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

Update prepared by
Climate Prediction Center / NCEP
December 10, 2007

Outline

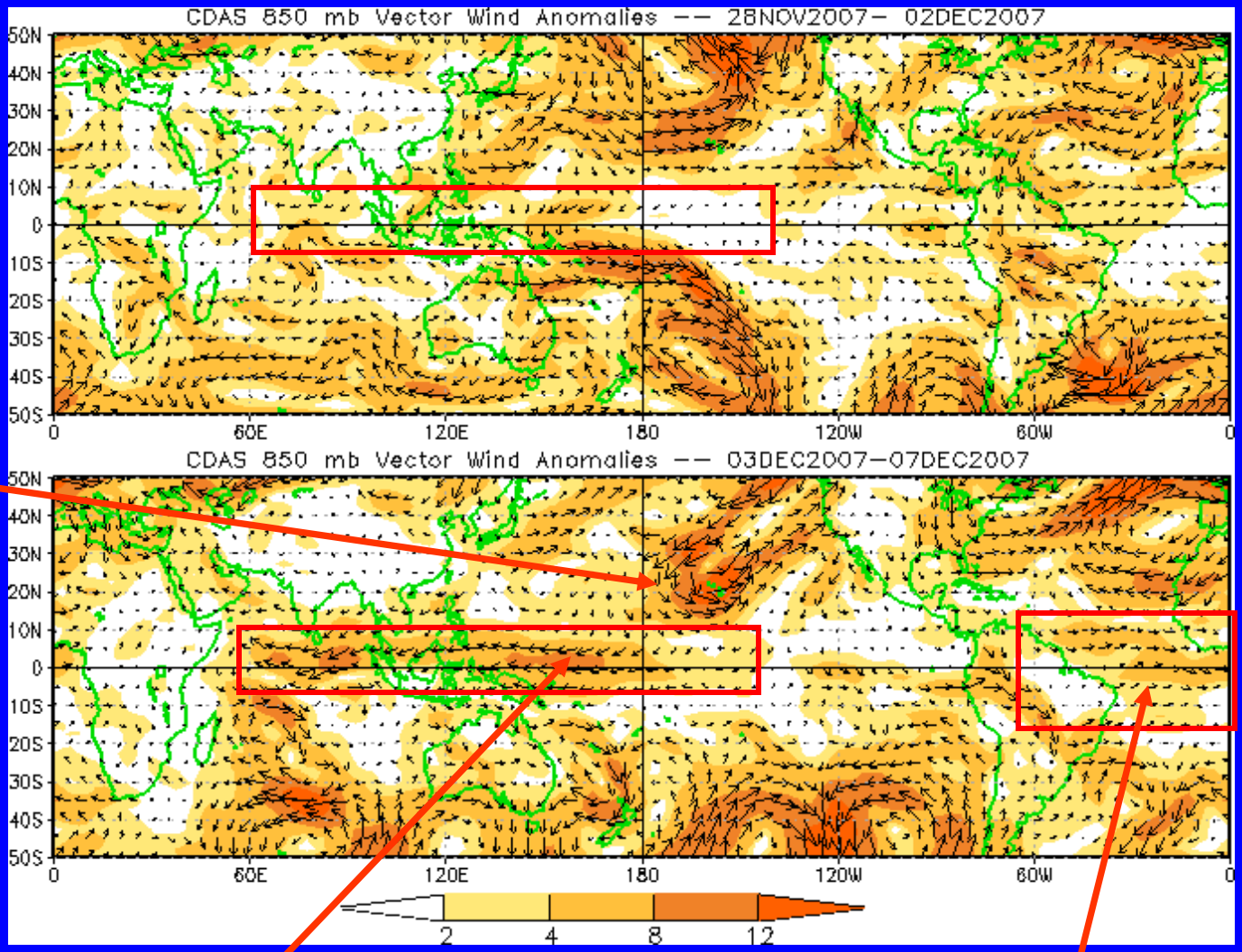
- Overview
- Recent Evolution and Current Conditions
- Madden-Julian Oscillation Forecast

Overview

- Moderate MJO activity continues.
- The enhanced phase is now centered in the Indian Ocean while large-scale suppressed convection extends from the Pacific Ocean into the western hemisphere.
- Continued propagation of the MJO is likely in the short-term (within week 1) but a substantial decrease in eastward movement is likely.
- Most dynamical MJO forecast tools indicate the enhanced phase of the MJO will generally be located across the eastern Indian Ocean and western Maritime continent during much of the period.
- Likely impacts across the global tropics include wet conditions stretching from the equatorial Indian Ocean to the Maritime continent and an elevated risk of tropical cyclogenesis for the central Indian Ocean (week 1) and later the waters northwest of Australia (week 2).

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

Note that shading denotes the magnitude of the anomalous wind vectors

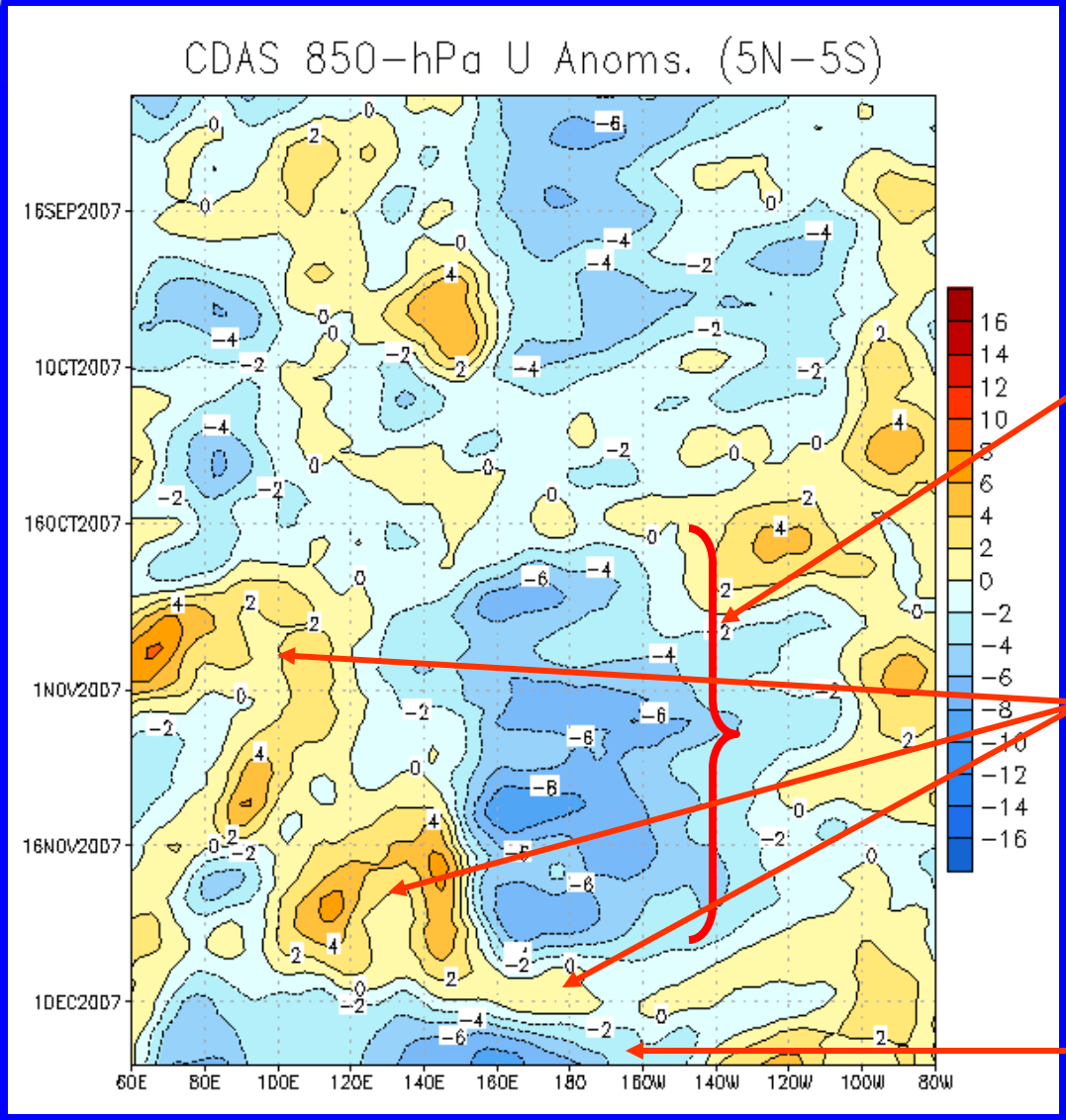


Anomalous cyclonic circulation is evident near Hawaii during the last five days.

Easterly wind anomalies have emerged from the equatorial central Indian Ocean into the western Pacific consistent with the propagation of the MJO.

Westerly wind anomalies developed across the Atlantic Ocean and Africa near the equator.

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



Time

Longitude

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

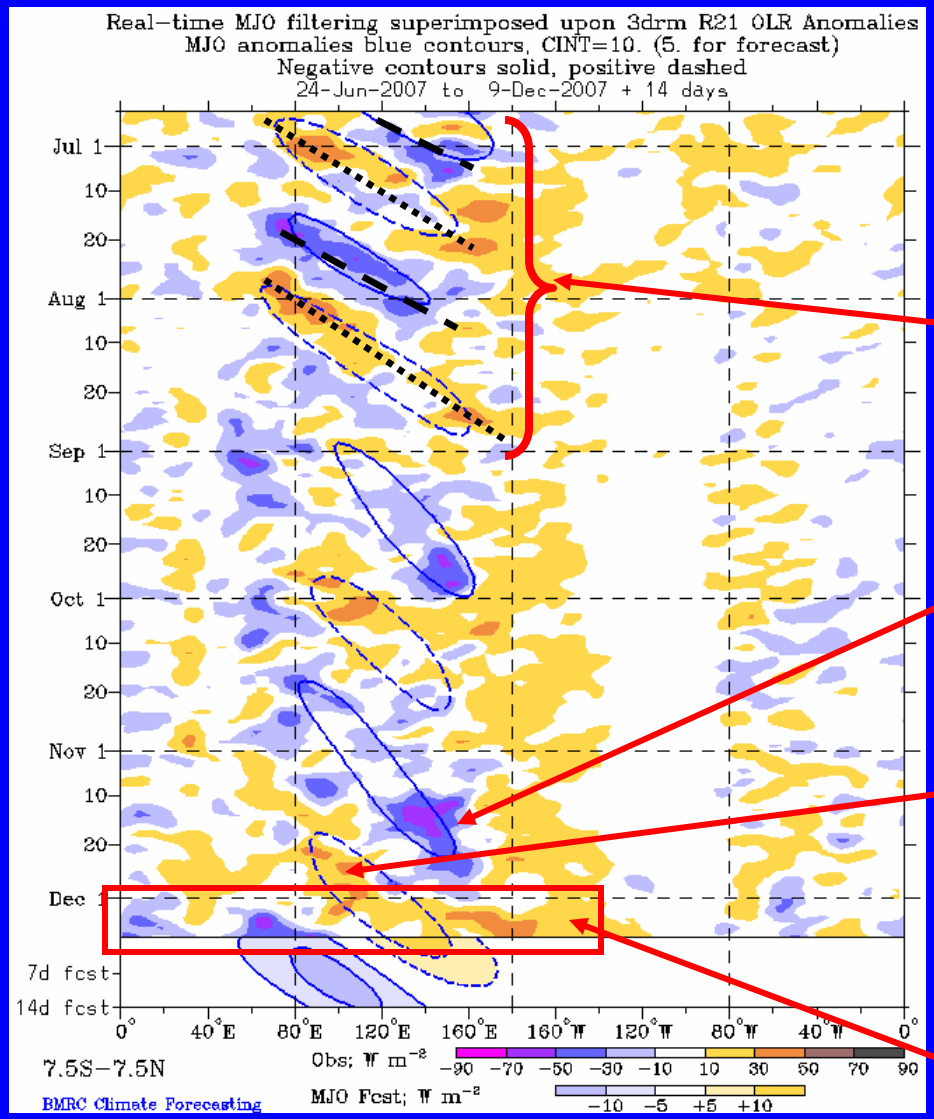
Easterly anomalies (blue shading) represent anomalous east-to-west flow.

Strong easterlies were in place from mid-October through mid-November across much of the Pacific generally beginning near 160 °E.

Since late October, anomalous westerlies have very slowly shifted eastward from the Indian Ocean to the Maritime continent and later to the Date Line.

During the past week, easterly anomalies have strengthened across the western Pacific Ocean and areas in the Indian Ocean.

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



Time

Longitude

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

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

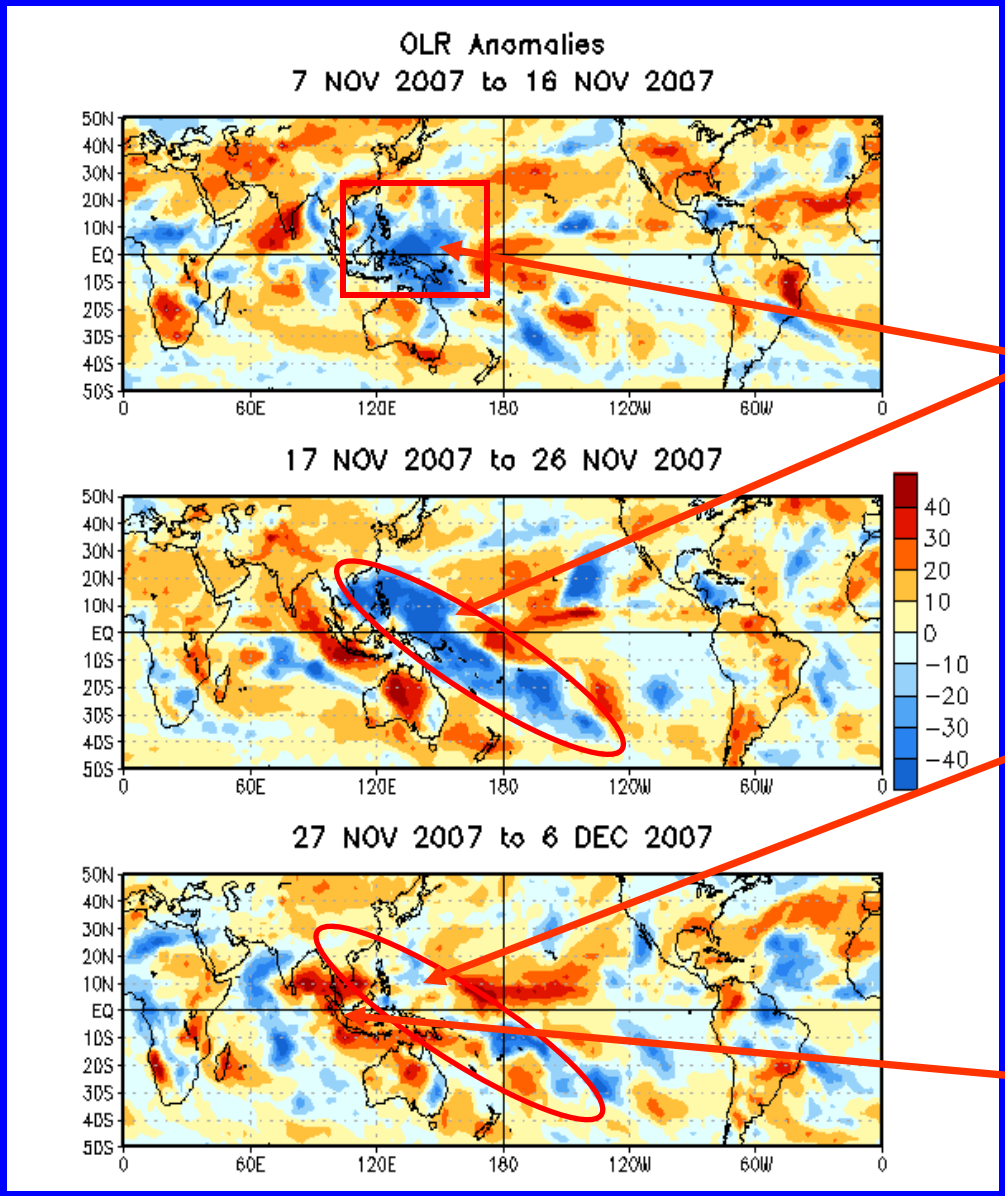
Beginning in mid May, weak-moderate MJO activity was observed as regions of suppressed and enhanced convection shifted eastward from the Indian Ocean into the far western Pacific.

Substantial enhanced convection developed across the eastern Maritime continent and far western Pacific Ocean during November but only shifted eastwards late in the month.

Dry conditions associated with the MJO shifted from the Indian Ocean to the western Pacific Ocean during late November and early December.

Recently, a strong couplet of enhanced (suppressed) convection is clear in the Indian (western Pacific) Oceans.

OLR Anomalies: Last 30 days



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

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

During mid-late November, enhanced convection was evident across the eastern Maritime continent and later the far western Pacific Ocean and South Pacific Convergence Zone (SPCZ).

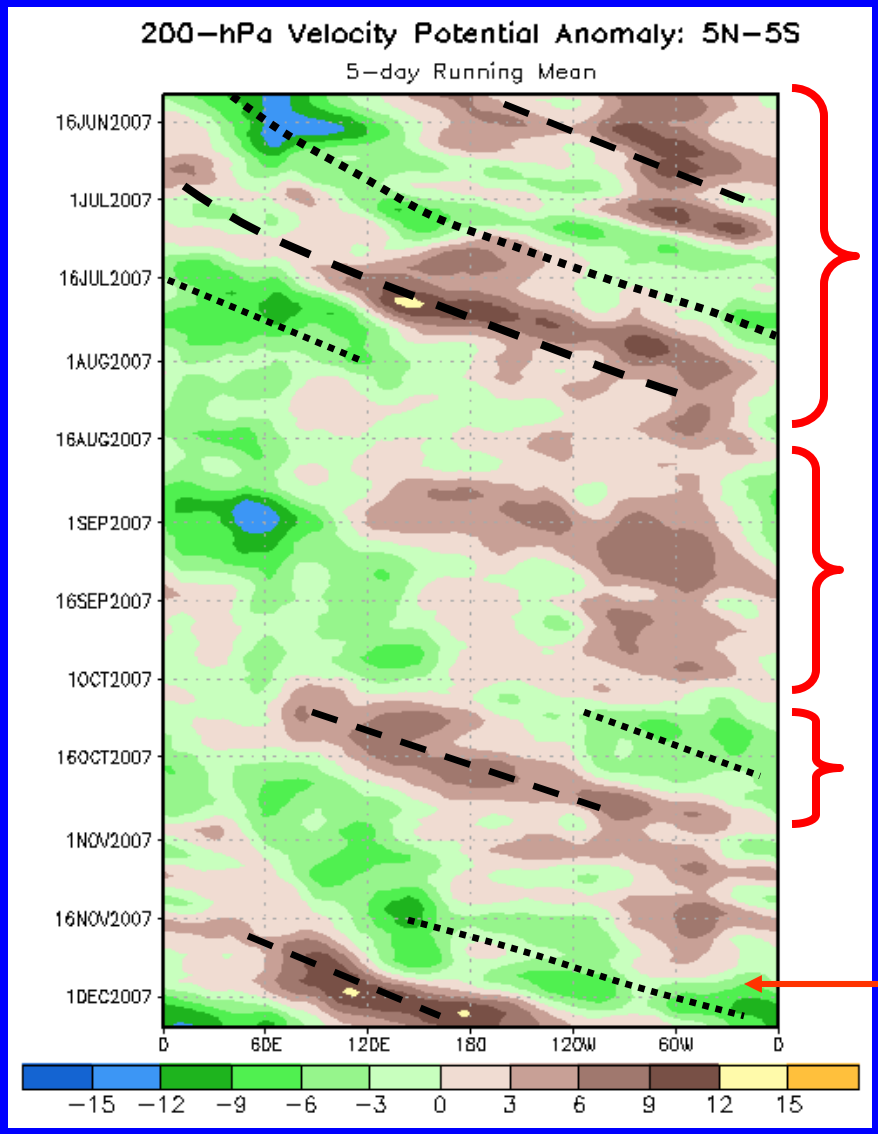
Convection diminished significantly across the western Pacific Ocean and SPCZ as the suppressed phase of the MJO shifted eastward.

Dry conditions persisted across the eastern Indian Ocean and sections of Australia into early December.

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

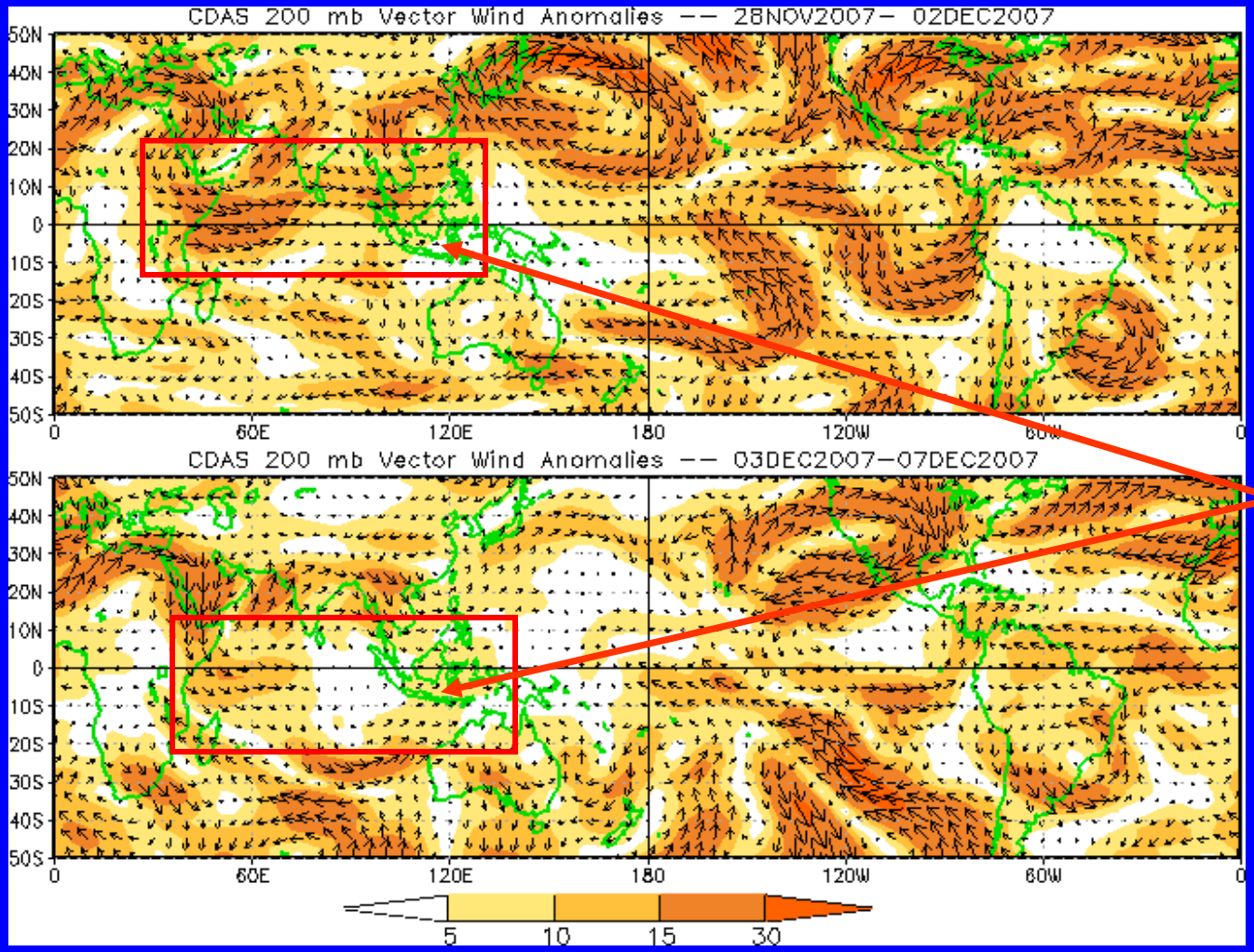
From mid-May into early August, weak to moderate MJO activity was observed as velocity potential anomalies increased and propagated eastwards.

The MJO was weak or incoherent during much of August and September.

The MJO strengthened during October but coherent propagation was short-lived.

The strongest and most coherent MJO activity since the summer period developed during the second half of November.

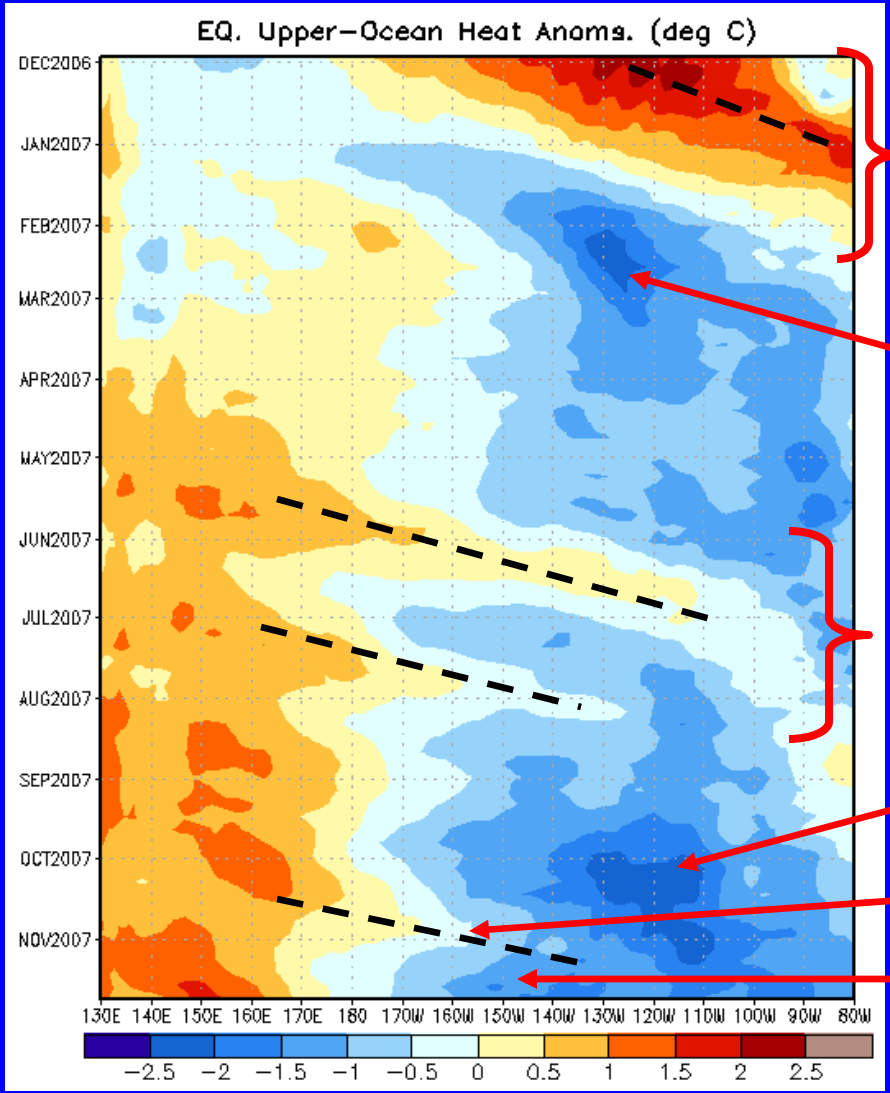
200-hPa Vector Wind Anomalies (m s^{-1})



Note that shading denotes the magnitude of the anomalous wind vectors

Westerly anomalies across the Indian Ocean and Maritime continent decreased during the last five days and became less uniform variable.

Weekly Heat Content Evolution in the Equatorial Pacific



Time

Longitude

During late 2006, an eastward-propagating Kelvin wave (warm phase indicated by the dashed line) caused considerable positive anomalies in the upper-ocean heat content.

Beginning in February, negative heat content anomalies developed prevailed across the eastern equatorial Pacific.

Weak Kelvin wave activity was observed from May into August and affected the sub-surface temperature departures.

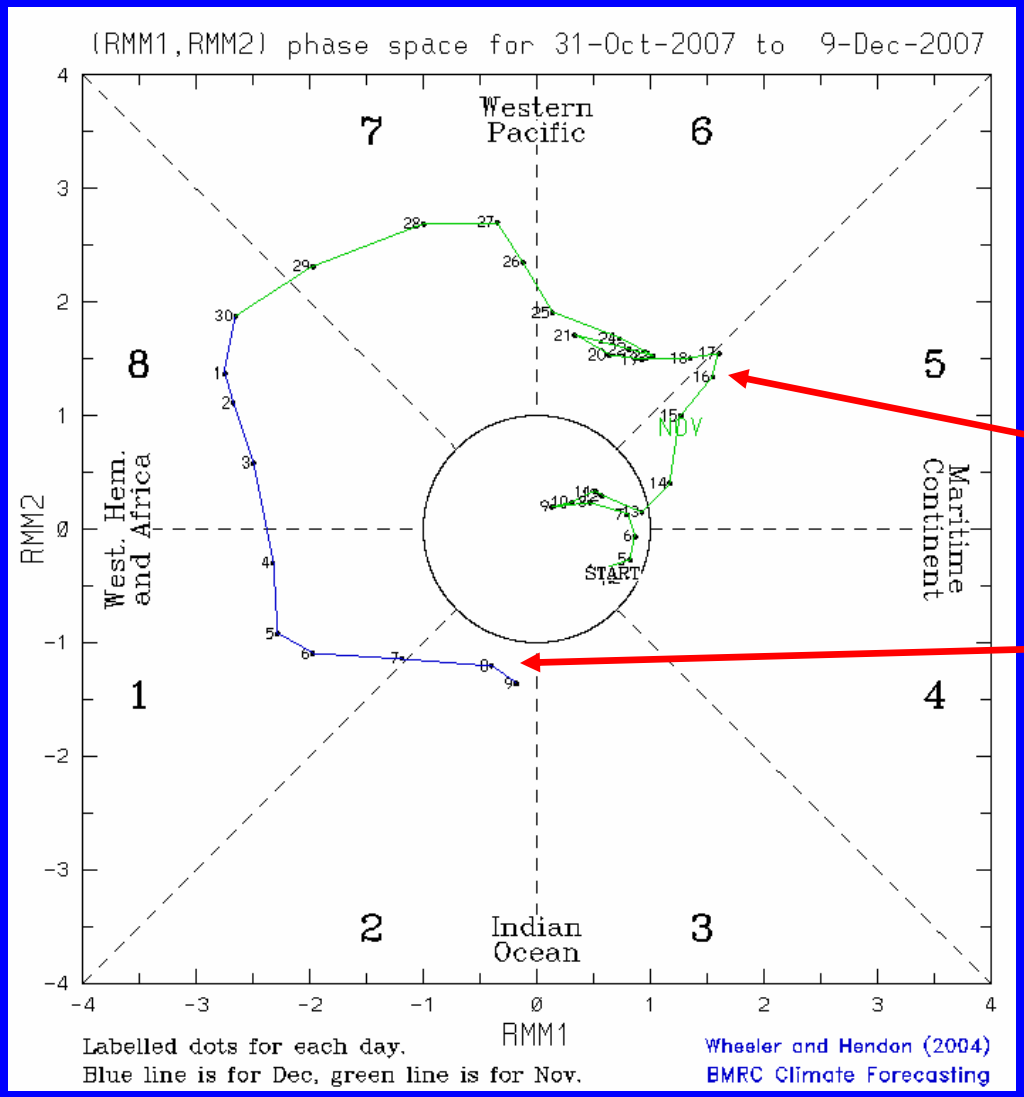
During October, negative heat content anomalies increased across the eastern Pacific Ocean, but weakened slightly in the central and east-central Pacific in association with a weak Kelvin wave.

Most recently, negative heat content anomalies have increased.

MJO Index

The current state of the MJO as determined by an index based on Empirical Orthogonal Function (EOF) analysis using combined fields of near-equatorially-averaged 850-hPa and 200-hPa zonal wind and outgoing longwave radiation (OLR) (Wheeler and Hendon, 2004).

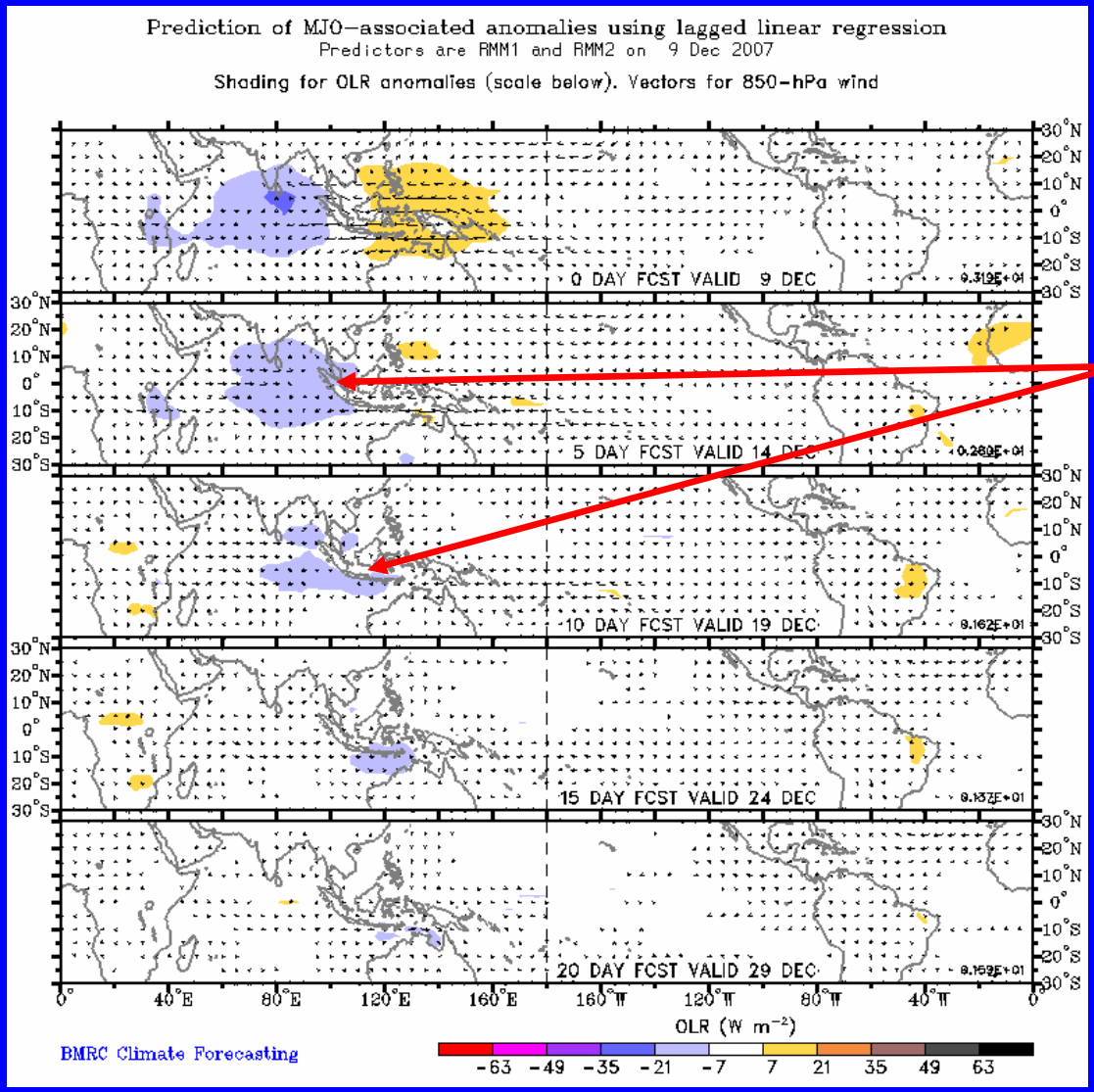
The axes represent the time series of the two leading modes of variability and are used to measure the amplitude while the triangular areas indicate the phase or location of the enhanced phase of the MJO. The farther away from the center of the circle the stronger the MJO. Different color lines indicate different months.



The MJO index increased in amplitude during mid-late November.

During the past ten days, the index continues to indicate a moderate-strong MJO with fast eastward propagation.

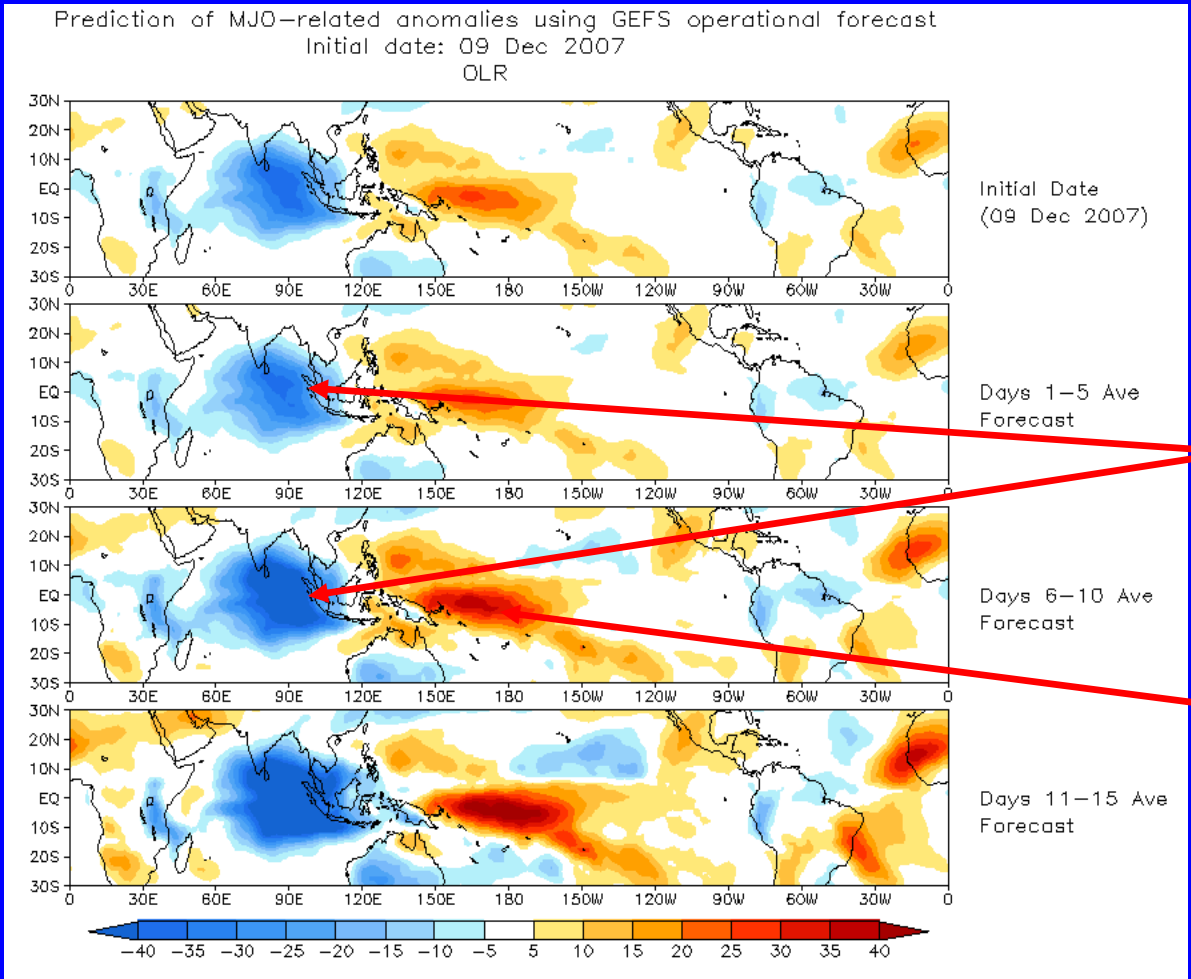
Statistical MJO OLR Forecast



The statistical MJO forecast indicates moderate MJO activity during the upcoming 1-2 week period.

Wet conditions are forecast for the eastern Indian Ocean and western Maritime continent during the period.

Experimental GFS MJO OLR Forecast



The GFS forecasts a moderate-strong MJO signal but little eastward propagation during the period.

Wet conditions are expected for portions of eastern Africa and much of the Indian Ocean throughout the period.

Suppressed convection is forecast for the far western Pacific Ocean during much of the period.