

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



**Update prepared by the Climate Prediction Center  
NWS / NCEP / CPC  
17 March 2025**

# Overview

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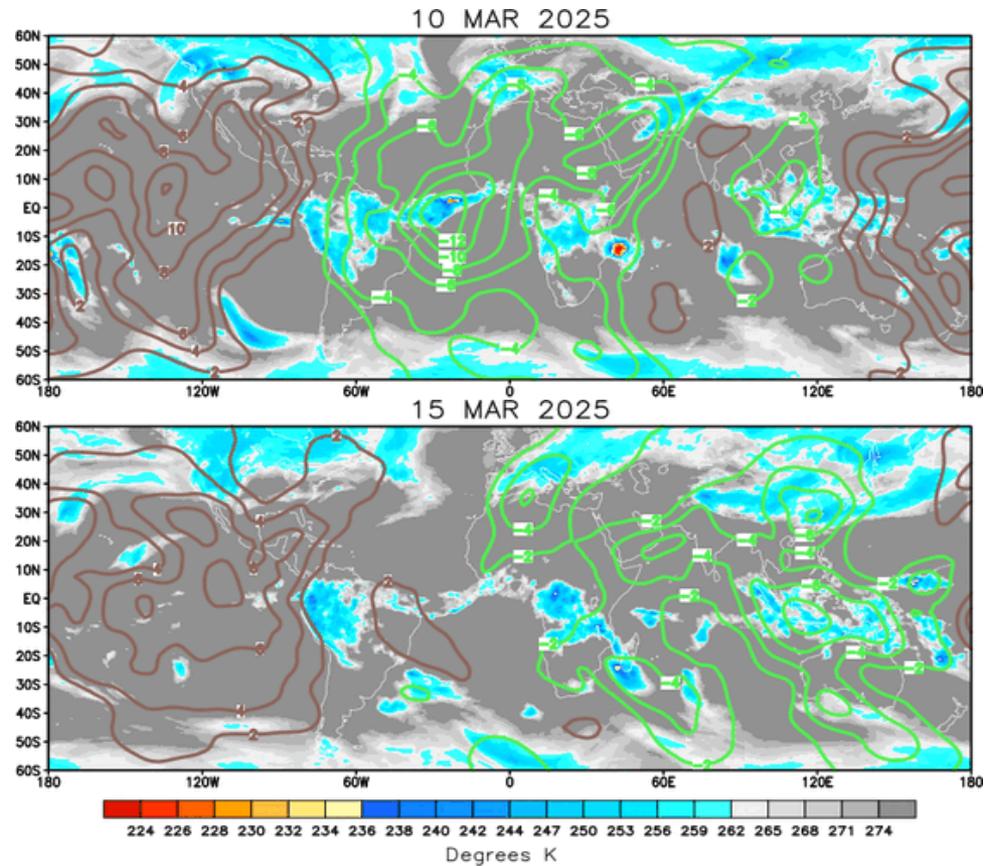
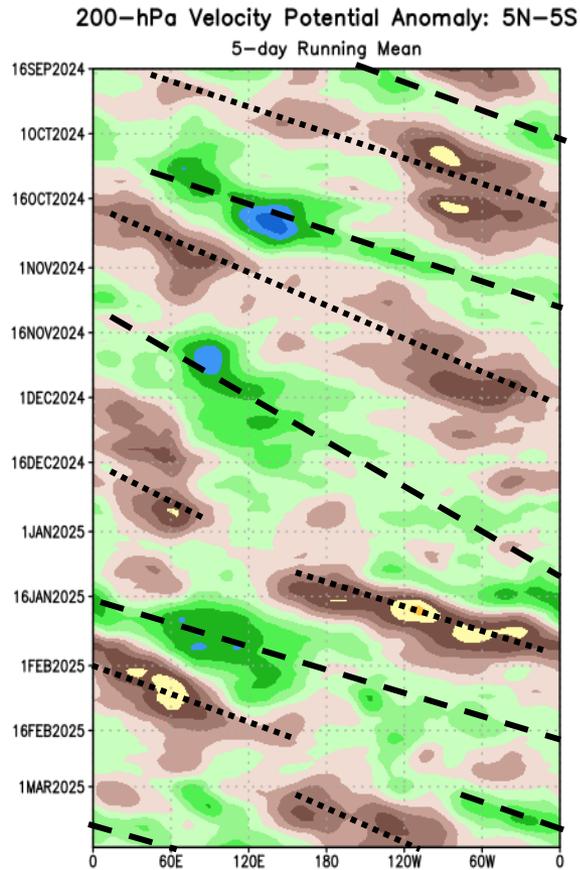
- Based on upper-level velocity potential and zonal wind anomalies, the MJO remains active, however other modes of variability appear to be playing an increased role in tropics.
  - Notably, a low frequency disruption of the trade wind regime over the eastern Pacific has resulted in rapid warming of SSTs east of 150W. Enhanced trades and below-normal SSTs persist but remain confined near and west of the Date Line.
- Dynamical model RMM forecasts favor a weakened MJO signal that quickly propagates to the Western Pacific later in March.
  - The fast phase speed favored appears to be related to an abrupt easing of enhanced convection over the western Indian Ocean during week-1, with the enhanced convective MJO envelope actually residing closer to the Western Pacific.
- Extended range forecasts remains divided in regards to the coherence of the MJO over the Western Pacific, with several solutions failing to maintain its eastward propagation contributing to increased uncertainty in the outlook.
  - Should the MJO manage to remain organized, low-level westerly wind anomalies over a warmer than normal West Pacific Warm Pool could result in a downwelling oceanic Kelvin wave that would further erode the La Niña.
- Despite these uncertainties associated with the MJO, the large scale environment remains supportive for Tropical Cyclone development in the southeastern Indian Ocean and South Pacific later in March and into early April.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

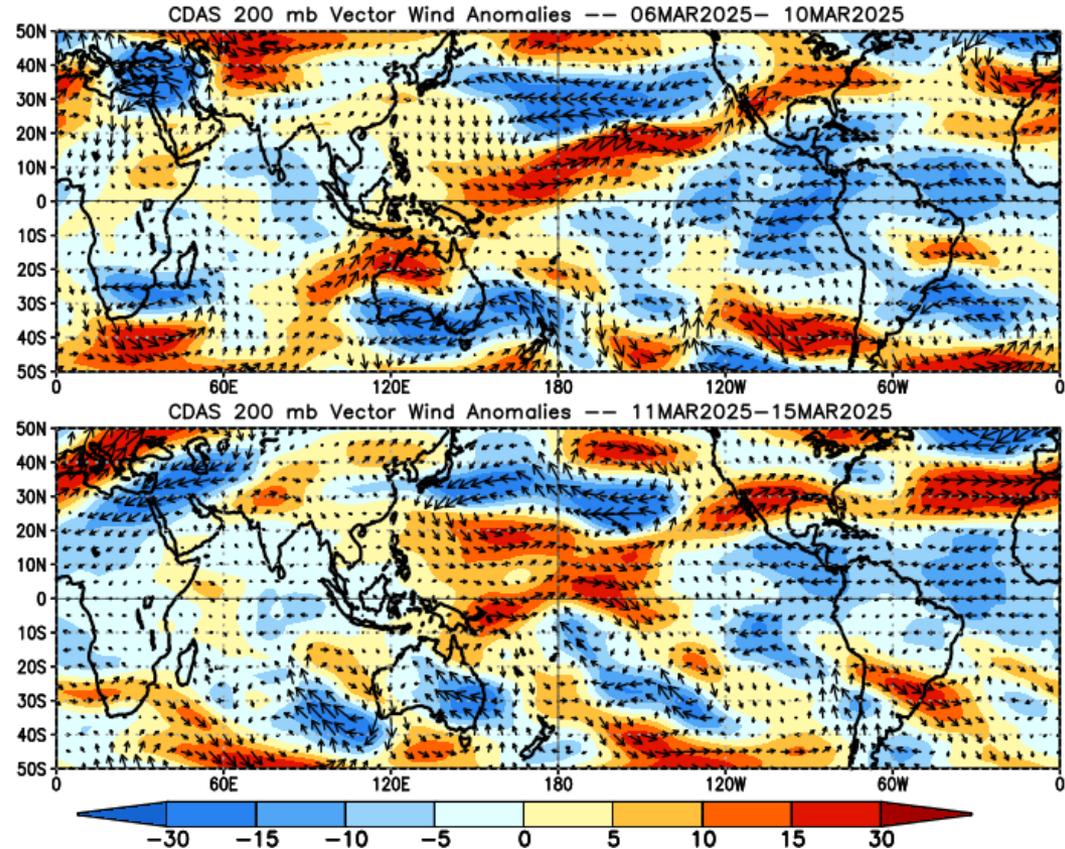
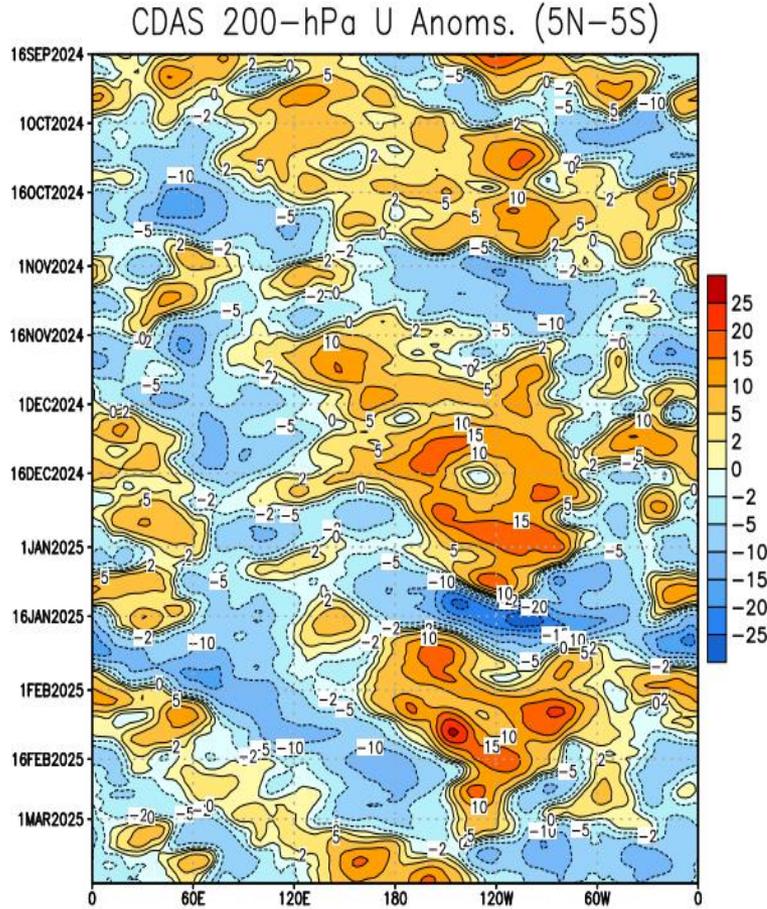
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Upper-level velocity potential anomaly fields suggest subseasonal activity remains coherent with a wave-1 pattern through the middle of March.
- The suppressed envelopes have been slow to propagate eastward, as there appears to be some separation of the main enhanced diffluent envelope, consistent with other modes of variability at play.

# 200-hPa Wind Anomalies

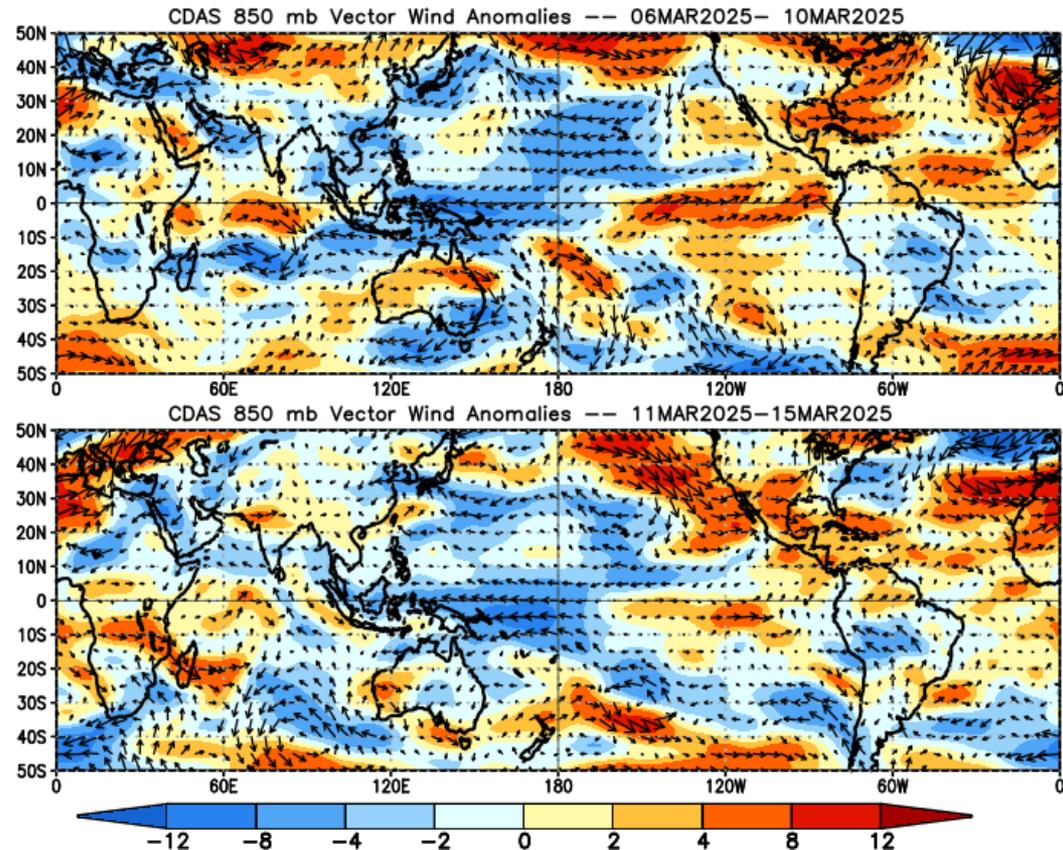
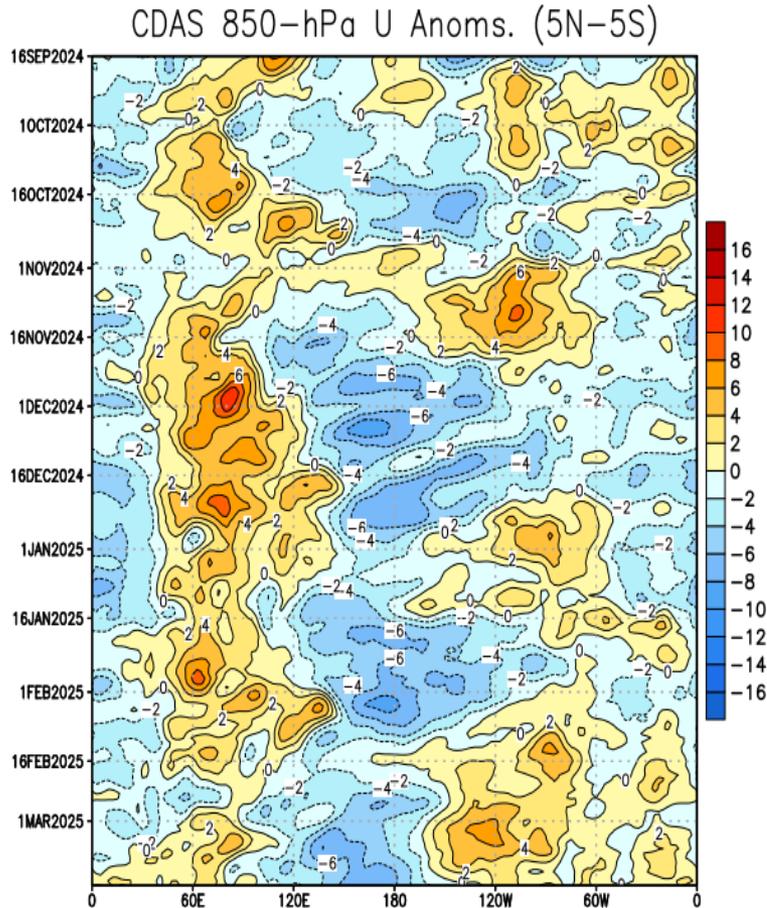
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Aloft, the easterly phase of the MJO managed to break through an area of persistent westerlies centered near 120W, with anomalous westerlies strengthening and expanding eastward beyond the Date Line.
- MJO activity appears less coherent over the Indian Ocean.
- The subtropical jet extends from the tropical Pacific to North America

# 850-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**

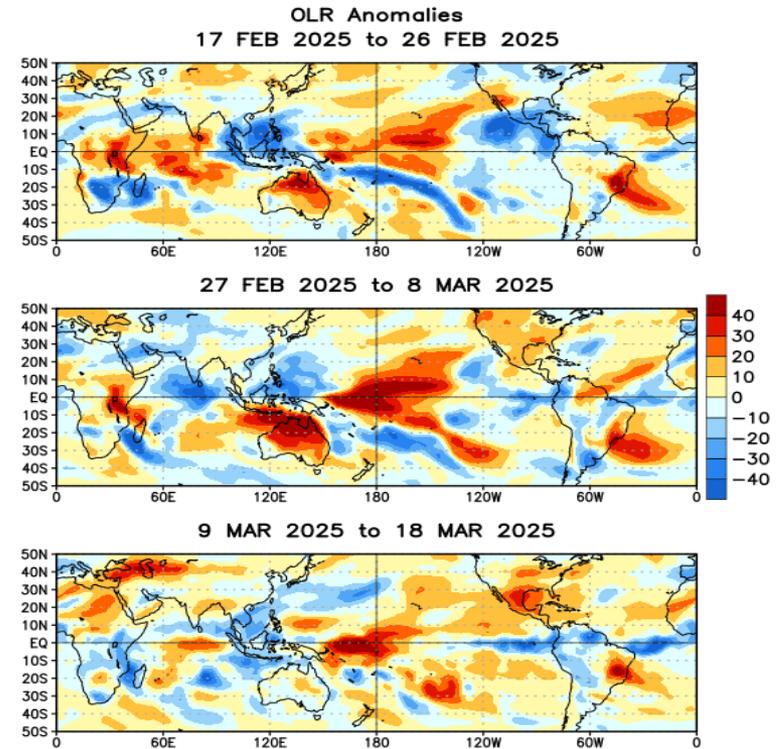
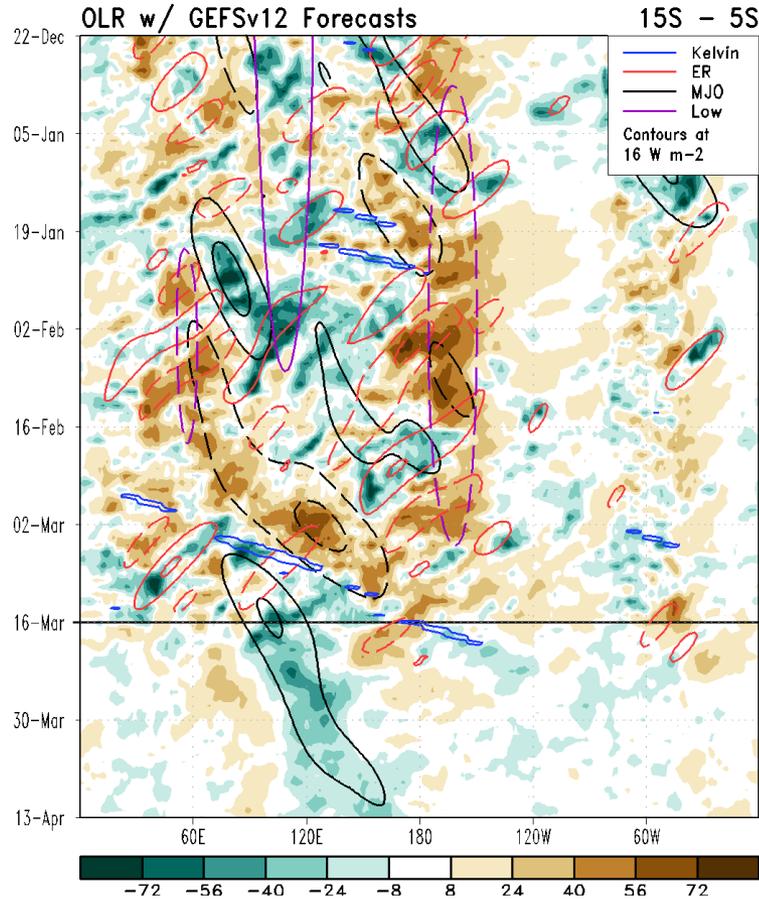


- Compared to the zonal winds aloft, there is less evidence of eastward propagating features in the low-level time/longitude plot.
- Although weaker more recently, a low frequency disruption of the trade winds is established over the eastern Pacific, which has reversed the negative SST anomalies in the region.
- Enhanced trades persist near and west of the Date Line, with anomalous westerlies remaining entrenched over the western Indian Ocean.

# Outgoing Longwave Radiation (OLR) Anomalies

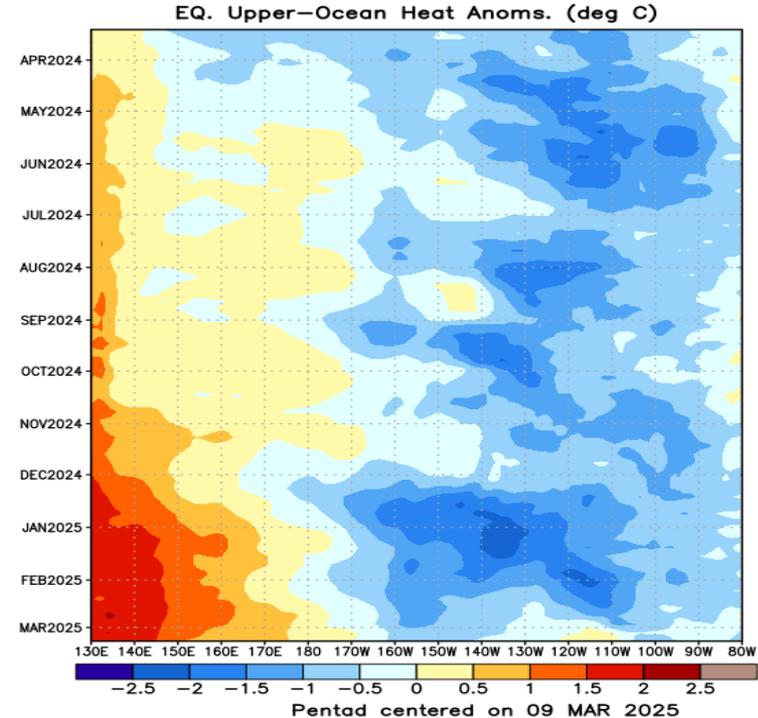
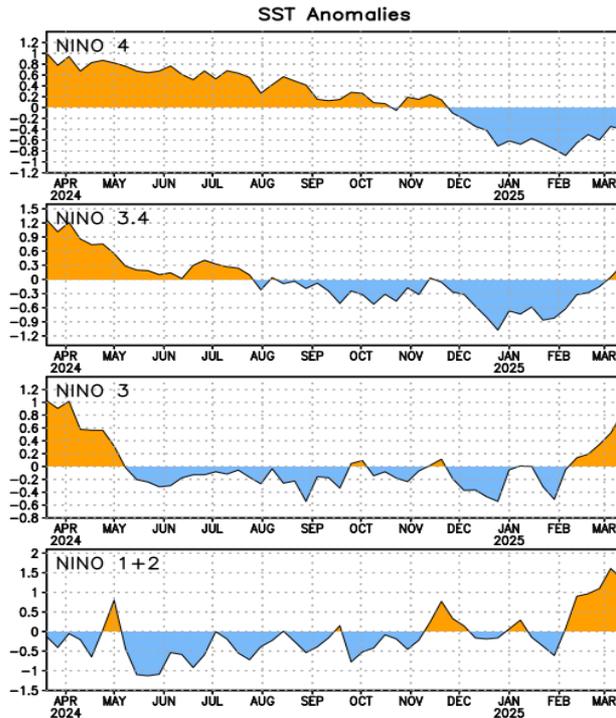
**Green shades:** Anomalous convection (wetness)

**Brown shades:** Anomalous subsidence (dryness)



- The low frequency lower-level wind features have contributed to the enhancement (suppression) of convection over the eastern (western and central) equatorial Pacific.
- OLR forecasts and objective filtering from the GEFS indicate MJO activity is centered near 100E recently, and is favored to propagate eastward into the western Pacific during the next several weeks.
- Any weakening of the suppressed convective La Niña footprint tied to the MJO looks to be better expressed south of the equator in the guidance.

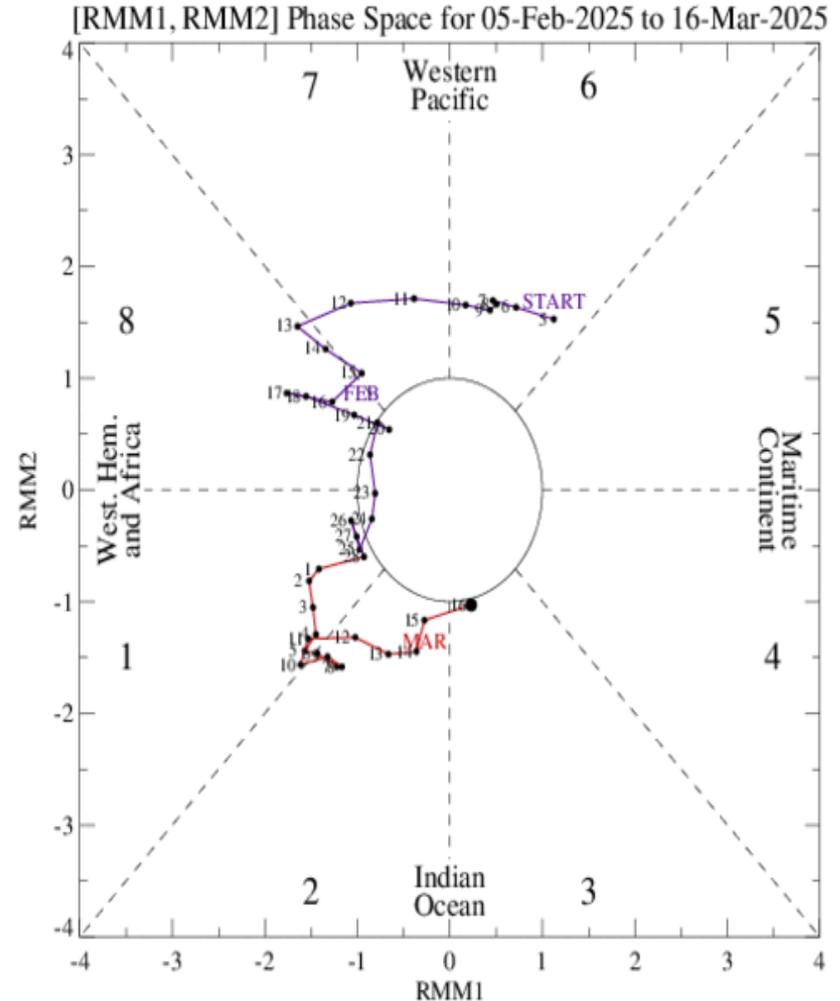
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Negative SST anomalies decreased to near zero in the Niño 3.4 region, and have trended positive in the easternmost basins.
- The Niño 1+2 and Niño 3 region continue to warm, where there is a reversal of sign in the subsurface anomalies between 120W and 110W.
- Given the extent of warm ocean water availability over the West Pacific, the current La Niña conditions are vulnerable to any downwelling oceanic Kelvin wave events that could initiate due to MJO activity.

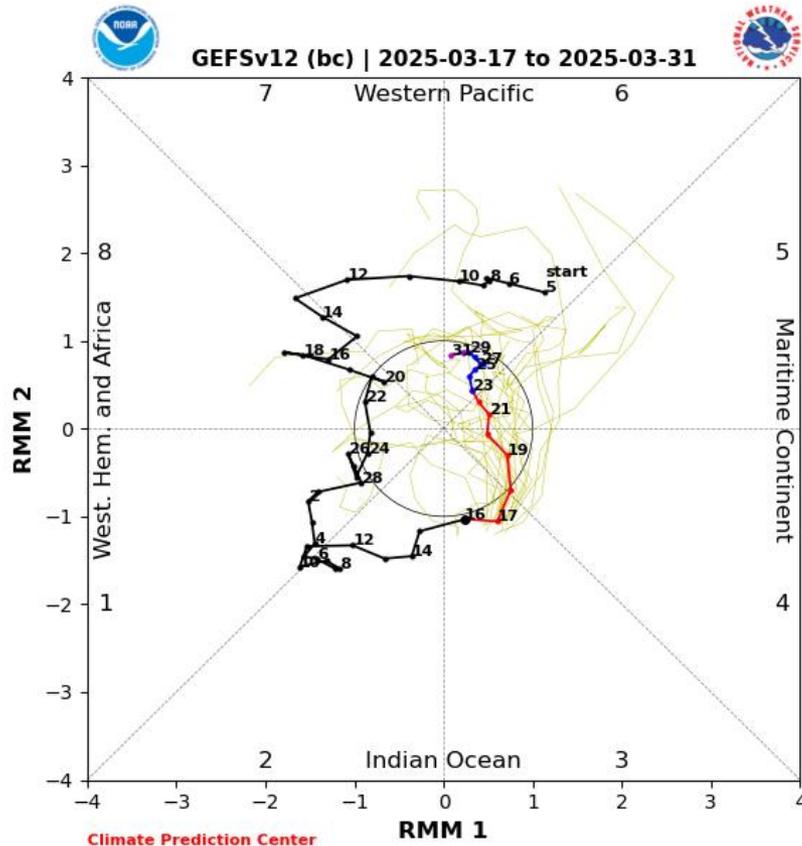
# MJO Index: Recent Evolution

- Since regaining amplitude over the Western Hemisphere earlier in March, RMM observations show a slowed MJO signal as it entered the Indian Ocean.
- During the past few days, the signal accelerated eastward but is gradually losing amplitude.

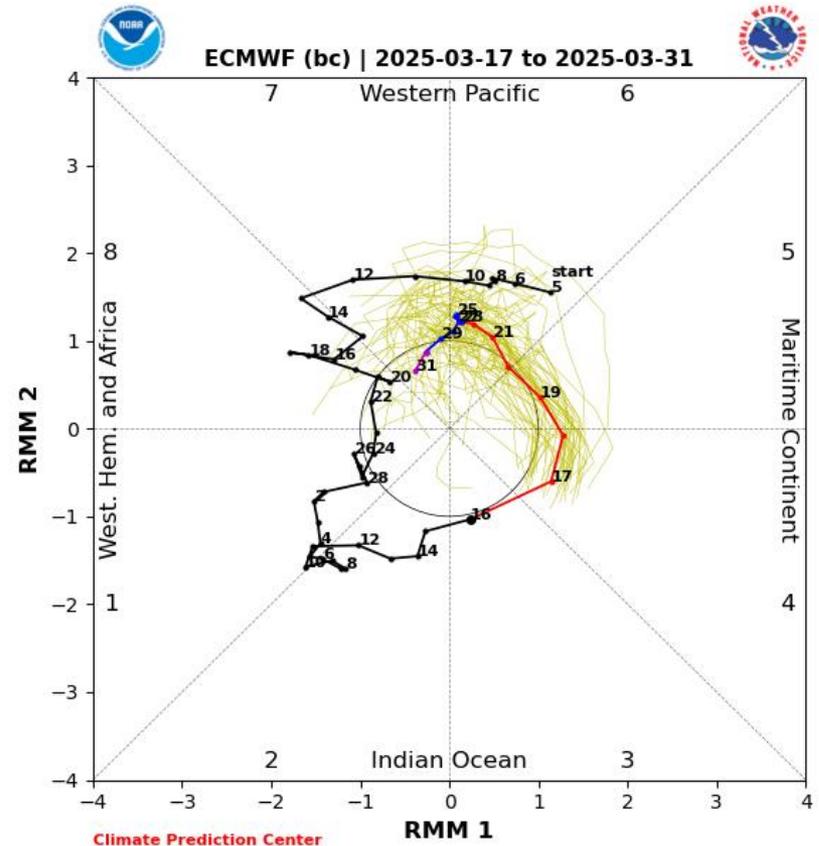


For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)

# MJO Index: Forecast Evolution



**GEFS Forecast**



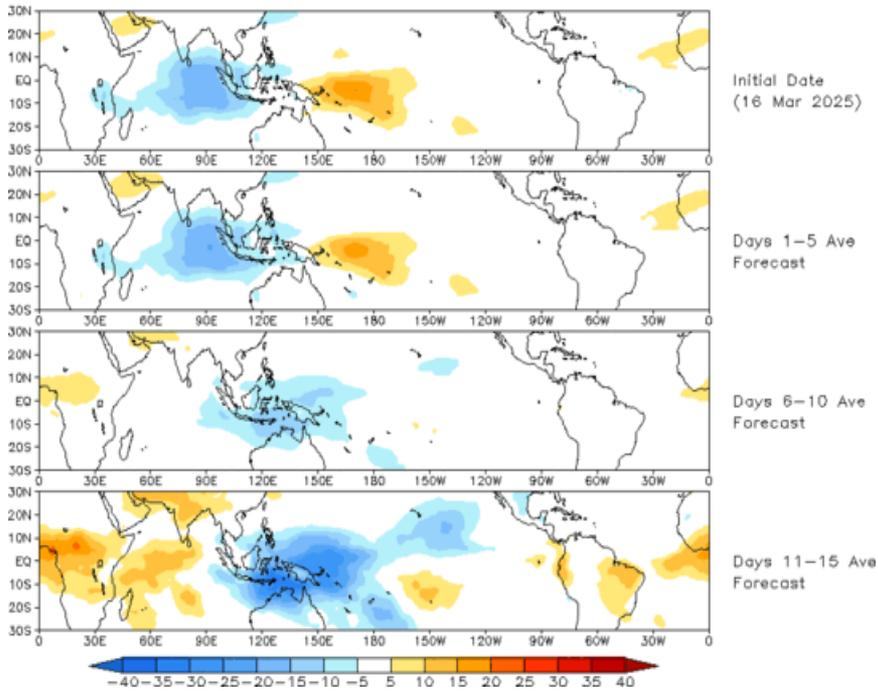
**ECMWF Forecast**

- Both the GEFS and ECMWF depict a weakened MJO signal, that quickly darts from the Indian Ocean to the western Pacific during the next week or so.
- The fast phase speed appears to be related to an abrupt reversal from enhanced to suppressed convection in the western Indian Ocean tied to an exiting Kelvin Wave, with the index “catching up” to the enhanced convective MJO envelope that actually lies closer to the western Pacific.

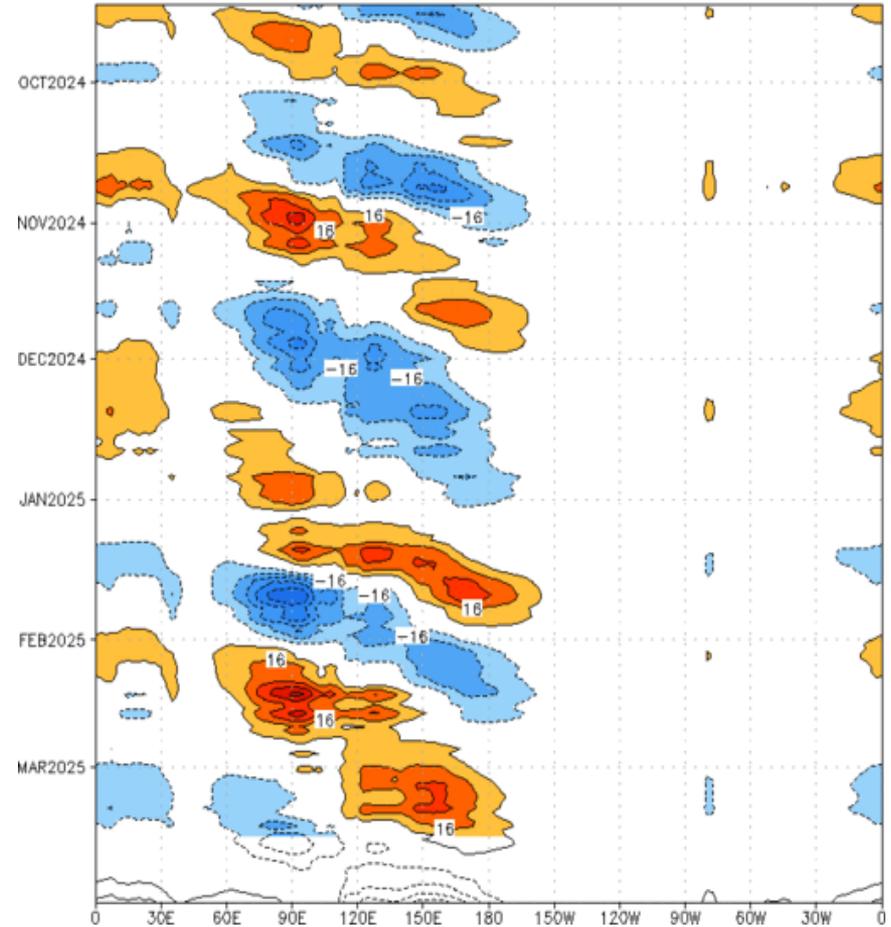
# MJO: GEFS Forecast Evolution

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, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 16 Mar 2025  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:14-Sep-2024 to 16-Mar-2025  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

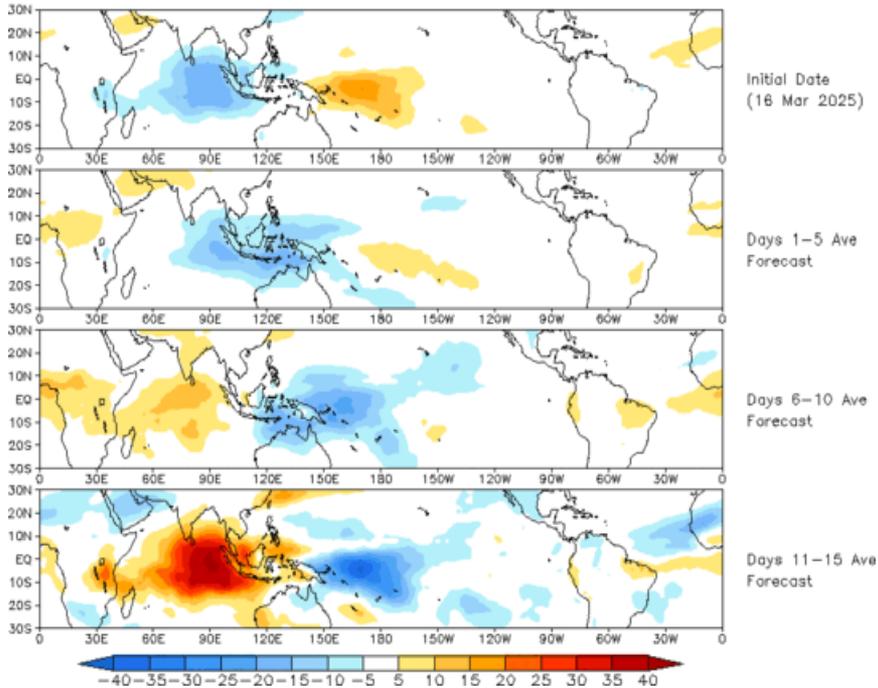


- The GEFS OLR forecast based on the RMM index forecast depicts continued MJO activity with enhanced convection shifting eastward into the Western Pacific, and suppressed convection developing over Africa and the Indian Ocean.

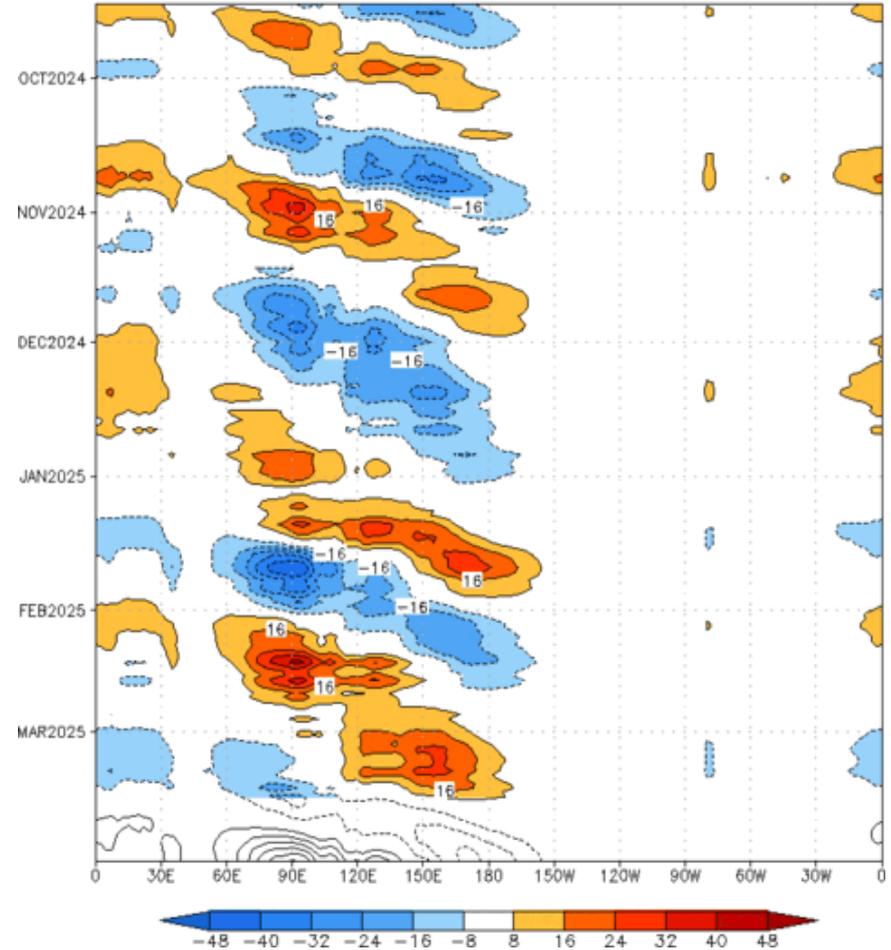
# MJO: Constructed Analog Forecast Evolution

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, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (16 Mar 2025)



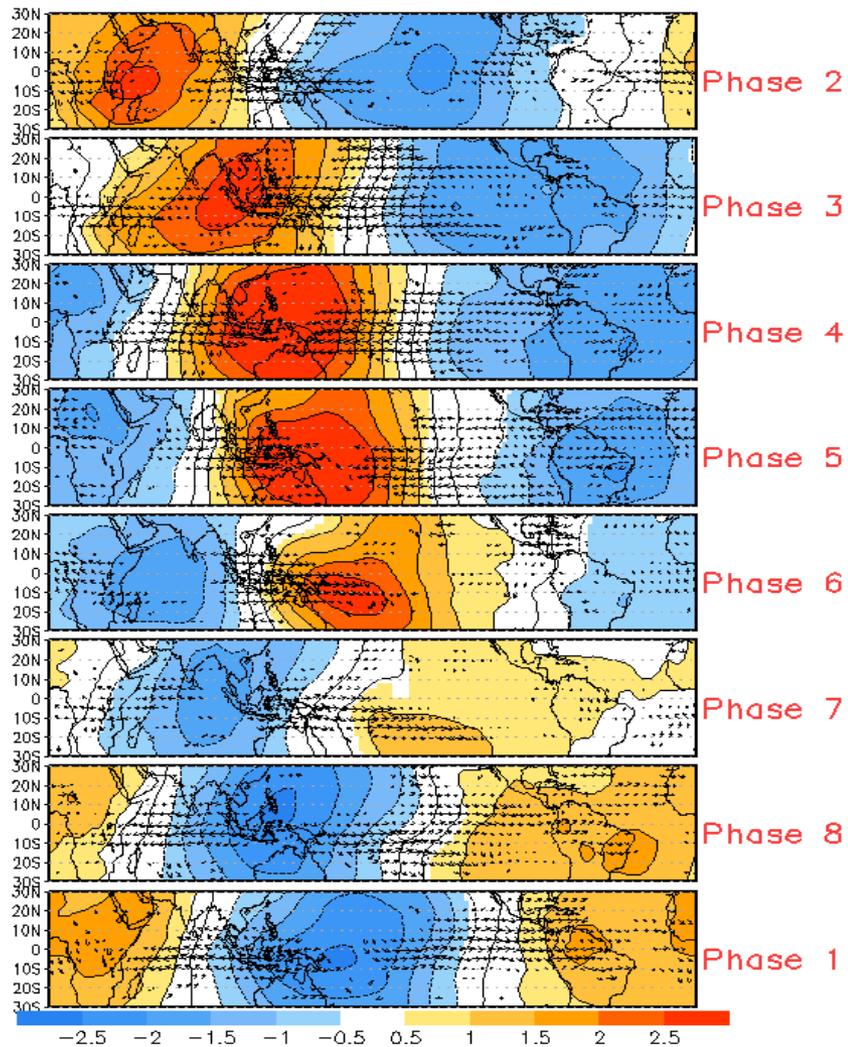
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:14-Sep-2024 to 16-Mar-2025  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



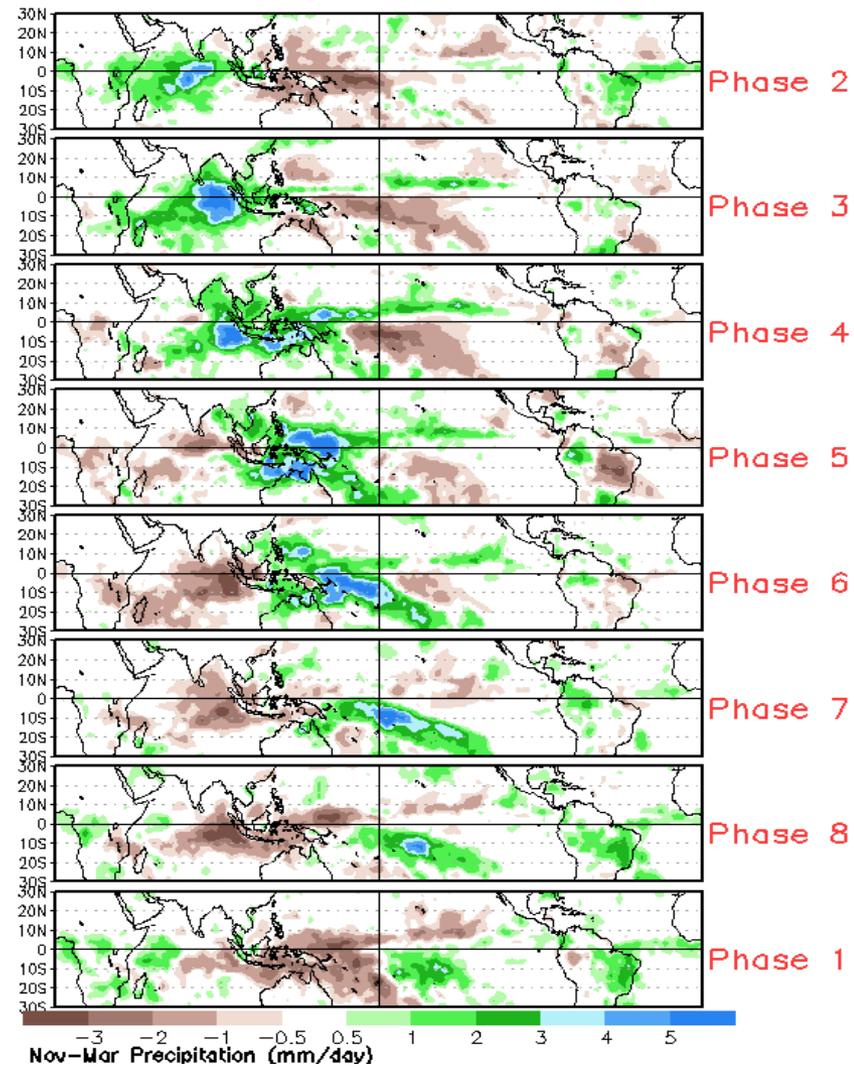
- The constructed analog forecast is similar to the GEFS, but is more robust and progressive with the suppressed convection over the Indian Ocean.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



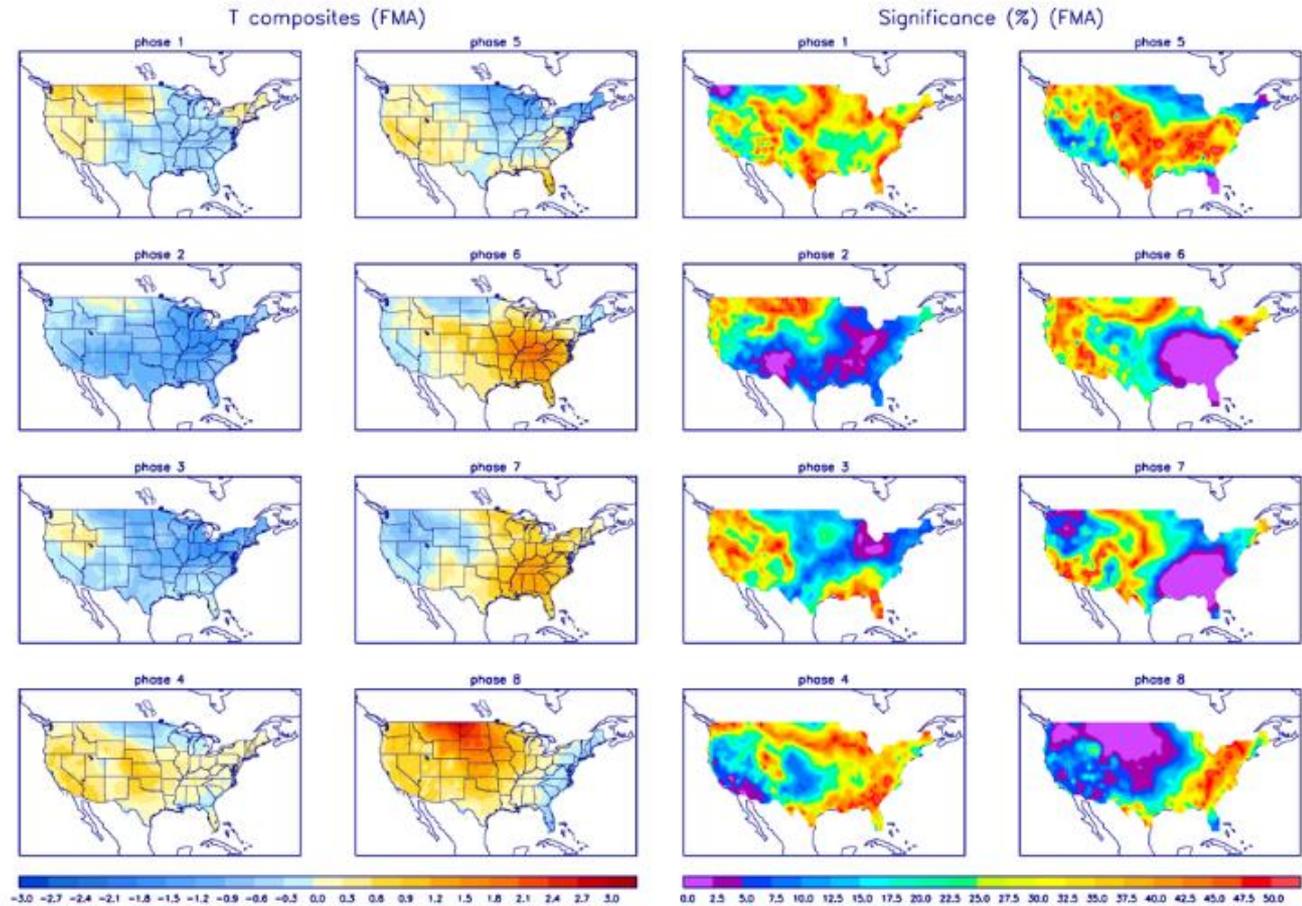
## Precipitation Anomalies



# MJO: CONUS Composite Maps by RMM Phase - Temperature

Left hand side plots show temperature anomalies by MJO phase for MJO events that have occurred over the three month period in the historical record. Blue (red) shades show negative (positive) anomalies respectively.

Right hand side plots show a measure of significance for the left hand side anomalies. Purple shades indicate areas in which the anomalies are significant at the 95% or better confidence level.



# MJO: CONUS Composite Maps by RMM Phase - Precipitation

Left hand side plots show precipitation anomalies by MJO phase for MJO events that have occurred over the three month period in the historical record. Brown (green) shades show negative (positive) anomalies respectively.

Right hand side plots show a measure of significance for the left hand side anomalies. Purple shades indicate areas in which the anomalies are significant at the 95% or better confidence level.

