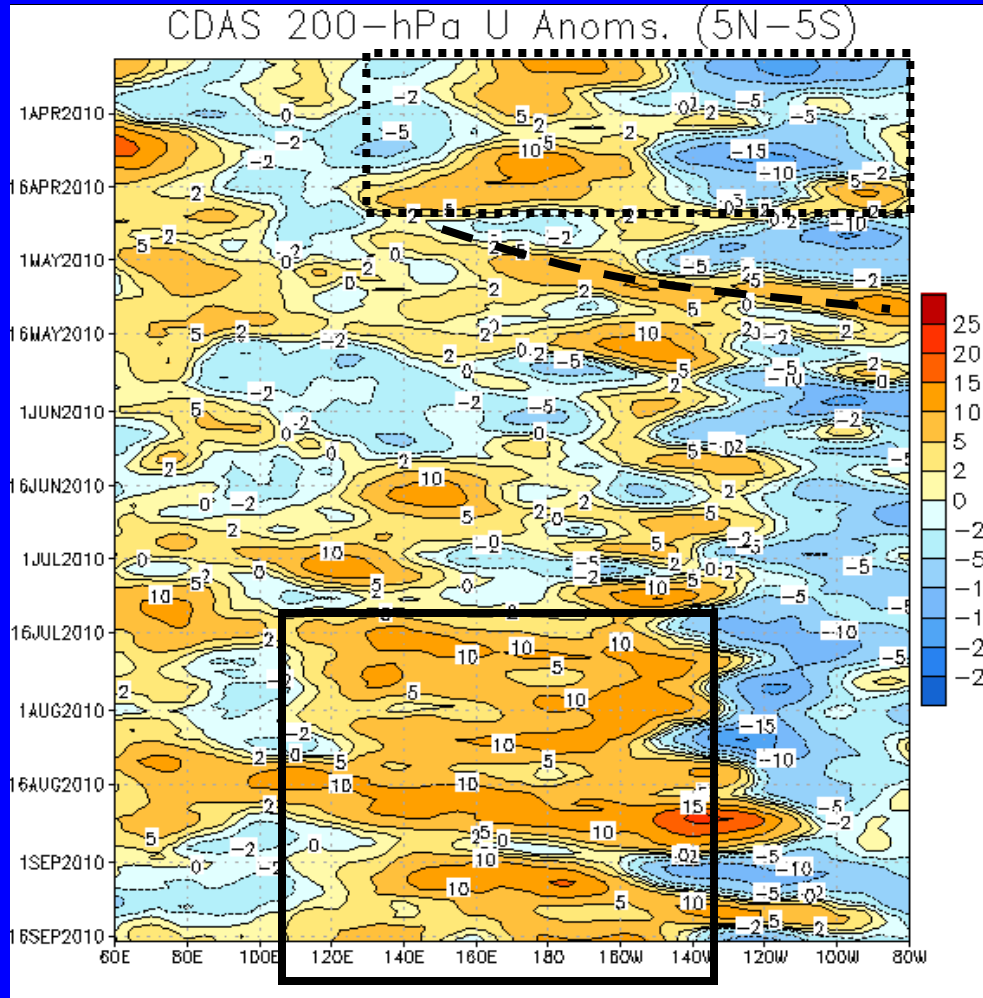
Westerly anomalies continued over the western Pacific although they have weakened during the last five days (blue box). Easterly anomalies continued across the Atlantic Ocean and Africa (red boxes).



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 (easterly) anomalies prevailed across the central (eastern) Pacific (red box) for much of the period during March and April (black dotted box).

In early May, there was some eastward propagation of westerly anomalies across the Pacific in association with the MJO at that time (dashed black line).

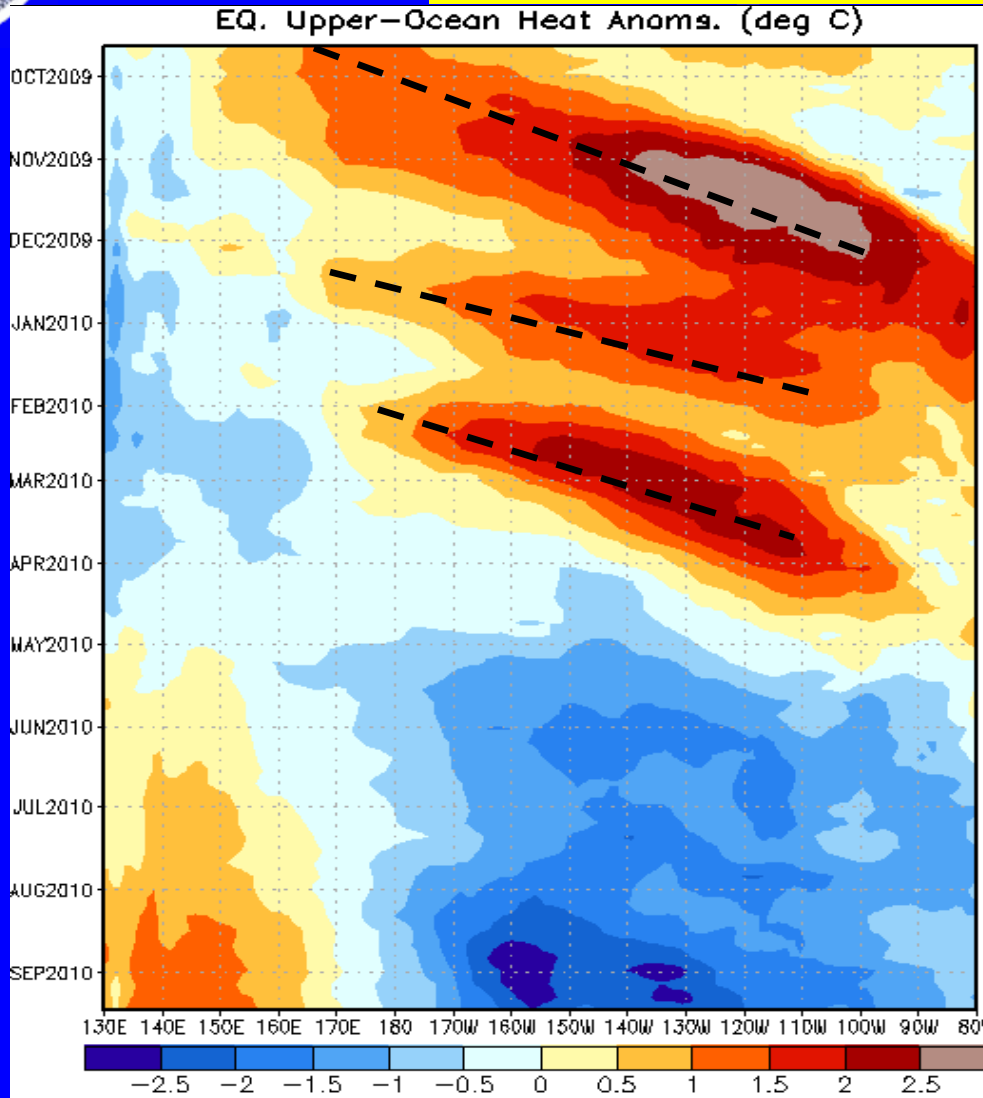
Westerly anomalies have persisted across a large area from the Maritime Continent to the central Pacific (black solid box) since early July.

Eastward propagation of westerly anomalies in August and September are not associated with the MJO.



Weekly Heat Content Evolution in the Equatorial Pacific

Time
↓



From Aug 2009 through March 2010, heat content anomalies remained above-average for much of the period.

From November 2009 – February 2010 three ocean Kelvin waves contributed to the change in heat content across the eastern Pacific (last three dashed black lines).

During April 2010 heat content anomalies decreased across the Pacific in association with the upwelling phase of a Kelvin wave and later during the early summer due to the development of La Nina.

Currently, negative heat content anomalies extend across the central and eastern Pacific with positive anomalies in the western Pacific.

Longitude



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.

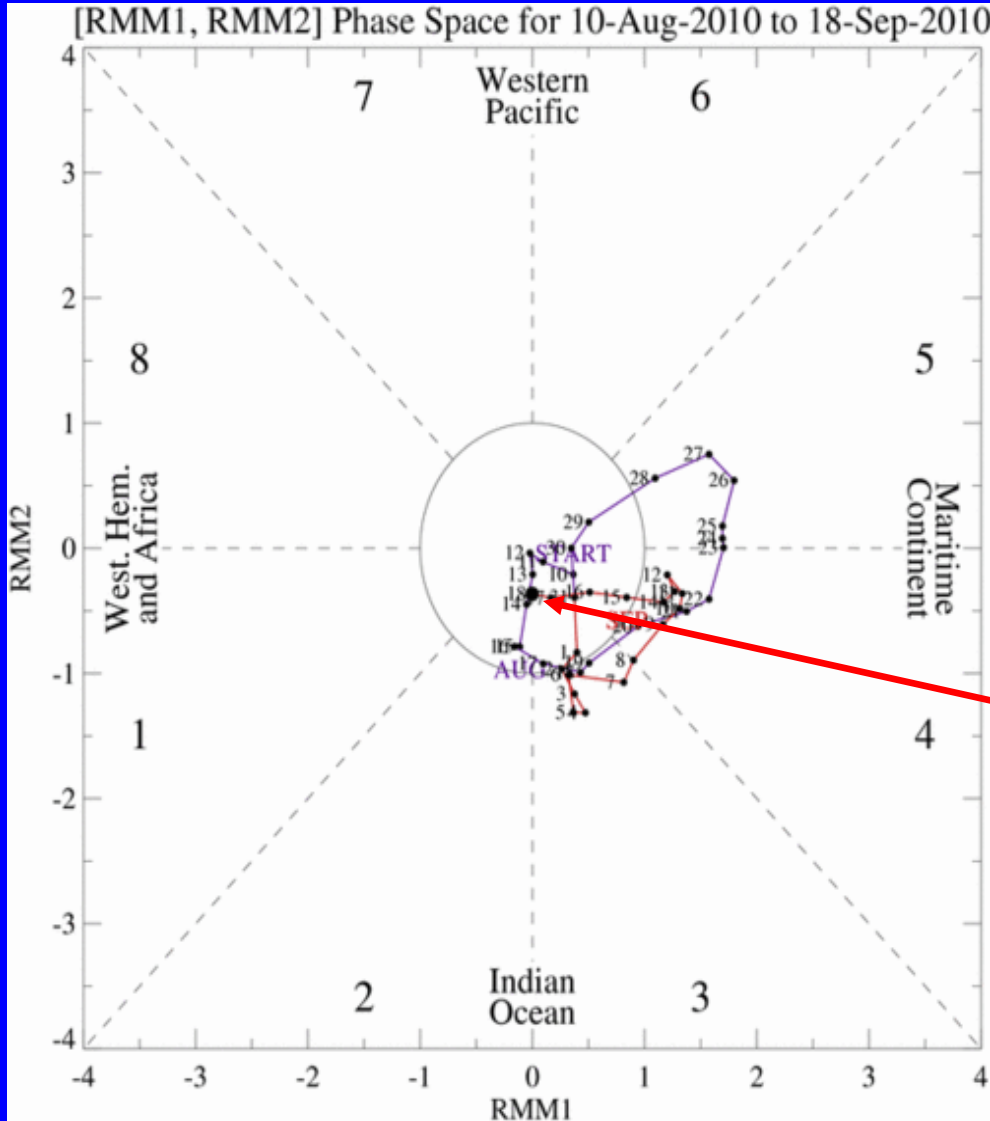
- The methodology is very similar to that described in WH2004 but does not include the linear removal of ENSO variability associated with a sea surface temperature index. The methodology is consistent with that outlined by the U.S. CLIVAR MJO Working Group.

Gottschalck et al. 2010: A Framework for Assessing Operational Model MJO Forecasts: A Project of the CLIVAR Madden-Julian Oscillation Working Group, *Bull. Amer. Met. Soc.*, In Press.

- 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

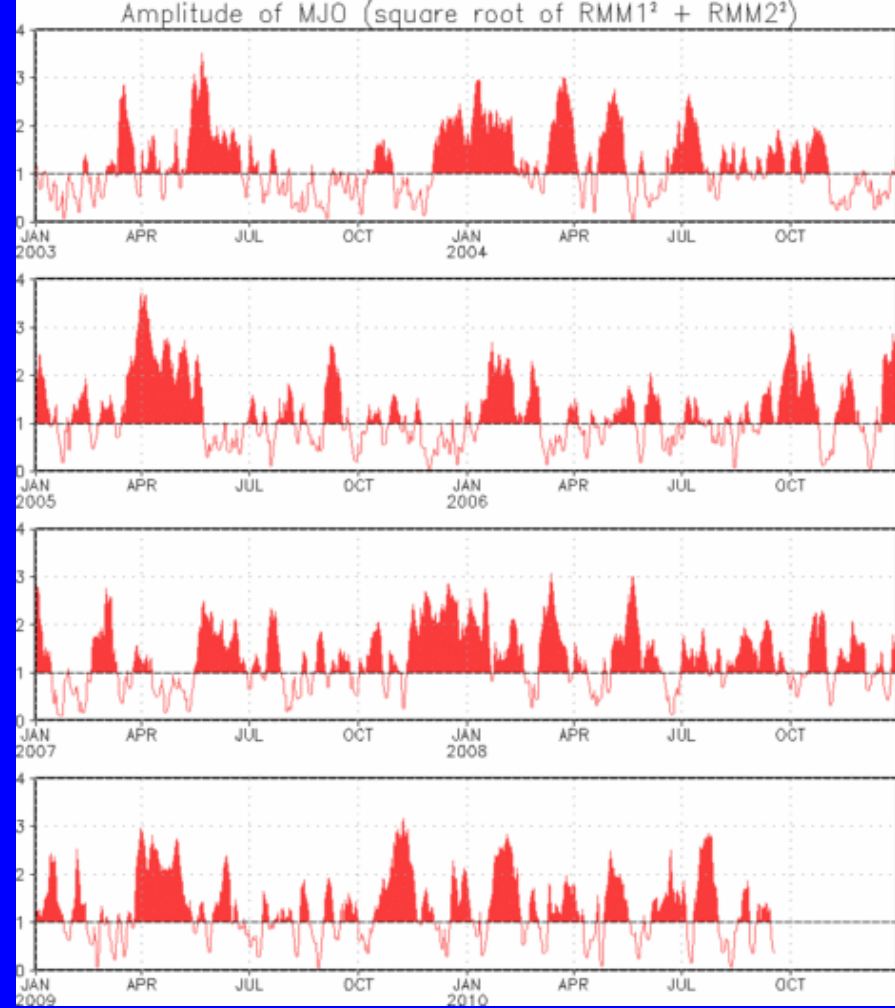
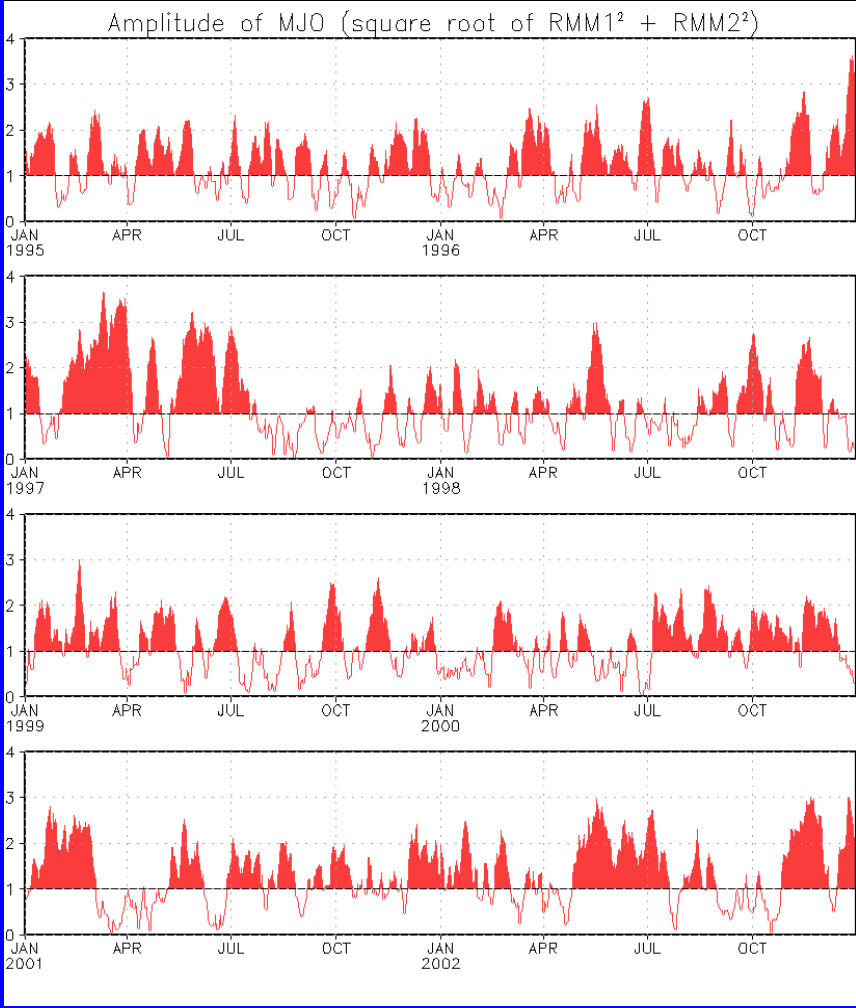


- The axes (RMM1 and RMM2) represent daily values of the principal components from the two leading modes
- The triangular areas indicate the location of the enhanced phase of the MJO
- Counter-clockwise motion is indicative of eastward propagation. Large dot most recent observation.
- Distance from the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

During the past week, the MJO index has indicated an incoherent 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.



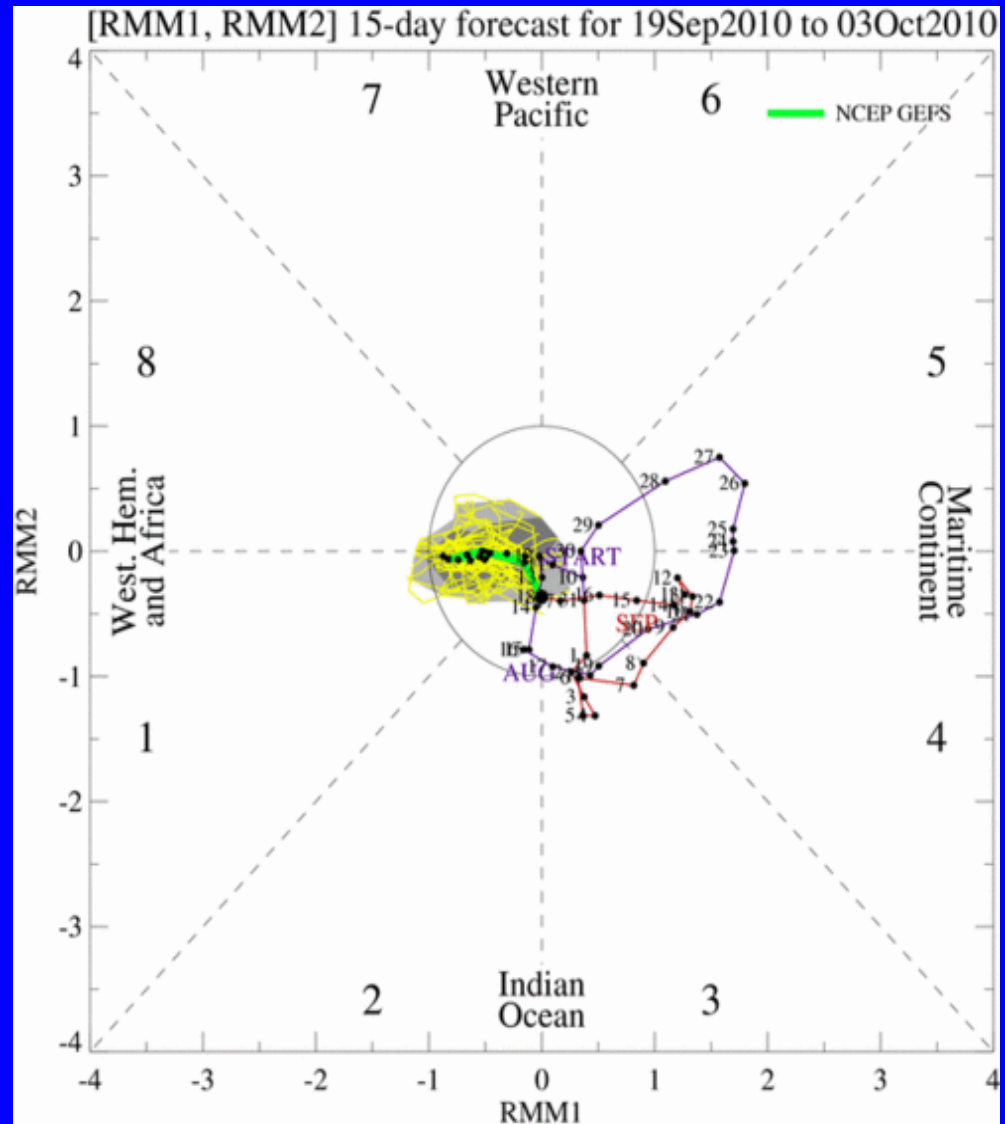
Ensemble GFS (GEFS) MJO Forecast

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 GFS forecasts indicate weak MJO activity during the next two weeks.



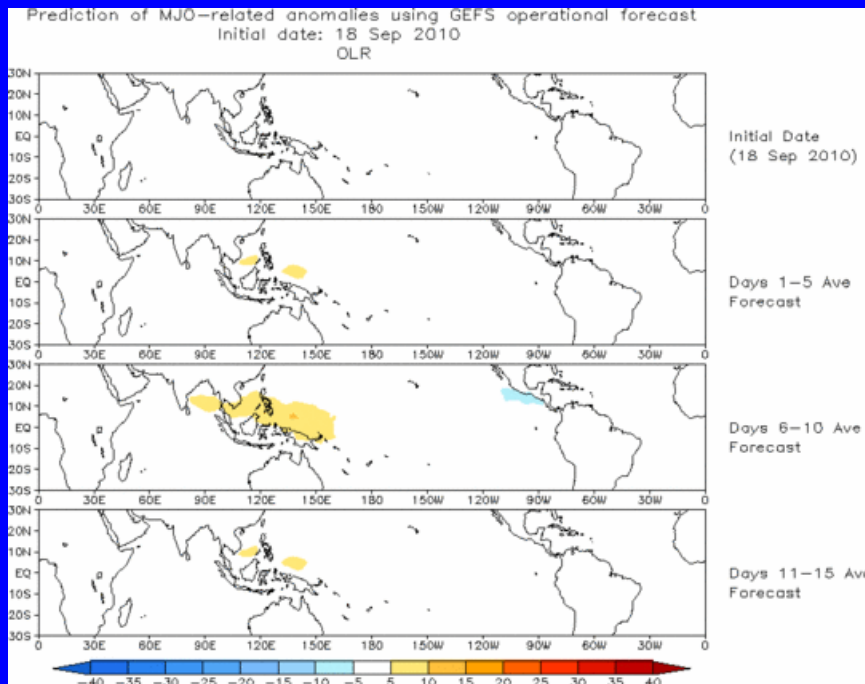


Ensemble Mean GFS MJO Forecast

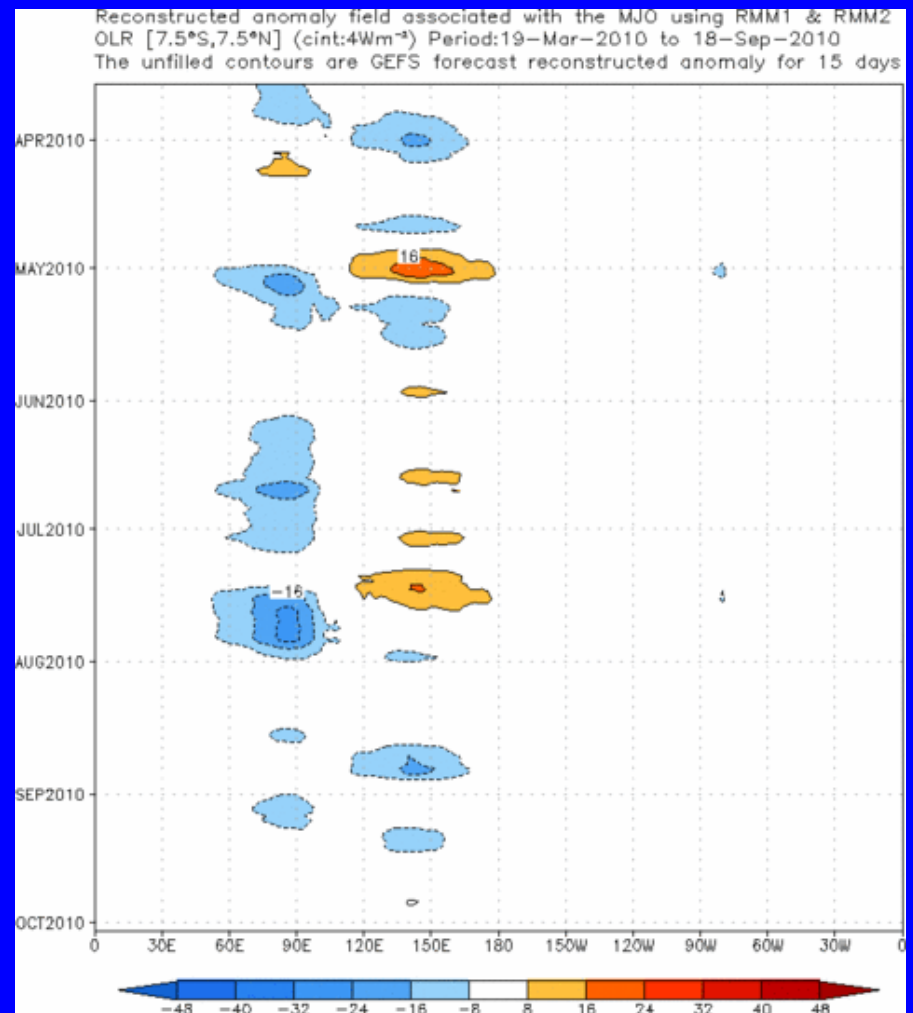
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons)

Spatial map of OLR anomalies for the next 15 days

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



The GEFS ensemble mean forecast indicates very weak convective anomalies during the period.





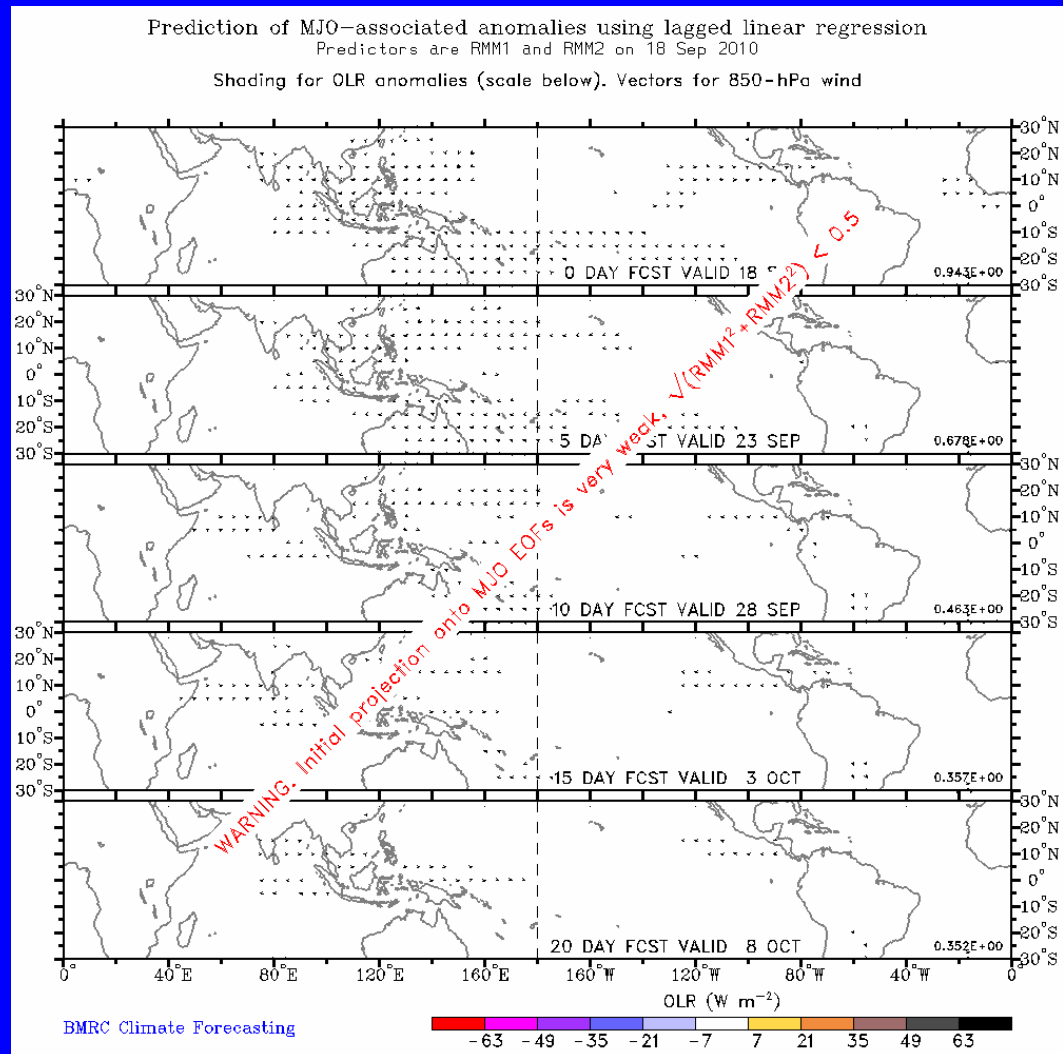
Statistical MJO Forecast

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 vectors for the next 20 days

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

Weak MJO activity is forecast during the period.





MJO Composites – Global Tropics

Precipitation Anomalies (May-Sep)

850-hPa Wind Anomalies (May-Sep)

