

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



**Update prepared by the Climate Prediction Center**  
**NWS / NCEP / CPC**  
**22 July 2024**

# Overview

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- The MJO has remained weak since June, with little propagation. Higher frequency modes of variability have dominated the global tropics during the past month.
- Despite this, a more organized upper-level convective pattern exists, with the main convective envelope currently established over the Western Pacific.
- MJO forecasts generally remain weak, although a Convectively-Coupled Kelvin Wave may promote an increased convective signal moving over the Western Hemisphere during week-2.
- The prevailing pattern favors increased tropical cyclone (TC) activity to continue over the Western Pacific, and expand into the Eastern Pacific. The Atlantic is more uncertain but increasing climatology may favor enhanced chances for TC development in the Main Development Region by early August.

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

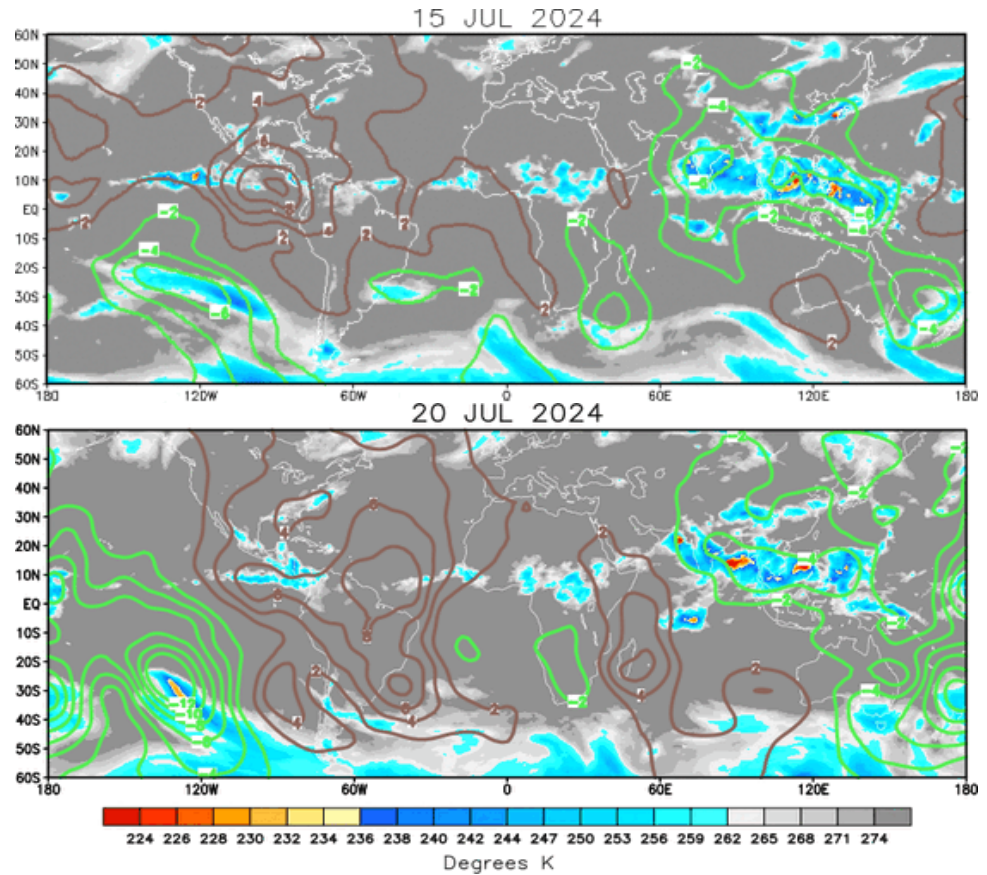
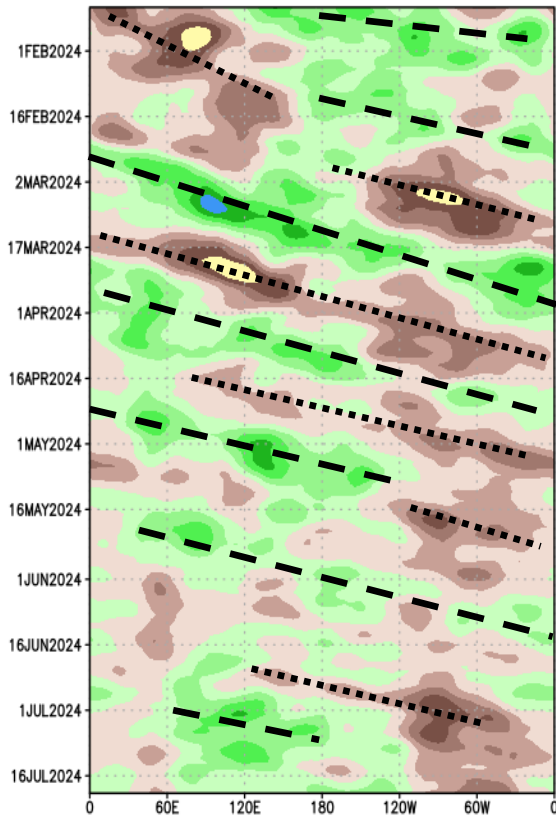
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

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

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

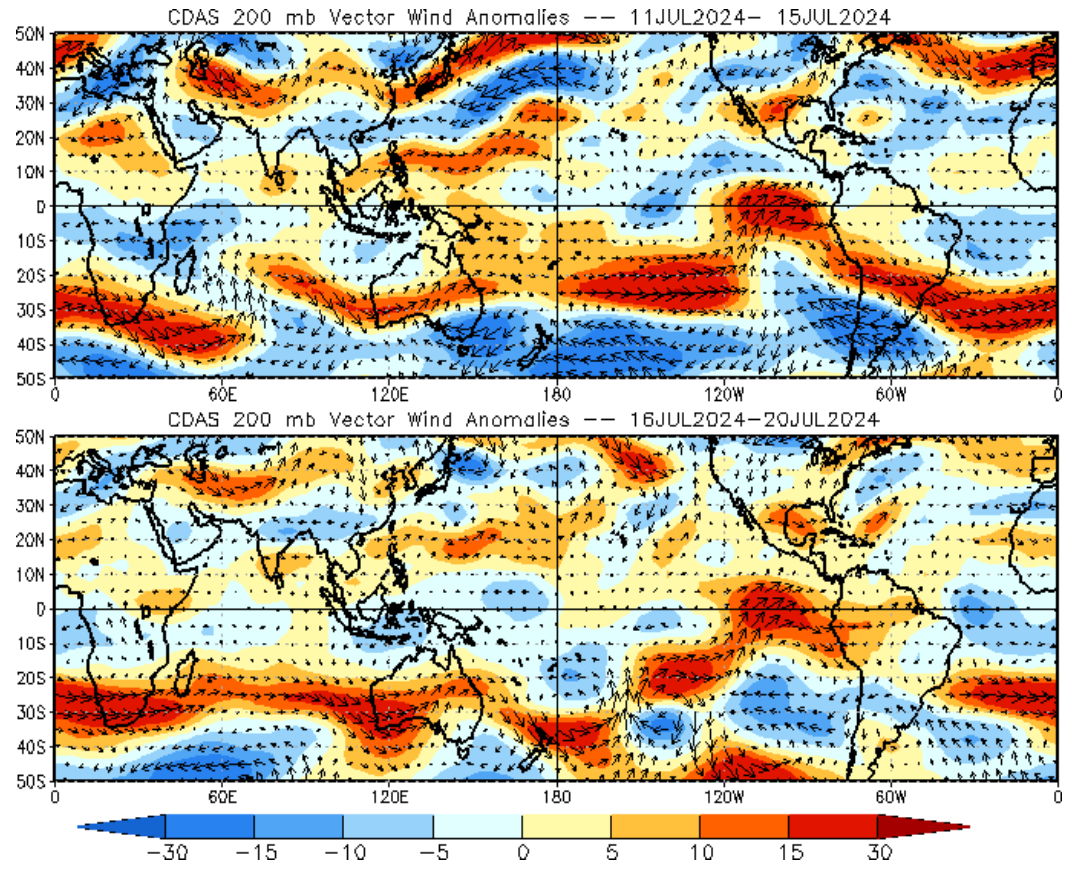
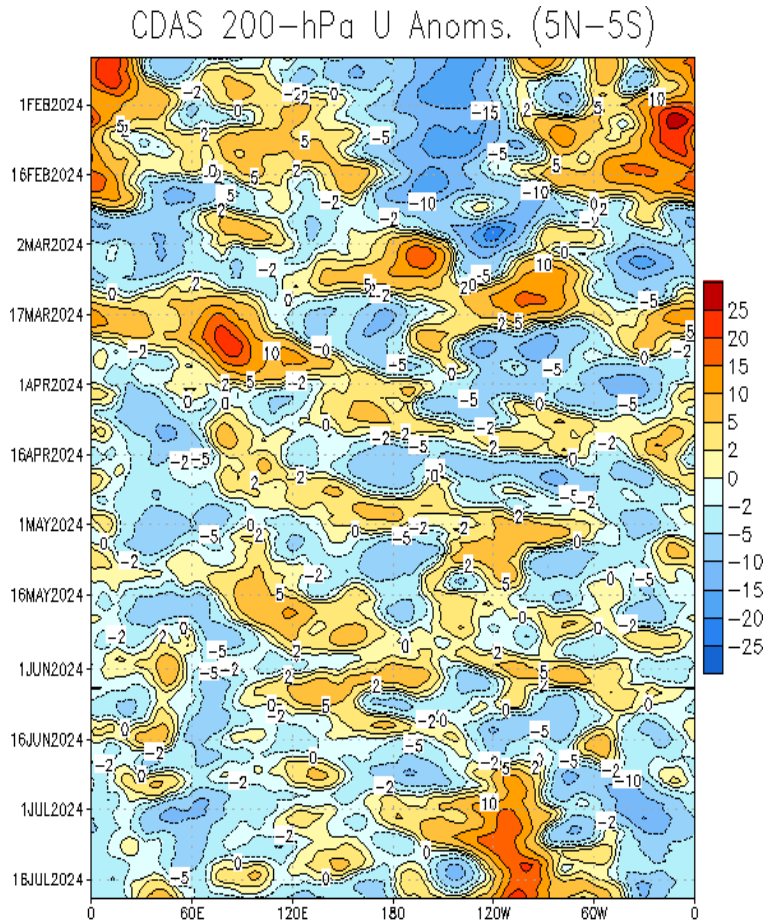
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- There has been little to weak MJO activity since June with higher frequency modes of variability (i.e. Rossby Waves) dominating the global tropics.
- Despite the weak MJO activity, the global upper-level velocity potential pattern has become more organized resembling a wave-1 asymmetry with anomalous convergence over the Americas and Atlantic and anomalous divergence over eastern Asia and the Western Pacific.

# 200-hPa Wind Anomalies

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

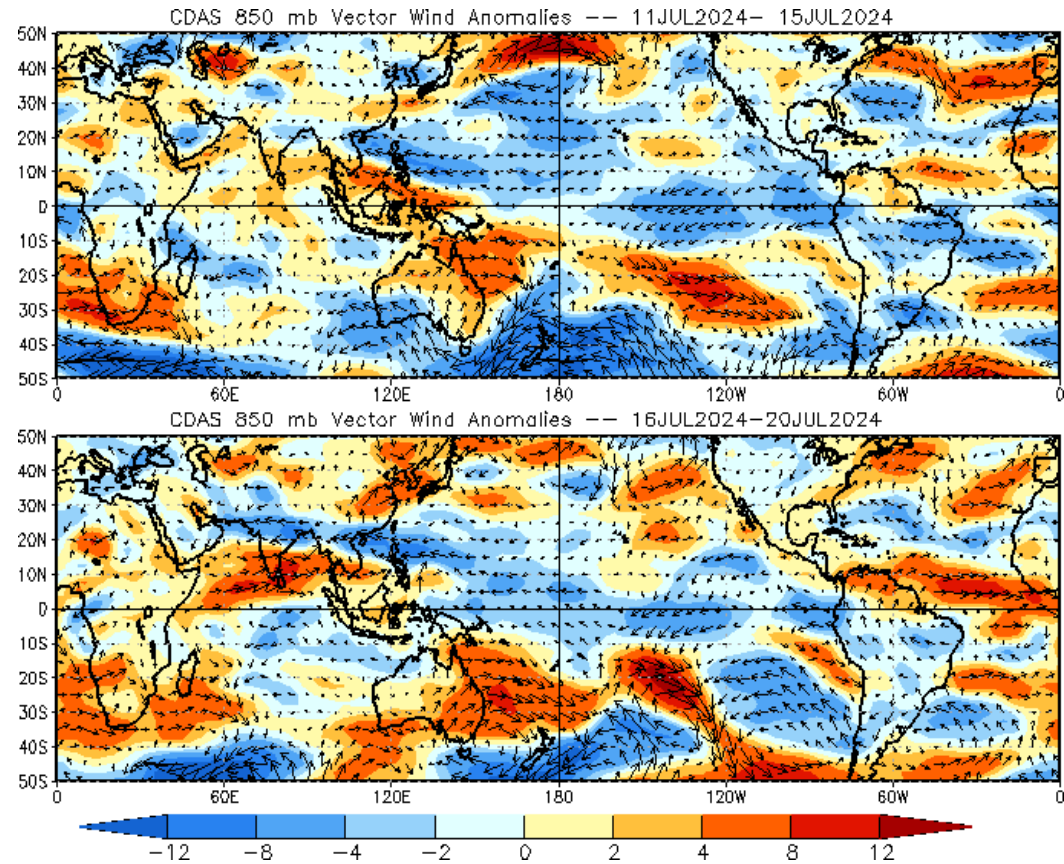
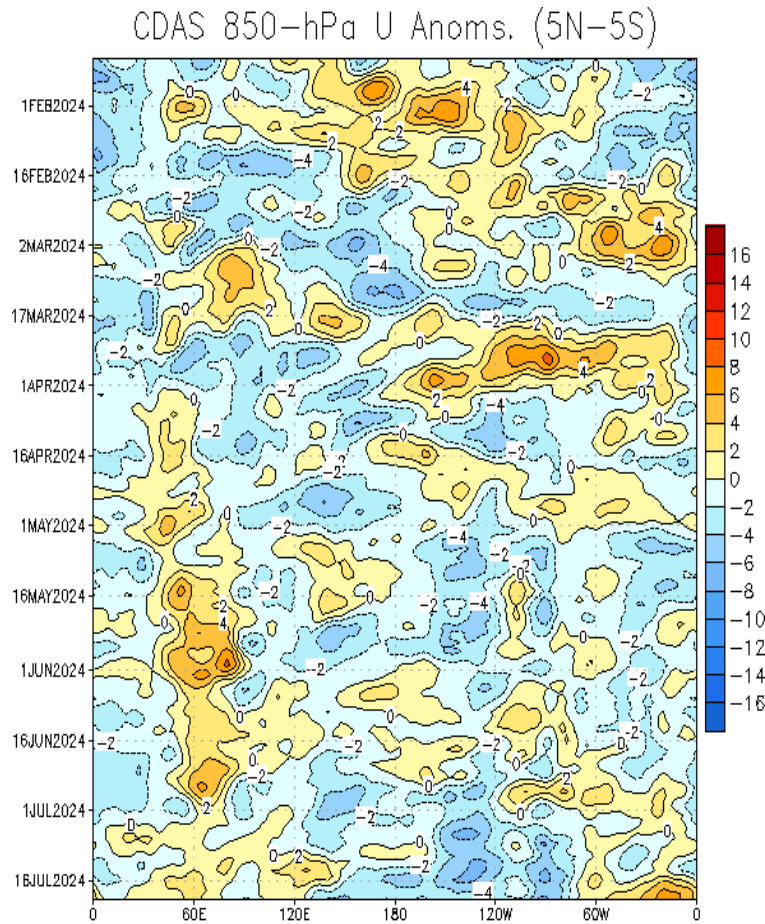


- Anomalous upper-level westerlies over the West Pacific near the Equator have weakened
- Strong upper-level westerlies continue across the Eastern Pacific which have been limiting TC development.



# 850-hPa Wind Anomalies

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

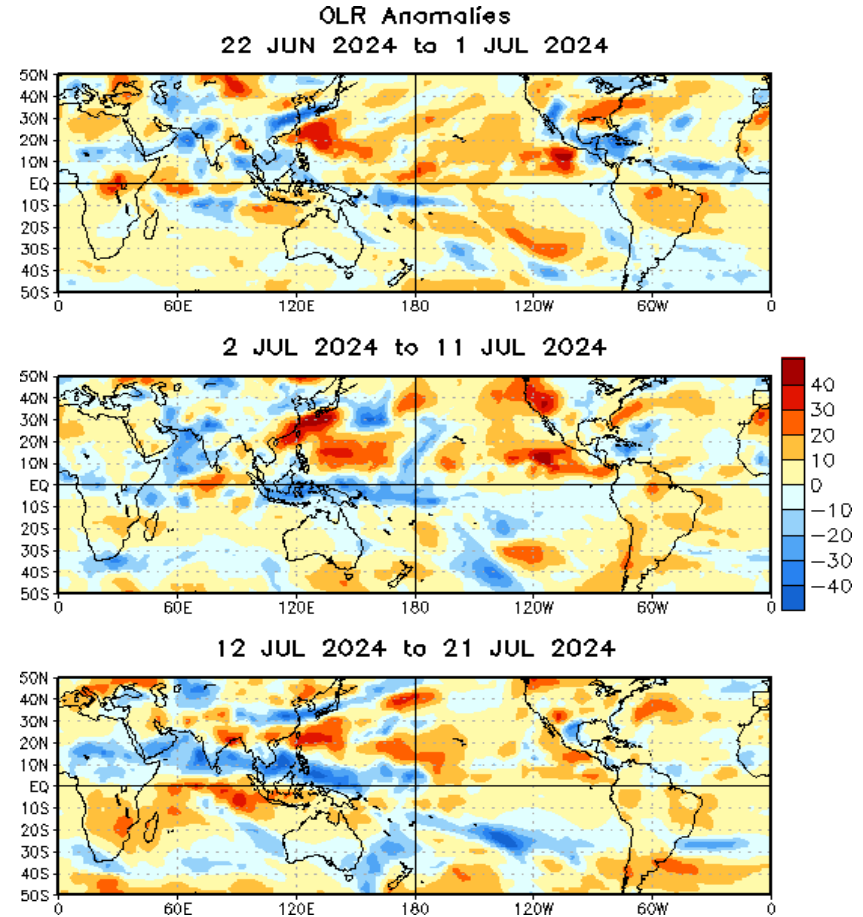
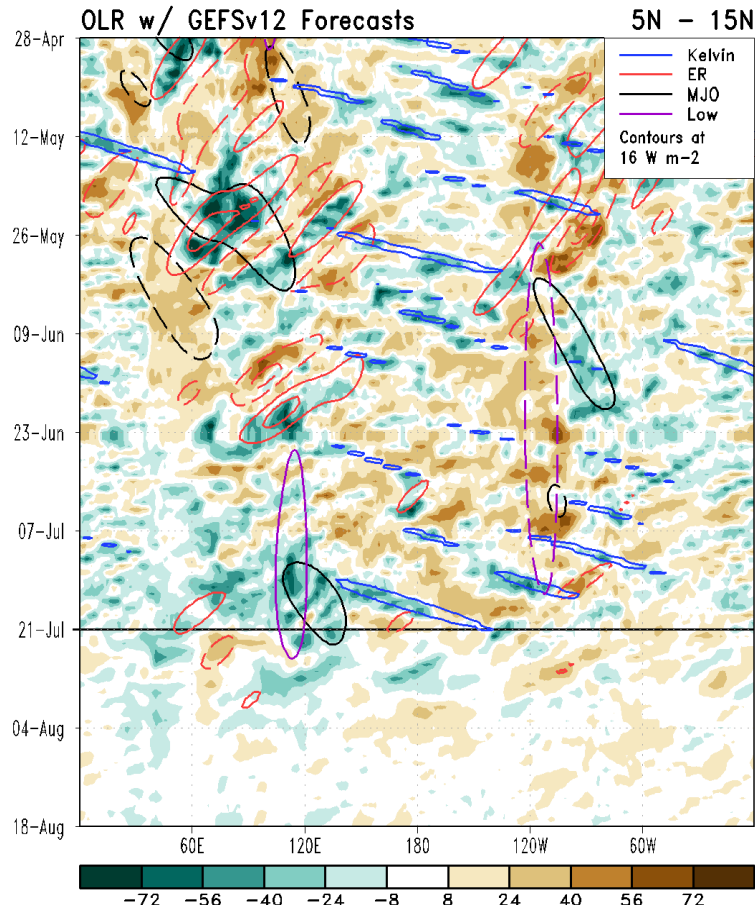


- Trade winds remain enhanced across the Pacific east of the Date Line, with anomalous low-level easterlies extending to into parts of the Western Pacific
- Anomalous low-level westerlies have increased across the Atlantic north of the Equator, with a broad cyclonic flow pattern beginning to take shape.

# Outgoing Longwave Radiation (OLR) Anomalies

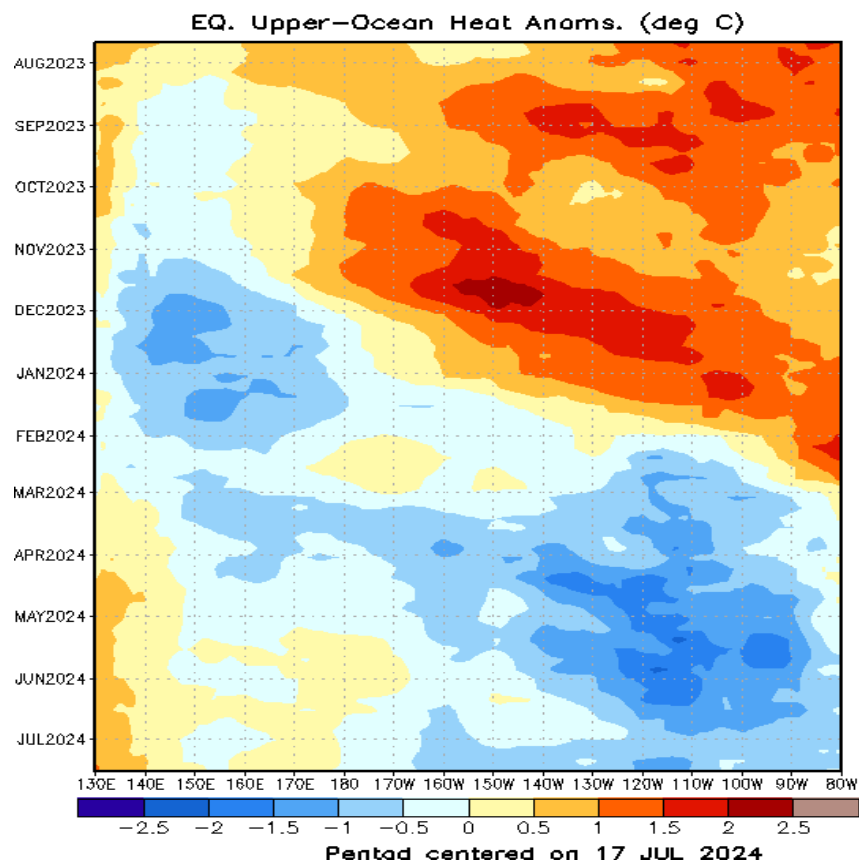
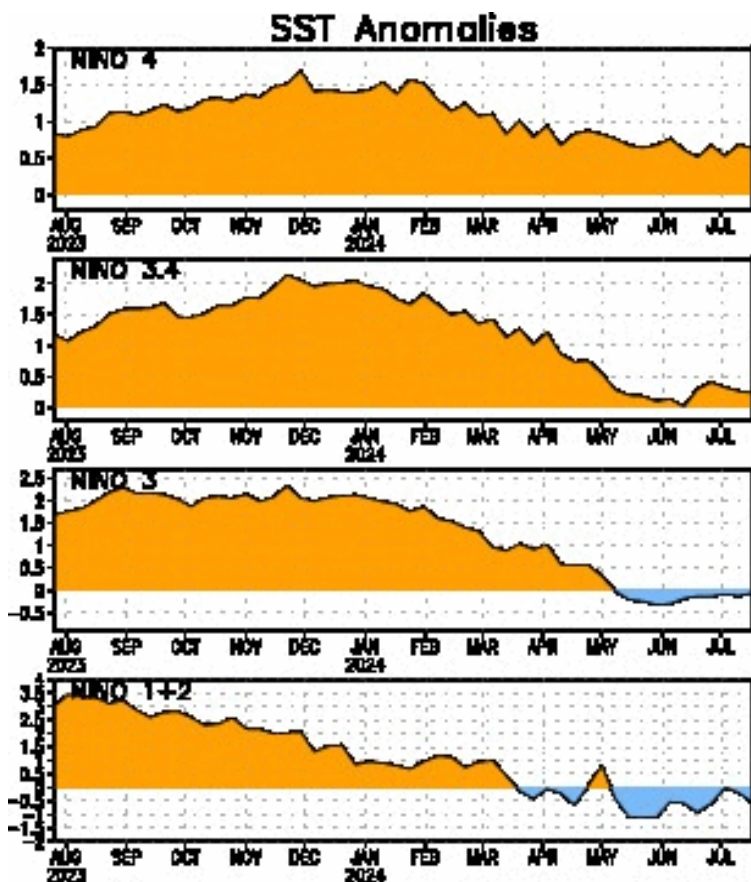
**Green shades:** Anomalous convection (wetness)

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



- A low frequency signal along with the MJO is apparent through the objective filtering of the OLR anomalies over the West Pacific.
- Spatial OLR plots show an elongated region of negative OLR anomalies across the northern Indian Ocean into the Western Pacific.
- GEFS forecasts depict little signal in the OLR field.

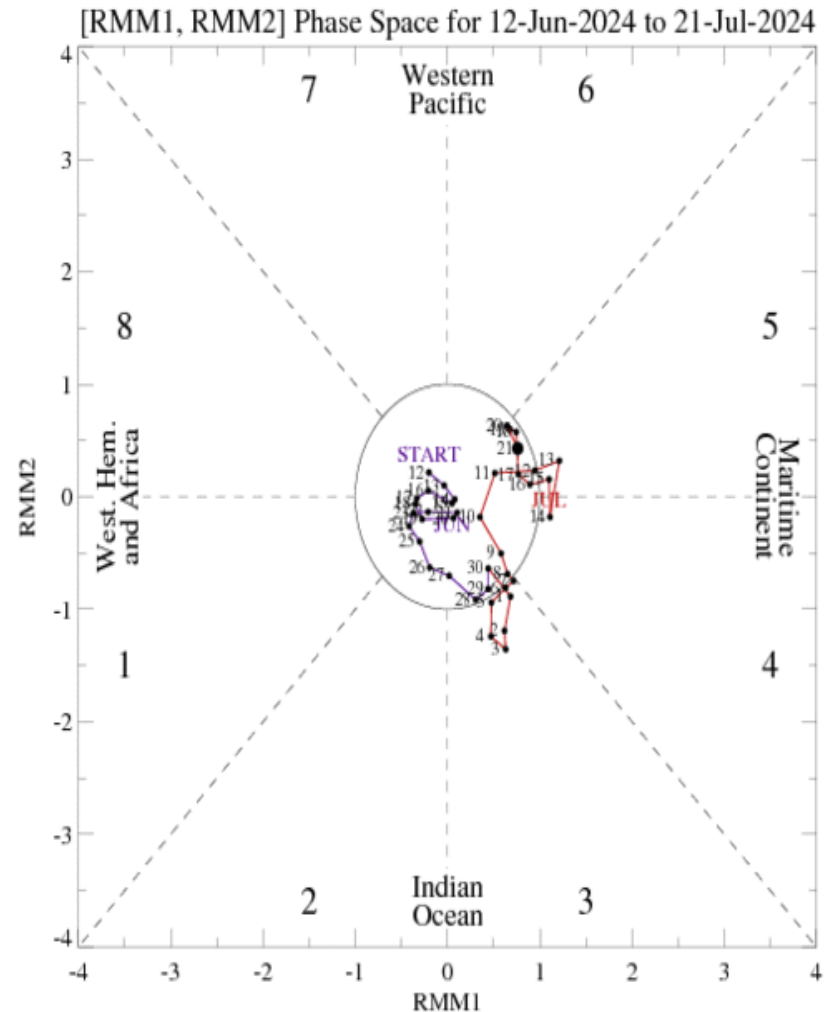
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- The downward trend in SSTs has leveled off in the past month with positive (negative) SST anomalies over the western (eastern) Niño regions.
- Negative oceanic heat content anomalies have persisted and increased slightly over the eastern half of the Pacific during the month of July.

# MJO Index: Recent Evolution

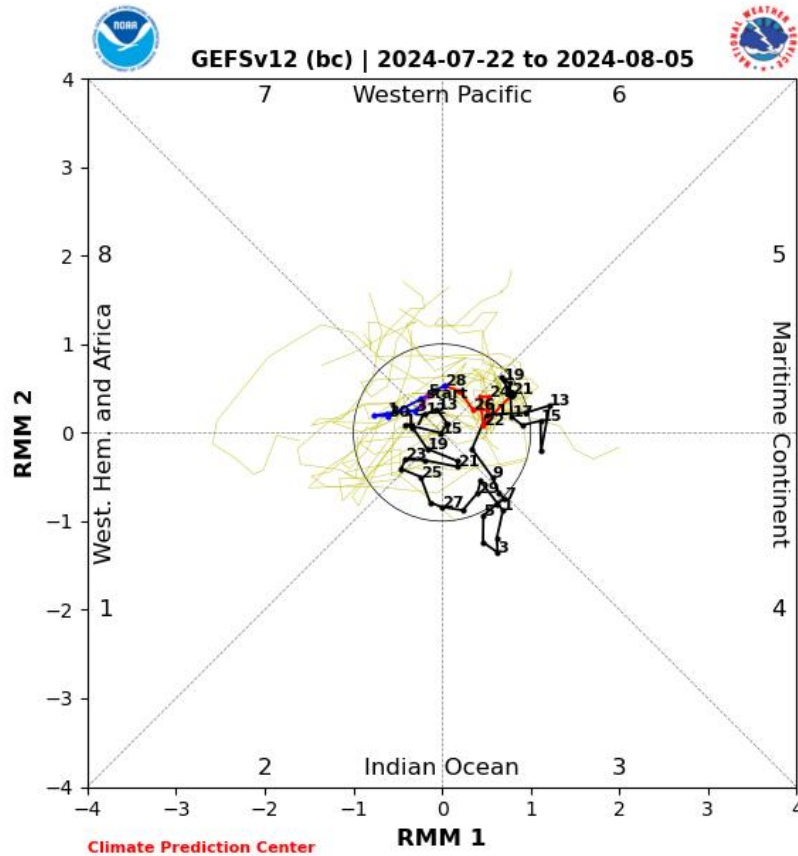
- With the exception of some occasional short bursts of activity, the RMM-based MJO index has remained within the unit circle since June.



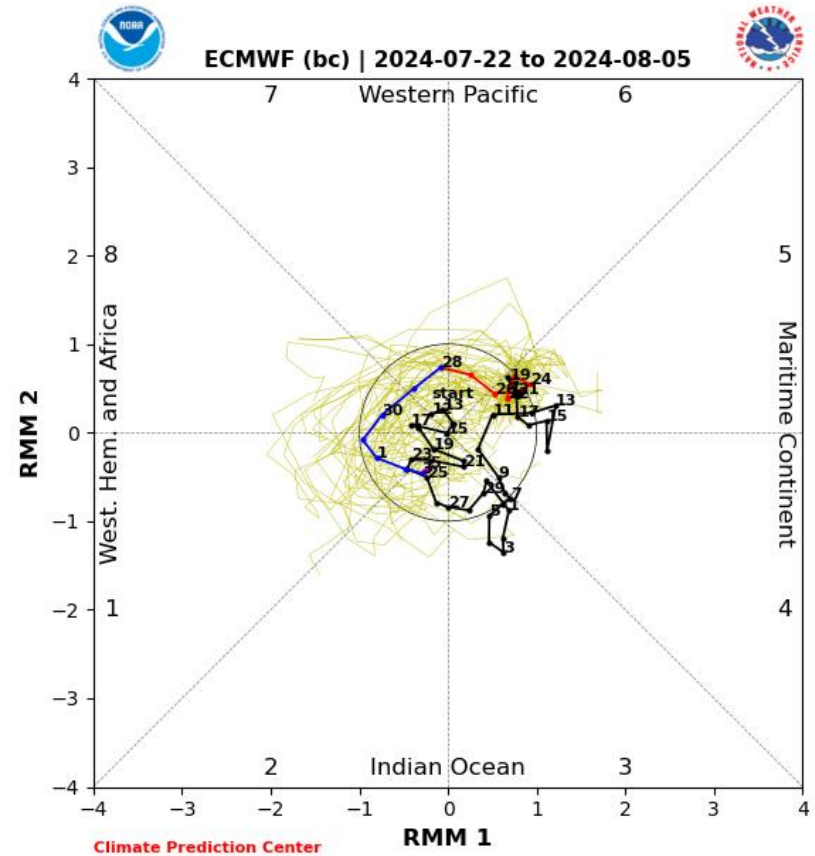
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



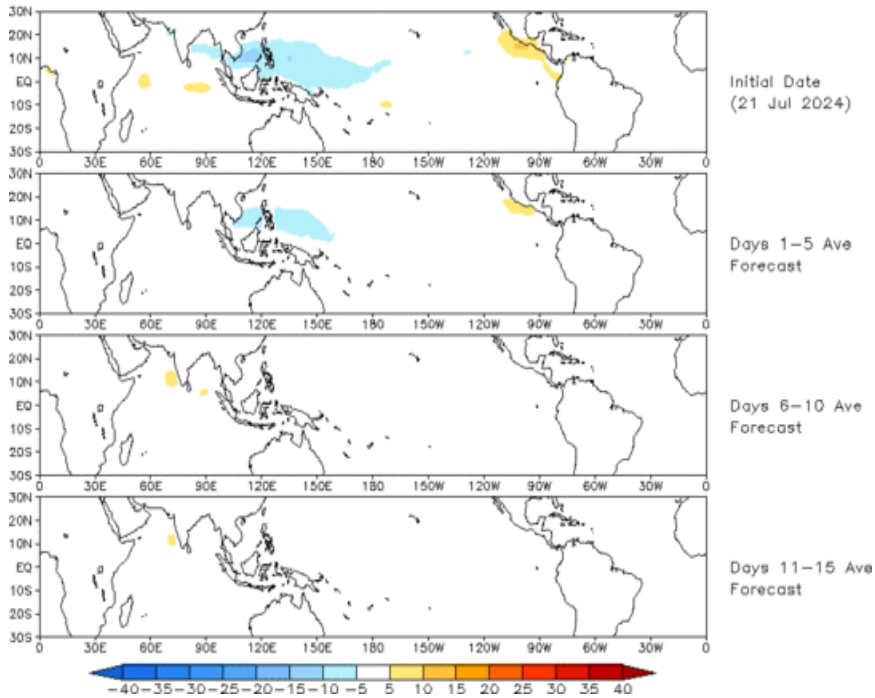
**ECMWF Forecast**

- The GEFS depicts continuing low-amplitude MJO activity during the next 2 weeks, with most individual members keeping the signal within the unit circle.
- There is more evidence of an eastward propagating MJO into the Western Hemisphere in the ECMWF ensemble, although the signal is weak and more likely a fast-moving Convectively-Coupled Kelvin Wave.

# MJO: GEFS Forecast Evolution

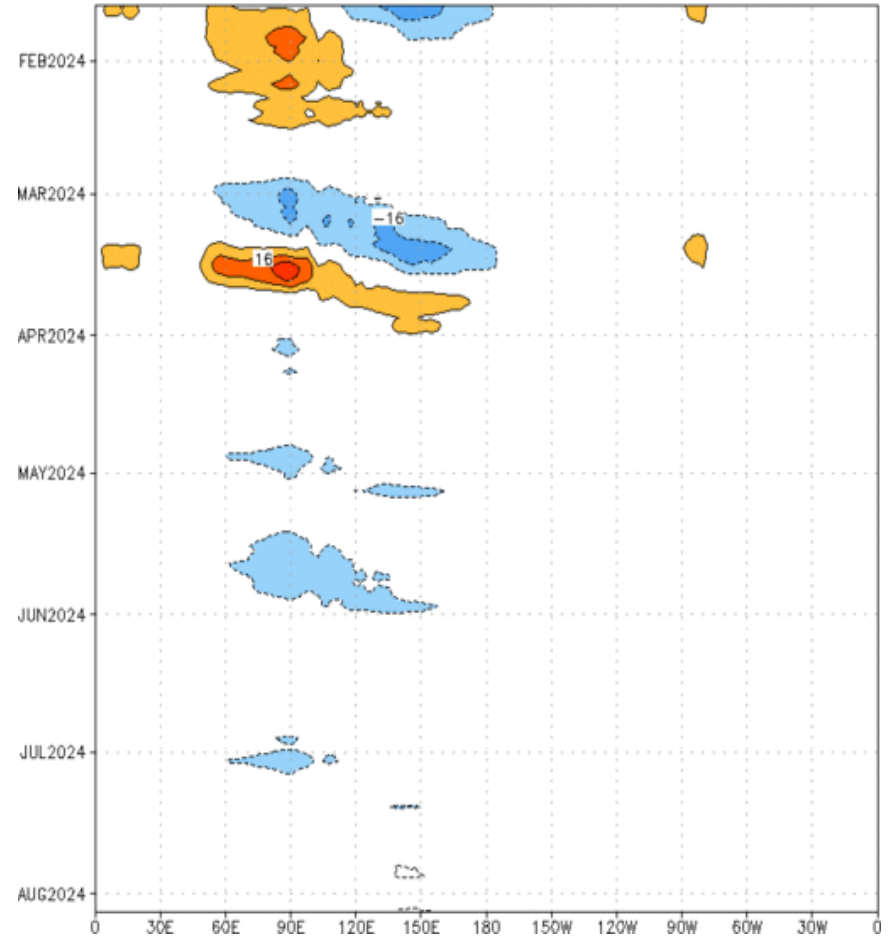
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 21 Jul 2024  
OLR



- The GEFS depicts weak negative OLR anomalies (enhanced convection) across the Western Pacific in week-1, with no signal across the globe in week-2.

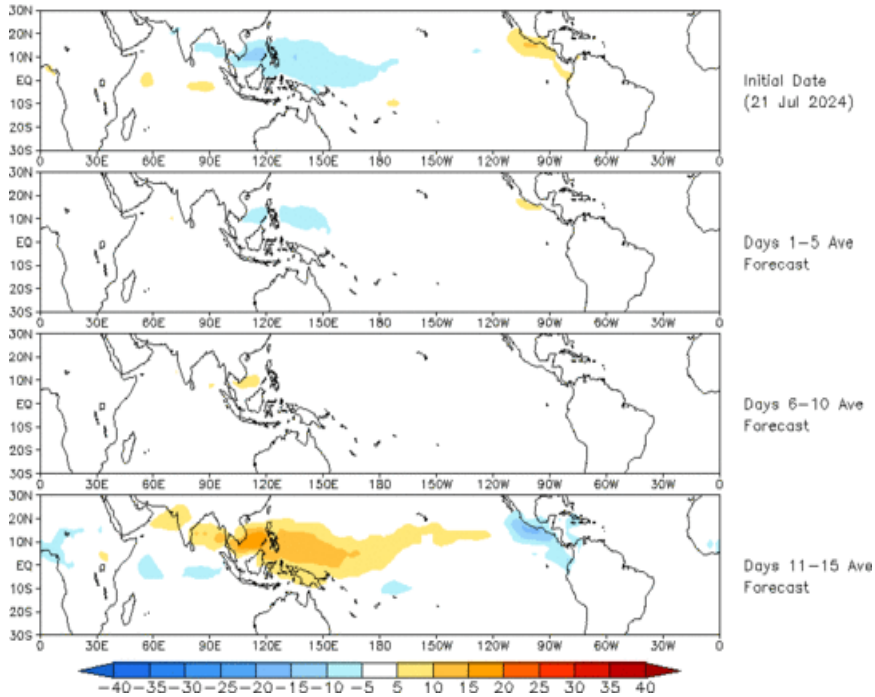
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:20-Jan-2024 to 21-Jul-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



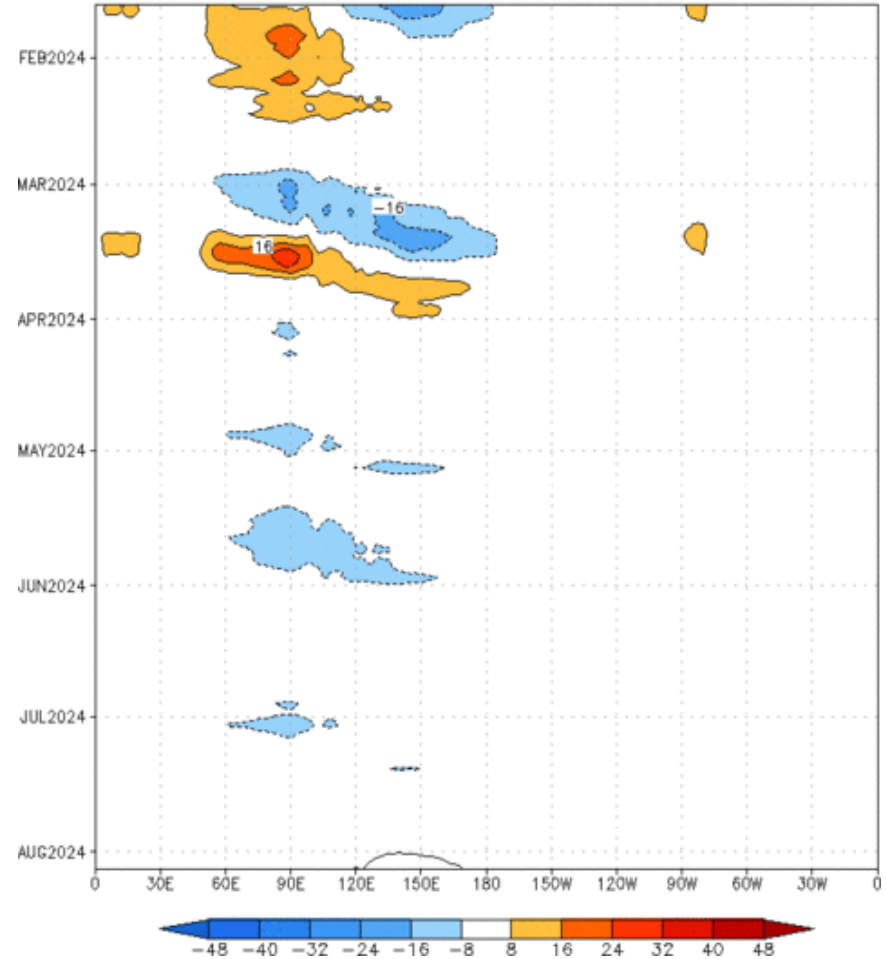
# MJO: Constructed Analog Forecast Evolution

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 (21 Jul 2024)



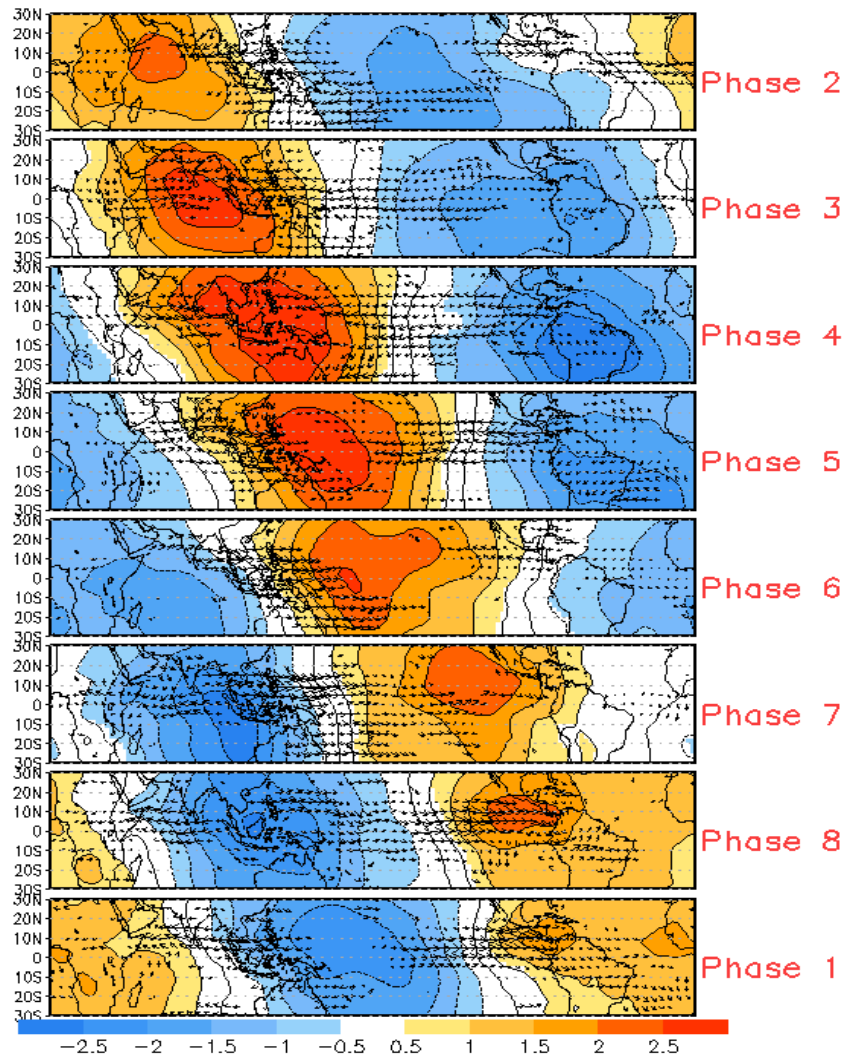
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:20-Jan-2024 to 21-Jul-2024  
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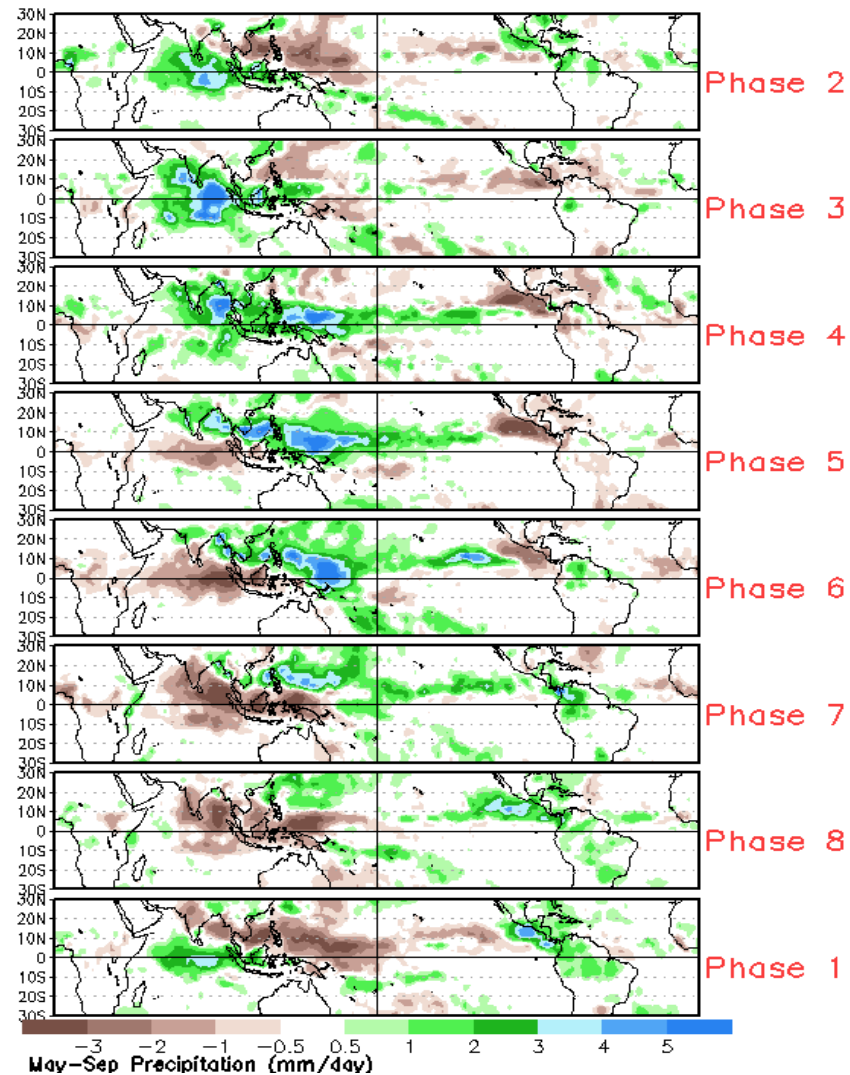
- By the end of week-2, the constructed analog tool depicts a more expansive region of positive OLR anomalies (suppressed convection) over the Western Pacific, and negative OLR anomalies (enhanced convection) over the Eastern Pacific and Caribbean.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



## Precipitation Anomalies

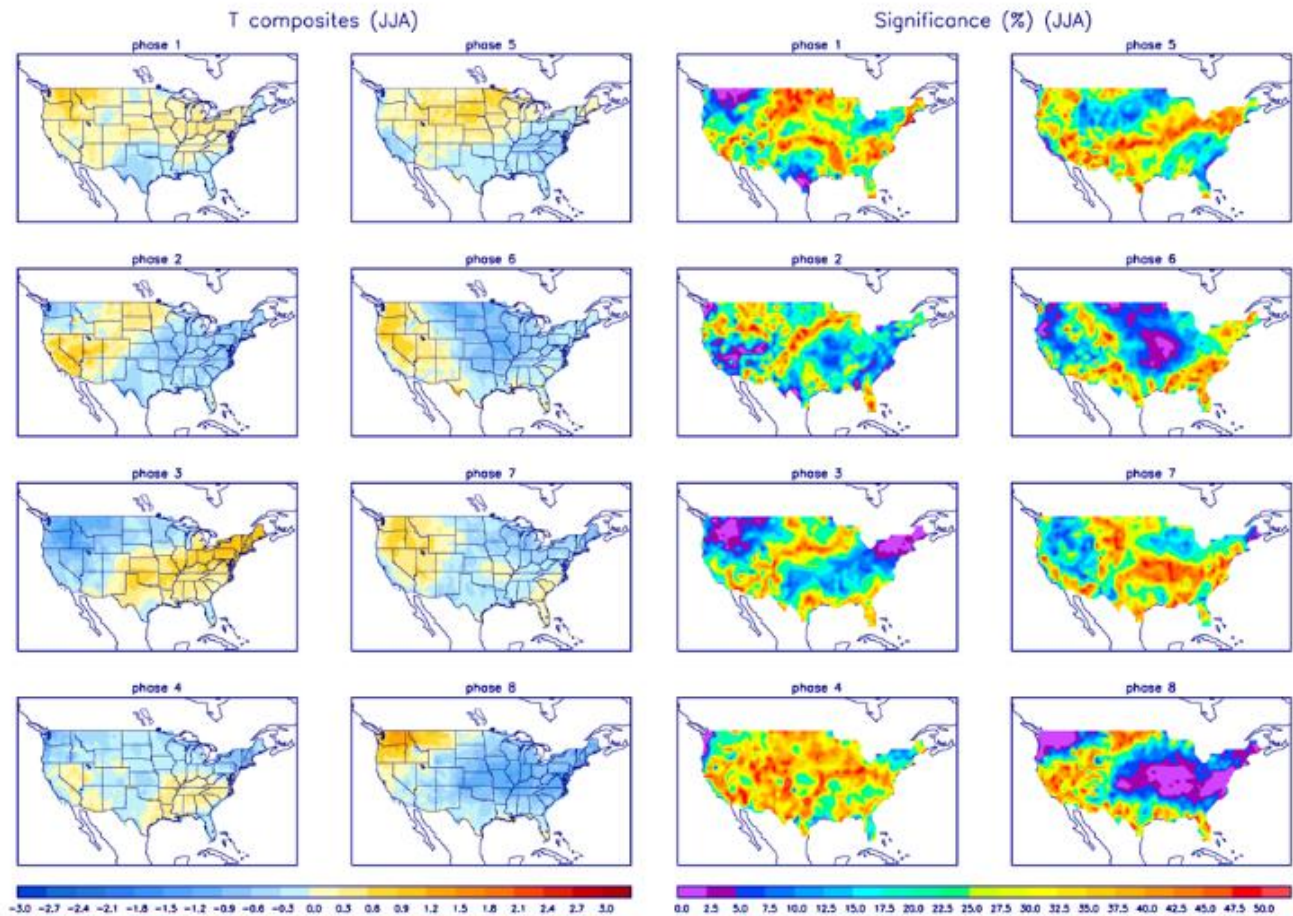




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

