

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



**Update prepared by the Climate Prediction Center**  
**NWS / NCEP / CPC**  
**2 September 2024**

# Overview

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- The MJO has been largely coherent since early August, having propagated from the Western Hemisphere into the Indian Ocean. The RMM signal has strengthened lately after the MJO emerged from destructive interference from Rossby wave activity.
- RMM forecast suggest this modulating signal is likely to continue, as dynamical models indicate the potential for further interference from Rossby waves.
- The large scale environment is expected to continue to be favorable for Tropical Cyclone (TC) Development in the Western Pacific during the next several weeks.
- Should the MJO remain coherent over the Maritime Continent and Western Pacific, this historically supports increasingly less favorable conditions for TC formation in the East Pacific and the Main Development Region of the Tropical Atlantic. However, any lowered TC potential is counteracted by an active climatology as well as other modes of tropical variability that contribute to genesis.

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

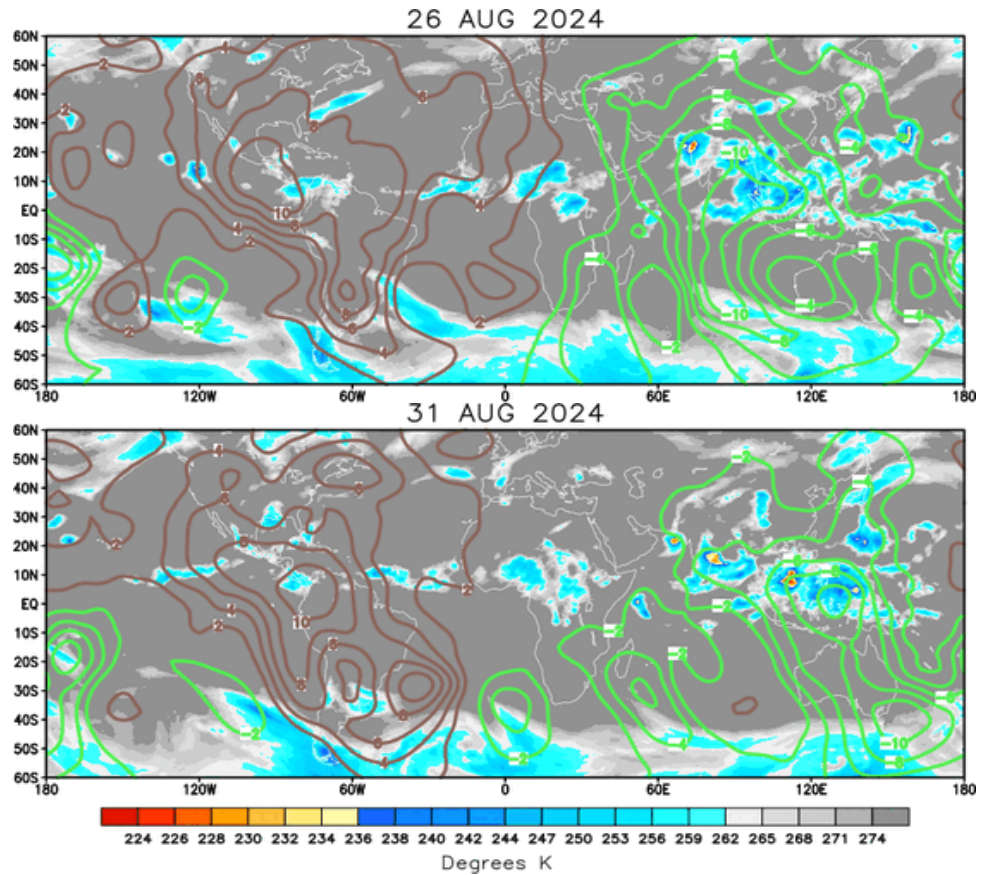
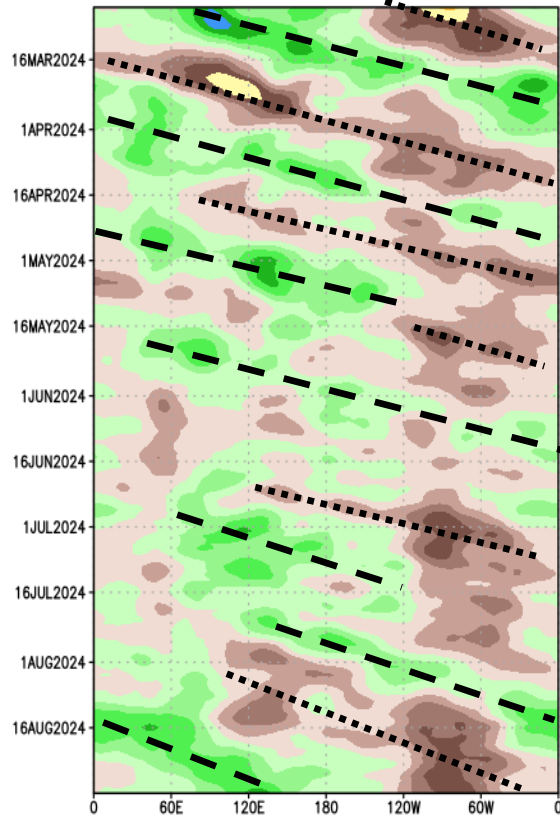
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

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

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

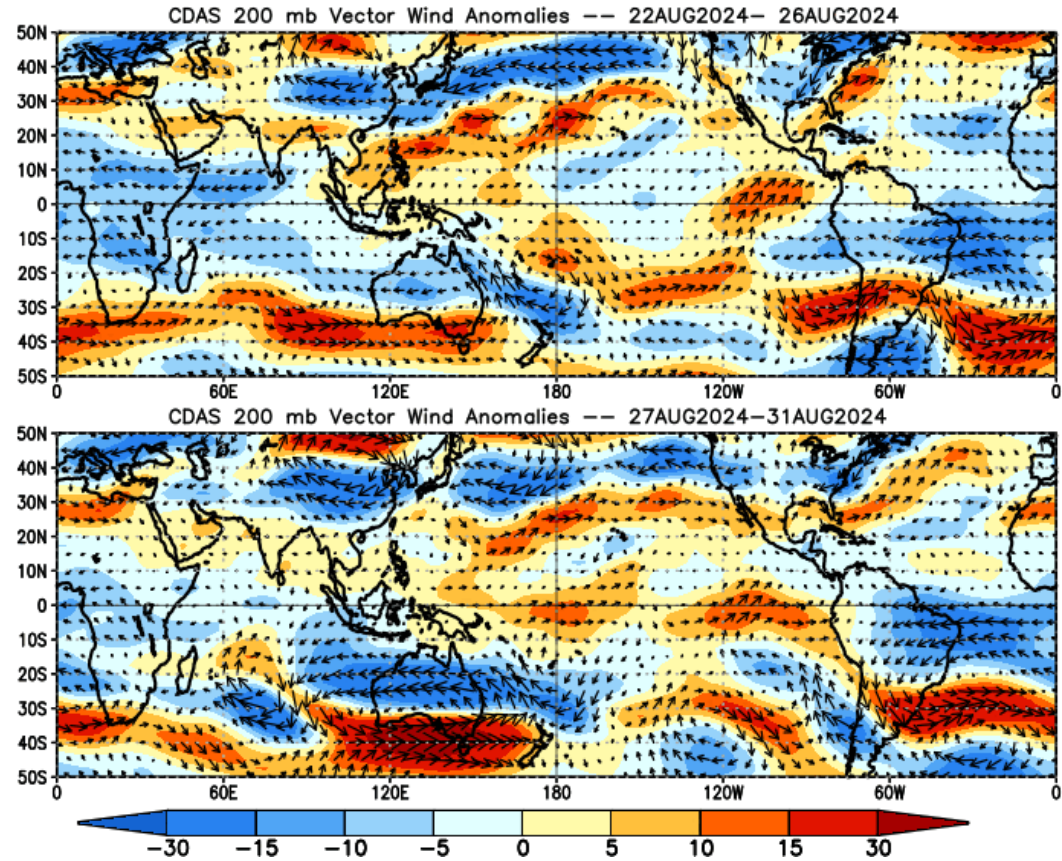
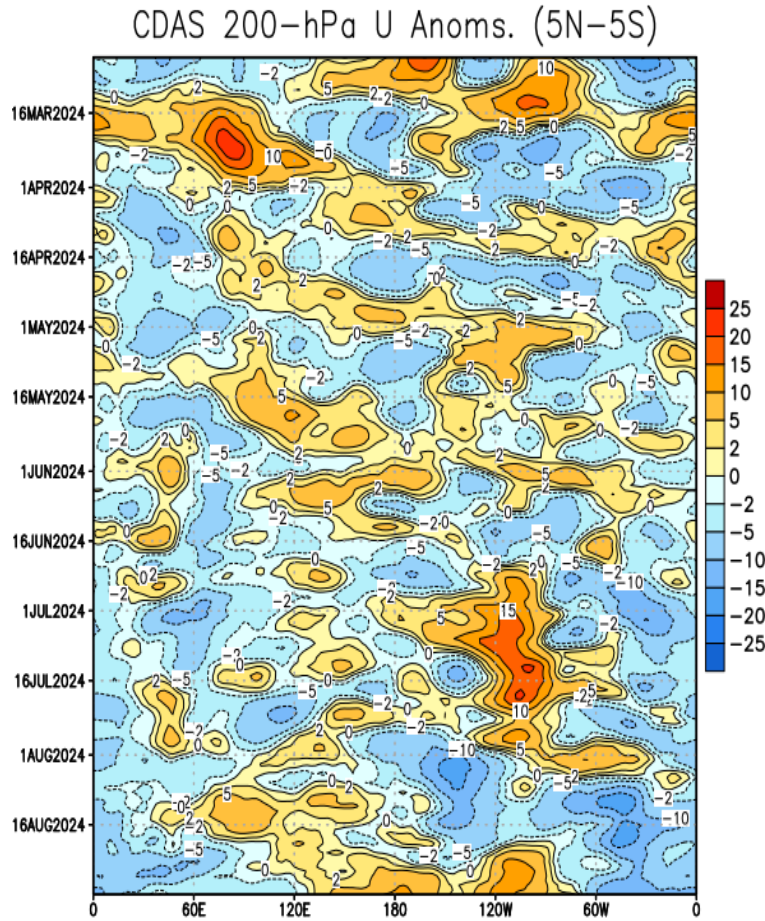
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- A well-defined wave-1 pattern has been present since early August, with the enhanced (suppressed) phase currently moving over the Maritime Continent (Tropical Americas).
- A suppressed phase of the MJO has been firmly anchored over the Americas for the last few weeks, while the enhanced phase has been showing more eastward propagation during the same time period.

# 200-hPa Wind Anomalies

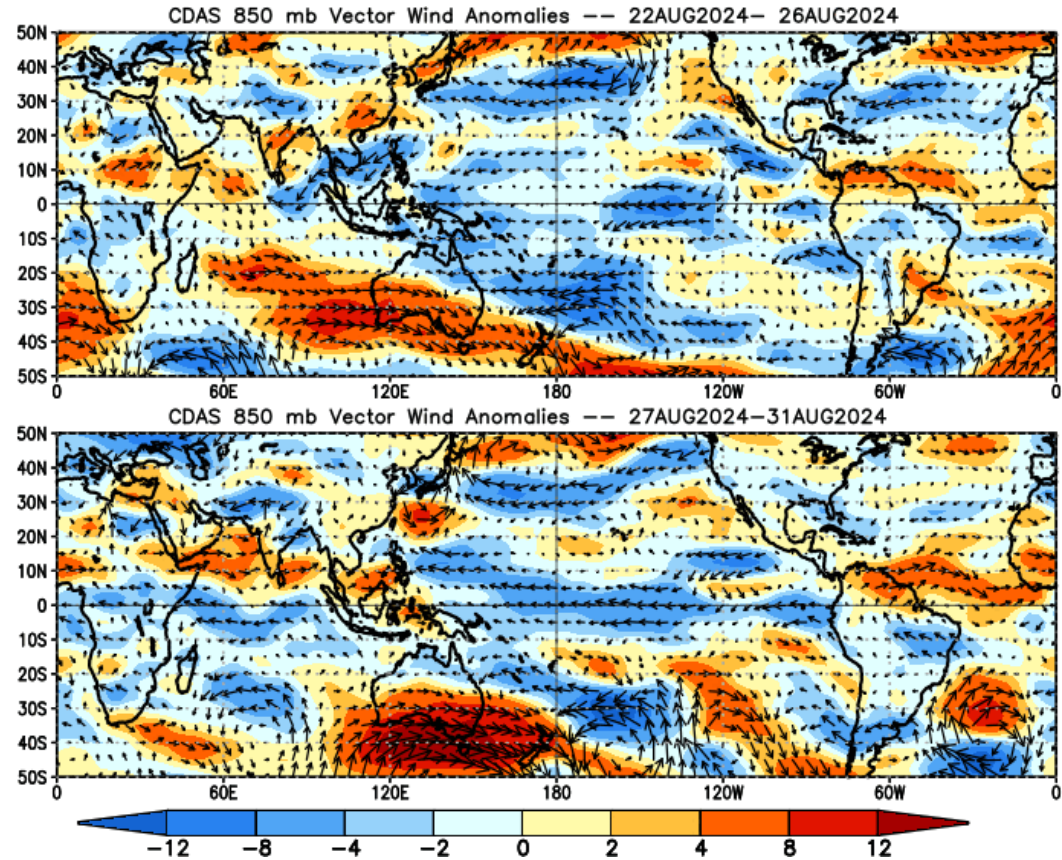
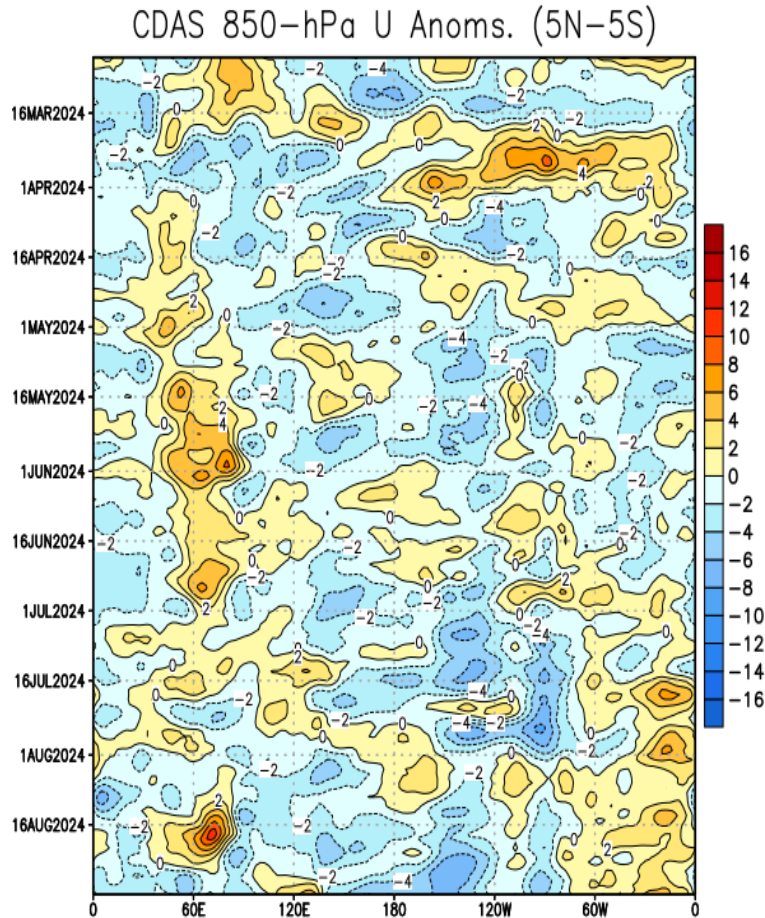
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies have been persistent and widespread over much of the tropical Pacific, while enhanced easterlies have been present over the tropical Atlantic since early August.
- The subtropical north Pacific is characterized by parallel easterly/westerly anomalies, suggesting a southward displacement of typical synoptic flow.
- Anomalous easterlies are noted over equatorial Africa, potentially enhancing African easterly wave activity.

# 850-hPa Wind Anomalies

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

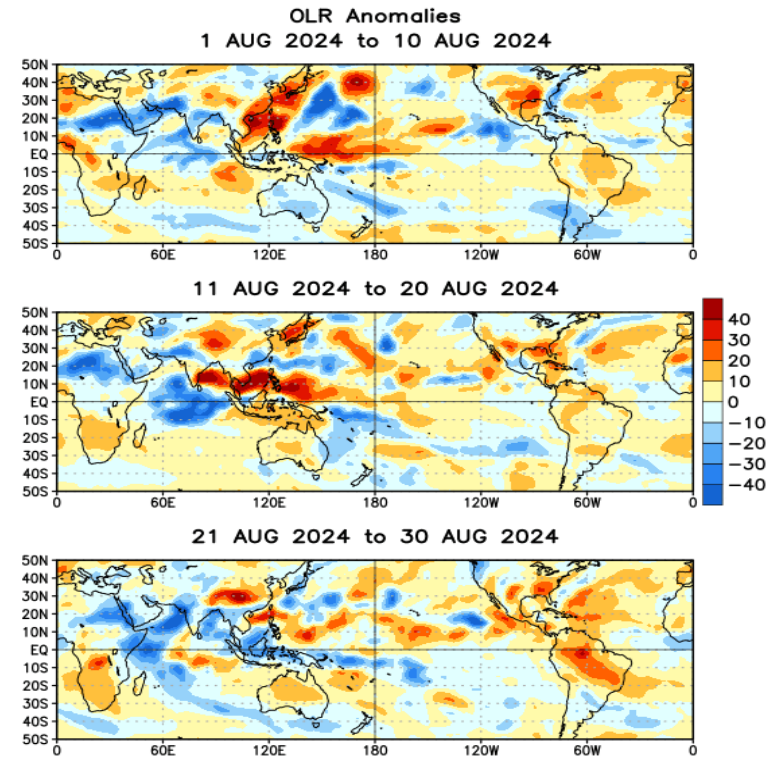
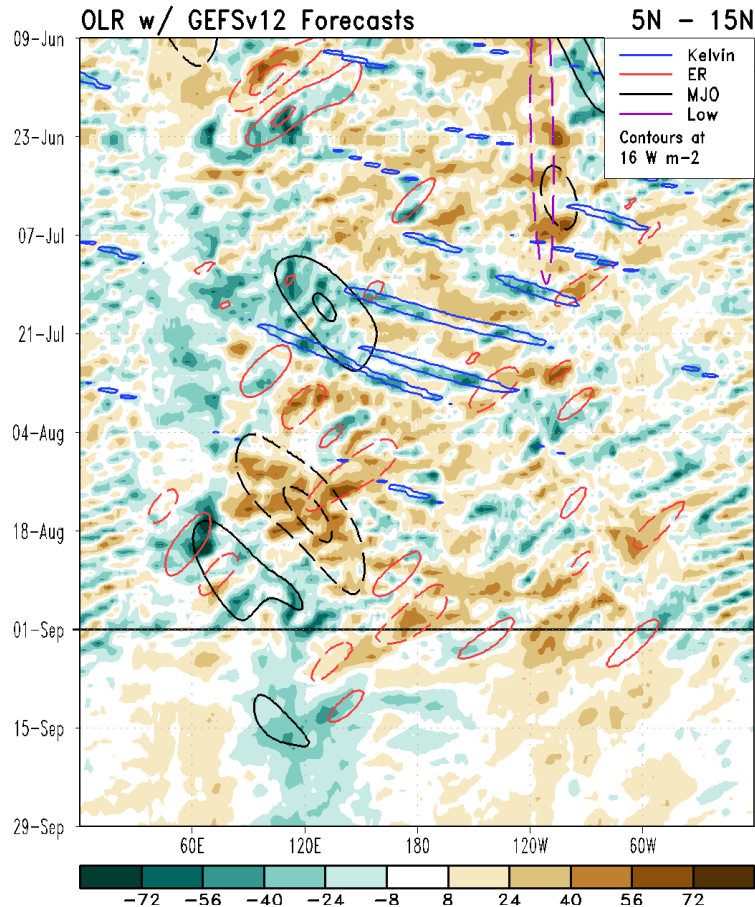


- An enhanced trade regime continues across the tropical Pacific with easterly anomalies becoming more widespread and increasing in intensity.
- Westerlies persist over the tropical Atlantic to reduce shear, although upper-level easterly anomalies have become less pronounced recently.

# Outgoing Longwave Radiation (OLR) Anomalies

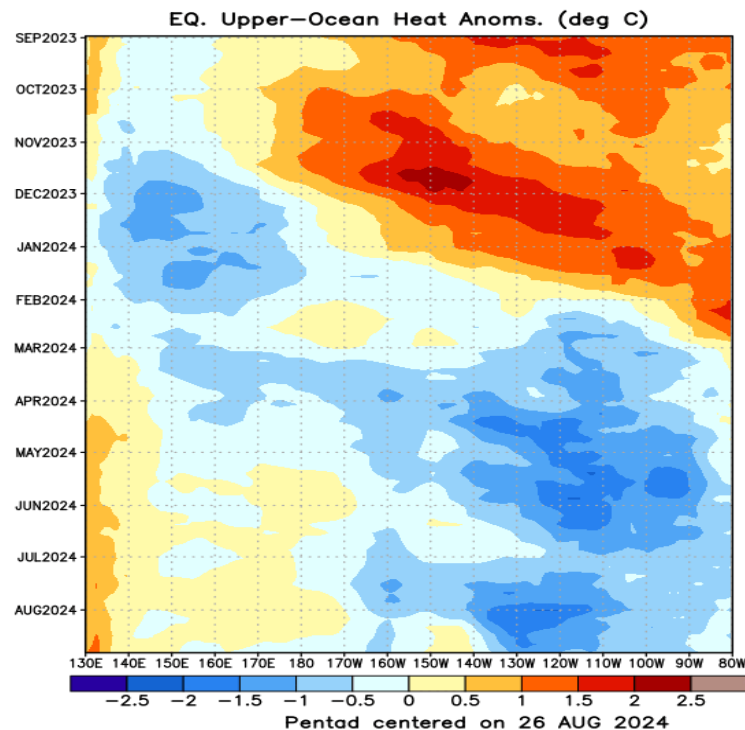
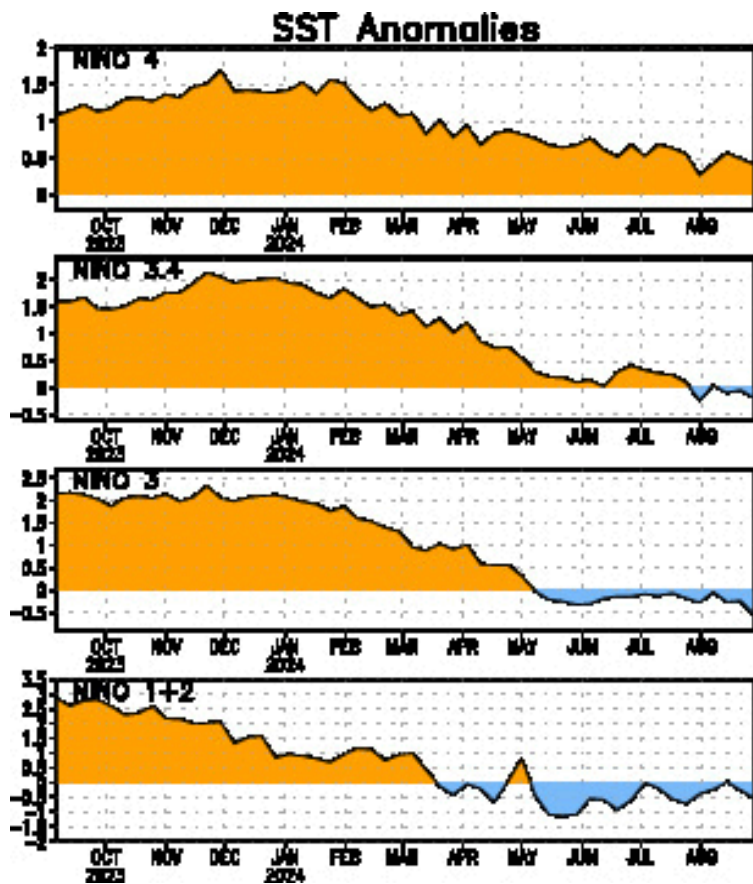
**Green shades:** Anomalous convection (wetness)

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



- Tied to the eastward propagating MJO and the WWB event, enhanced convection has been moving steadily eastward from the Horn of Africa into the Maritime Continent over the month of August.
- Objective filtering of OLR anomalies continue to show MJO activity in the observations and forecast heading into September. Equatorial Rossby waves are also coming through filtering, which could destructively interfere with the MJO.

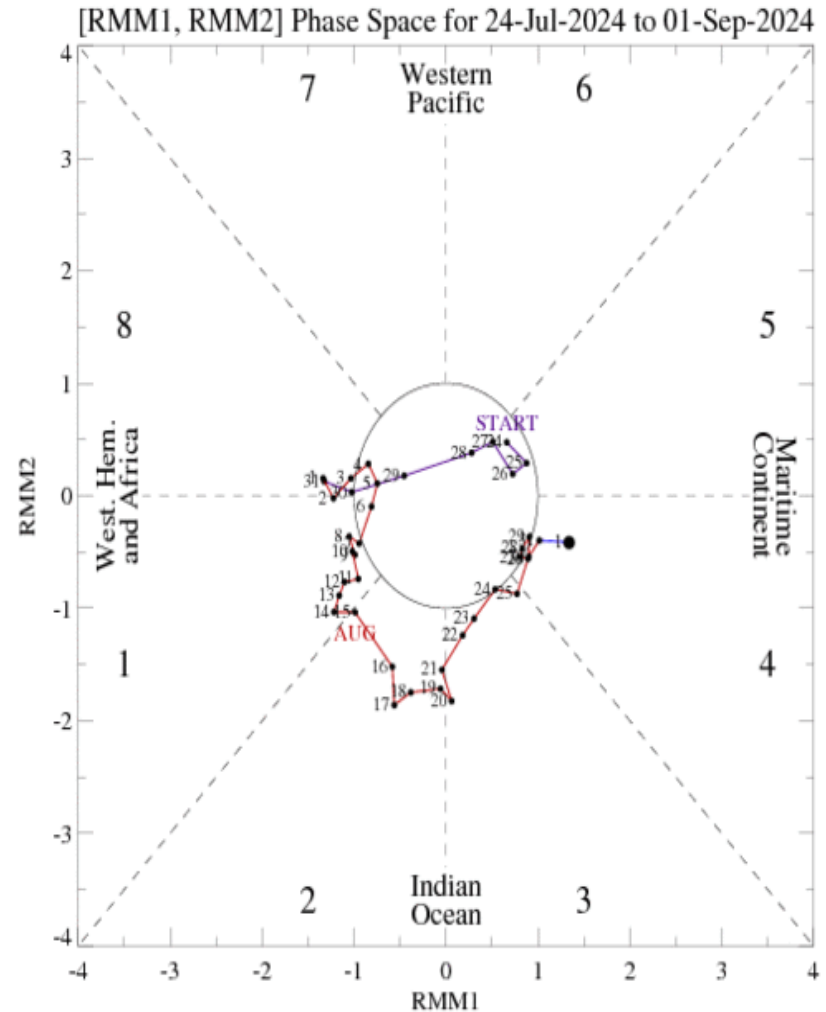
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- The downward trend in SST anomalies became nearly flat over the summer. It does not appear to have stopped completely however, and all Niño regions have ticked downward recently.
- Below normal subsurface heat content anomalies remain established from roughly 160°W eastward, except for a region between 150W-140W where warming was observed since early August.

# MJO Index: Recent Evolution

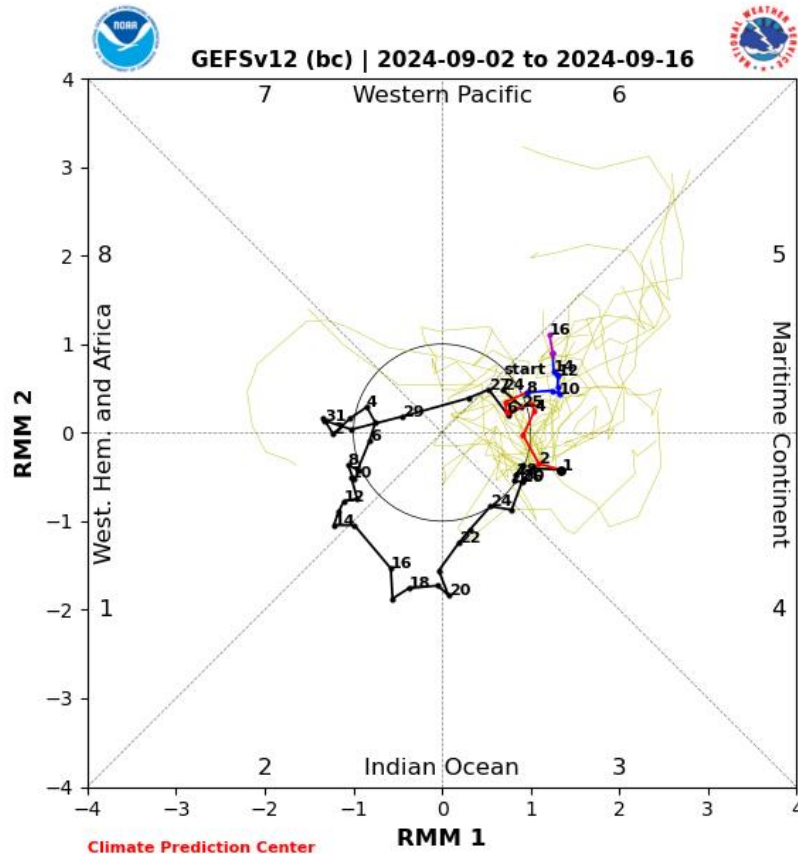
- Since reemerging over the Western Hemisphere in early August, the MJO gained amplitude and propagated eastward over the Indian Ocean, then weakened somewhat as it approached the Maritime Continent, possibly due to Rossby wave interference.
- The MJO signal has increased over the last couple days as it moves away from the destructive interference mentioned above.



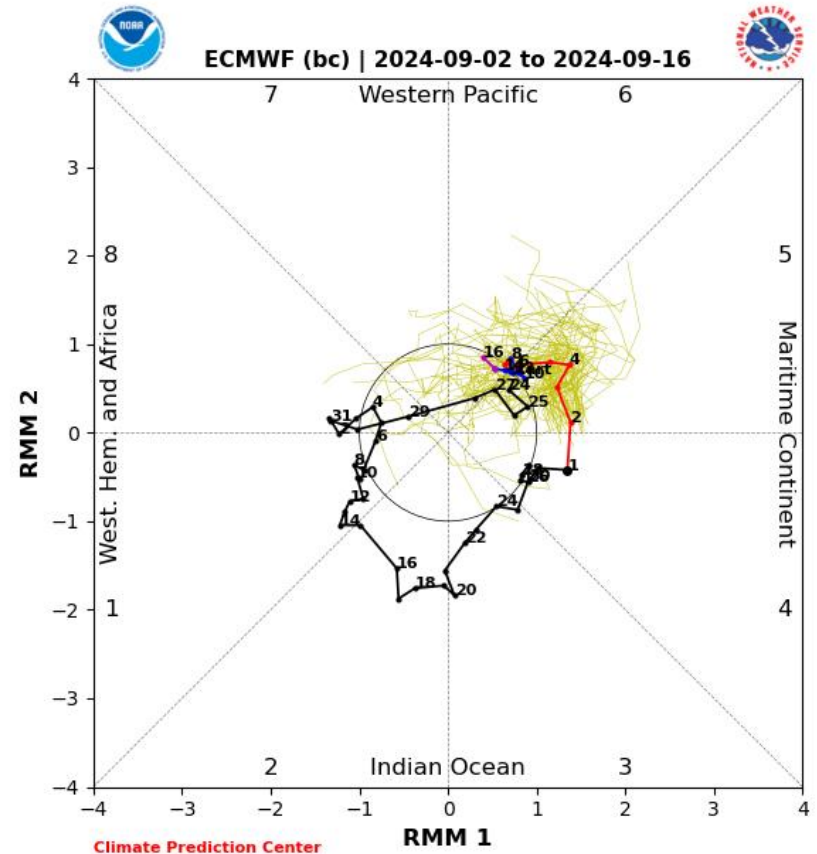
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



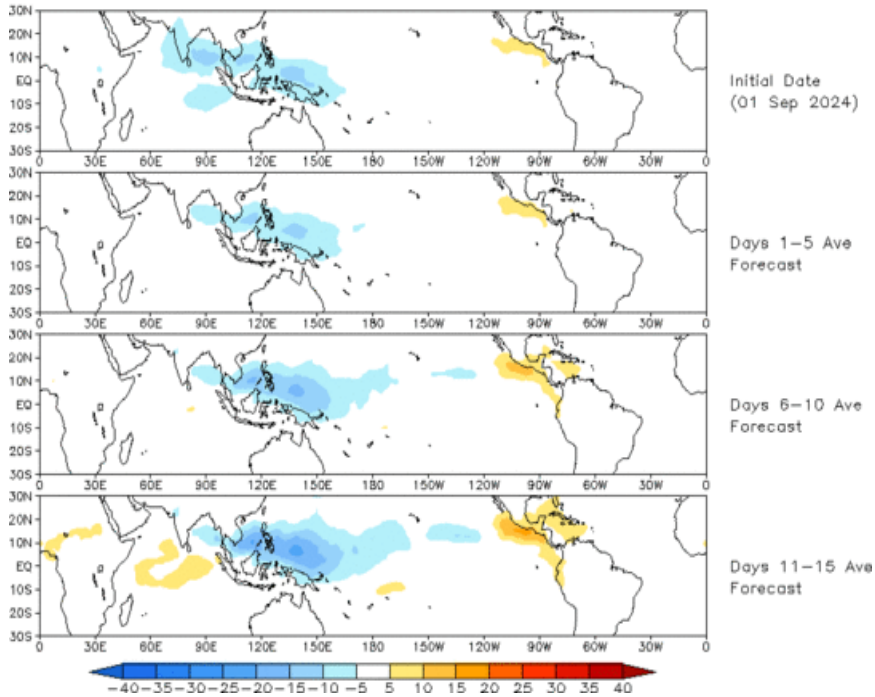
**ECMWF Forecast**

- The recent modulation of the RMM signal appears to be a regular feature in the near future for the MJO as it encounters periods of interference with further Rossby wave activity.
- GEFS is comparably weaker with the MJO during week-1 then increases the signal strength, while the ECMWF favors the reverse evolution for the MJO into the middle of September.

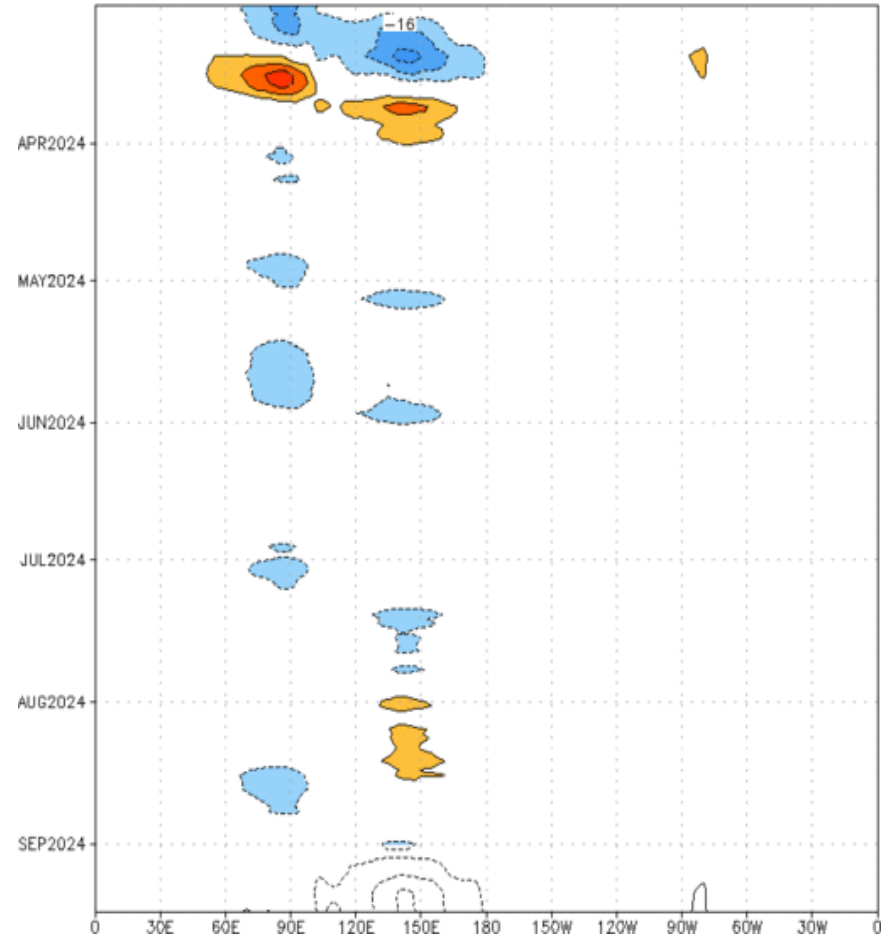
# MJO: GEFS Forecast Evolution

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: 01 Sep 2024  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:02-Mar-2024 to 01-Sep-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

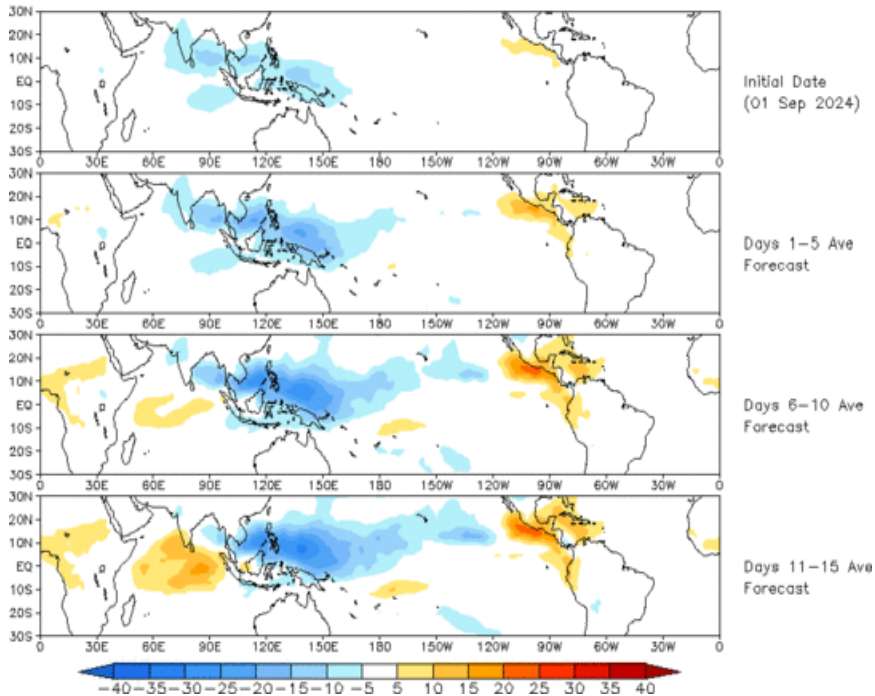


- The GEFS OLR anomaly forecast depicts a restrengthening MJO with convection becoming more enhanced (suppressed) over the Maritime Continent and western Pacific (eastern Pacific)

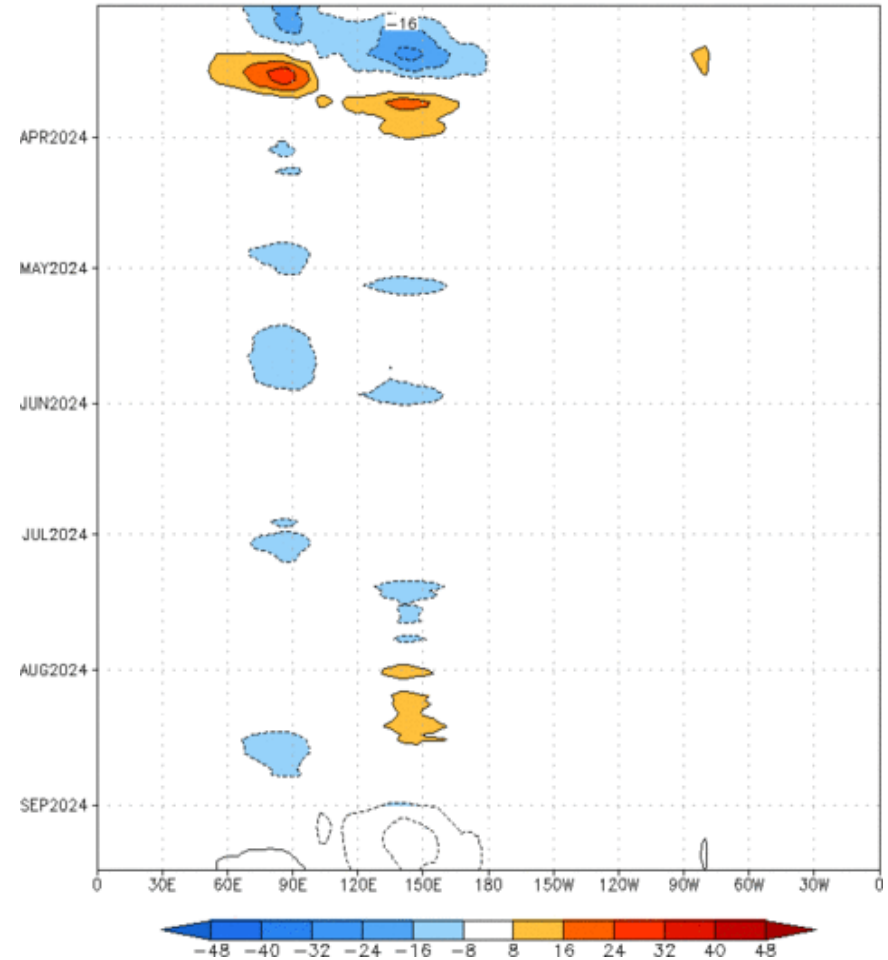
# MJO: Constructed Analog Forecast Evolution

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 (01 Sep 2024)



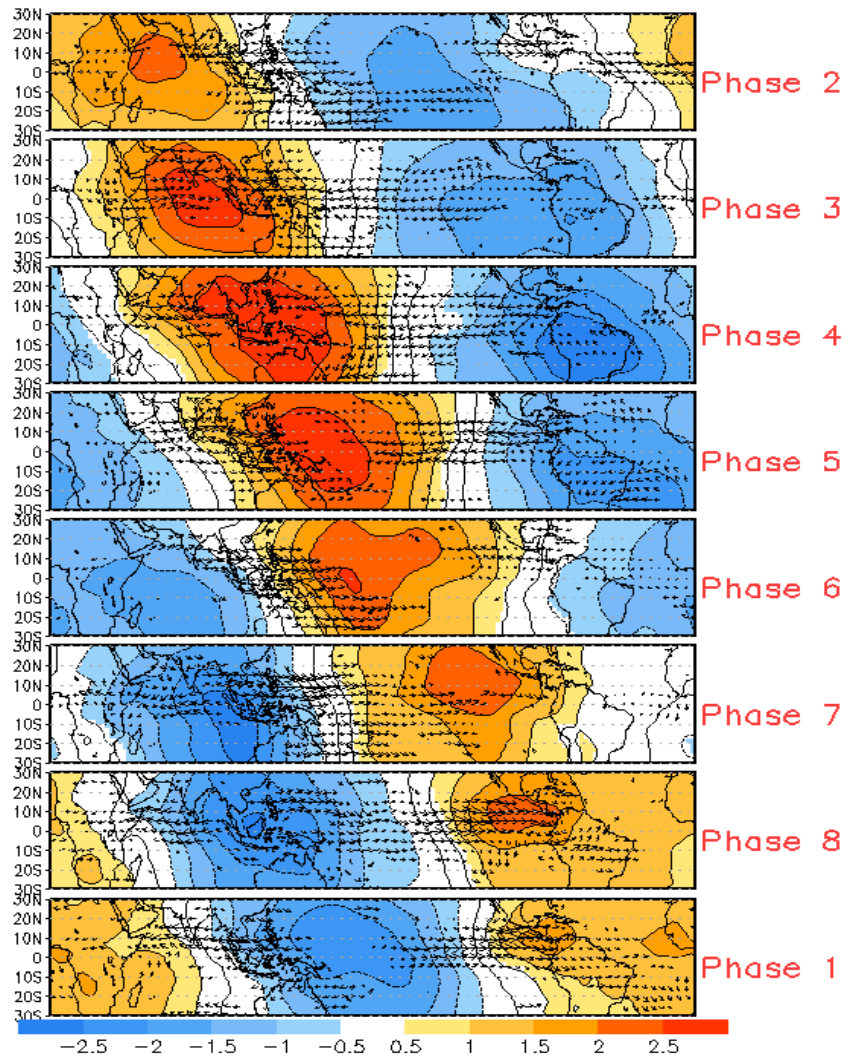
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:02-Mar-2024 to 01-Sep-2024  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



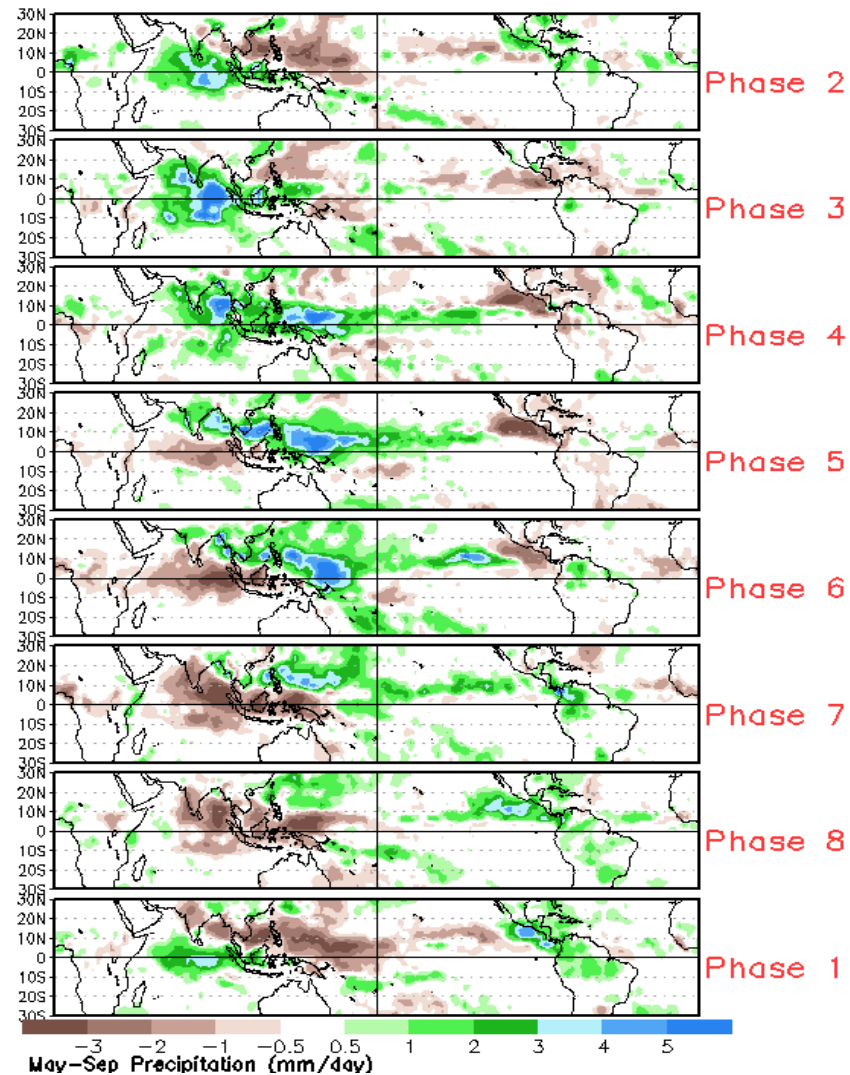
- The constructed analog is stronger with the development of convective anomalies than the GEFS, and features more suppressed convection developing in the Indian Ocean by the week-2 period.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



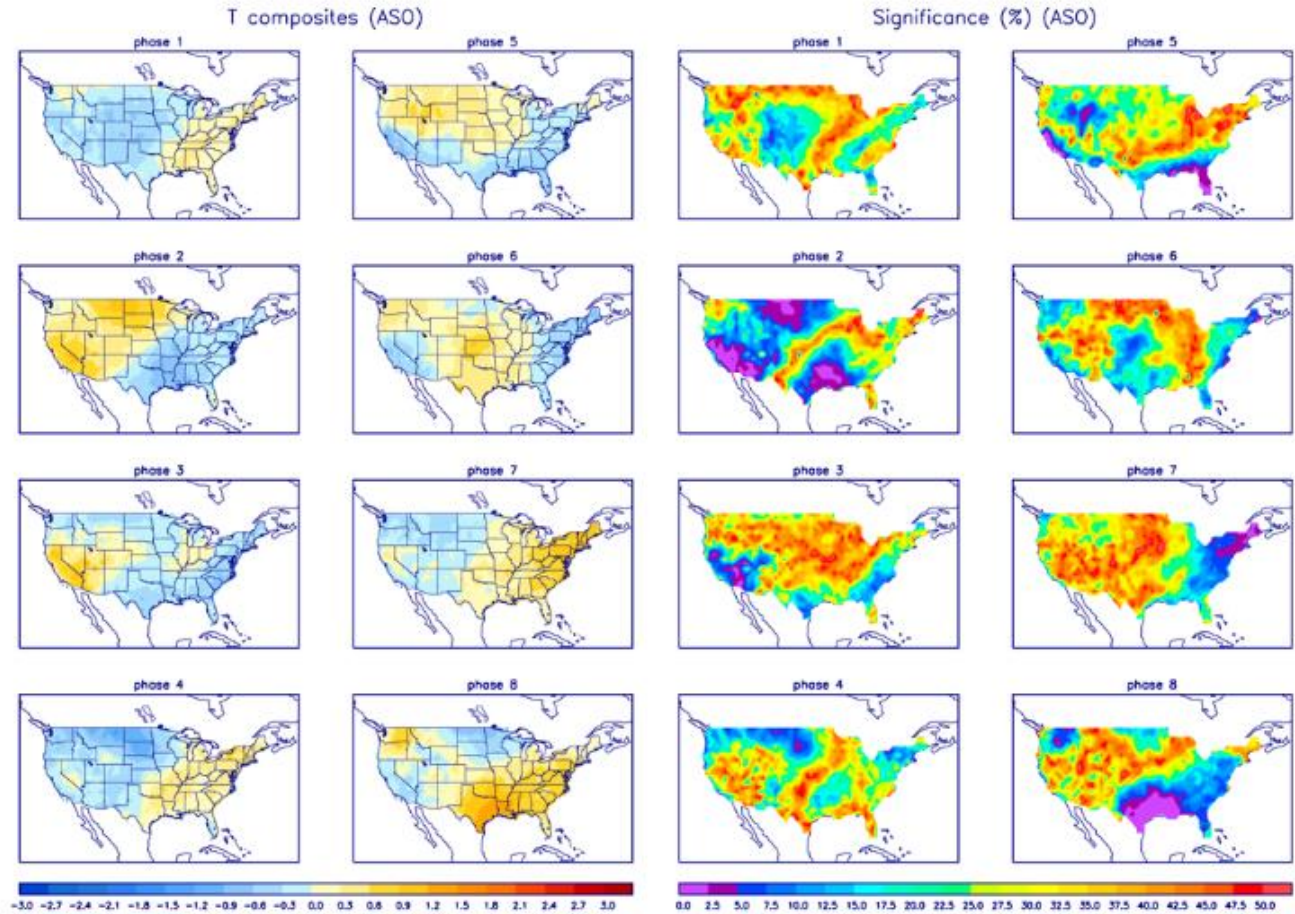
## Precipitation Anomalies



# 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.

