

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



**Update prepared by the Climate Prediction Center  
NWS / NCEP / CPC  
19 August 2024**

# Overview

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- During the past 2 weeks, the RMM-based MJO signal has increased in amplitude and is now located over the Indian Ocean (Phase 2).
- Dynamical models are in good agreement regarding enhanced MJO activity across the Indian Ocean and Maritime Continent during the next 2 weeks.
- The MJO propagation across the Indian Ocean and Maritime Continent supports an enhanced easterly wave train coming off of Africa in late August into early September.
- Combined with anomalously warm SSTs, and the approaching climatological peak of hurricane season, this favors high chances for tropical cyclone (TC) development over the Atlantic Main Development Region despite the suppressed convective pattern aloft.
- In the near term, the Western Pacific is forecast to be relatively quiet in terms of TC activity, although an uptick in TC formation potential is likely by weeks 2 and 3 as the enhanced convective envelope moves closer to the region.

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

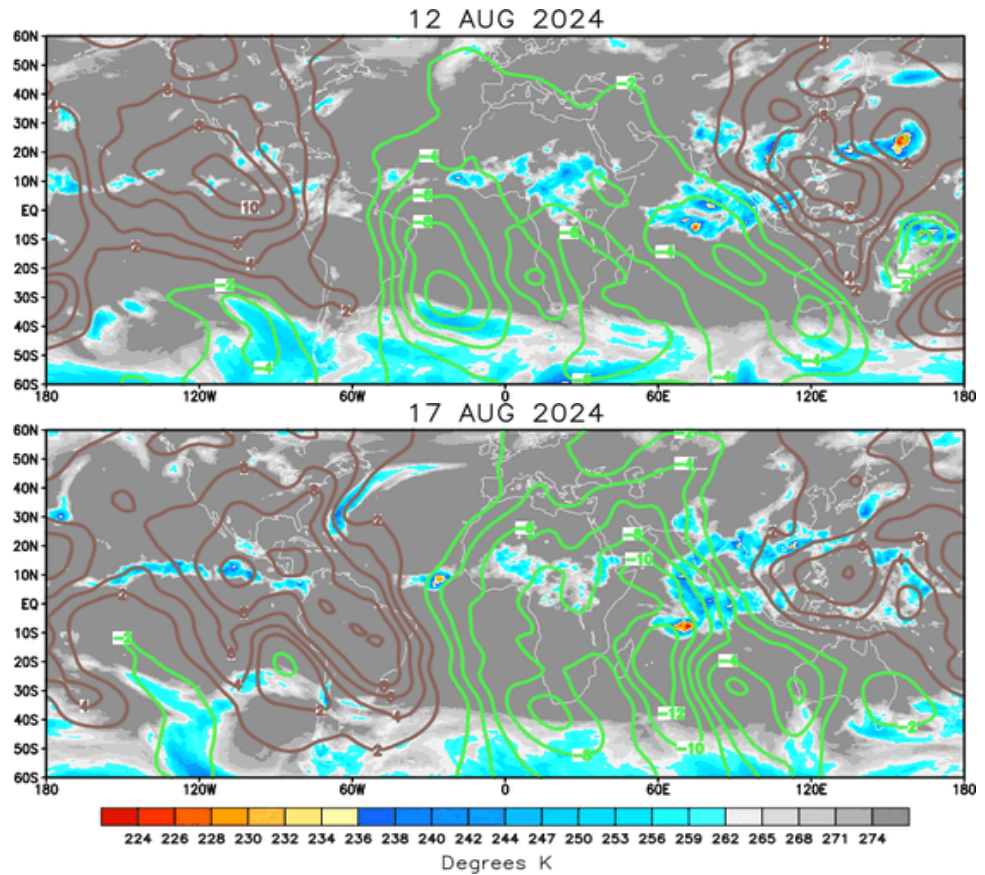
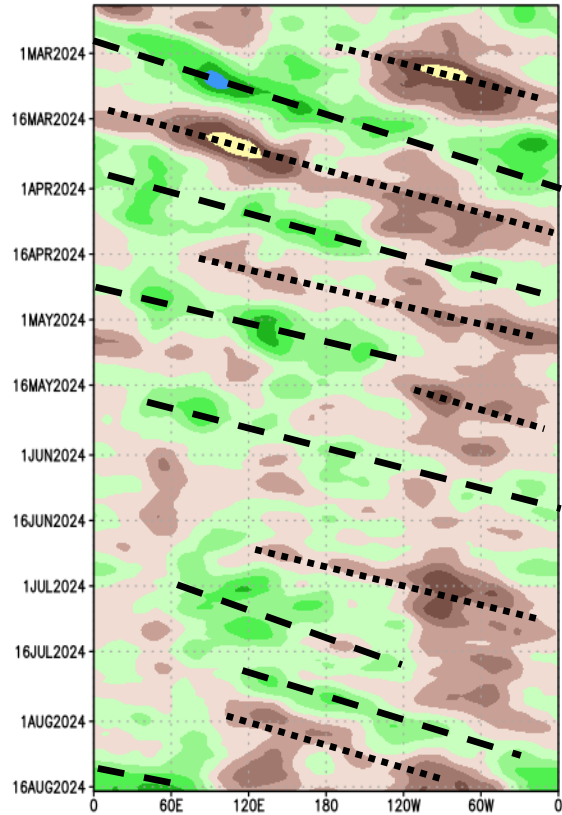
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 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

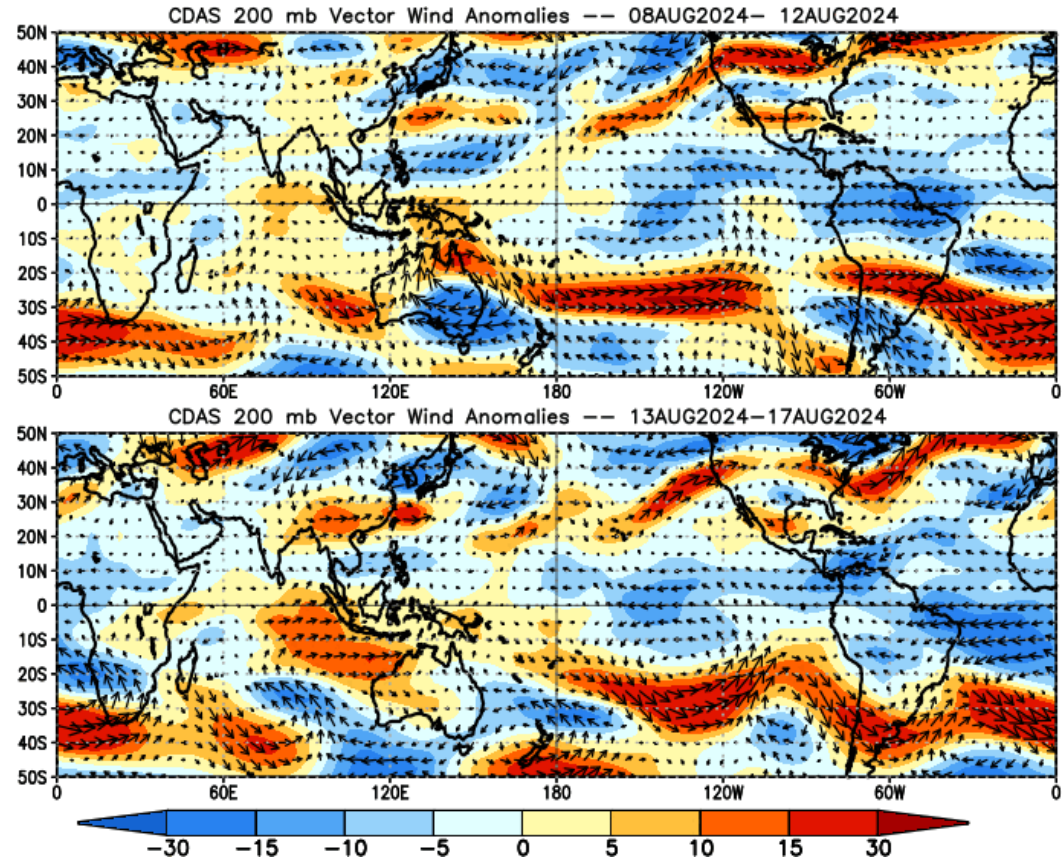
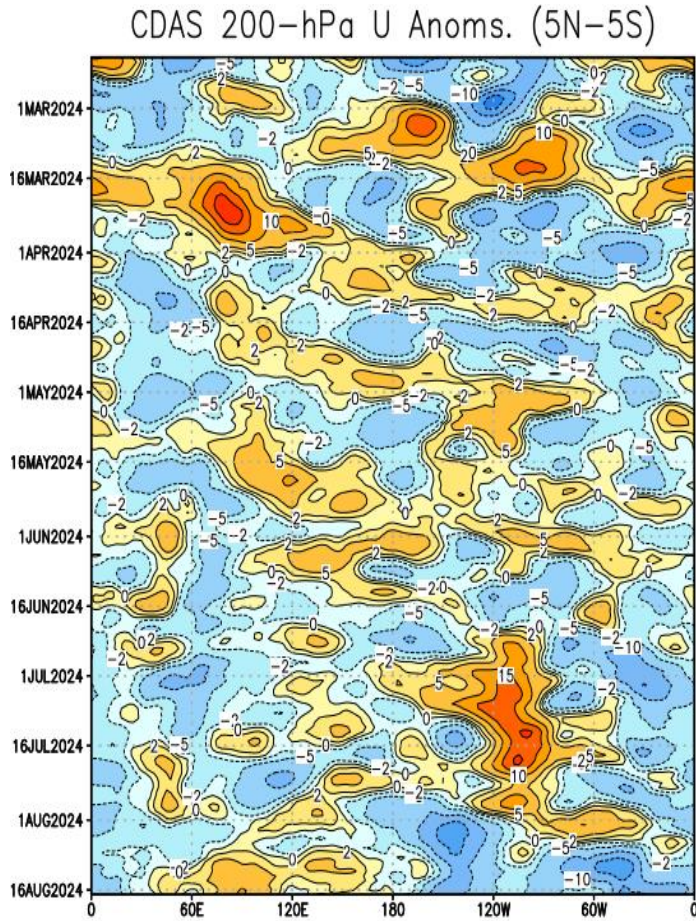


- A wave-1 asymmetry pattern has emerged in the spatial upper-level velocity potential field, with anomalous divergence over much of Europe, Africa, and the Indian Ocean, and anomalous convergence over the Pacific and Americas.
- The time/longitude plot depicts an eastward propagation of the enhanced and suppressed divergence signals during the month of August.



# 200-hPa Wind Anomalies

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

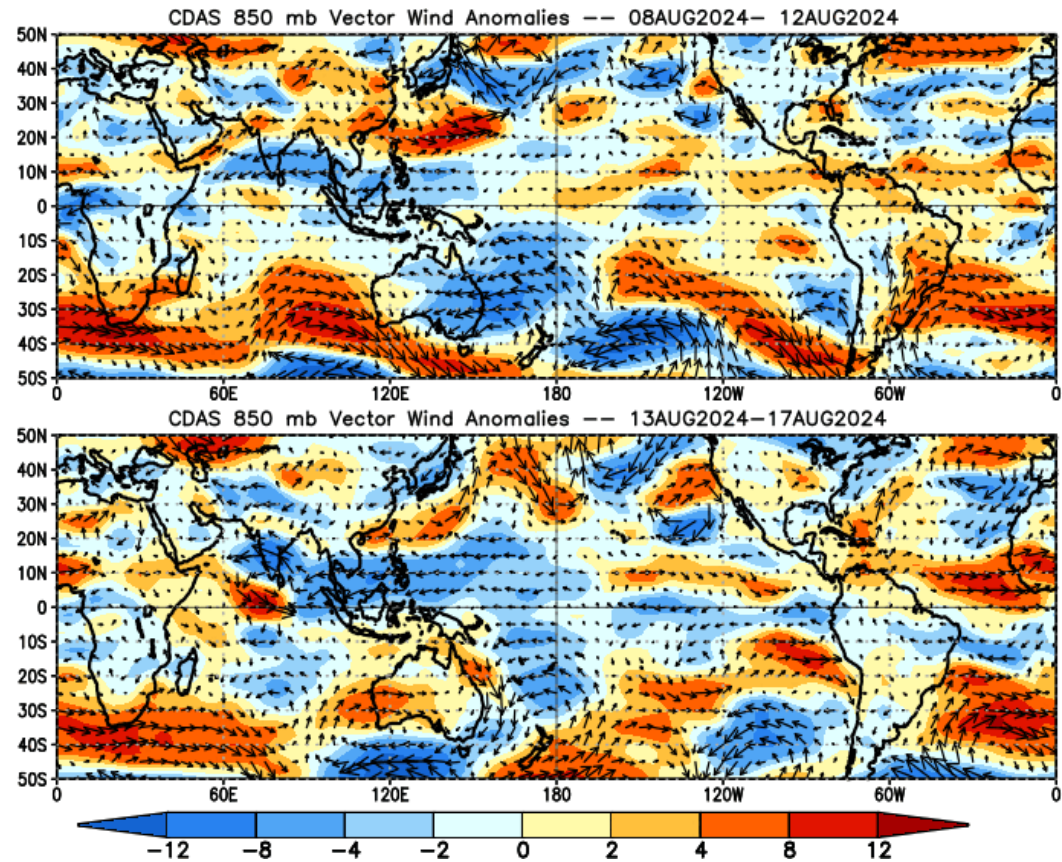
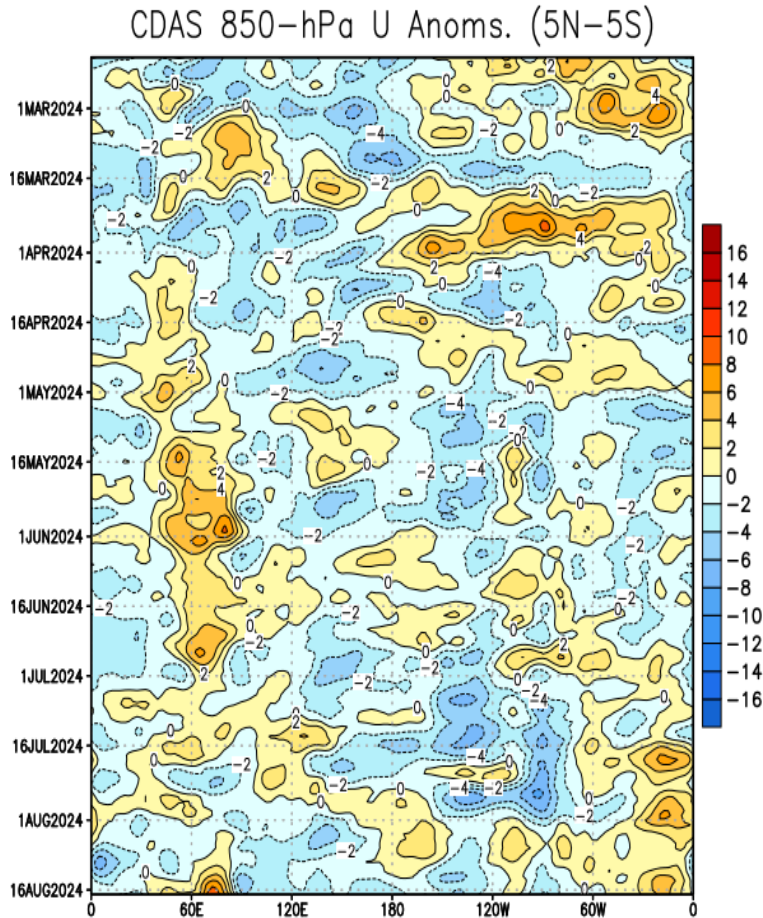


- Upper-level easterly anomalies have persisted across the tropical East Pacific and Atlantic basins during the past 2 weeks, contributing to decreased wind shear and a resultant uptick in tropical cyclone activity over both regions.
- Anomalous upper-level westerlies expanded across the Indian Ocean and Maritime Continent suggestive of a strengthening MJO signal.



# 850-hPa Wind Anomalies

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

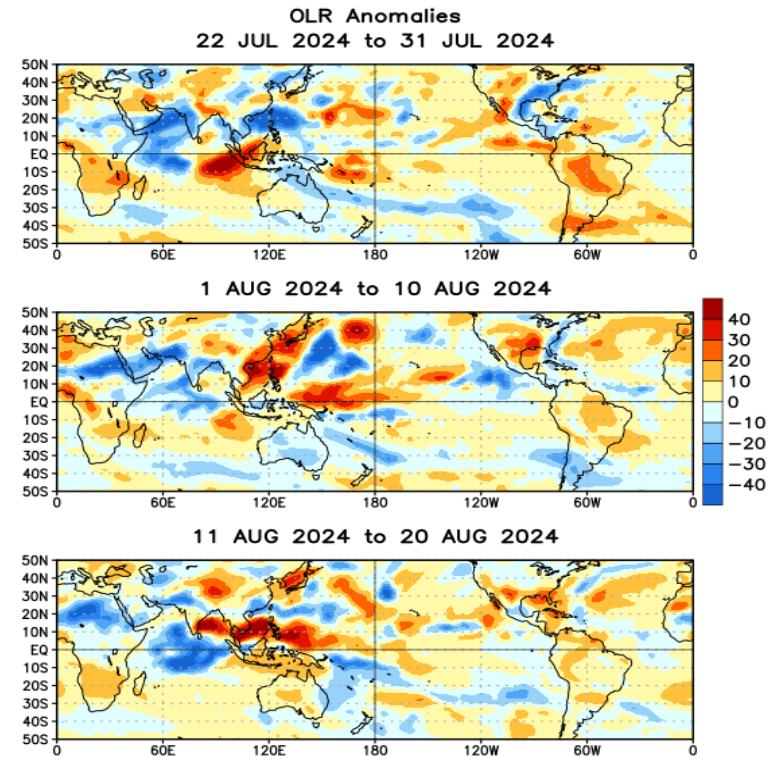
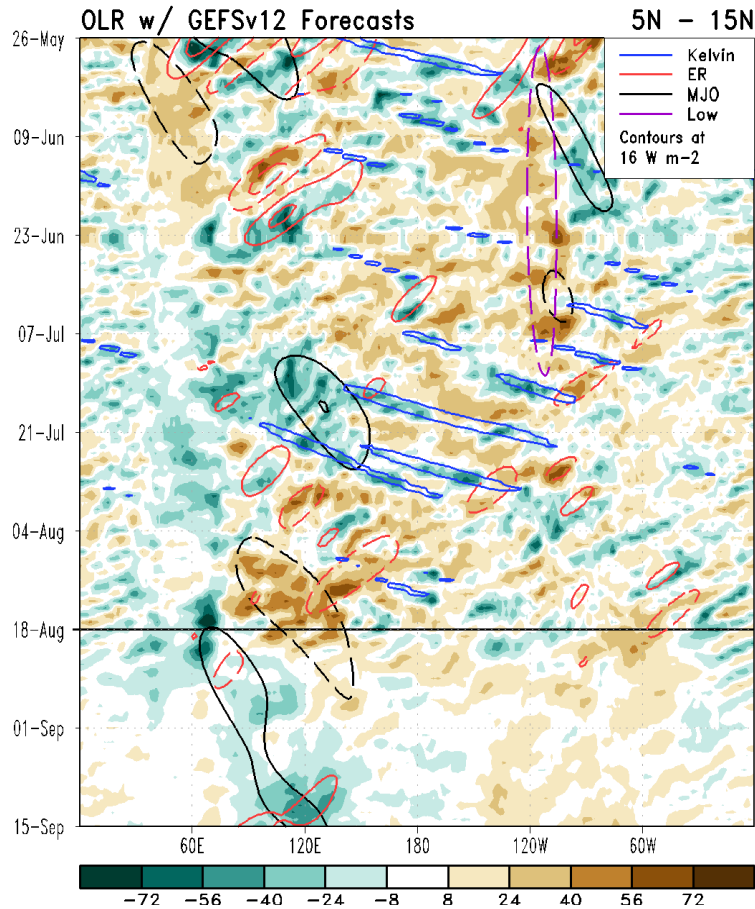


- Since July, there has been an eastward propagation of low-level anomalous westerlies across the globe, with the strongest signal now stretching from the eastern Atlantic to the Indian Ocean. A westerly wind burst (WWB) event appears to be occurring near 70°E.
- Low-level easterlies have increased across much of the Maritime Continent and Western Pacific, with enhanced trades extending across much of the Equatorial Pacific.

# Outgoing Longwave Radiation (OLR) Anomalies

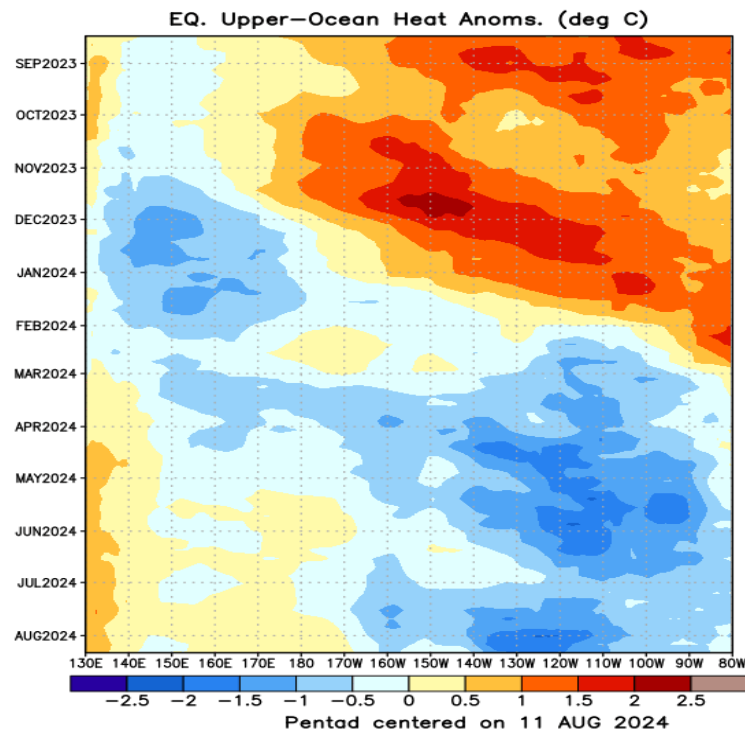
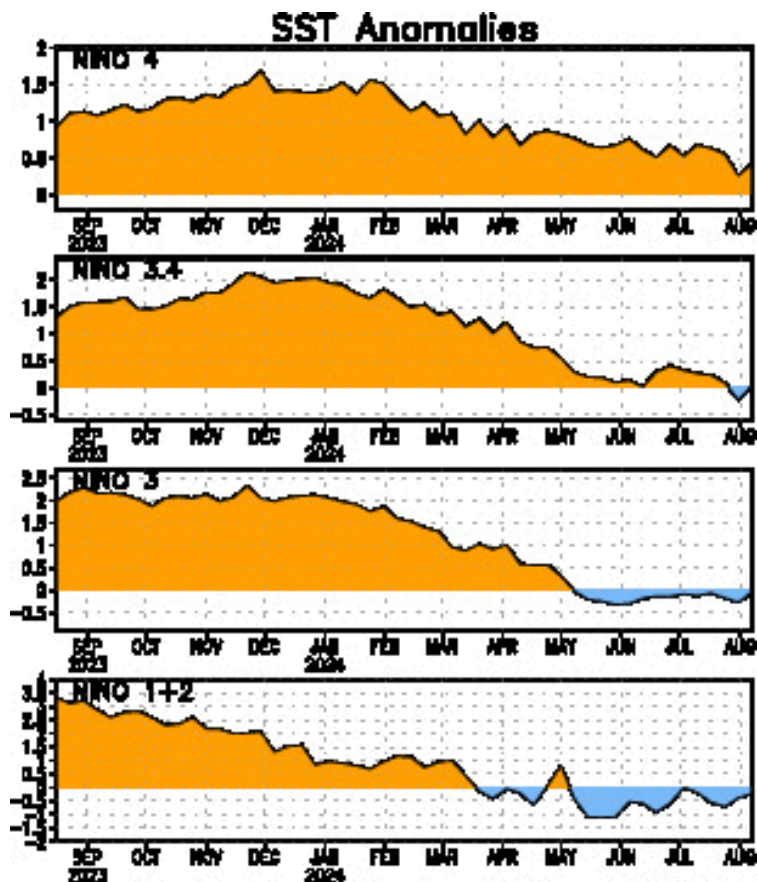
**Green shades:** Anomalous convection (wetness)

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



- Negative OLR anomalies increased across the Indian Ocean during the past week, with positive OLR anomalies across the equatorial western Pacific and the southern U.S.
- Enhanced MJO activity is coming through the objective filtering with constructive interference with equatorial Rossby Wave activity over the Western Pacific noted around mid-September.

# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

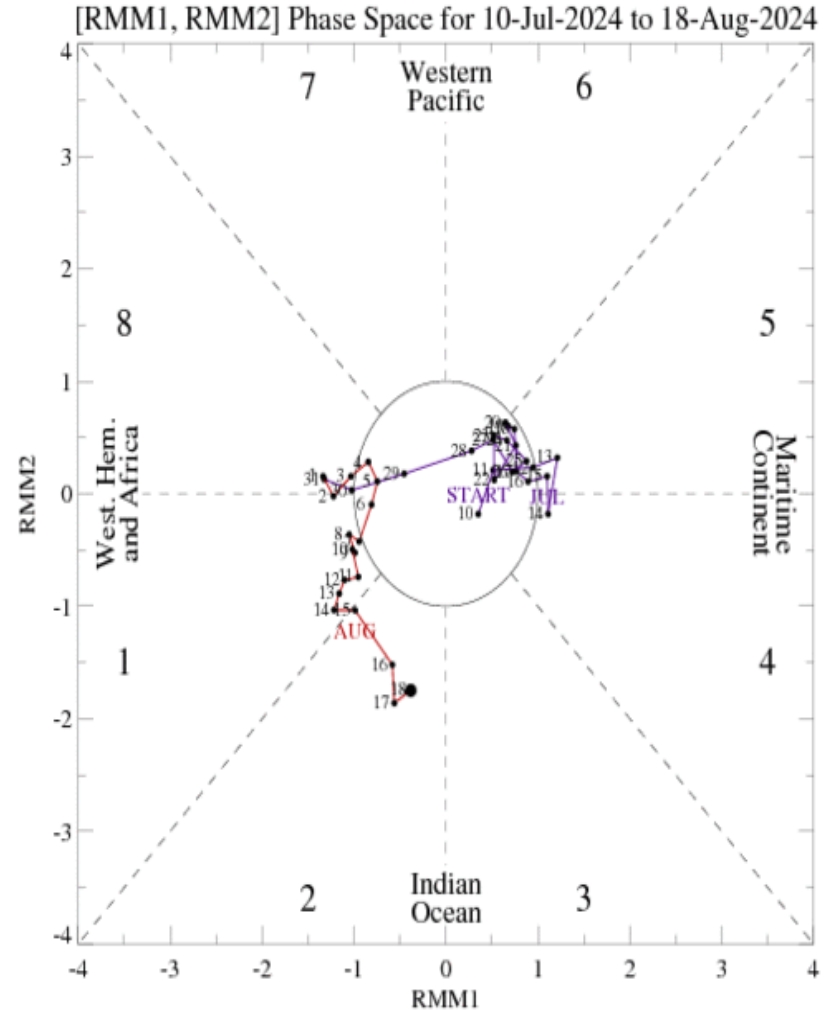


- The downward trend in SST anomalies appears to have flattened, with slightly negative SST anomalies over the easternmost NINO regions, and near normal SSTs over NINO 3.4.
- Below normal subsurface heat content anomalies remain established from roughly 160°W eastward, with slightly above normal oceanic heat content anomalies across the Western Pacific.



# MJO Index: Recent Evolution

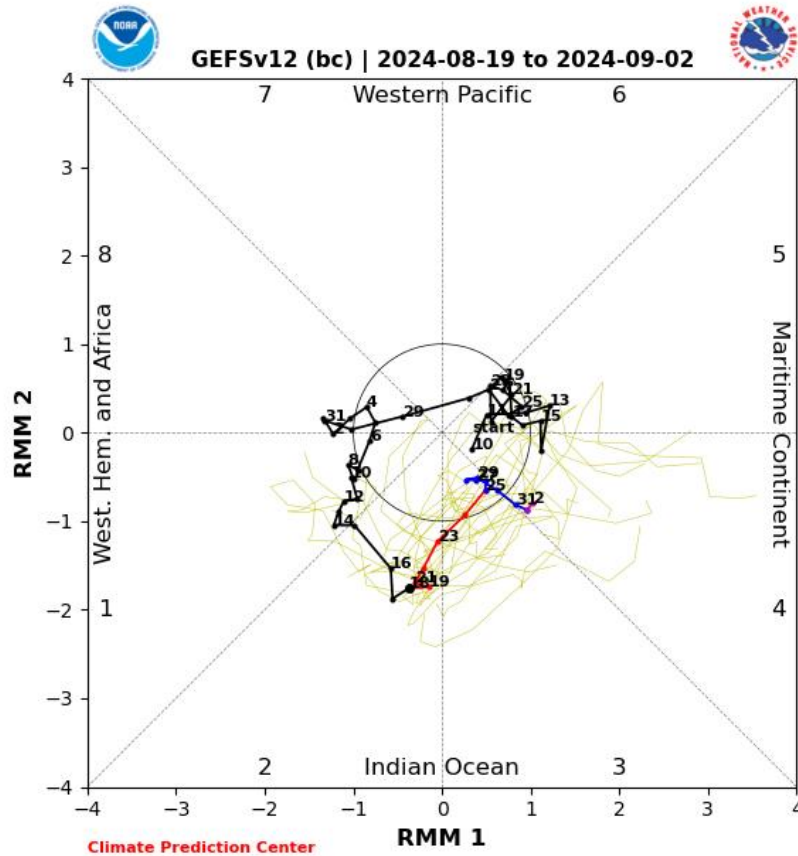
- The MJO continues to increase in amplitude and now resides across the Indian Ocean (Phase 2).



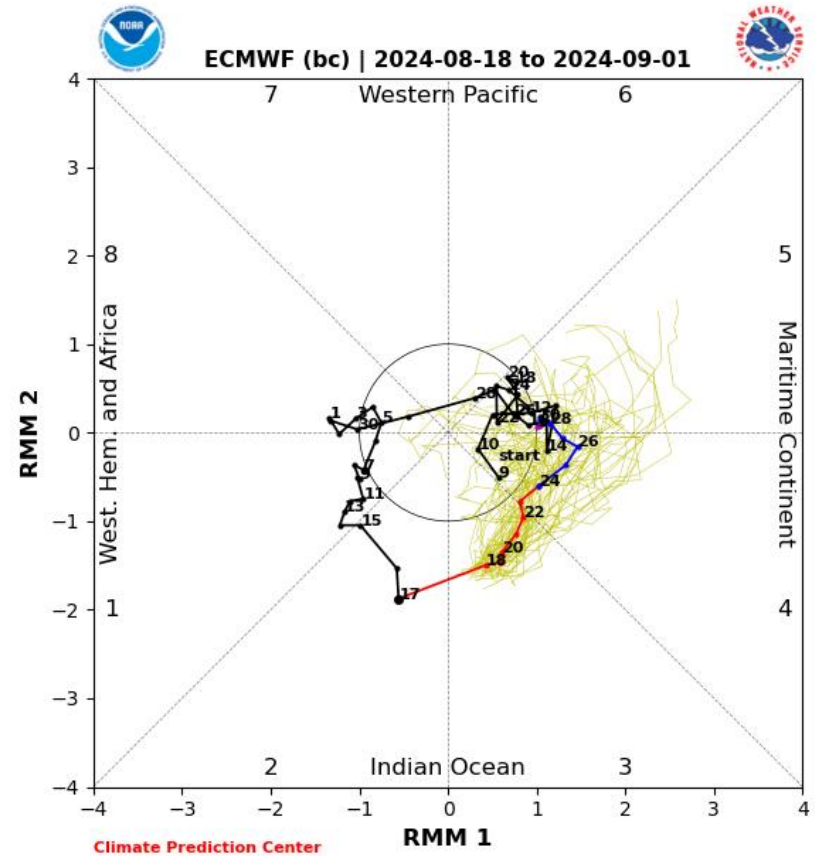
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



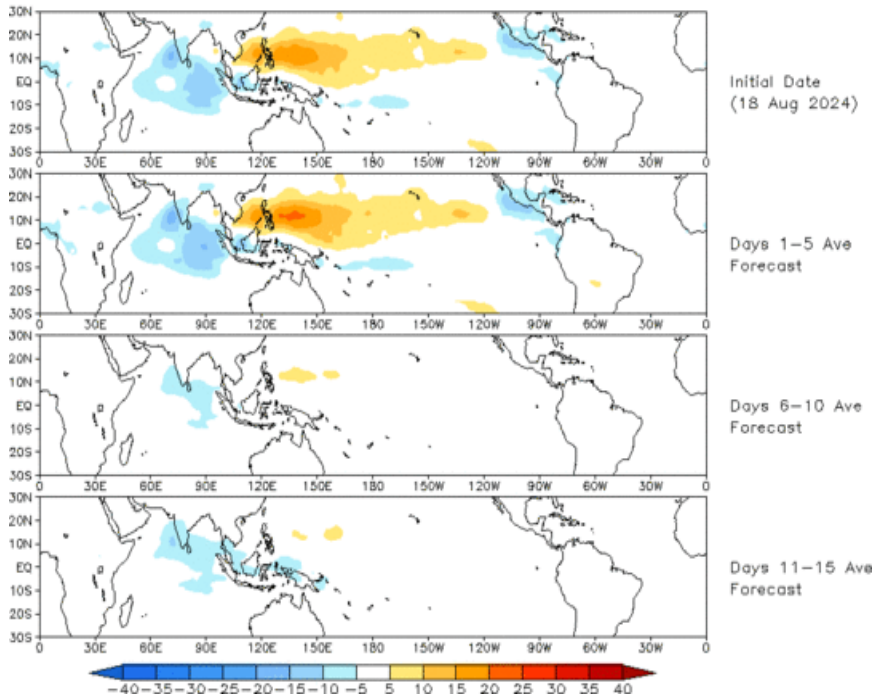
**ECMWF Forecast**

- There is generally good agreement between the GEFS and ECMWF ensembles regarding eastward propagation of the MJO into the Maritime Continent during the next 2 weeks.
- Individual members diverge regarding the amplitude of the MJO, although several ECMWF members depict a robust signal at the end of week-2.

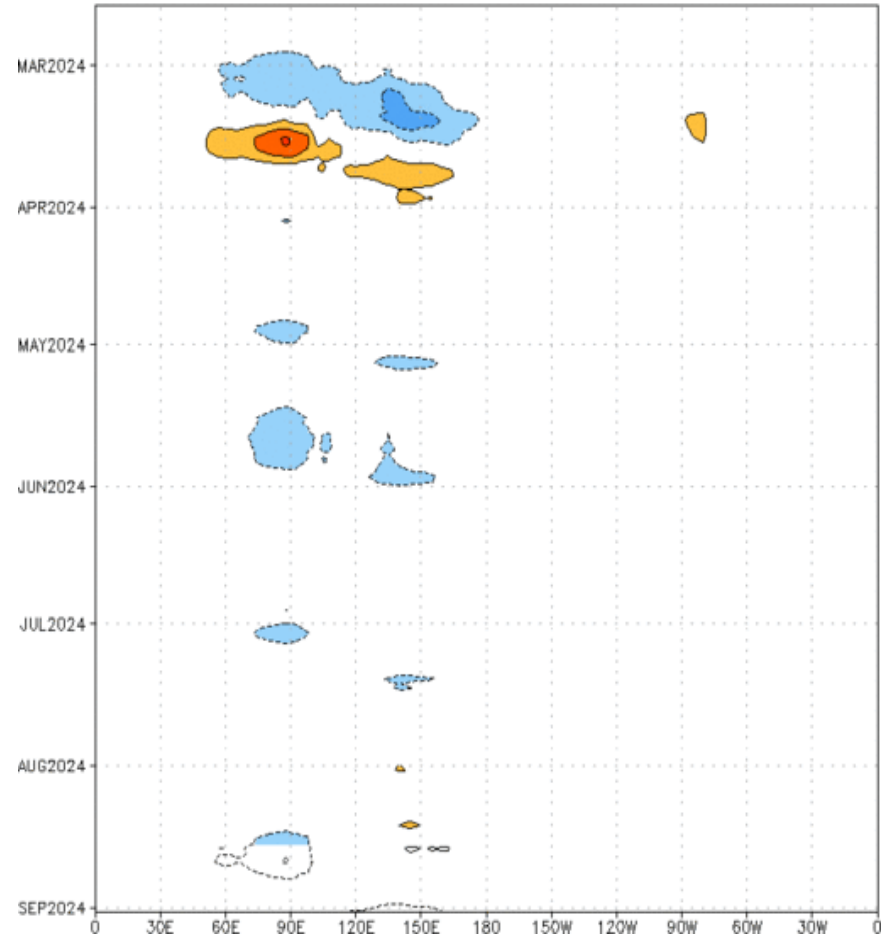
# MJO: GEFS Forecast Evolution

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: 18 Aug 2024  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [ $7.5^{\circ}S, 7.5^{\circ}N$ ] (cont:  $4Wm^{-2}$ ) Period: 17-Feb-2024 to 18-Aug-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

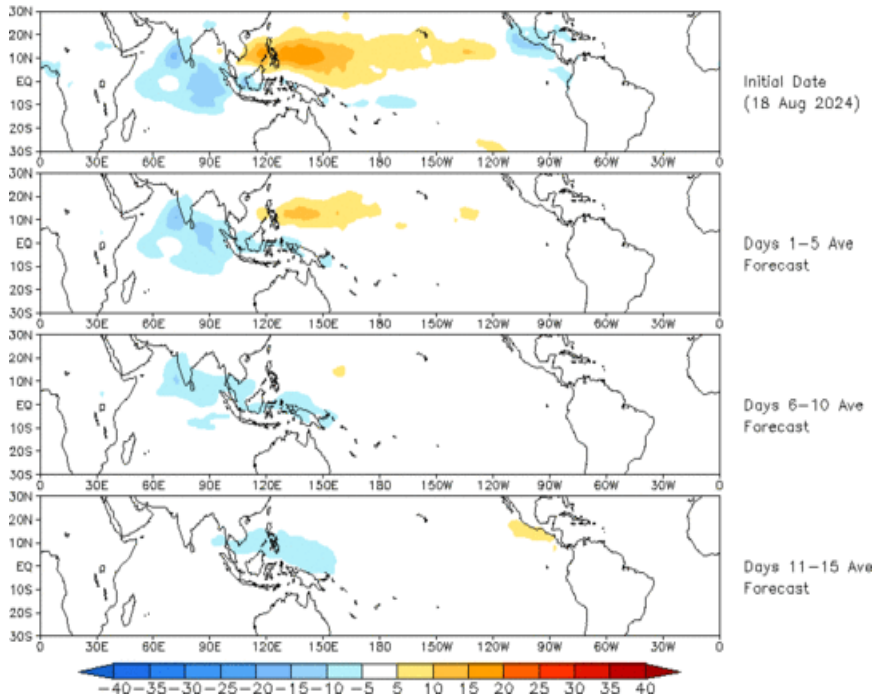


- The OLR anomaly evolution based on the GEFS RMM index depicts positive (negative) OLR anomalies across the much of the Pacific (Indian) Ocean during week1, with a weakening signal in week-2.

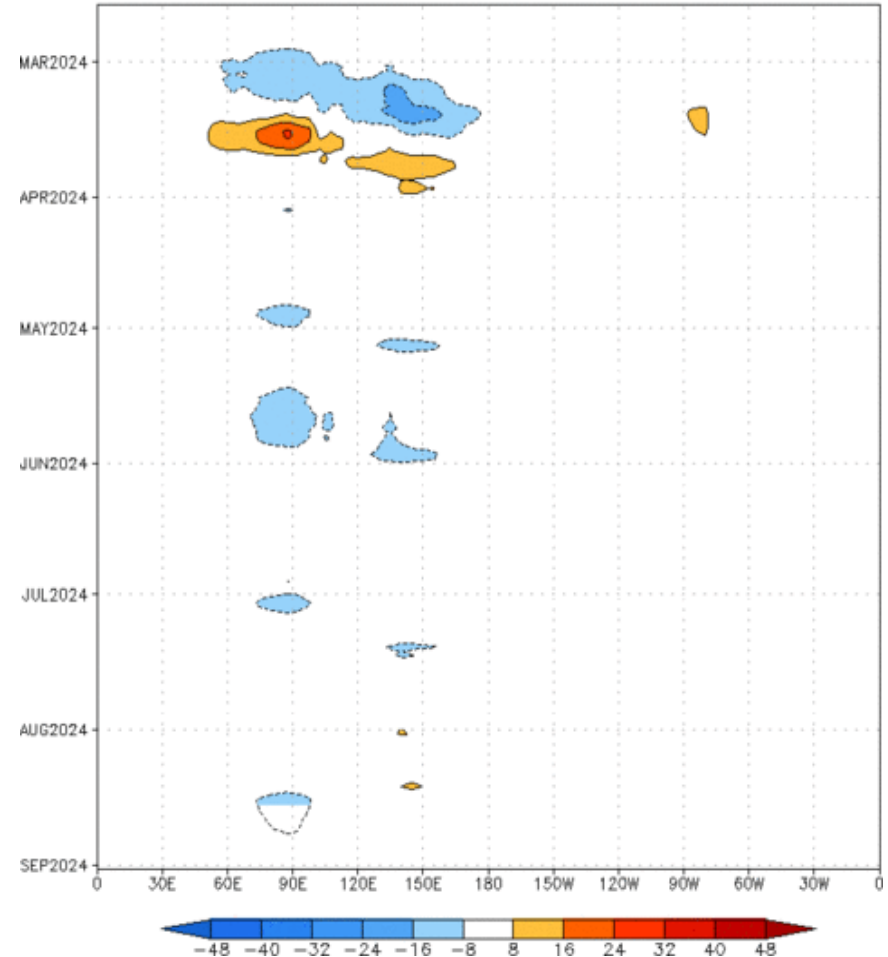
# MJO: Constructed Analog Forecast Evolution

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 (18 Aug 2024)



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:17-Feb-2024 to 18-Aug-2024  
The unfilled contours are CA forecast reconstructed anomaly for 15 days

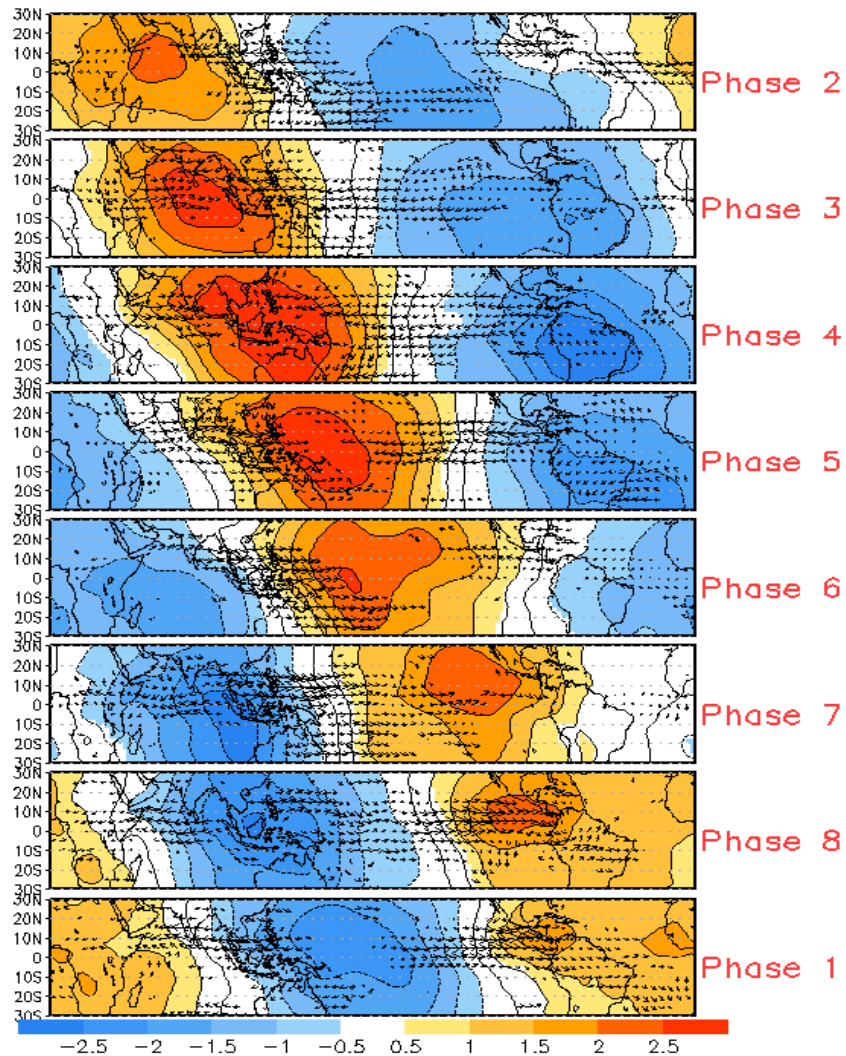


- The constructed analog is similar to the GEFs, with more eastward propagation of negative OLR anomalies into the Western Pacific during week-2.

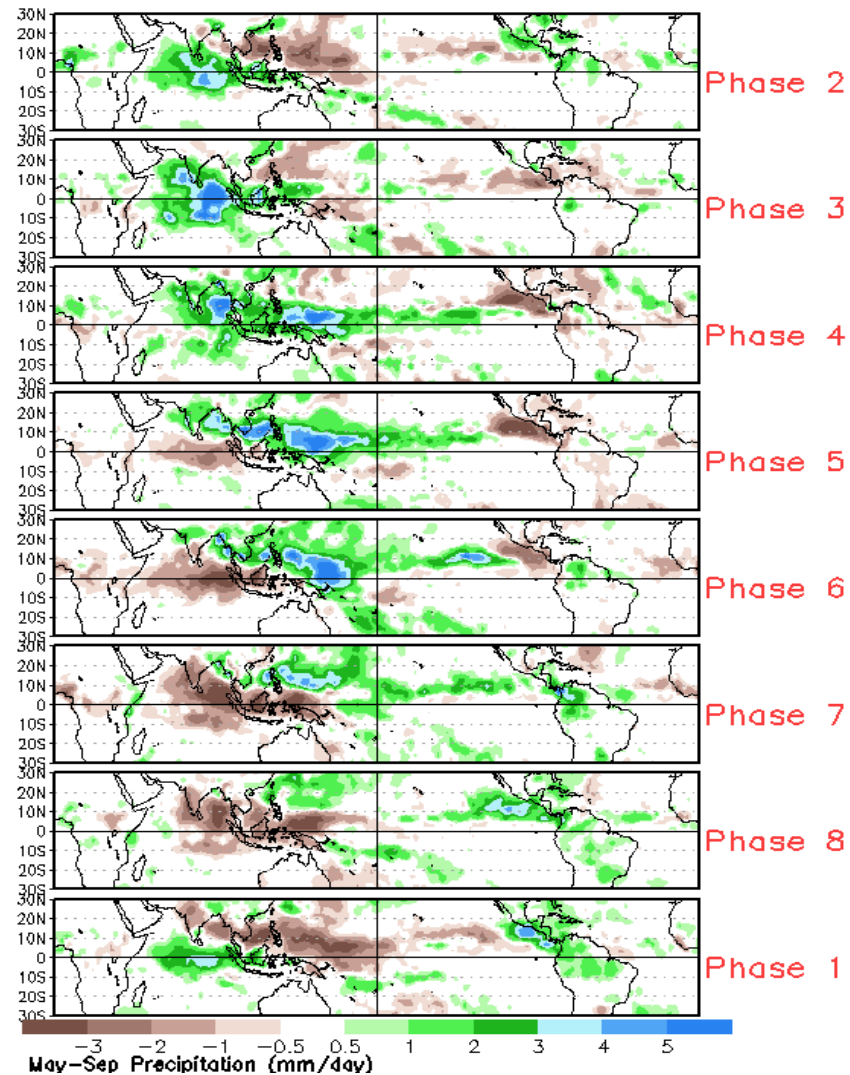


# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



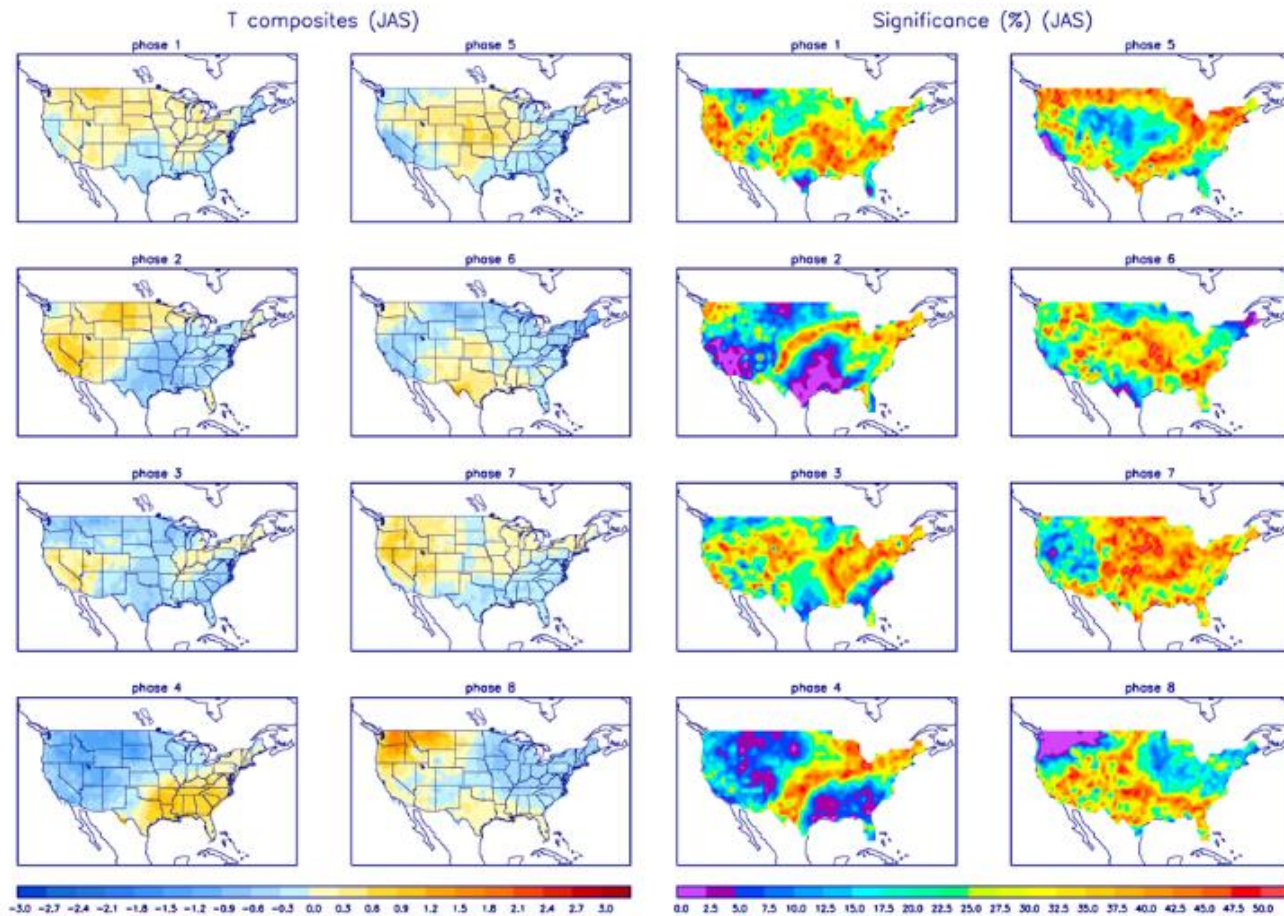
## Precipitation Anomalies



# 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.

