

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



**Update prepared by the Climate Prediction Center  
NWS / NCEP / CPC  
26 August 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. A loss of amplitude was observed this past week likely due to destructive interference with other modes of tropical variability.
- RMM forecast suggest this weakening will be short-lived, as dynamical models are supportive of the MJO regaining amplitude and propagating eastward across the Maritime Continent during the next few weeks, and possibly reaching the Western Pacific later in September.
- The large scale environment is expected to become increasingly 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.

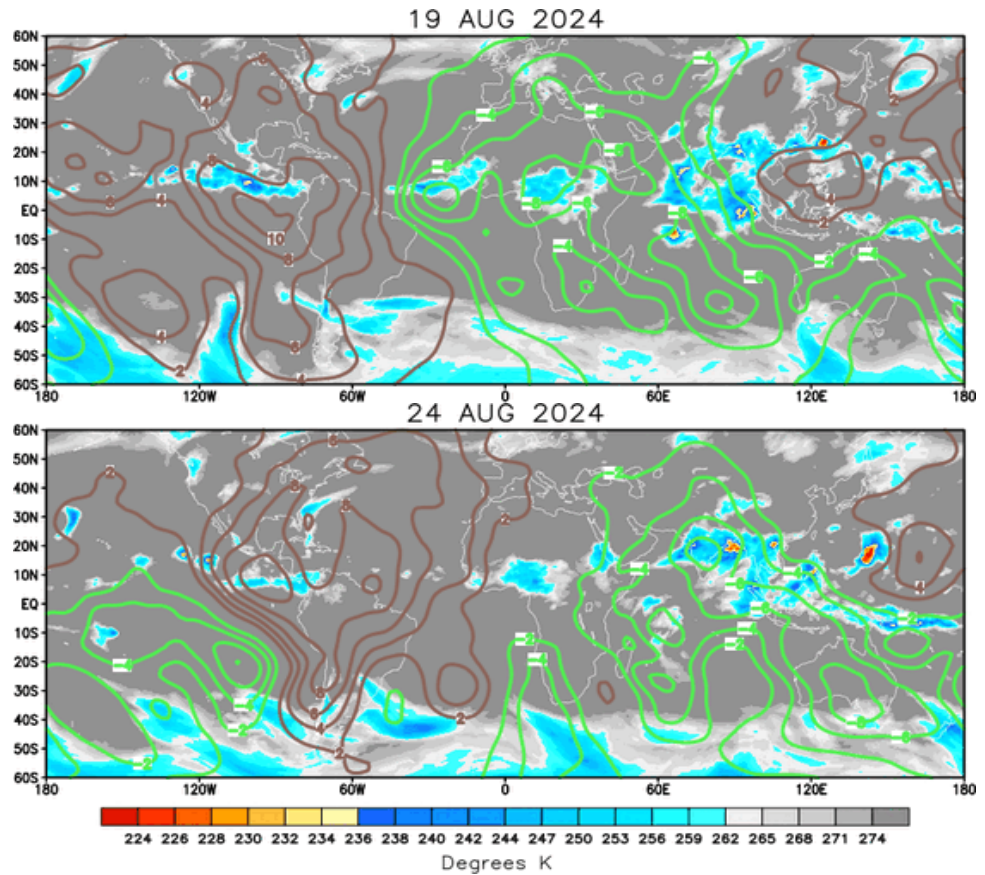
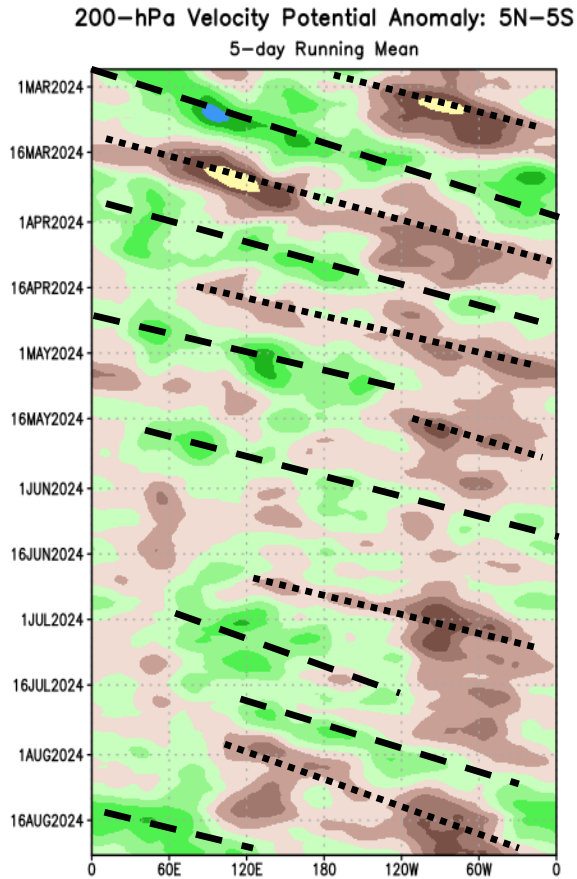
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

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

# 200-hPa Velocity Potential Anomalies

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

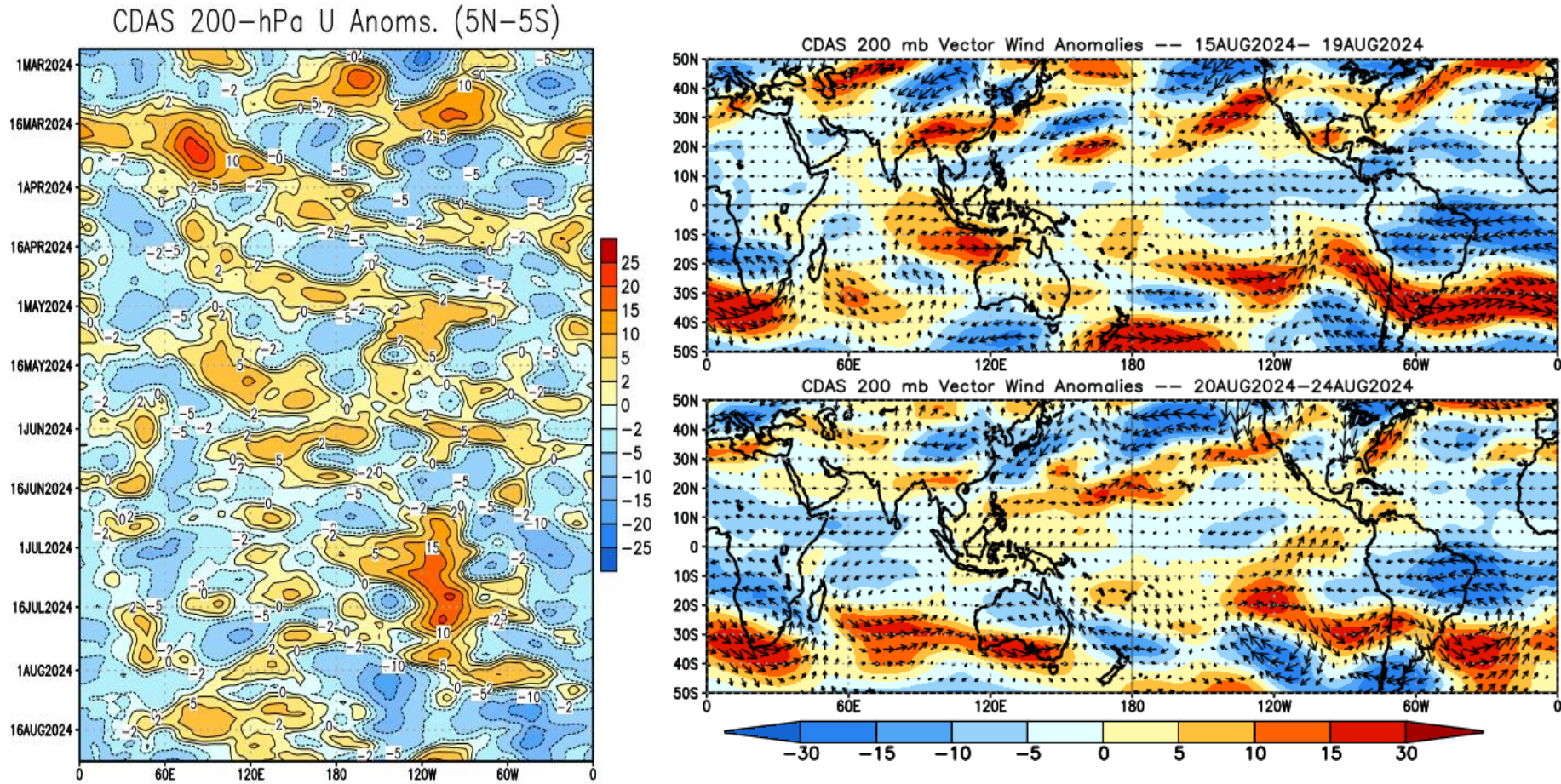
**Brown shades:** Anomalous convergence (unfavorable for precipitation)



- Since early August, upper-level velocity potential anomalies continue to indicate organized MJO activity, with the enhanced (suppressed) phase propagating over the Indian Ocean (Tropical Americas).
- A secondary envelope of enhanced divergence aloft is observed in the eastern Pacific mainly south of the equator, and appears to be tied to destructive interfering Rossby Wave activity.

# 200-hPa Wind Anomalies

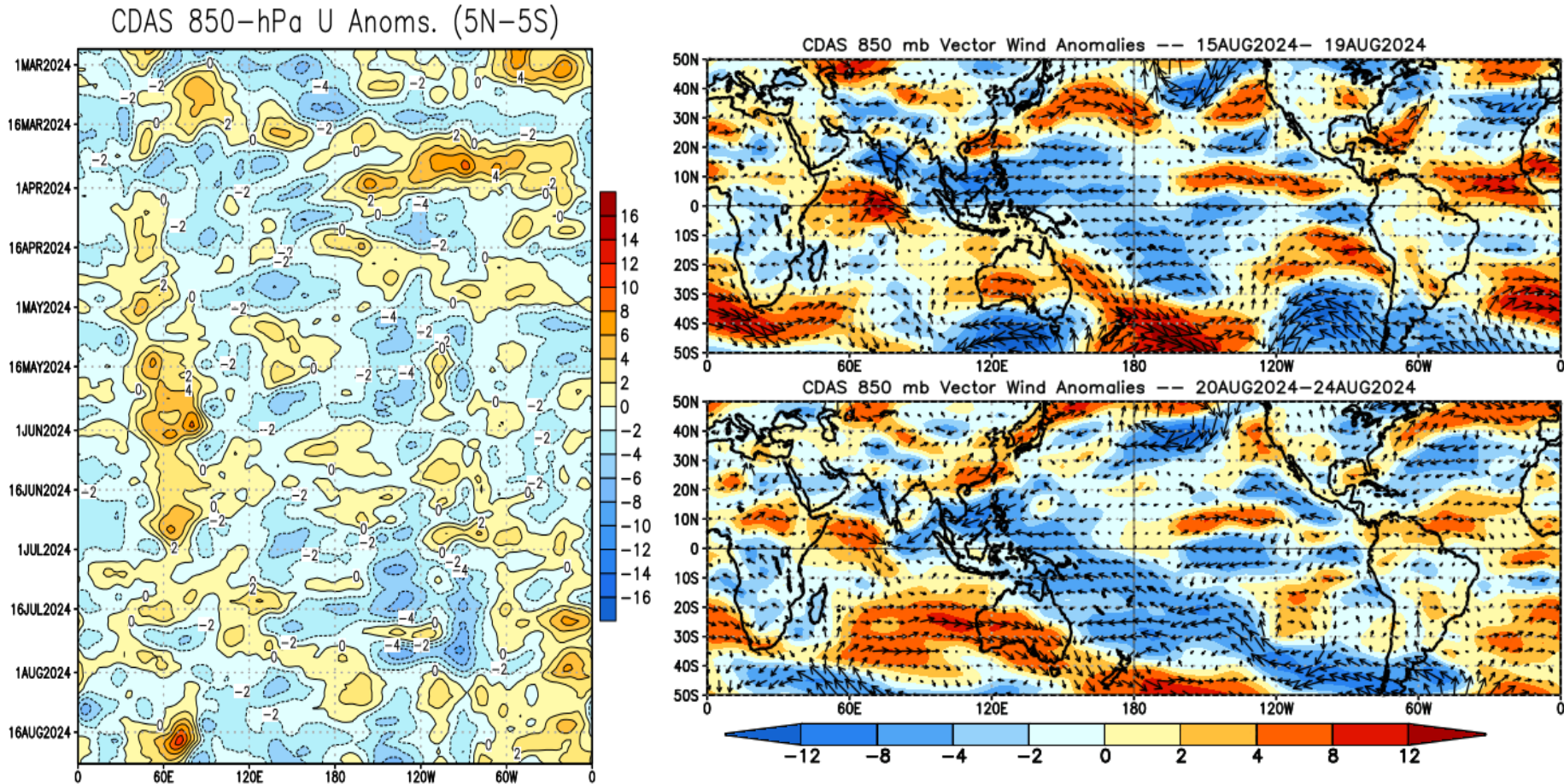
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- While anomalous westerlies remain somewhat weak near the Date Line, the easterly phase of the MJO became more pronounced over Africa and the western Indian Ocean.
- An enhanced jet is evident protruding from the western Pacific to North America, where anomalous ridging flanked by a pair of upper-level troughs consistent with an Omega block was observed over the CONUS.
- Anomalous westerlies returned over the eastern Pacific to the south of Mexico, however a band of enhanced easterlies to the west likely aided in Tropical Cyclone (TC) formation west of 120W

# 850-hPa Wind Anomalies

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

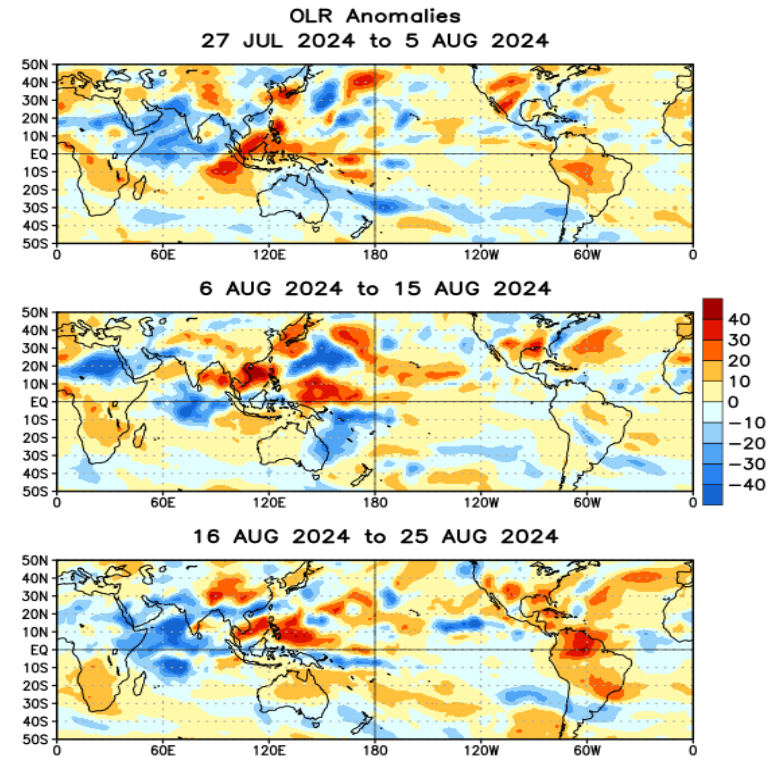
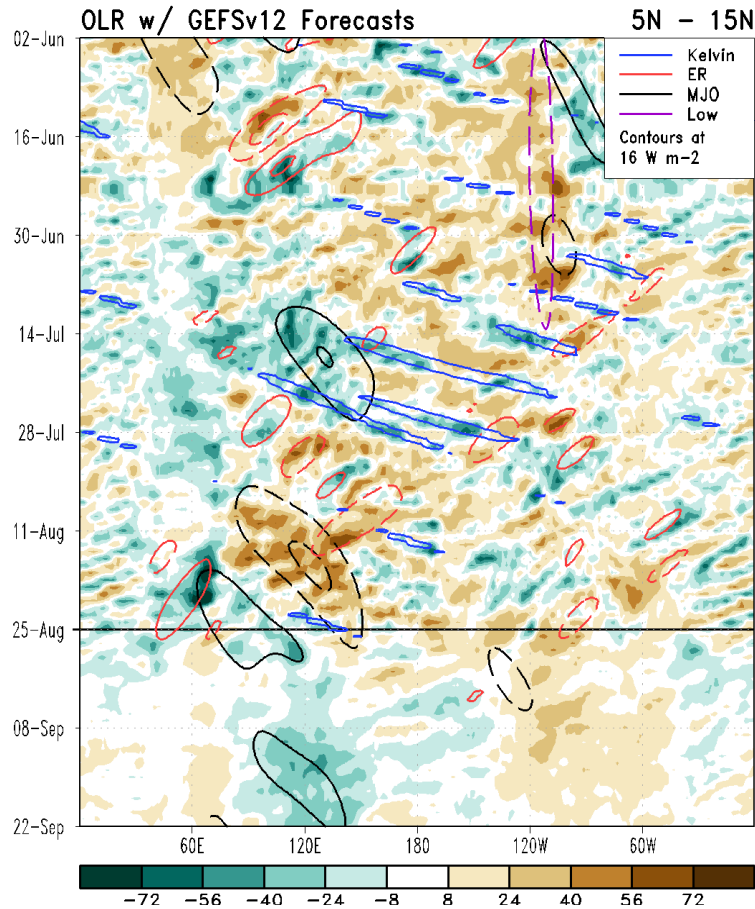


- A westerly wind burst (WWB) event was observed near 70°E. The ensuing easterly response (likely associated with the suppressed phase of an equatorial Rossby wave) is beginning to destructively interfere with the MJO over the Indian Ocean.
- An enhanced trade regime continues across western Pacific, through continued westerlies over the Northern Philippine Sea likely led to additional TC development in the basin.
- Combined with anomalous easterlies aloft, westerlies persist over the tropical Atlantic to reduce shear.

# Outgoing Longwave Radiation (OLR) Anomalies

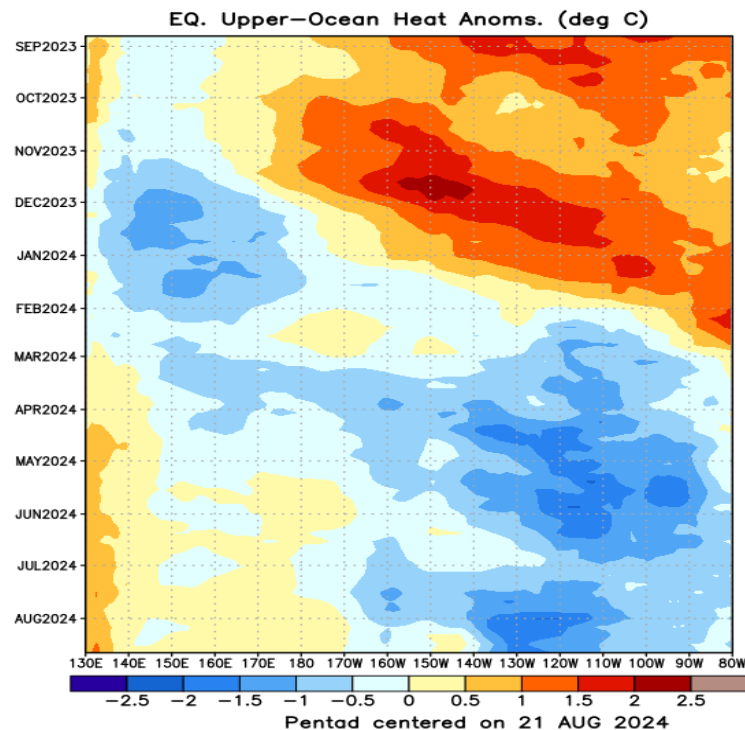
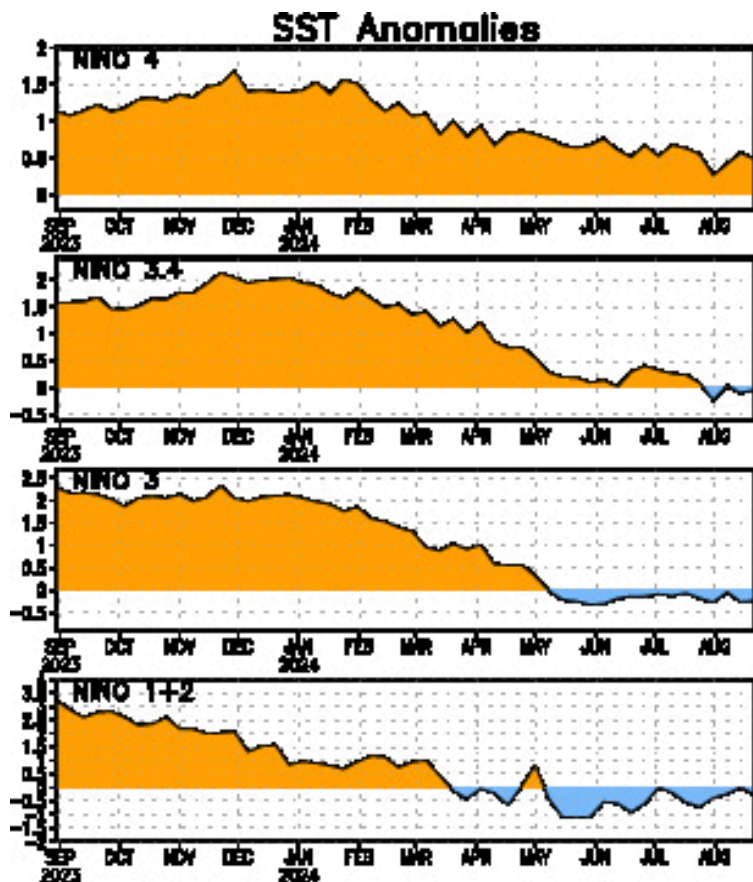
**Green shades:** Anomalous convection (wetness)

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



- Tied to the eastward propagating MJO and the WWB event, an uptick in convection is observed from the Horn of Africa to the central Indian Ocean, with suppressed convection becoming more widespread over many parts of the Americas
- Objective filtering of OLR anomalies continue to show MJO activity in the observations and forecast heading into September. Strong OLR signals are notably evident in the longer leads.

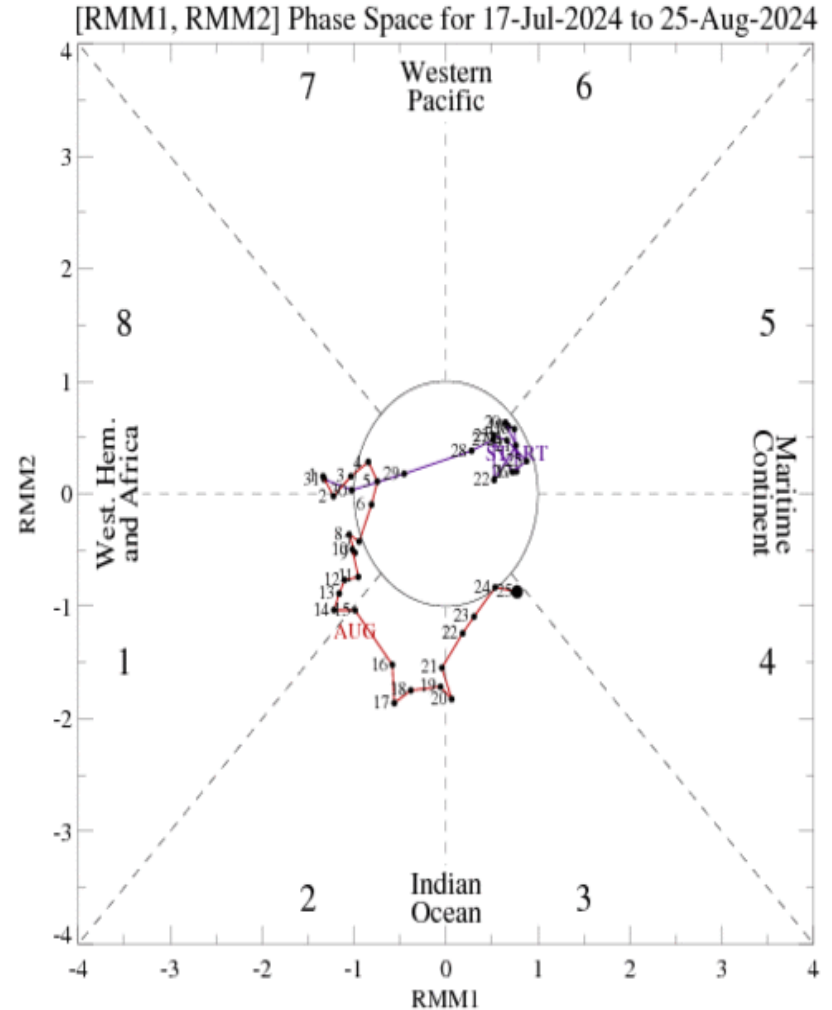
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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, except for an region between 150W-140W where warming was observed since early August.

# MJO Index: Recent Evolution

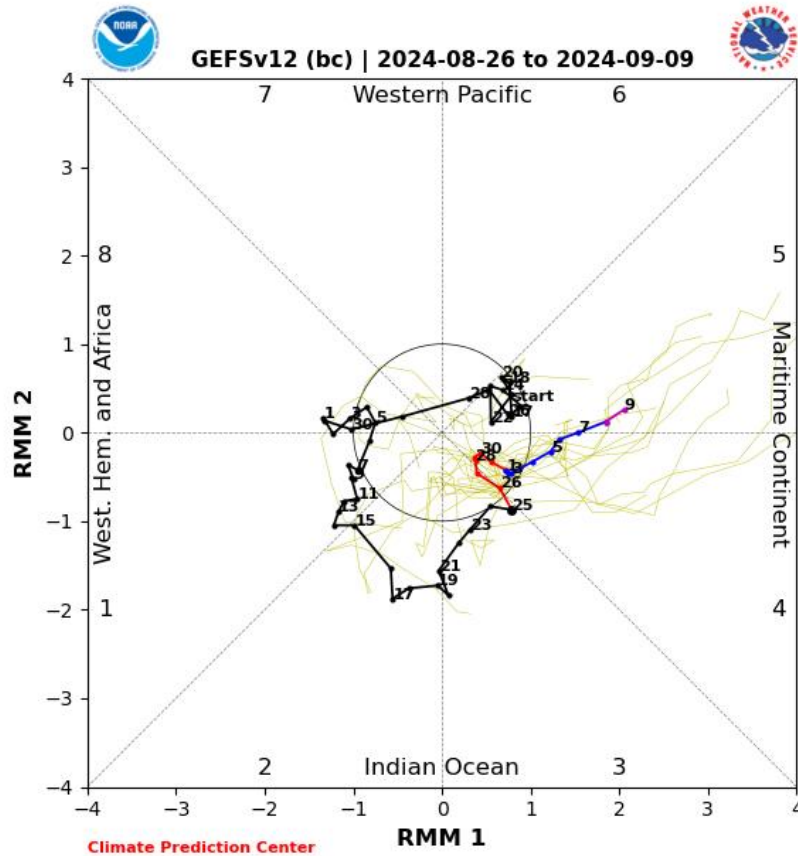
- Since reemerging over the Western Hemisphere in early August, the MJO gained amplitude and propagated eastward over the Indian Ocean.
- During the past week, the MJO signal has lost its amplitude over phase 3, likely tied to Rossby wave interference.



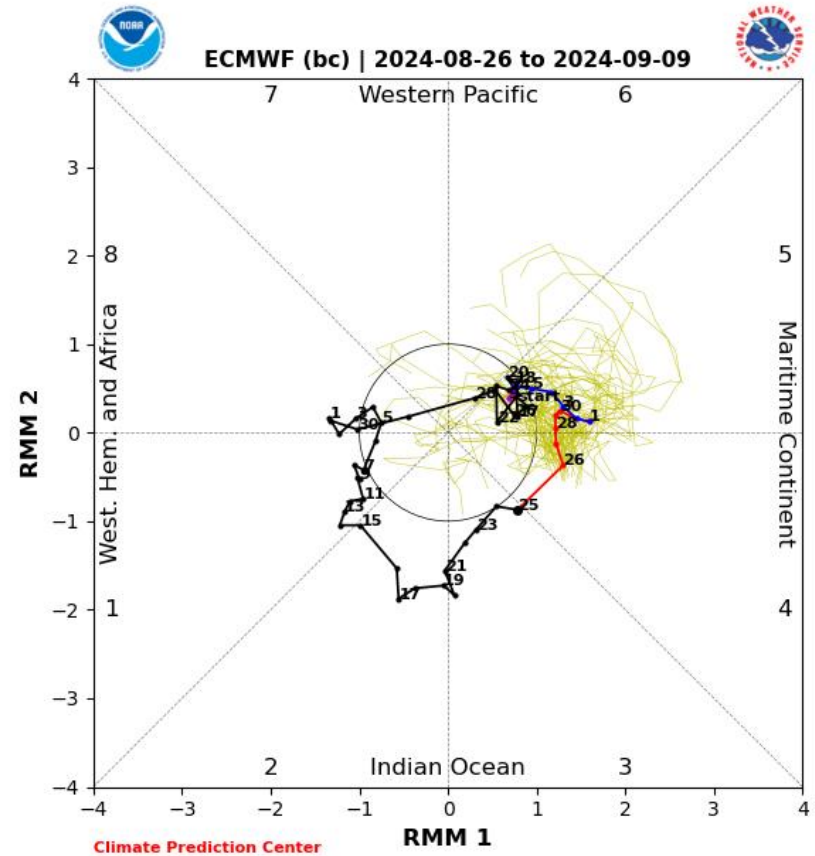
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



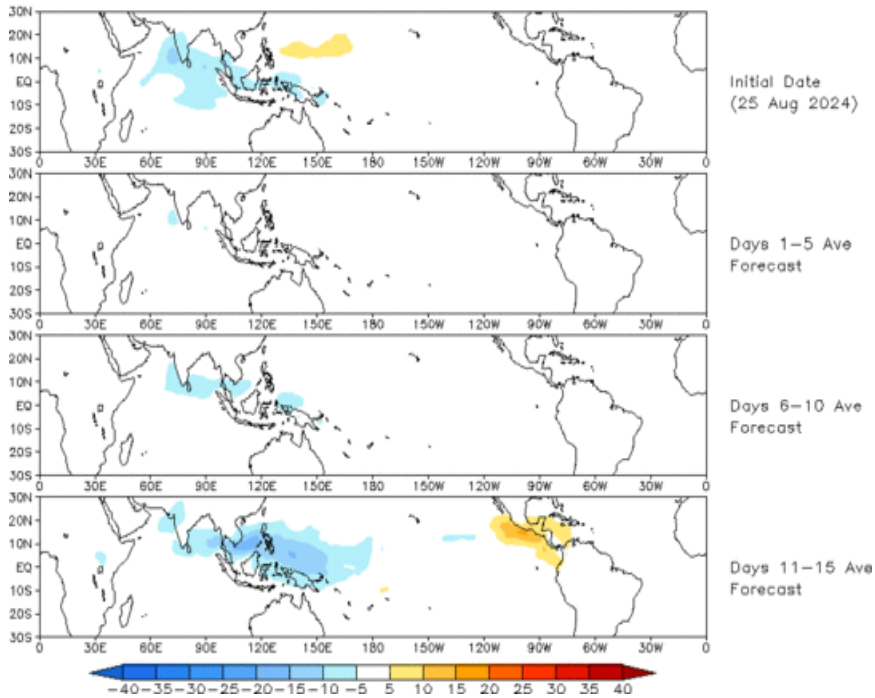
**ECMWF Forecast**

- The recent weakening of the MJO looks to be short-lived, as RMM forecasts generally favor a re-strengthening and slowed signal over the Maritime Continent.
- ECMWF is comparably weaker with the MJO, though several extended range solutions (not depicted here) point to the MJO the reaching the Western Pacific at a higher amplitude later in September.

# MJO: GEFS Forecast Evolution

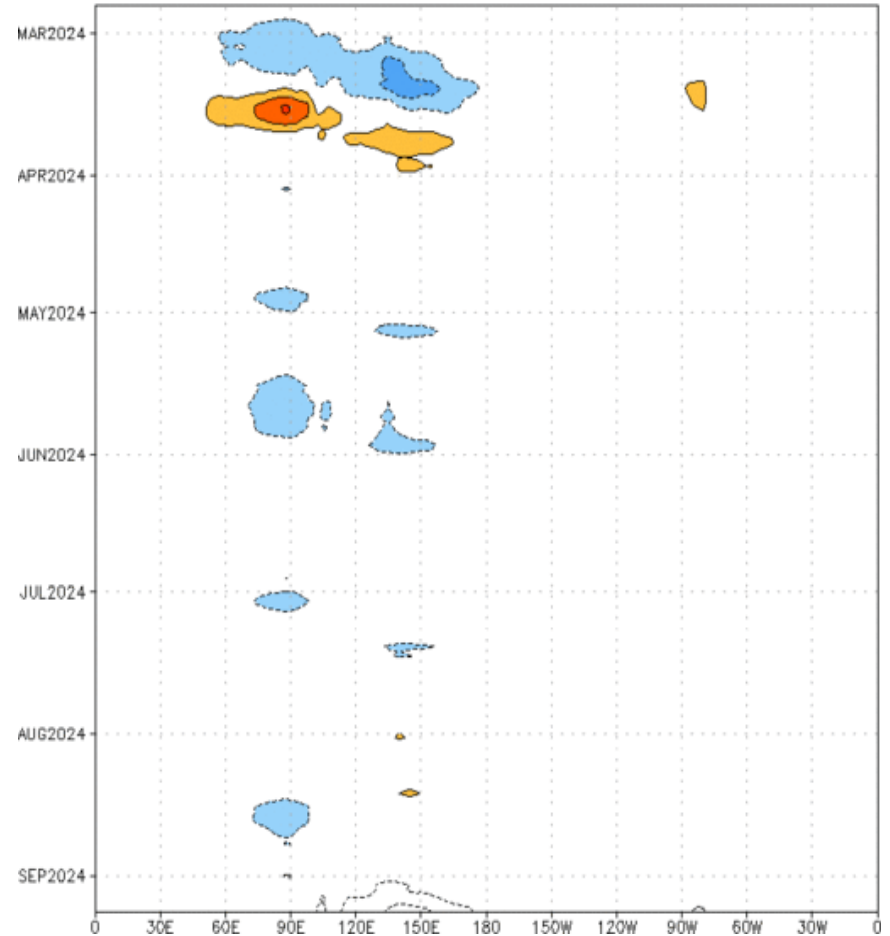
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 25 Aug 2024  
OLR



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

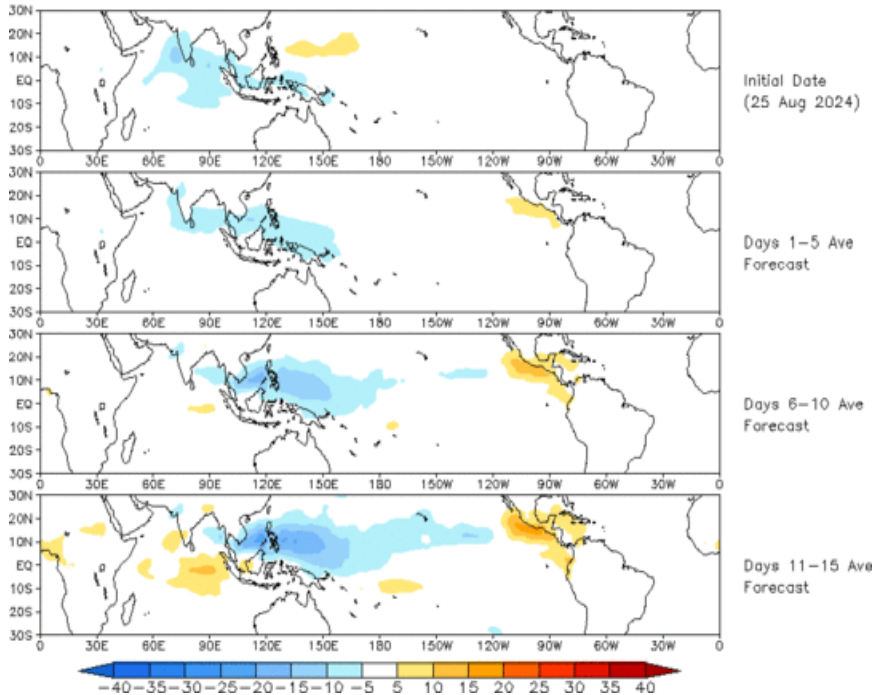
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:24-Feb-2024 to 25-Aug-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



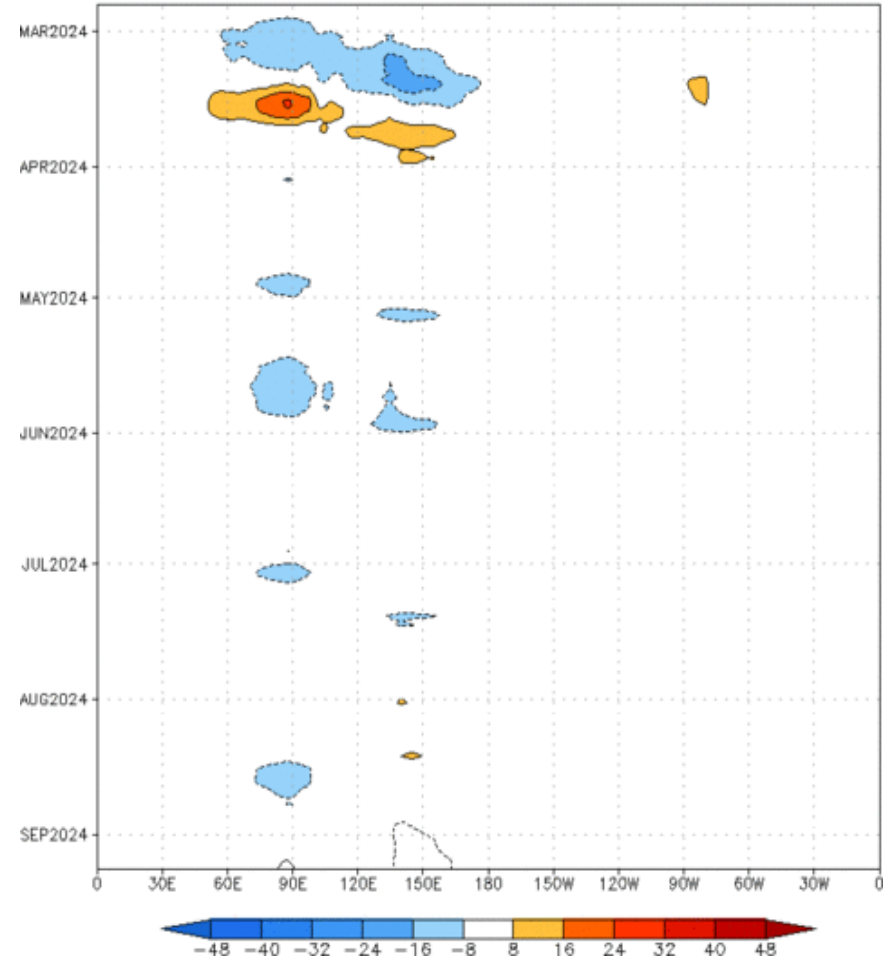
# MJO: Constructed Analog Forecast Evolution

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 (25 Aug 2024)



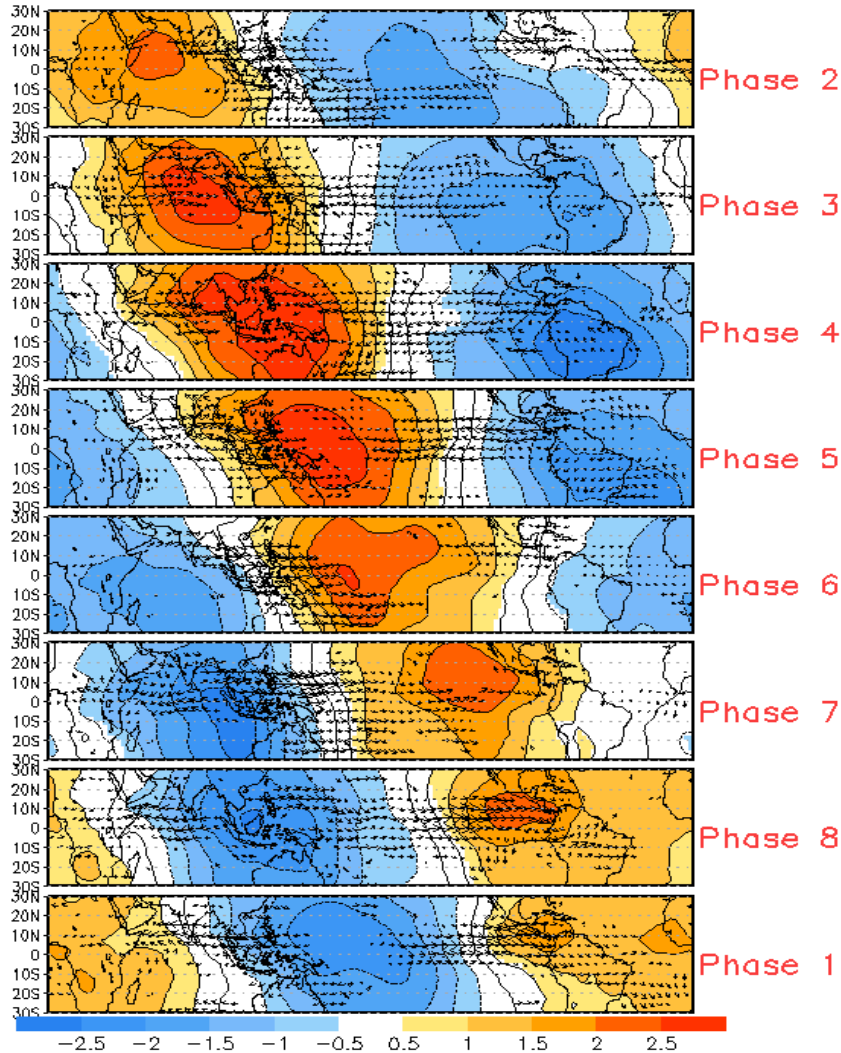
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:24-Feb-2024 to 25-Aug-2024  
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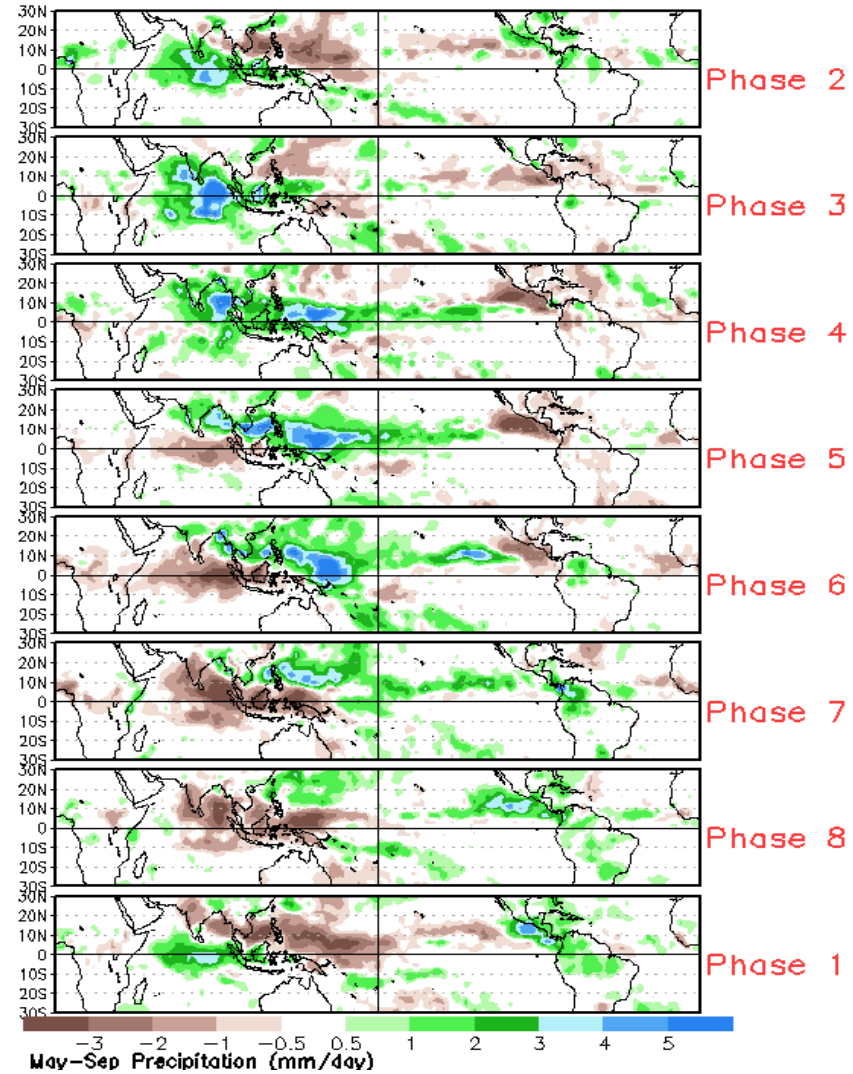
- The constructed analog is stronger with the development of convective anomalies than the GEFS, and features more suppressed convection developing in the Indian Ocean by the week-2 period.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



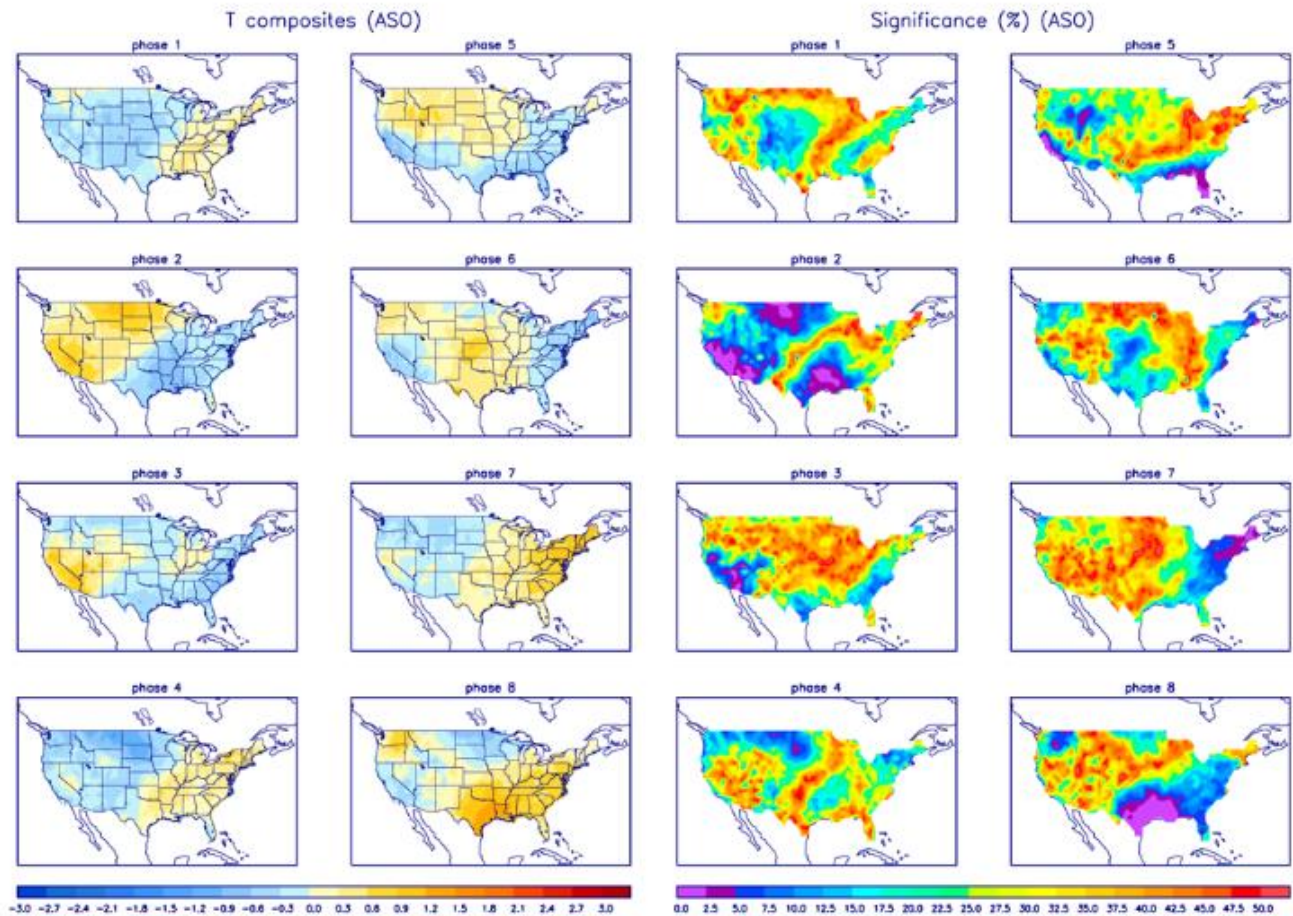
## Precipitation Anomalies



# 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.

