

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



**Update prepared by the Climate Prediction Center  
NWS / NCEP / CPC  
7 October 2024**

# Overview

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- The MJO continues to be a significant player in the global tropics. The RMM index currently places the enhanced convective envelope over the Indian Ocean.
- Dynamical model MJO forecasts depict eastward propagation of the intraseasonal signal into the Maritime Continent and Western Pacific during the next several weeks, with a more suppressed convective pattern developing across North America in the wake of the MJO.
- Tropical cyclone (TC) activity is favored to be greatest over the Indian Ocean and Western Pacific during weeks 2 and 3. The suppressed phase of the MJO is depicted over the Americas during this period which would tend to inhibit TC formation, however potential destructive Kelvin wave interference leads to lingering chances for TC activity on either side of Central America throughout the forecast period.

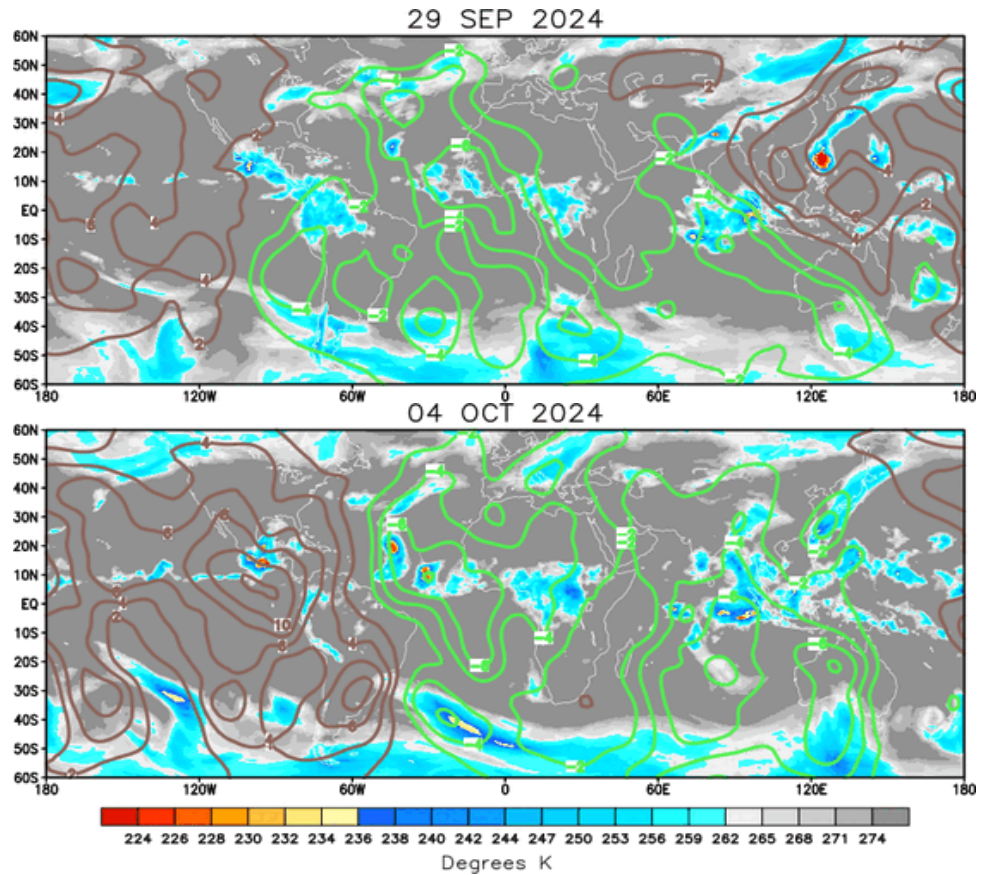
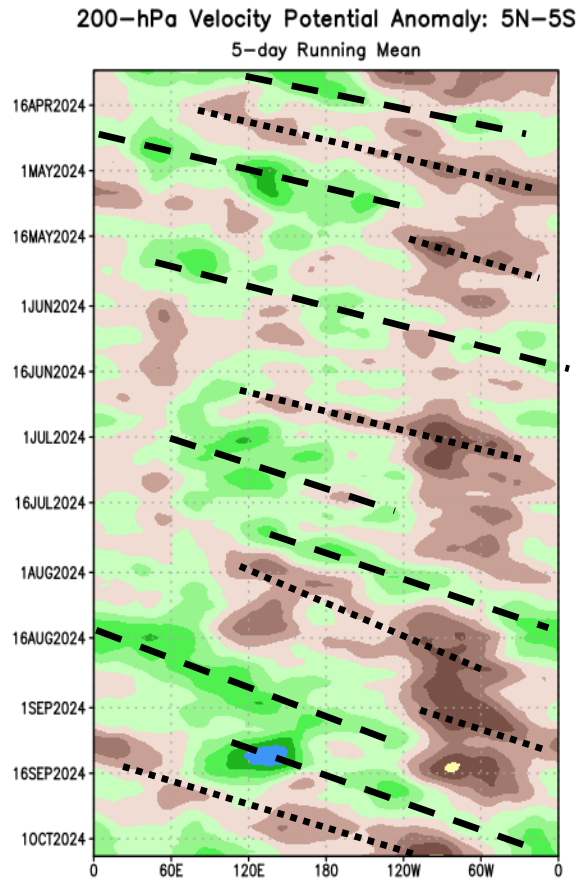
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

**Green shades:** Anomalous divergence (favorable for precipitation)

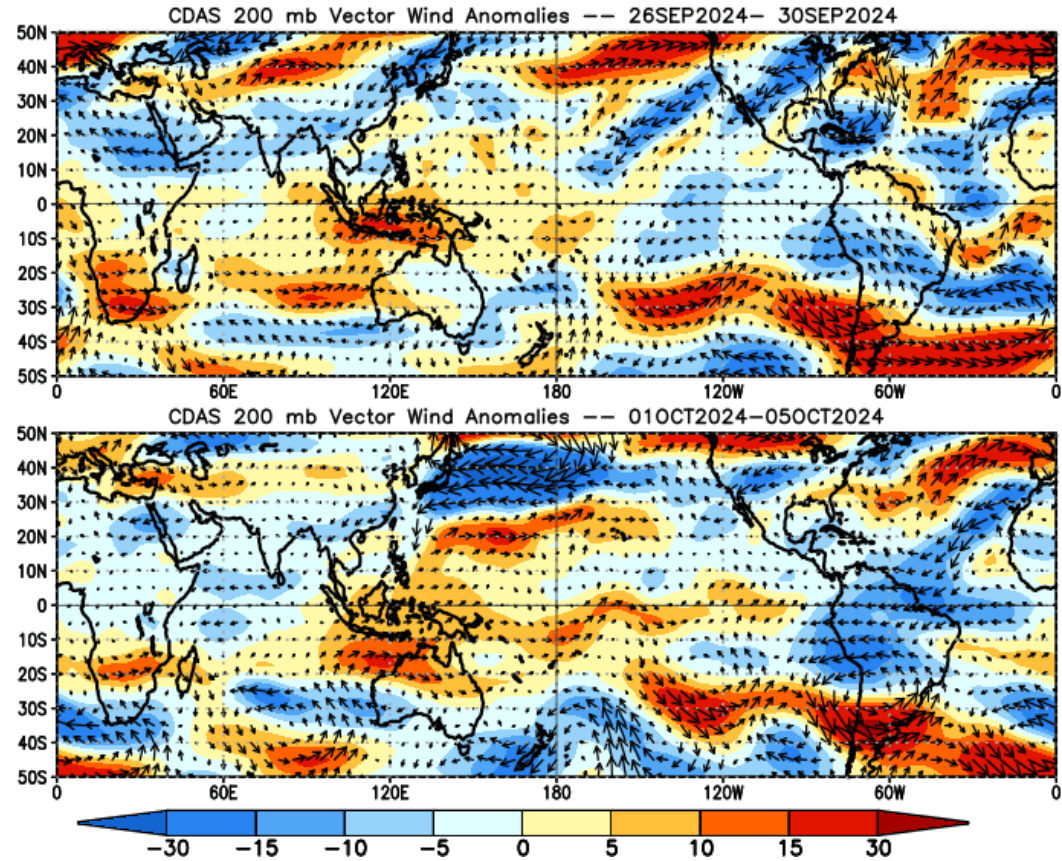
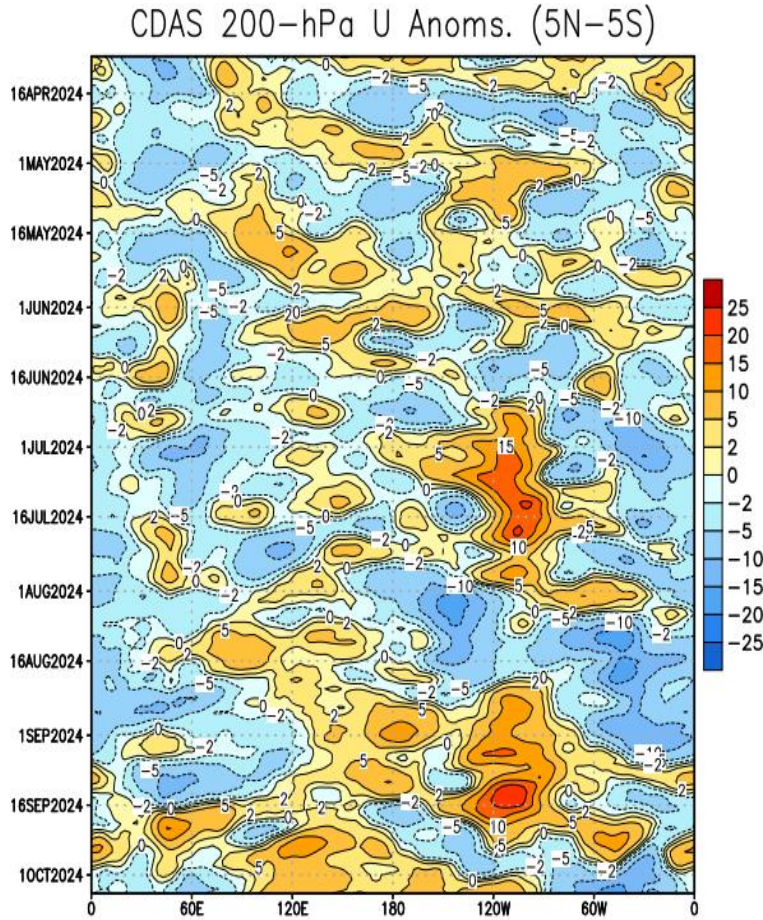
**Brown shades:** Anomalous convergence (unfavorable for precipitation)



- Upper-level velocity potential anomalies over the global tropics have settled back into a wave-1 pattern after a brief period of disorganization due to competing modes of variability.
- Currently, the enhanced(suppressed) convective envelope is situated over Africa/Indian Ocean(Western Pacific/Americas), with eastward propagation evident in both the recent maps and the Hovmoller.

# 200-hPa Wind Anomalies

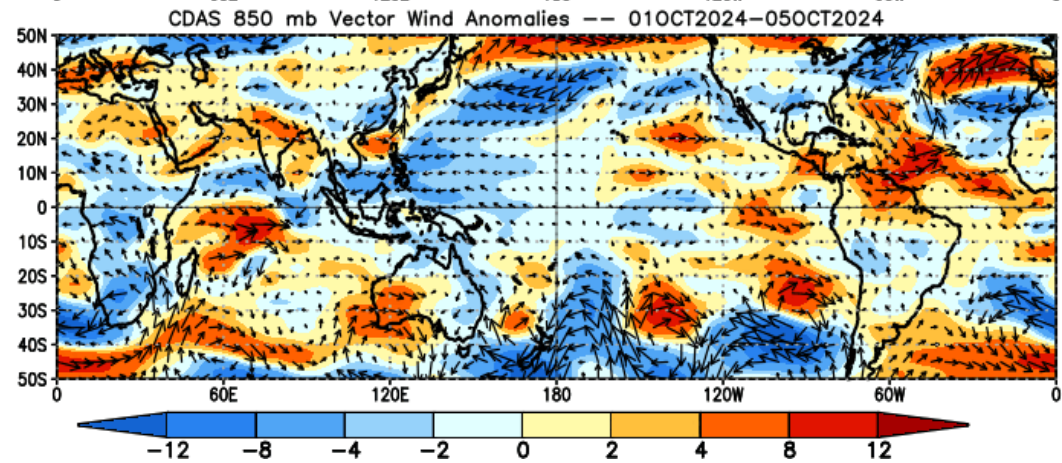
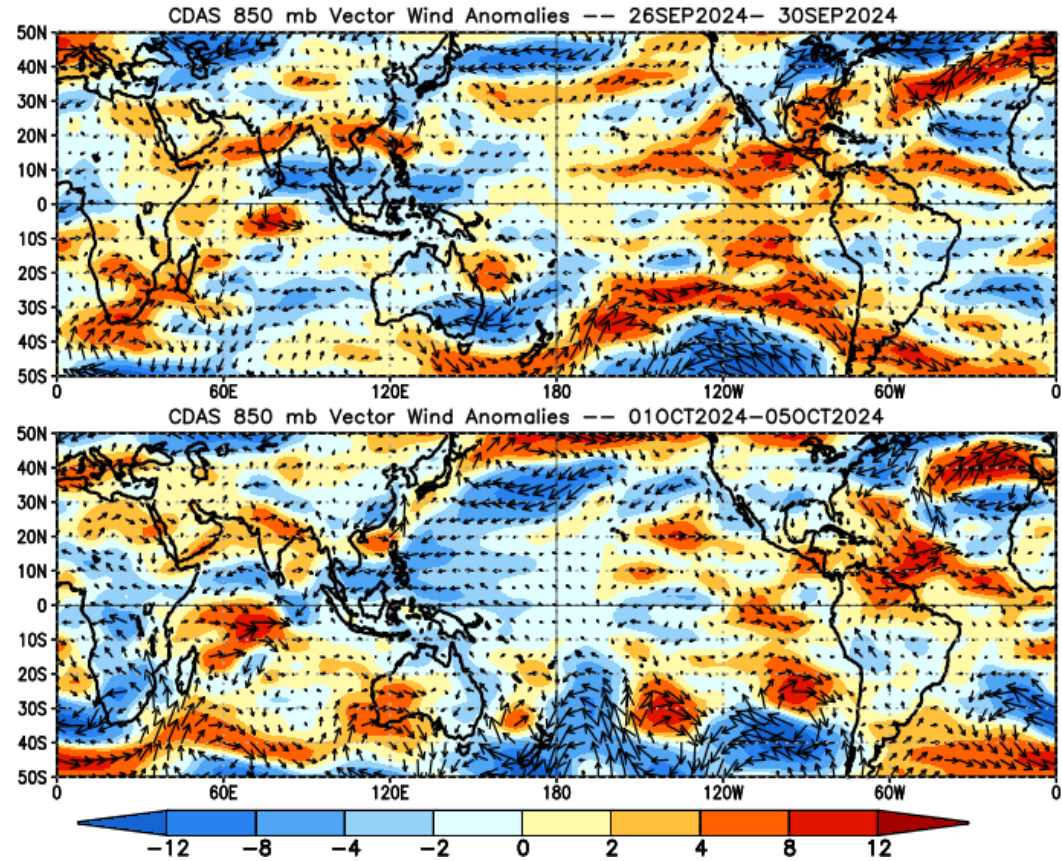
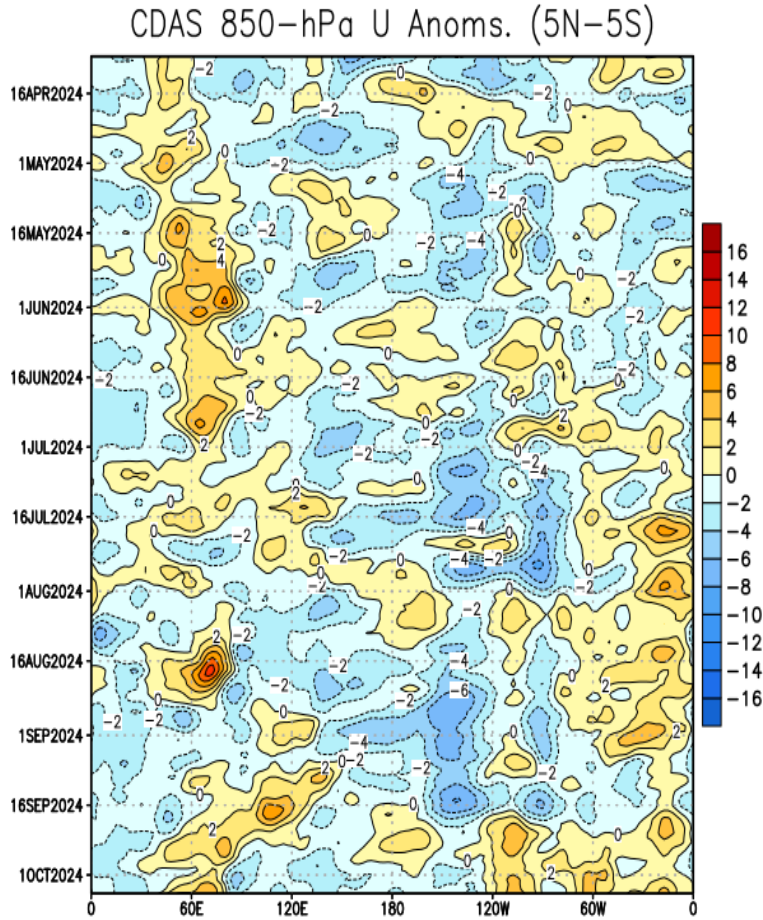
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- After a global circumnavigation of MJO-related anomalous westerlies during September, widespread westerly anomalies have emerged and expanded over the tropical Pacific.
- Strong anomalous easterlies are noted over the North Pacific, part of a large cyclonic feature over the subtropical western Pacific.

# 850-hPa Wind Anomalies

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

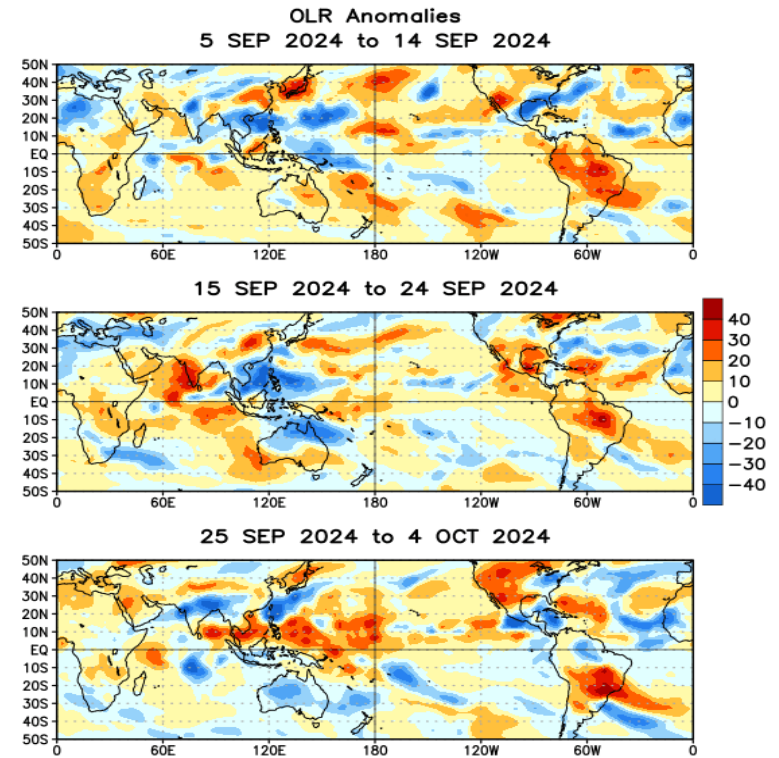
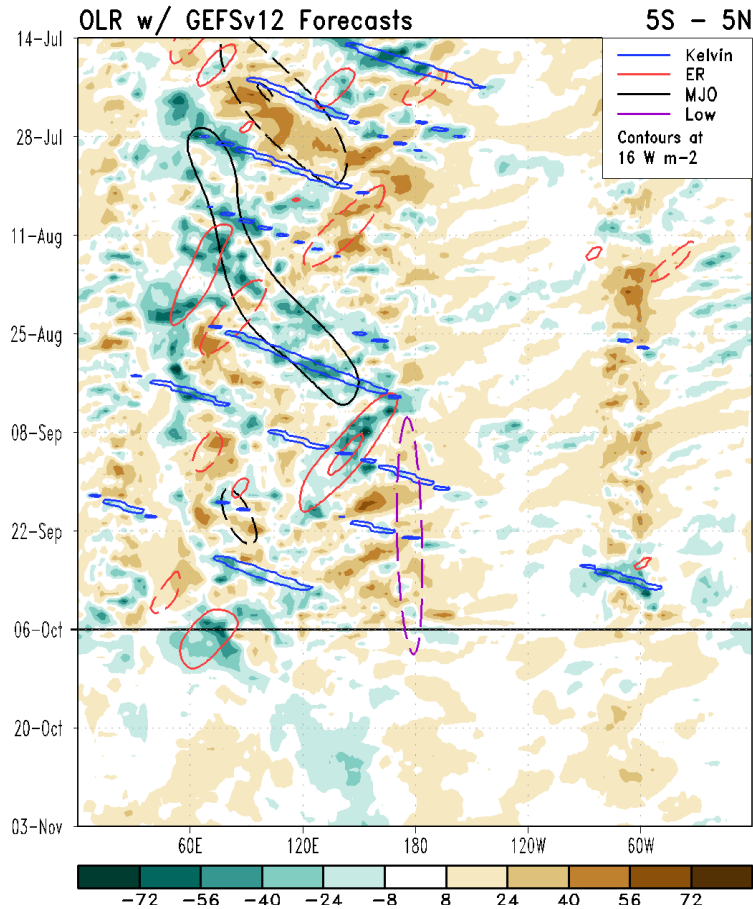


- Low-level westerly wind anomalies have continued to be a player in the Americas over the last week, potentially helping to fuel the active week for TC activity in the Atlantic basin.
- An emerging area of westerly anomalies over the southwestern Indian Ocean is noteworthy; these types of westerly wind events have the potential to kick off TC formation on either side of the equator.

# Outgoing Longwave Radiation (OLR) Anomalies

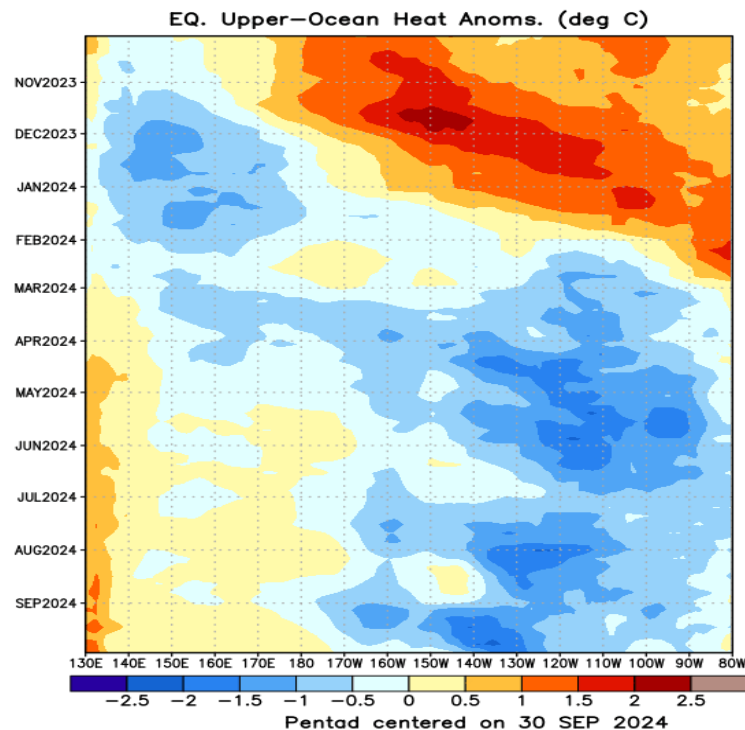
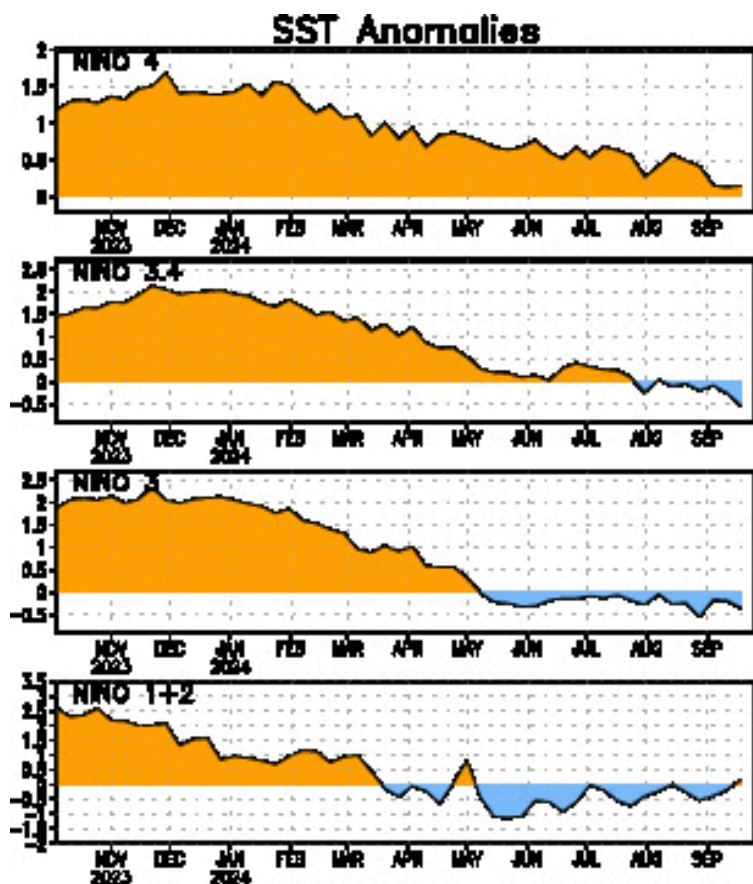
**Green shades:** Anomalous convection (wetness)

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



- The objective filtering of the OLR field seems to be having a hard time discerning a signal in the GEFS forecast today, but there does seem to be an indication of enhanced convection moving from the Indian Ocean into the Western Pacific over the next several weeks.
- Global OLR anomalies over the last few weeks are a bit noisy, reflective of multiple modes of tropical variability in play during the period.

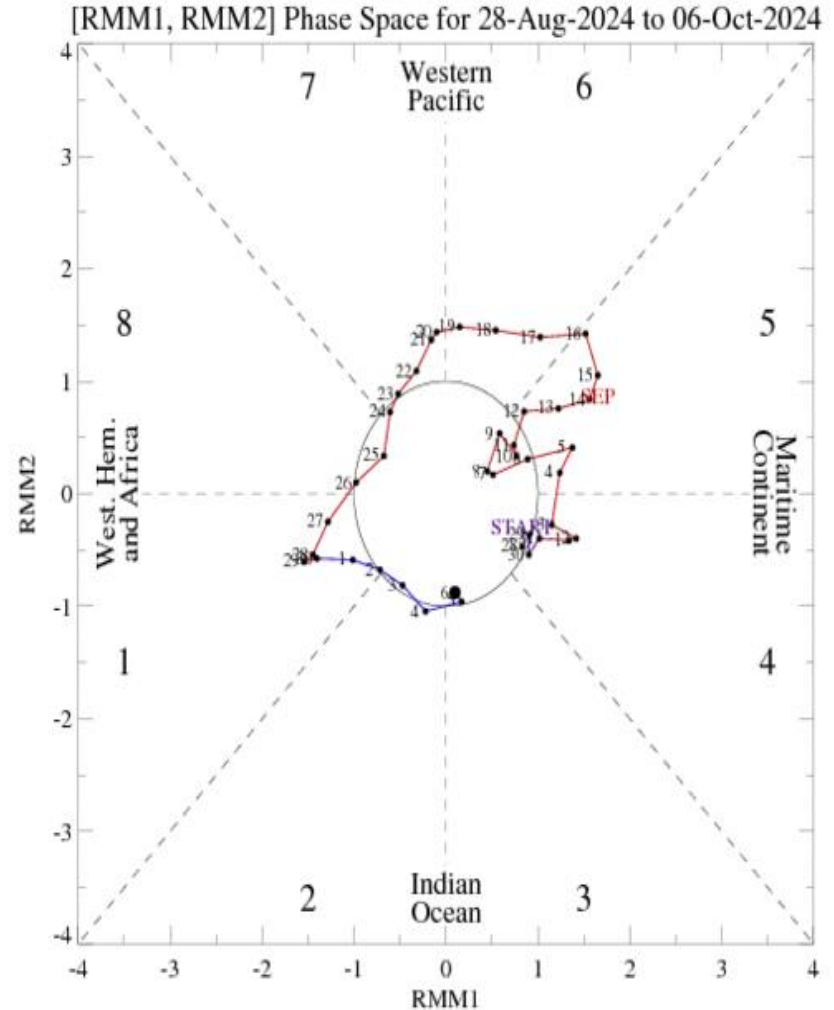
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Niño 3.4 continues to trend downward, mainly from cooling in the Niño 4 region; the downward trend has flattened in the Niño 3 region.
- Subsurface temperature anomalies have continued to cool east of the Date Line, while increasing positive anomalies over the Maritime Continent indicate an enhancement of the Western Pacific warm pool.

# MJO Index: Recent Evolution

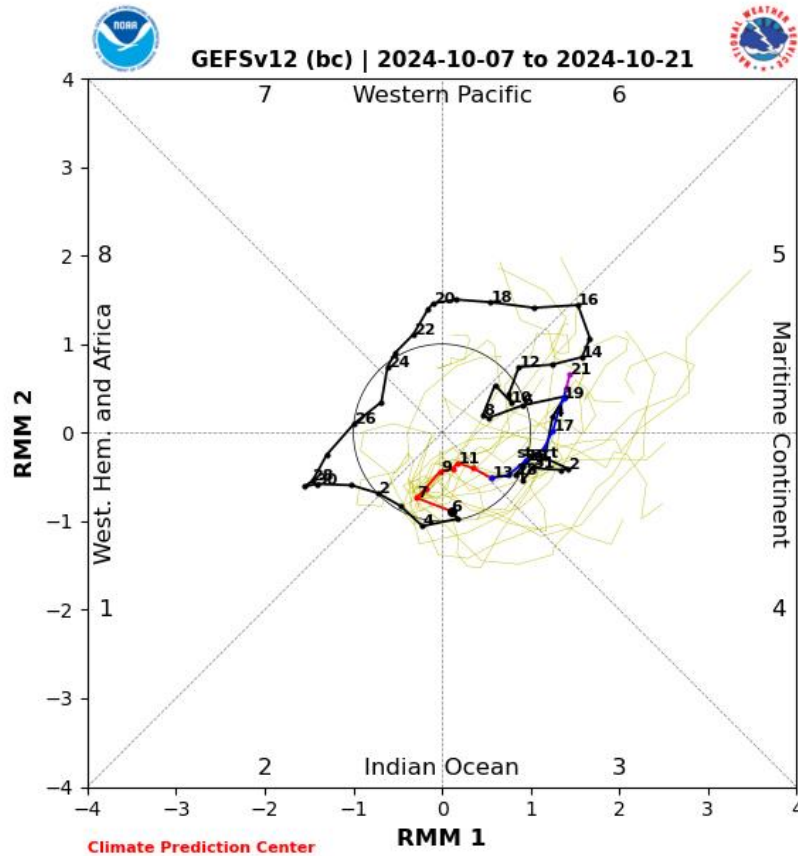
- The MJO has been active throughout most of September, with steady eastward propagation evident after a brief stall over the Maritime Continent early in the month. The RMM index is currently moving along the unit circle between phases 2 and 3.



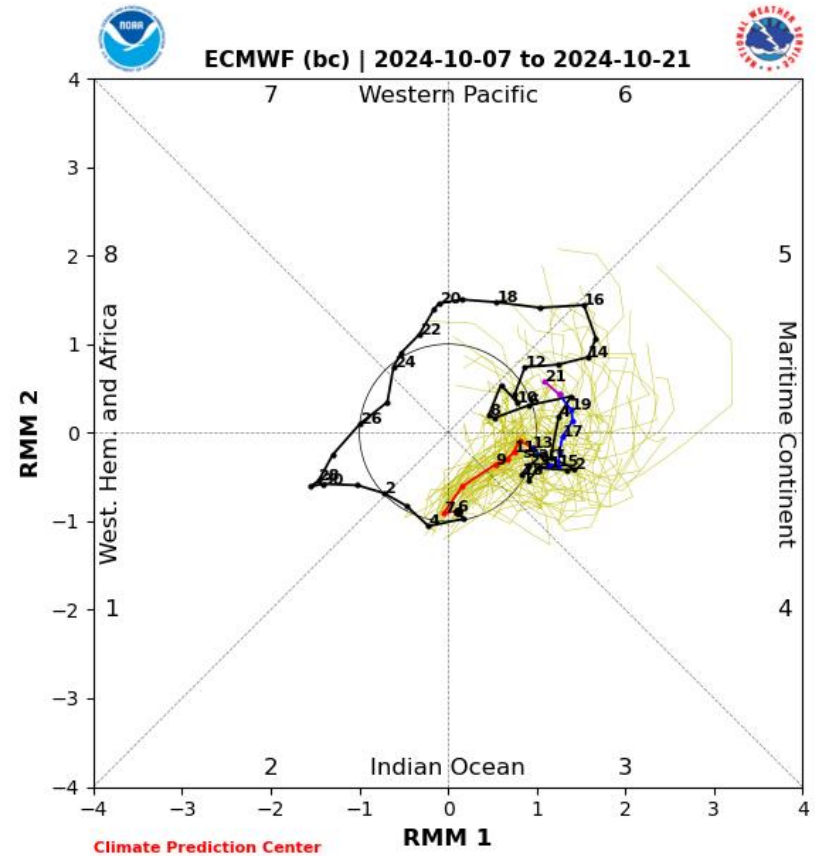
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



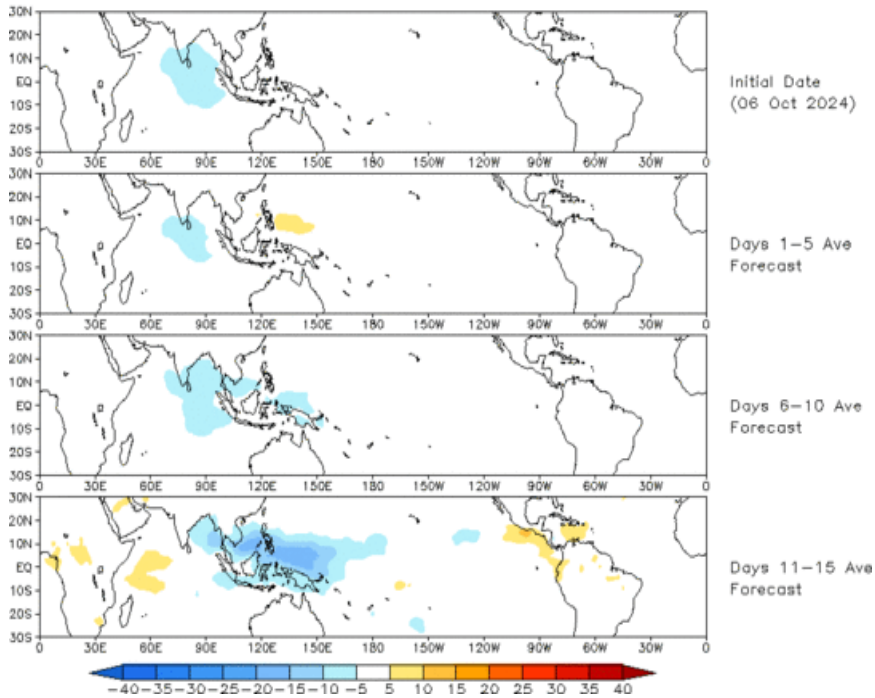
**ECMWF Forecast**

- Dynamical models are in pretty good agreement on a continuation of MJO activity for the next week or so, then the longer range models indicate a potential amplification of the RMM signal during weeks 3 and 4.
- The ECMWF ensembles are more tightly clustered with the magnitude near the edge of the RMM unit circle. There is more spread in the GEFS, with some members depicting a strong MJO event later in October (not pictured).

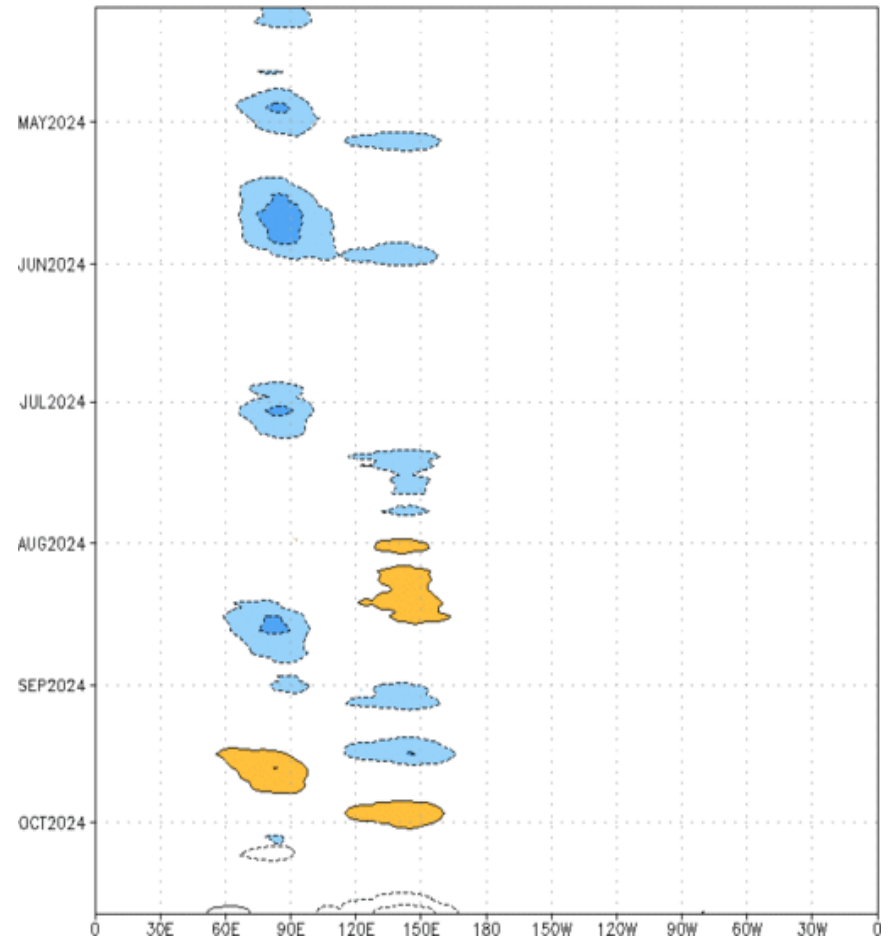
# MJO: GEFS Forecast Evolution

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: 06 Oct 2024  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [ $7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$ ] (cont:  $4\text{Wm}^{-2}$ ) Period: 06-Apr-2024 to 06-Oct-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

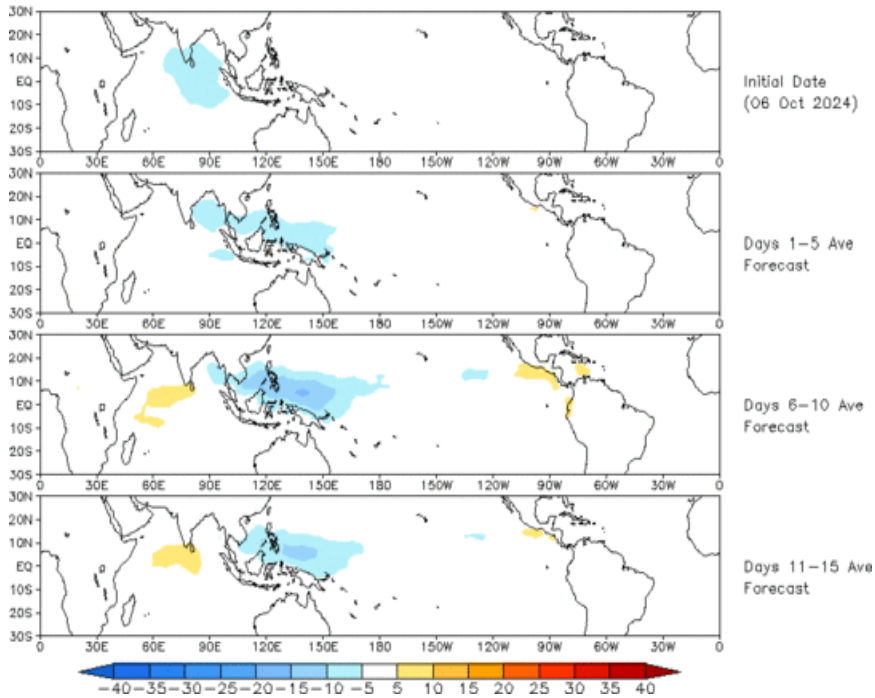


- The GEFS OLR anomaly forecast depicts negative OLR anomalies (enhanced convection) emerging over the Indian Ocean in week-1, shifting over the Maritime Continent and Western Pacific by the end of week-2.
- Positive OLR anomalies (suppressed convection) are favored around Central America later in week-2.

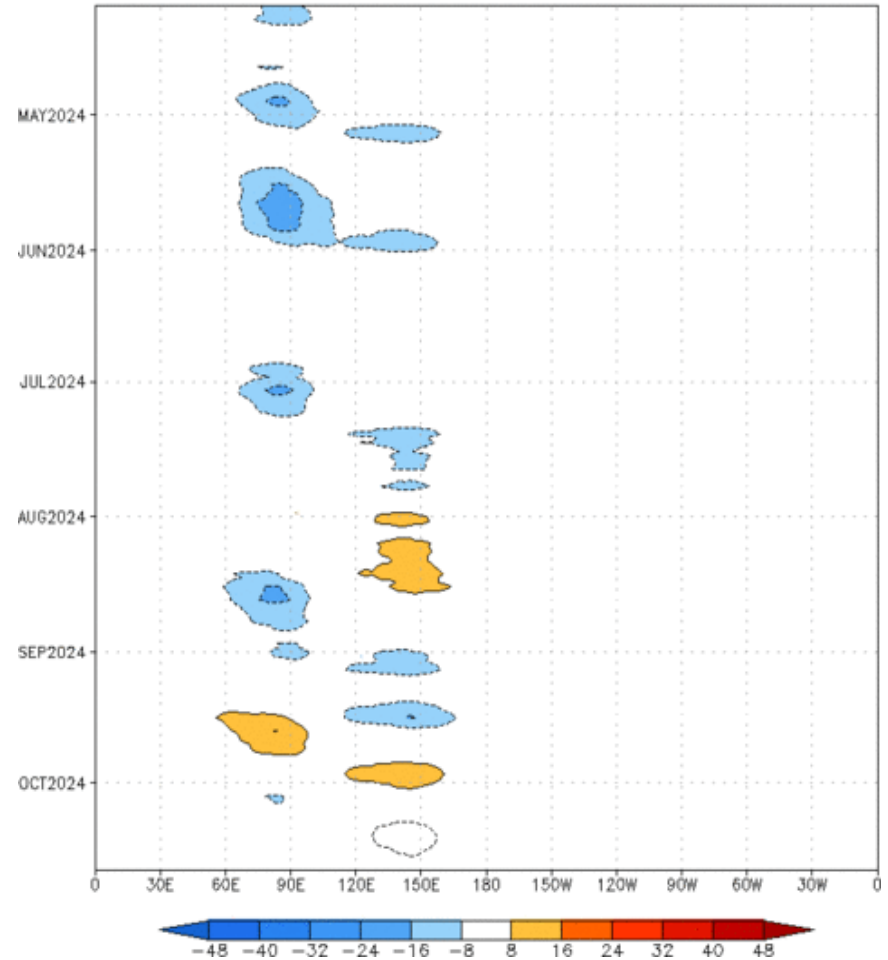
# MJO: Constructed Analog Forecast Evolution

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 (06 Oct 2024)



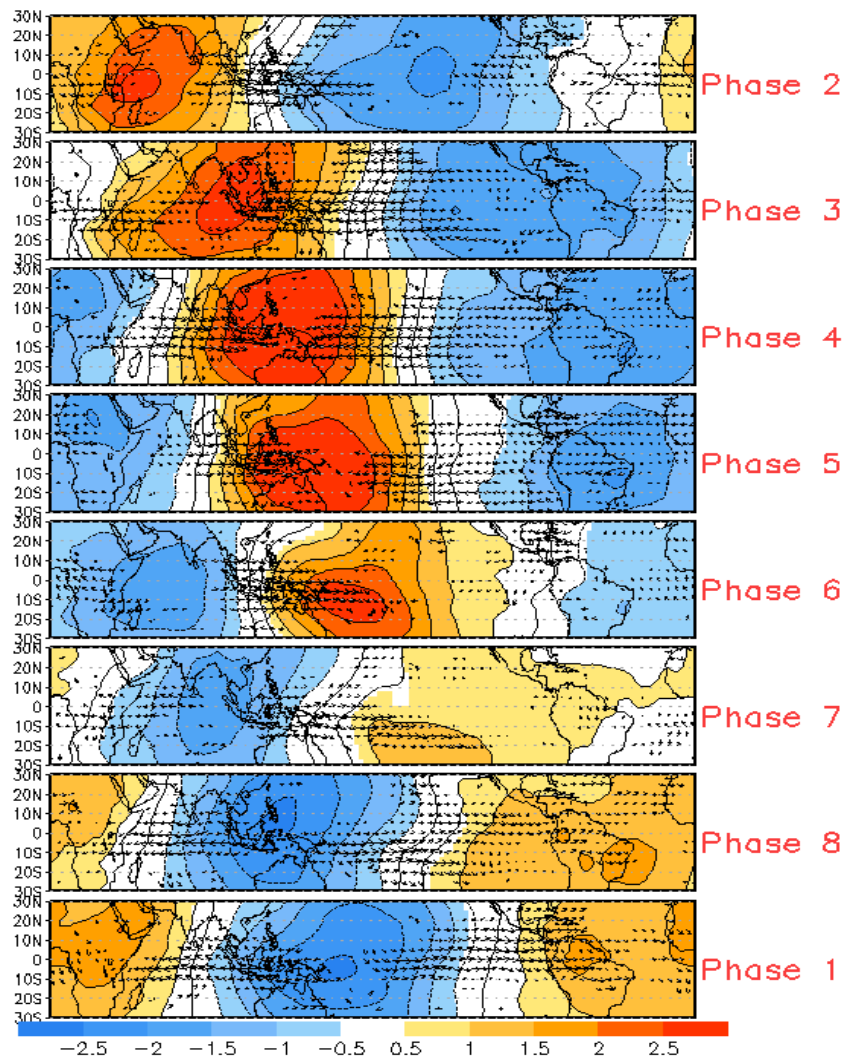
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:06-Apr-2024 to 06-Oct-2024  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



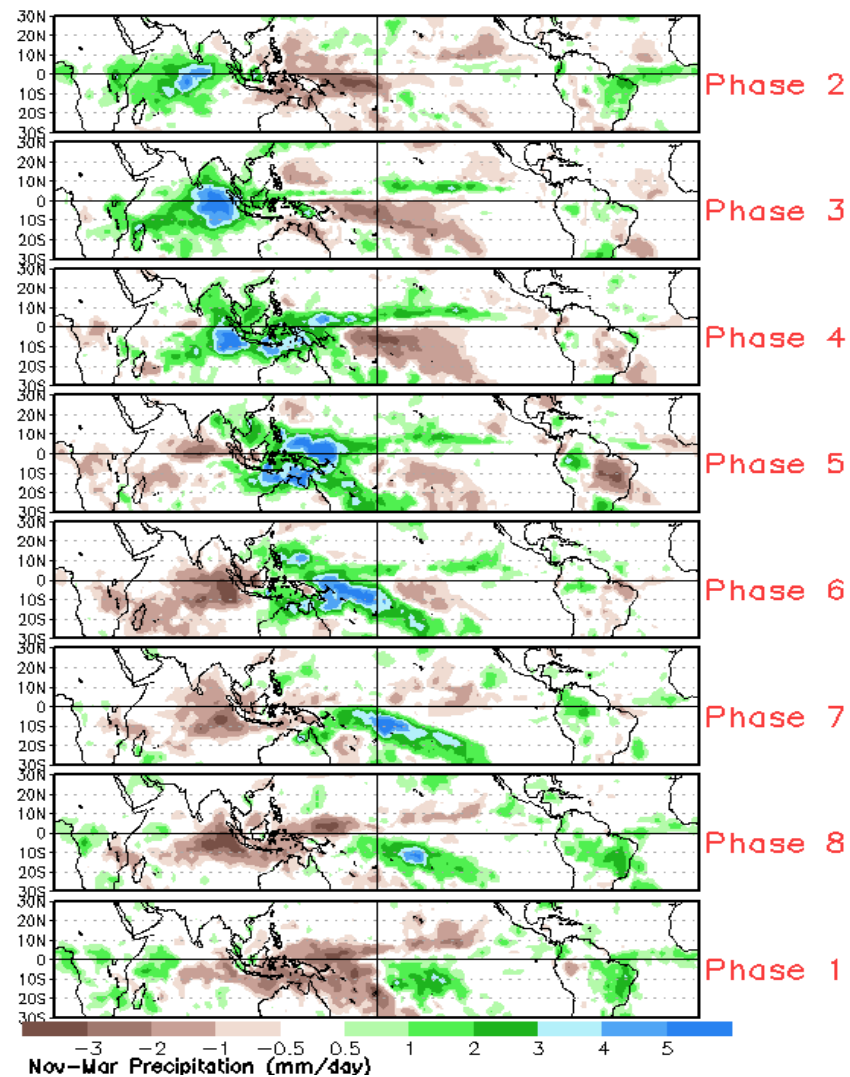
- The constructed analog forecast is similar to the GEFS in terms of positive OLR anomalies initially over the Indian Ocean, but shifts them eastward more quickly and favors a suppressed convective signal emerging over the western Indian Ocean in week-2.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



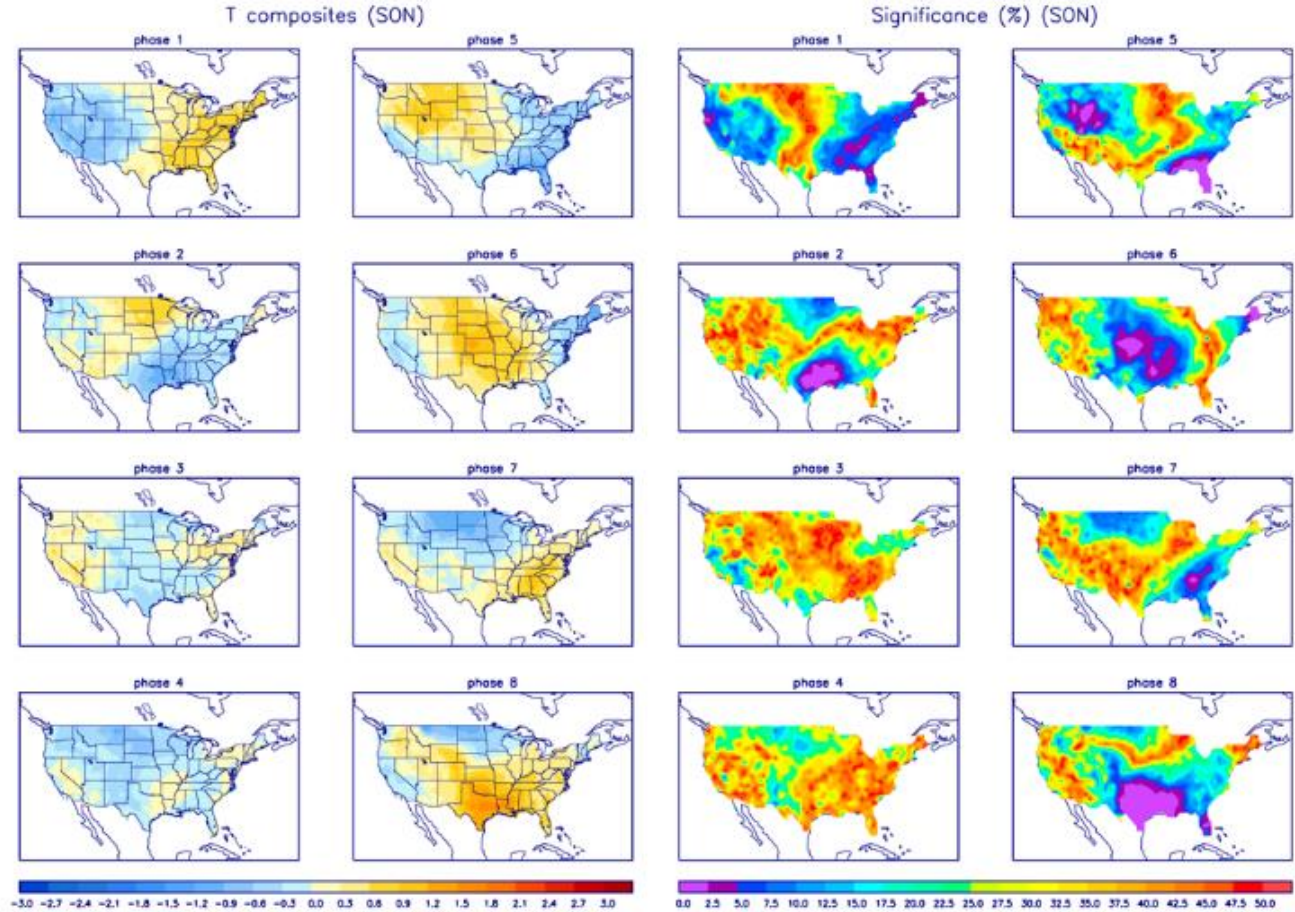
## Precipitation Anomalies



# 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.

