

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



Update prepared by the Climate Prediction Center  
NWS / NCEP / CPC  
25 November 2024

# Overview

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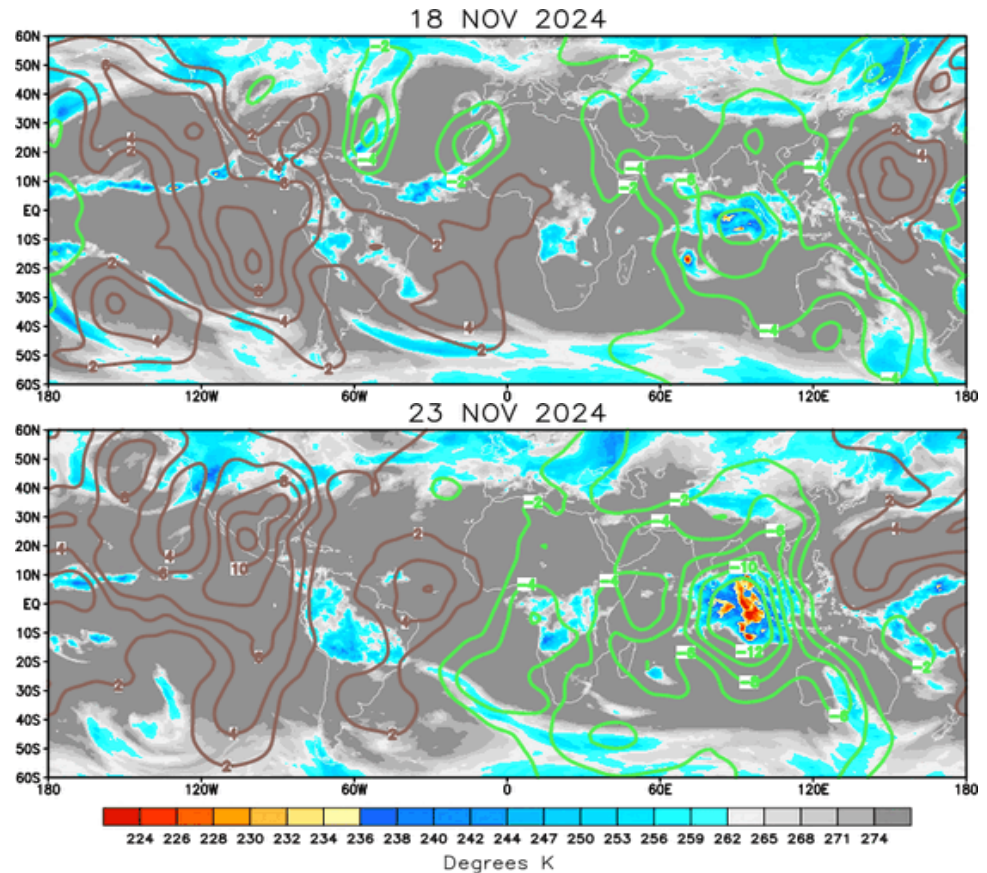
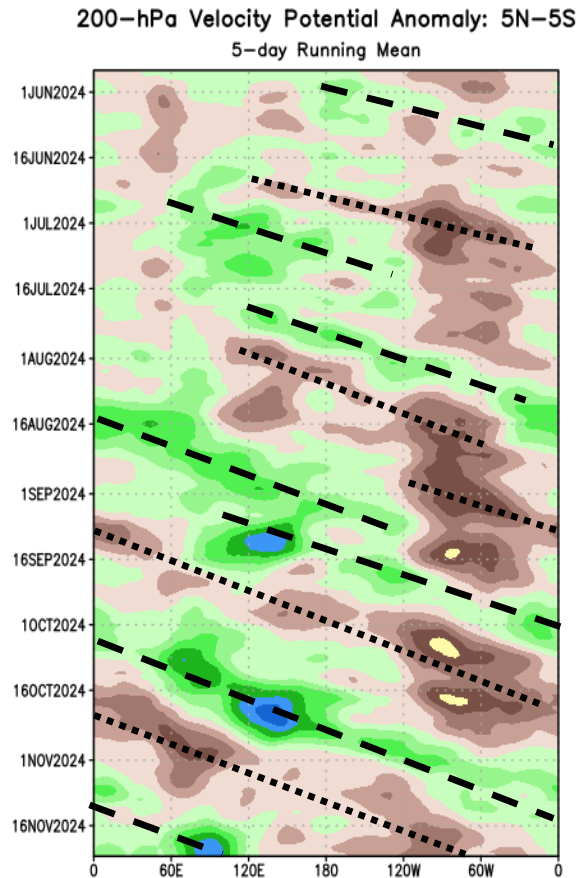
- Based on RMM and upper-level velocity potential anomalies, the MJO has regained amplitude while propagating eastward across the Indian Ocean during the past week or so.
- Dynamical models are in agreement favoring continued eastward propagation of the MJO over the Maritime Continent during the next few weeks. Later in December, there is some support for the MJO to enter the Western Pacific, but guidance remains varied on its amplitude.
- A westerly wind burst favored over the equatorial Indian Ocean is likely to contribute to twin Tropical Cyclone (TC) formations on both sides of the equator during week-1.
- A Maritime Continent MJO is expected to promote increased chances of tropical cyclone development over the eastern Indian Ocean and parts of the western Pacific from early to mid December.

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)

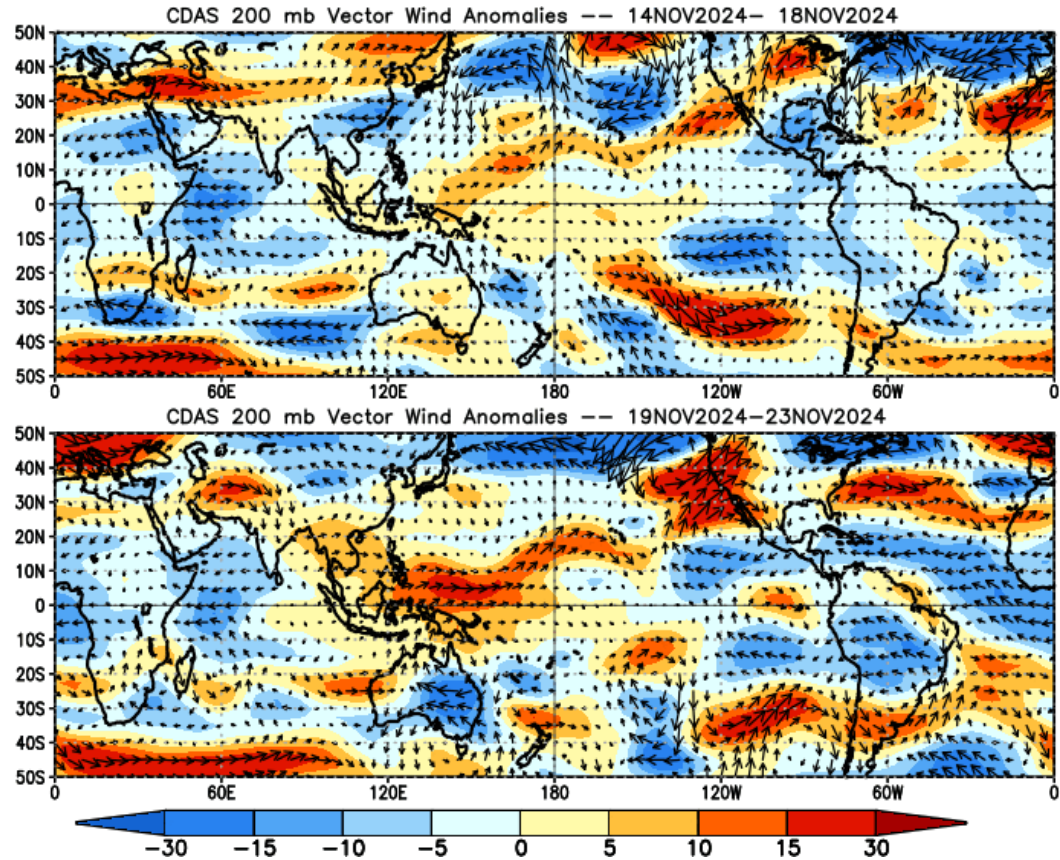
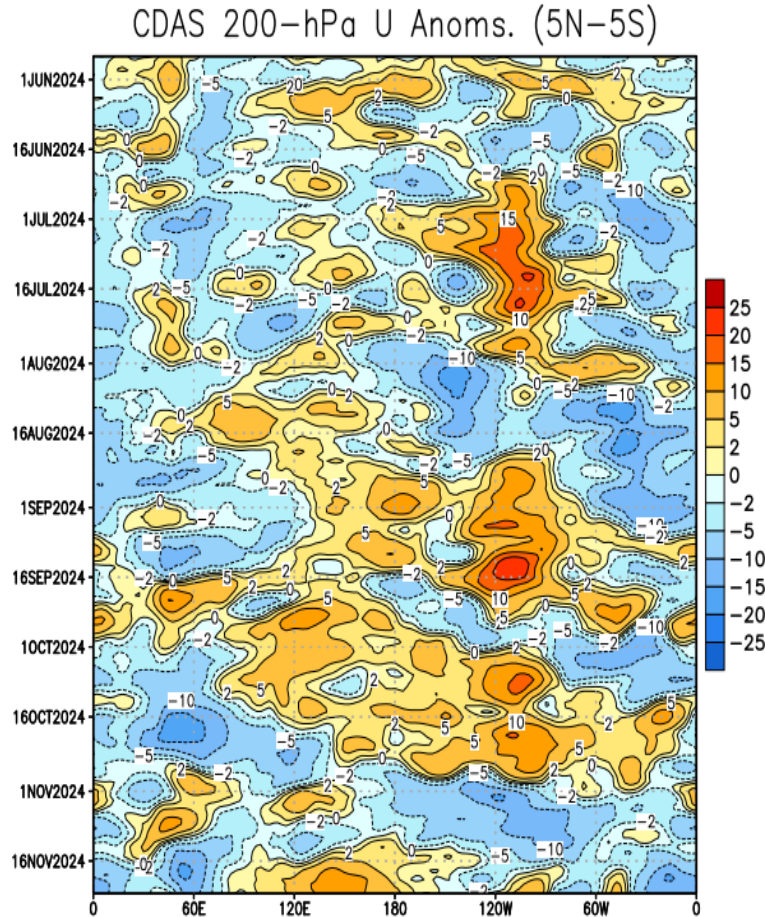
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Following some disorganization during mid-November, a better defined wave-1 pattern has reemerged.
- Enhanced convection has become quite robust over the eastern Indian Ocean, with the suppressed envelope of divergence aloft overspreading much of the equatorial Pacific and into the Americas.

# 200-hPa Wind Anomalies

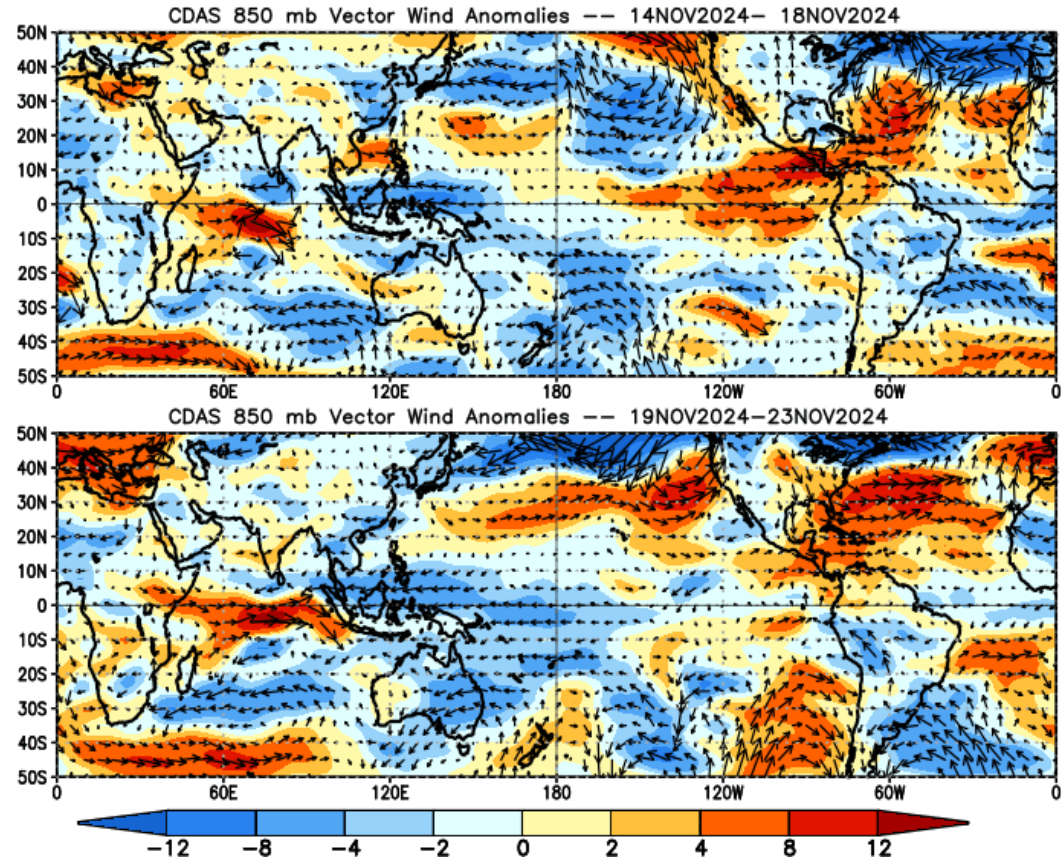
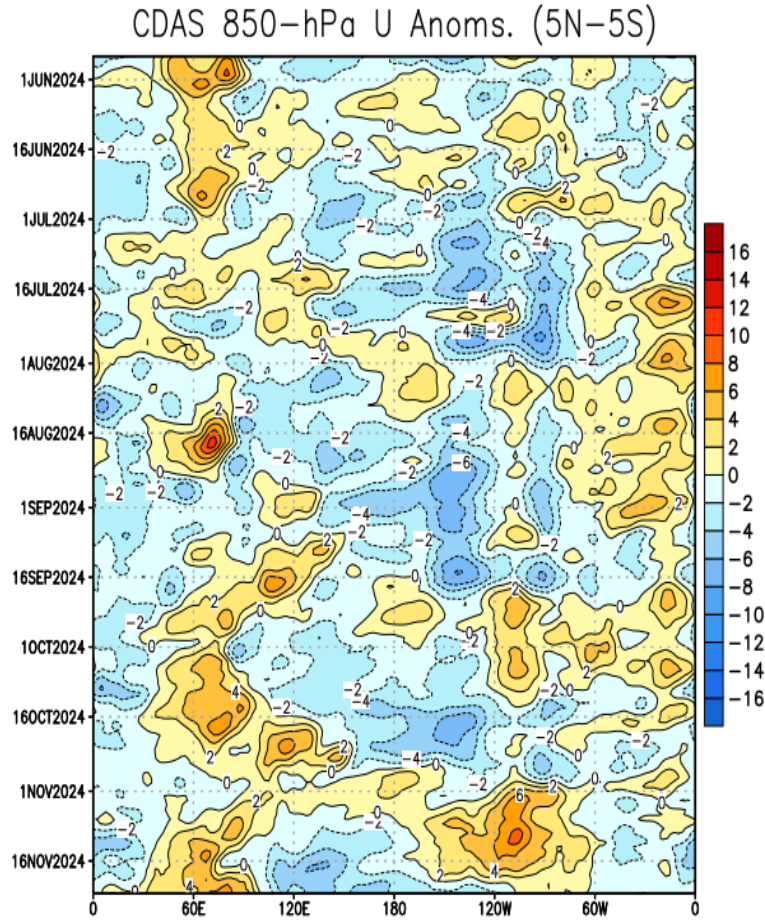
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The westerly phase of the MJO became better organized over the equatorial western Pacific, with stronger anomalies north of the equator likely contributing to a break in tropical cyclone activity.
- The easterly phase of the MJO struggled to shift into the eastern equatorial Indian Ocean.
- An enhanced jet is observed protruding into the northeastern Pacific, and promoted increased onshore flow over the western U.S.

# 850-hPa Wind Anomalies

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

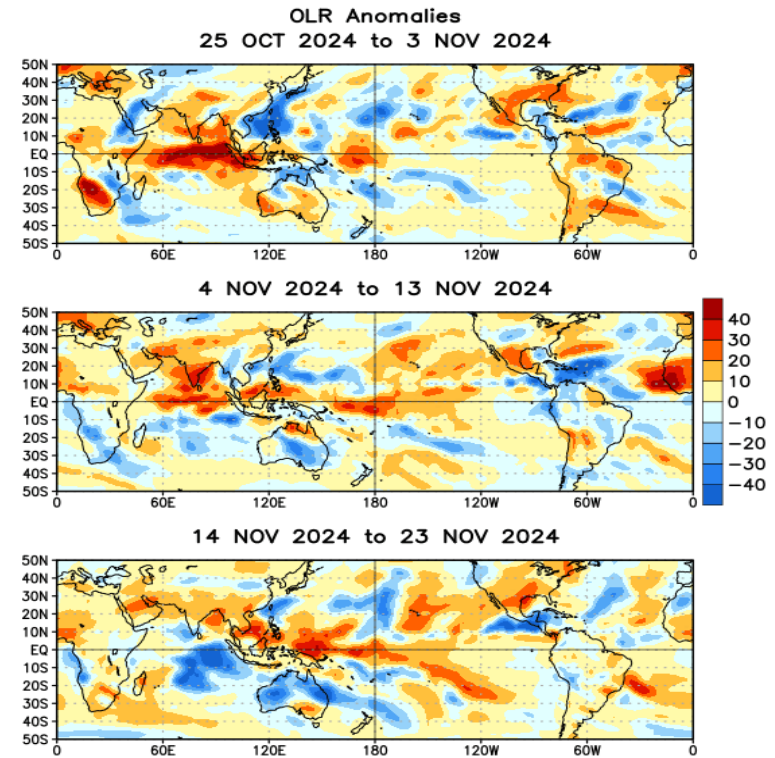
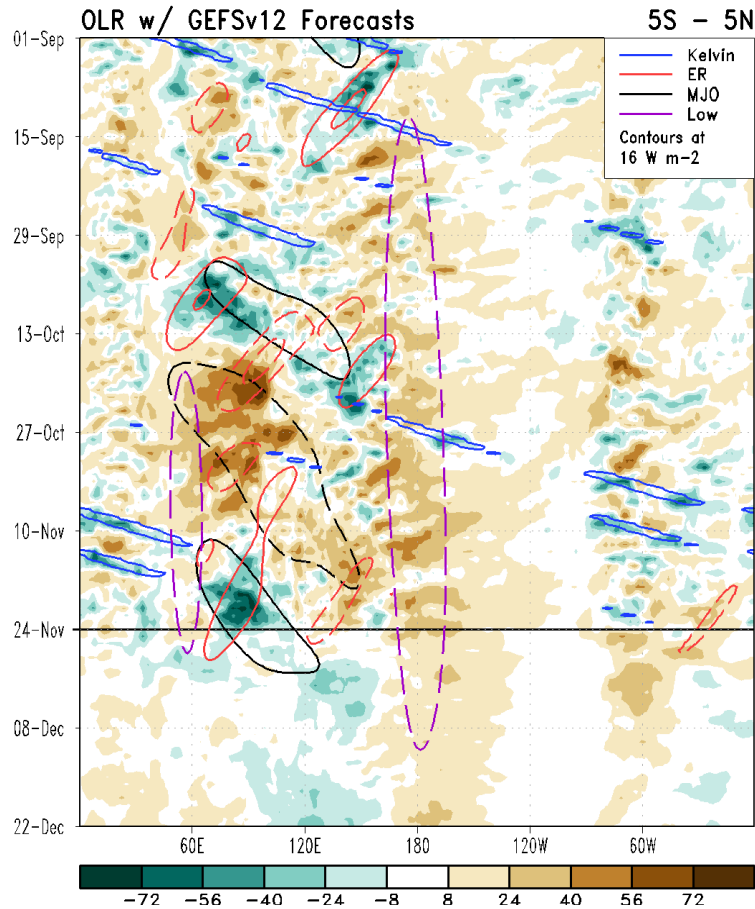


- Consistent with the suppressed convective phase of the MJO strengthening over the equatorial Pacific, an enhanced trade regime developed and shifted eastward beyond the Date Line, with a weakening of anomalous westerlies over the eastern Pacific.
- Enhanced westerlies are also seen becoming more contiguous and stronger over the equatorial Indian Ocean, but still remain more concentrated south of the equator.

# Outgoing Longwave Radiation (OLR) Anomalies

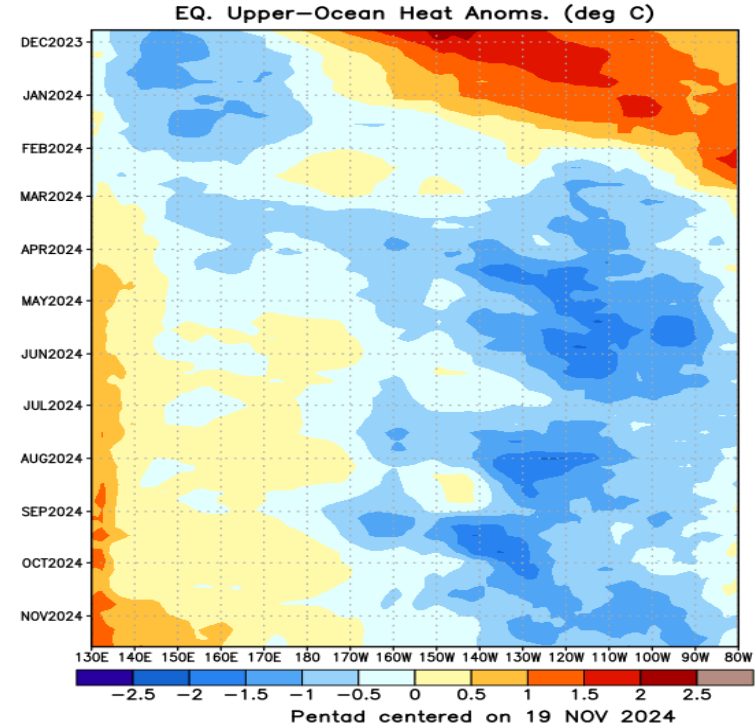
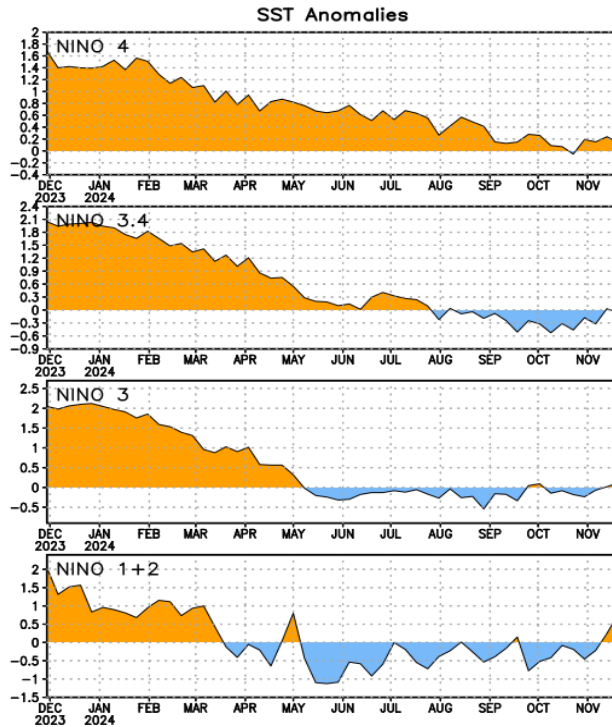
**Green shades:** Anomalous convection (wetness)

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



- The circulation anomalies tied to the MJO are consistent with the observed OLR responses, consisting of enhanced convection over the Indian Ocean, with suppressed convection throughout much of equatorial Pacific which is also reinforcing weak La Nina conditions.
- OLR forecasts show some semblance of continued eastward propagation, but this may be tied to other modes of tropical variability, as the GEFS favors little weakening of the suppressed convective footprint unfolding near the Date Line.

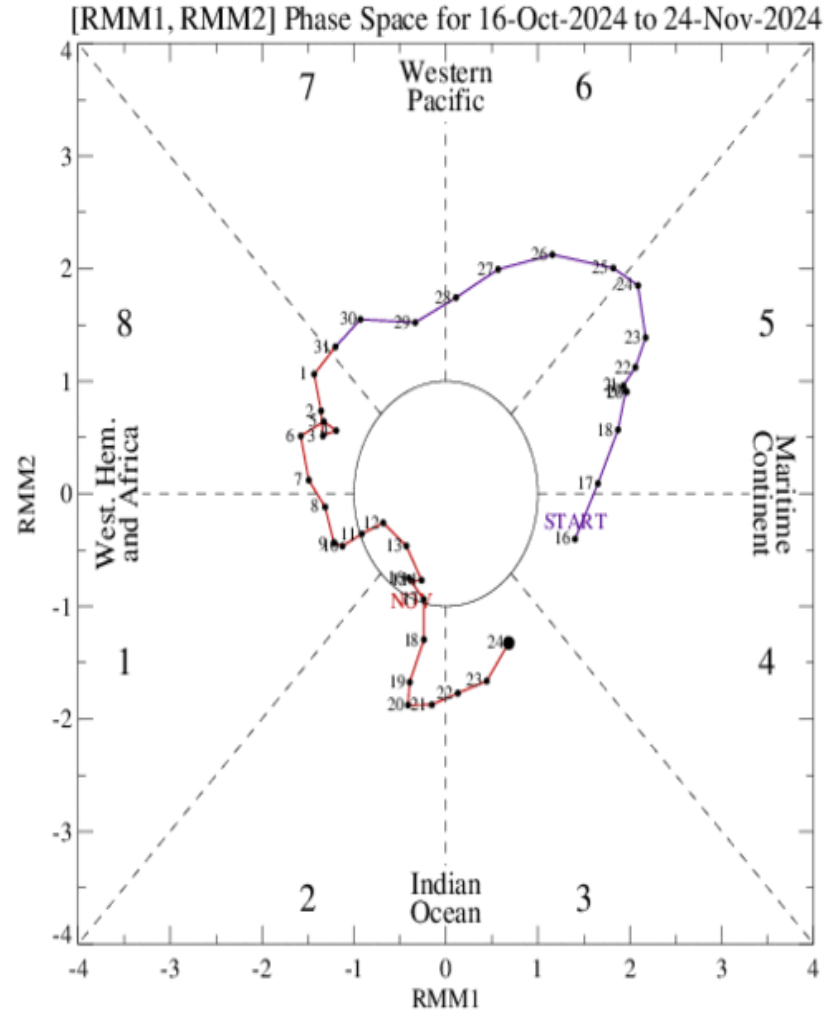
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs anomalies in the Niño regions dipped below zero, but some regions have since rebounded to slightly above-normal recently.
- Negative anomalies over the eastern Pacific remain at the subsurface, but have shown little sign in becoming colder. While warmer subsurface conditions have expanded eastward near 160E, there is small area near 170E that is below zero.

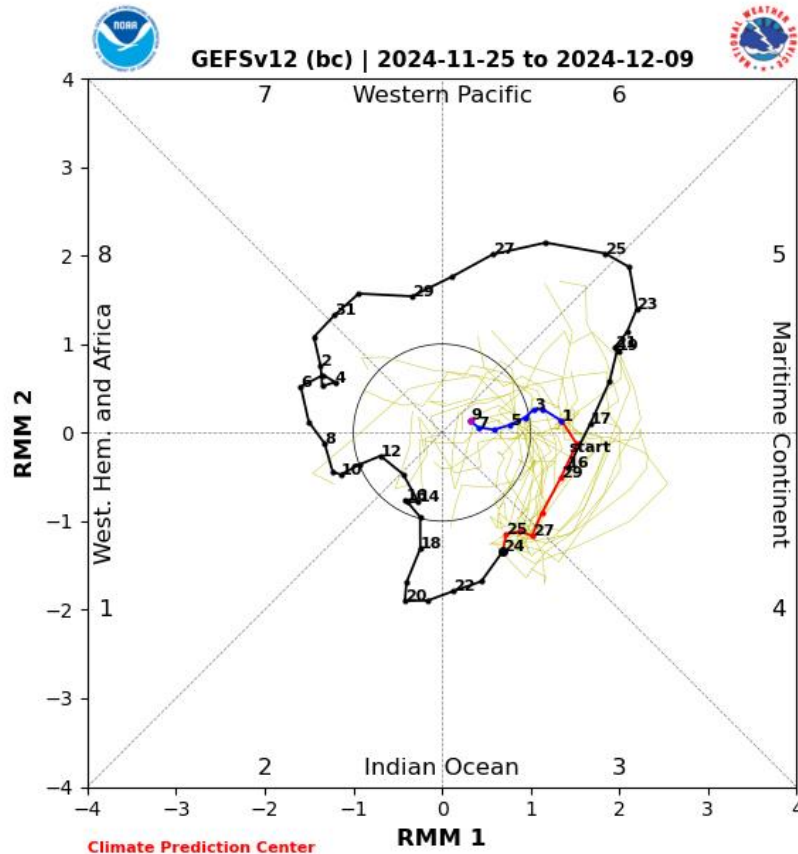
# MJO Index: Recent Evolution

- Following a weakening of the MJO signal during mid-November, the signal reemerged from the RMM unit circle, gained amplitude and resumed eastward propagation over the Indian Ocean.

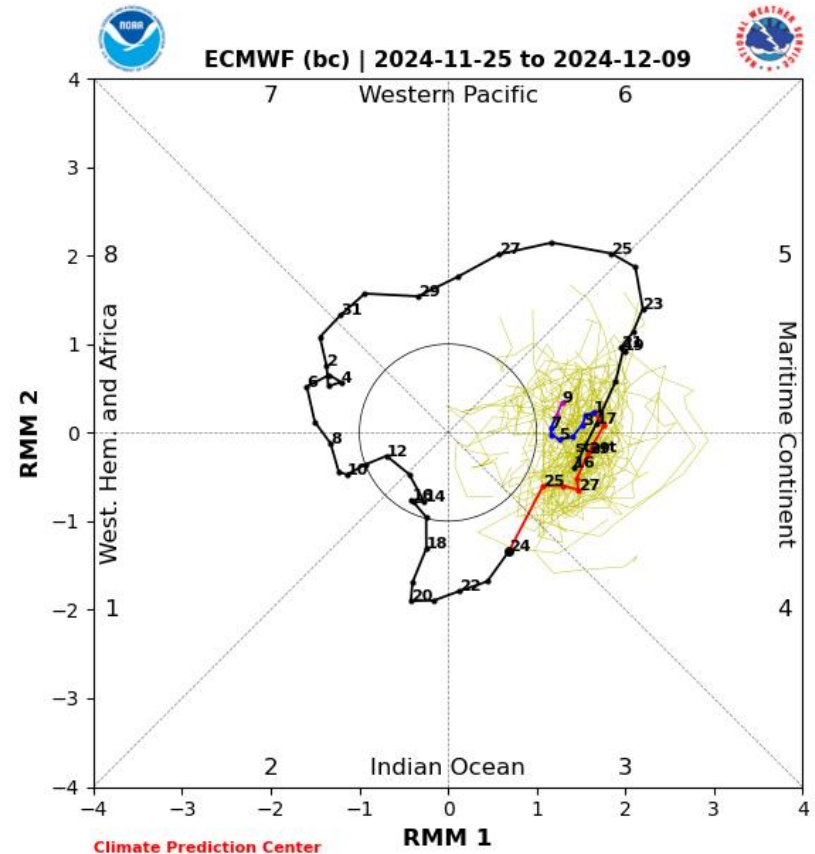




# MJO Index: Forecast Evolution



**GEFS Forecast**



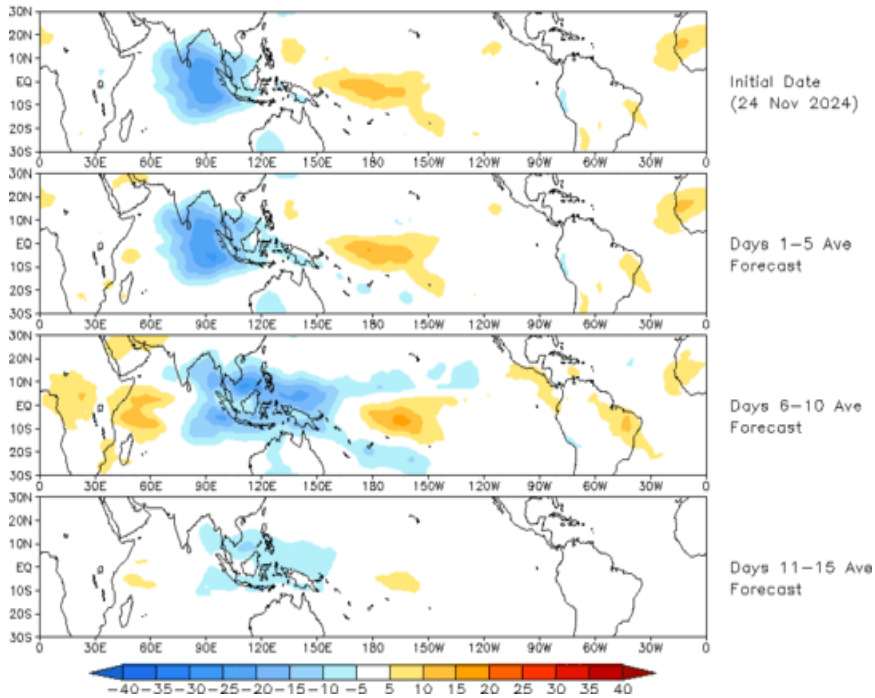
**ECMWF Forecast**

- The GEFS and ECMWF models both favor continued eastward propagation of the MJO over the Maritime Continent but weaken during the next few weeks.
- Extended range RMM solutions (not pictured) are more bullish on the MJO overcoming the Maritime Continent Barrier effect and entering the western Pacific, however there remains uncertainty in the eventual amplitude later in December.

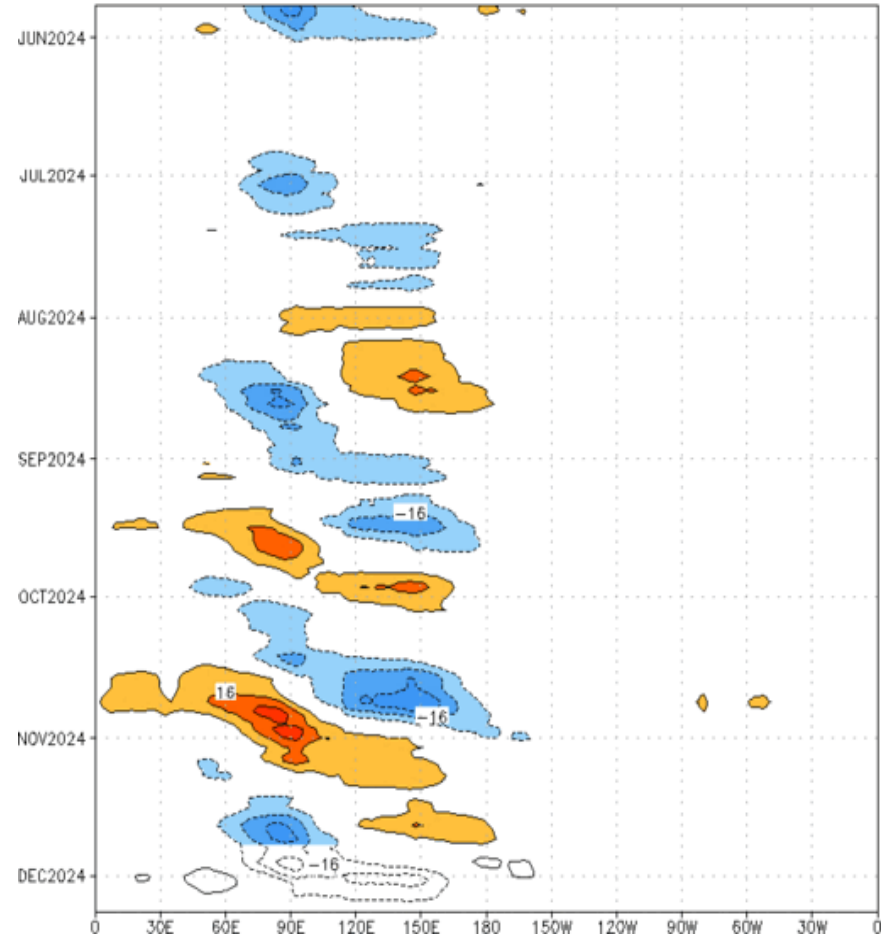
# MJO: GEFS Forecast Evolution

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: 24 Nov 2024  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:25-May-2024 to 24-Nov-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

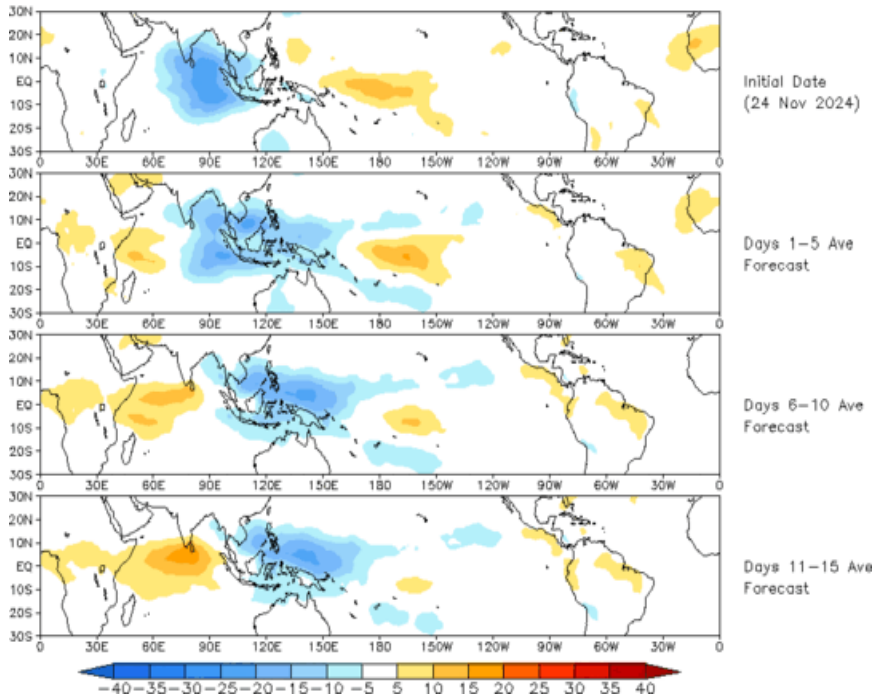


- The GEFS OLR anomaly forecast depicts a canonical evolution of the MJO, with enhanced (suppressed) convection reaching the Western Pacific (eastern Indian Ocean) but weakening towards the later portion of week-2.

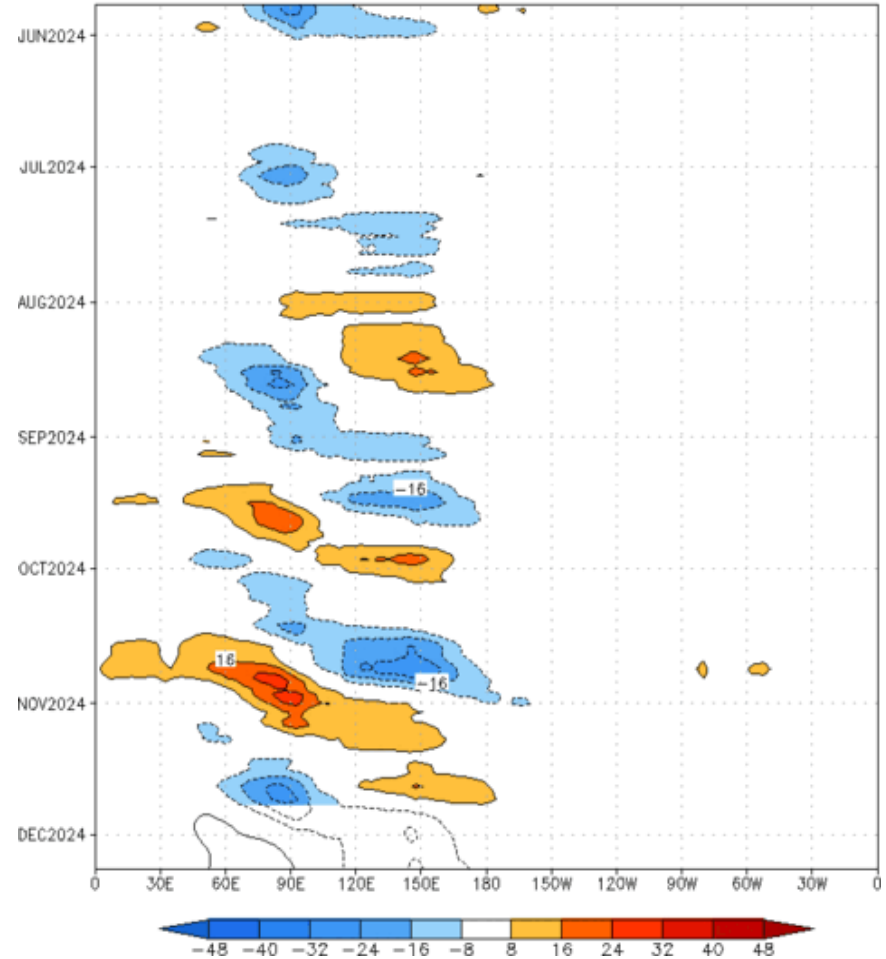
# MJO: Constructed Analog Forecast Evolution

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 (24 Nov 2024)



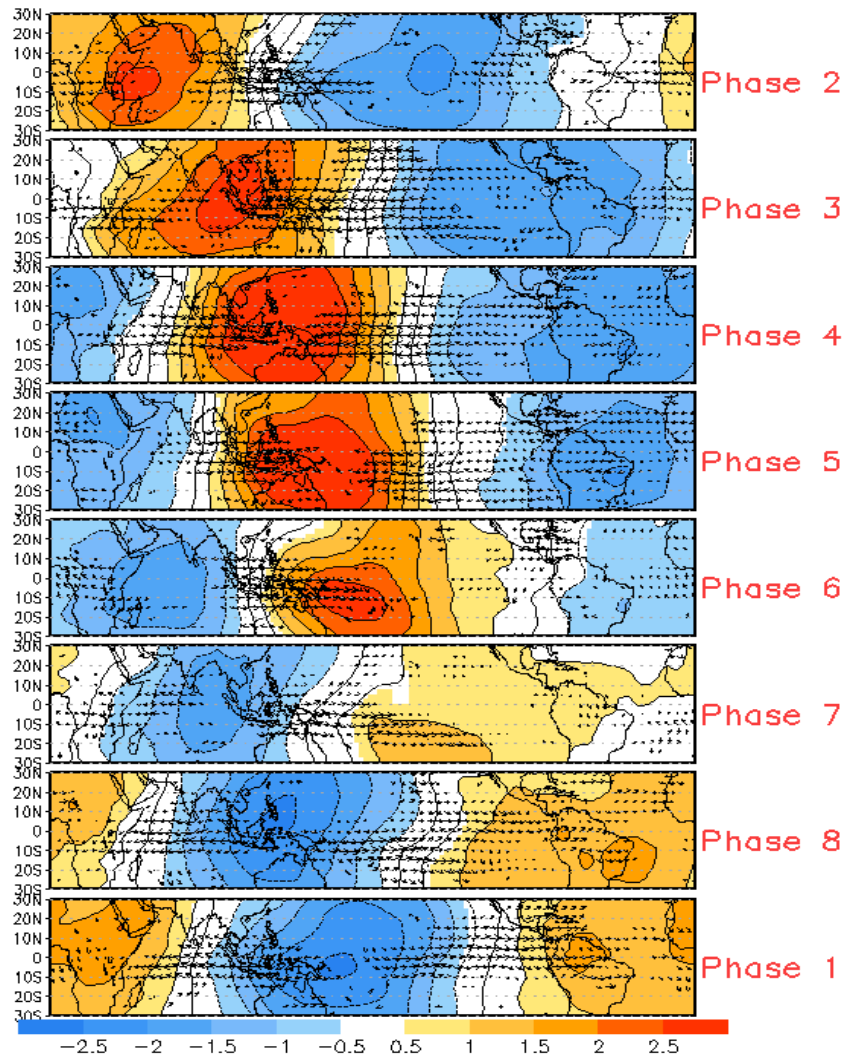
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:25-May-2024 to 24-Nov-2024  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



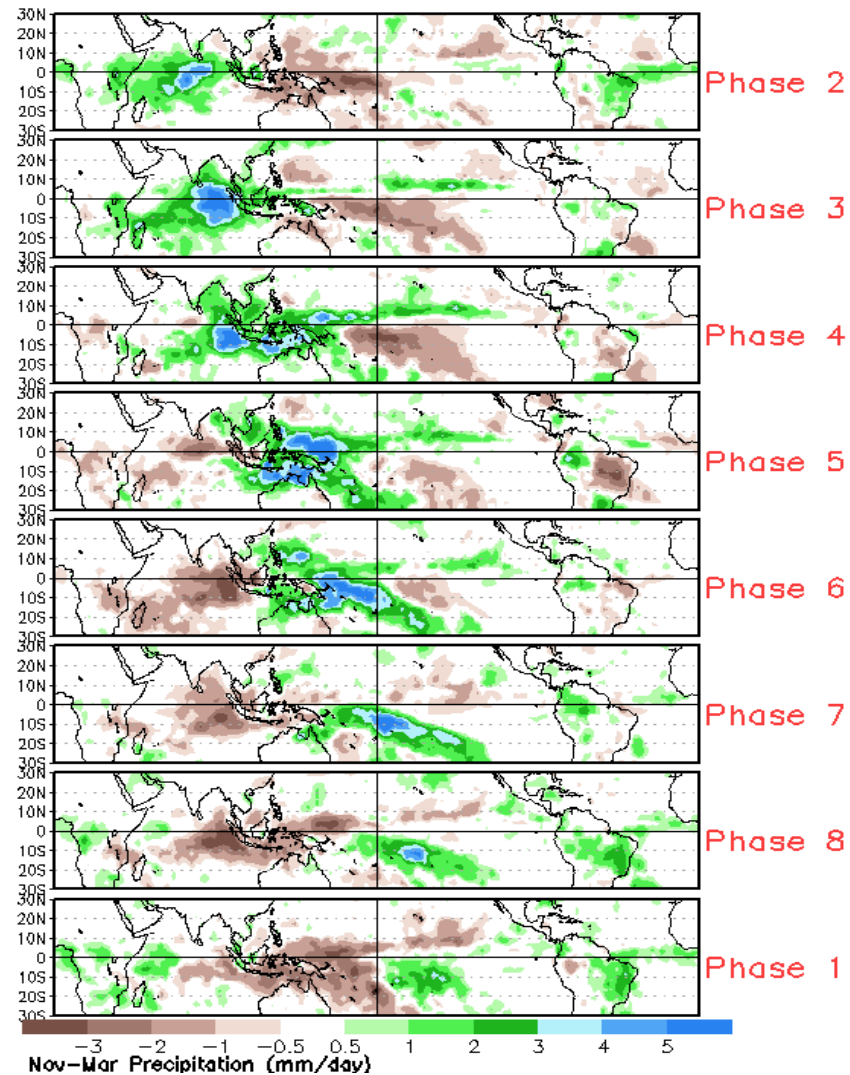
- The constructed analog forecast is consistent with the GEFS forecast, albeit stronger with the convective anomalies over time.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



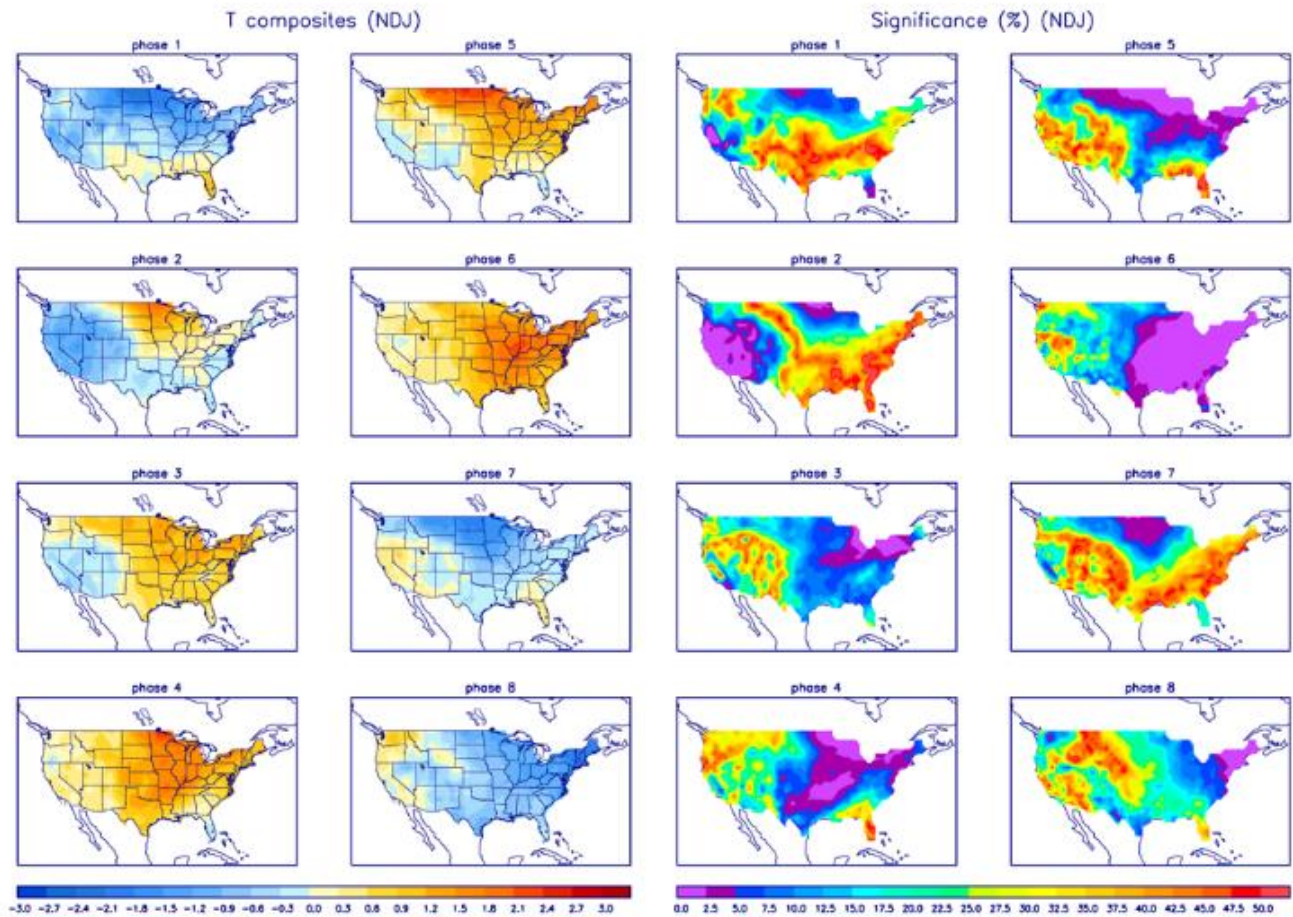
## Precipitation Anomalies



# 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.

