

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



**Update prepared by the Climate Prediction Center**  
**NWS / NCEP / CPC**  
**29 April 2024**

# Overview

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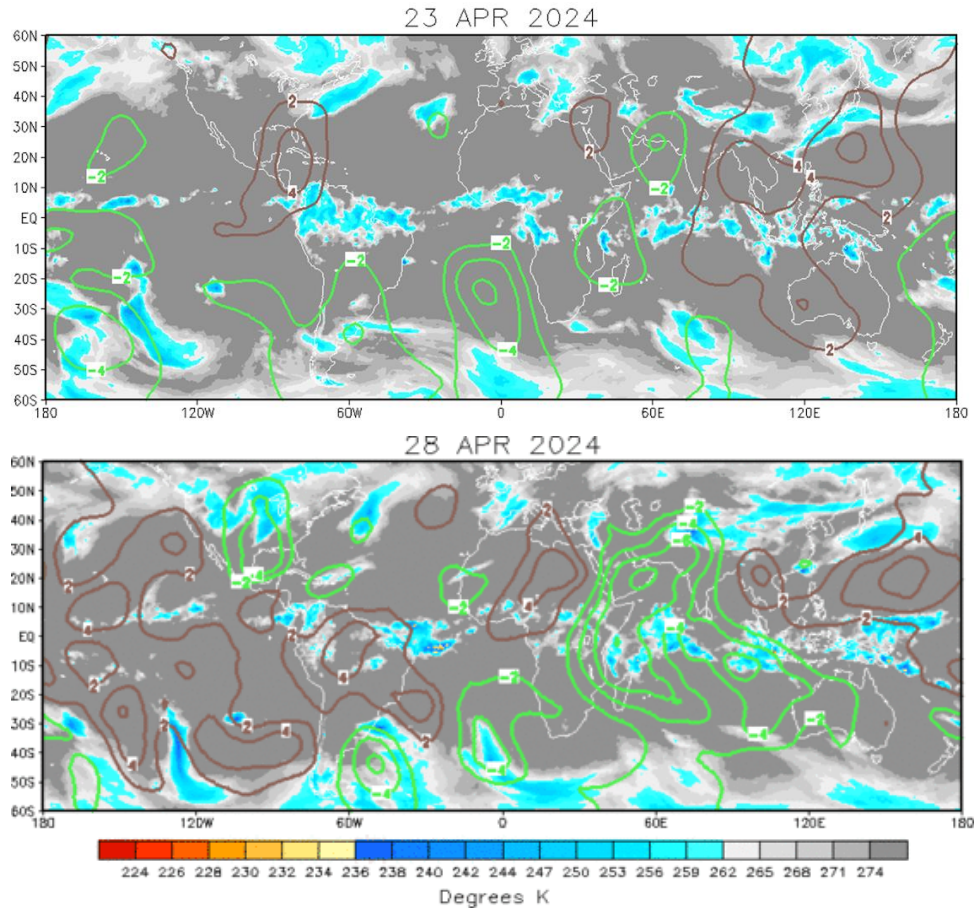
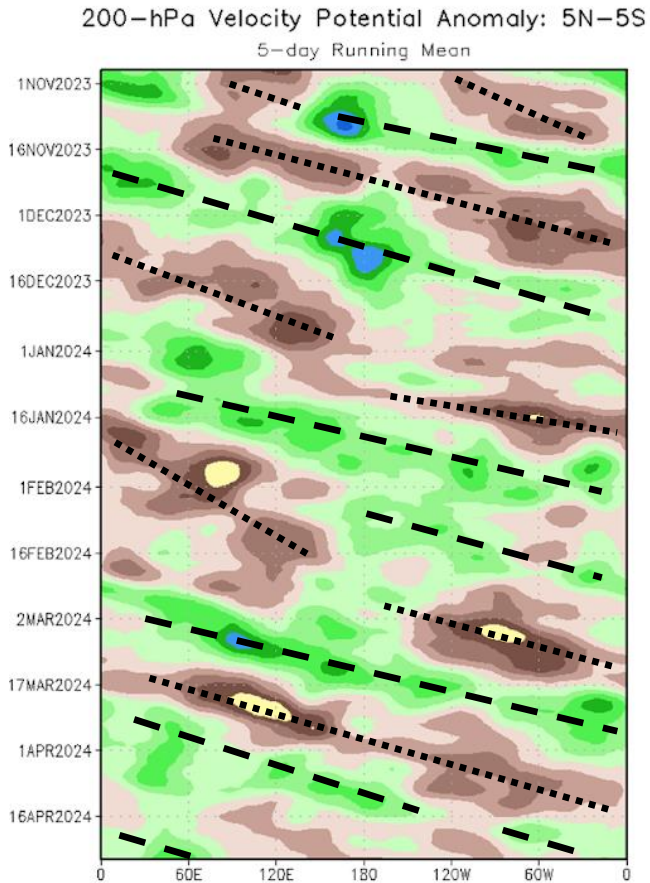
- The MJO weakened during mid- to late-April, with the global tropics continuing to remain quiet in regards to tropical cyclone development.
- Dynamical model forecasts favor a re-emerging MJO across the eastern Indian Ocean, with propagation across the Maritime Continent and Western Pacific forecast during early May.
- As the MJO amplitude increases, tropical cyclone development is possible across the Western Pacific on either side of the equator during week-2; by week-3 conditions may begin to become more favorable across the eastern North Pacific, especially if the MJO continues its propagation into 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)**

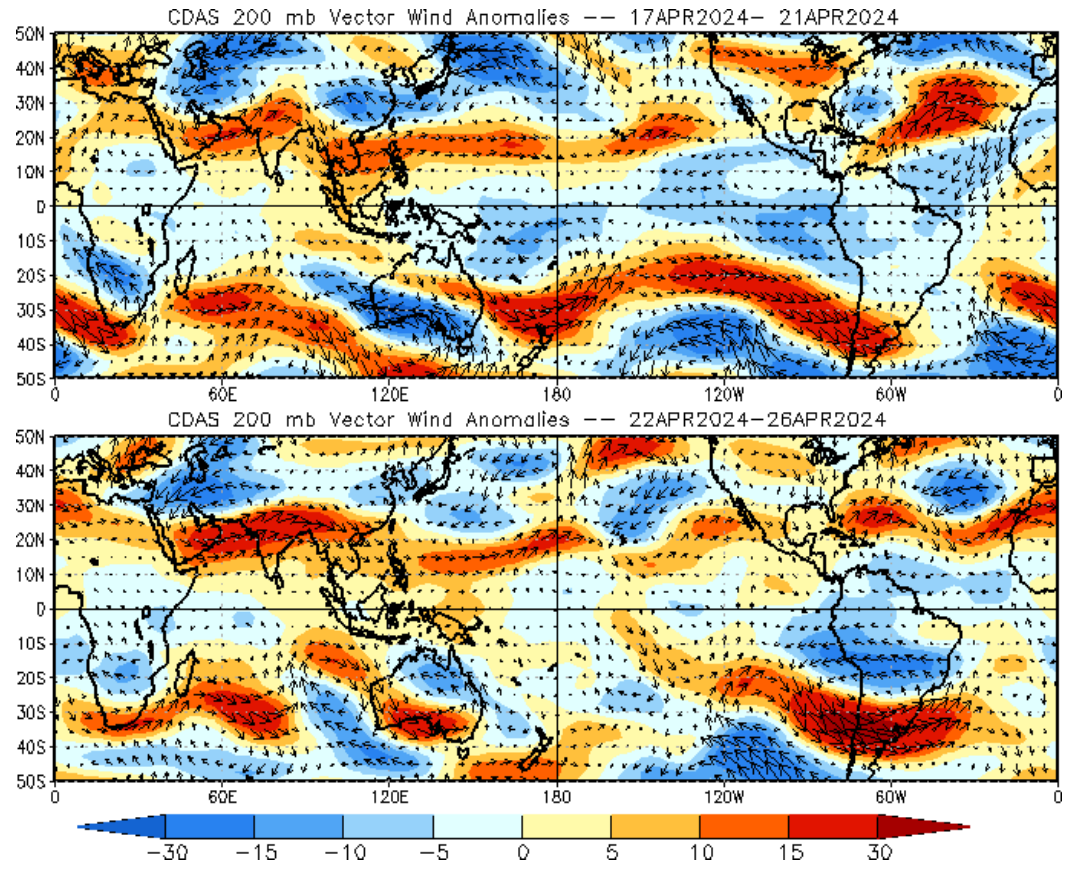
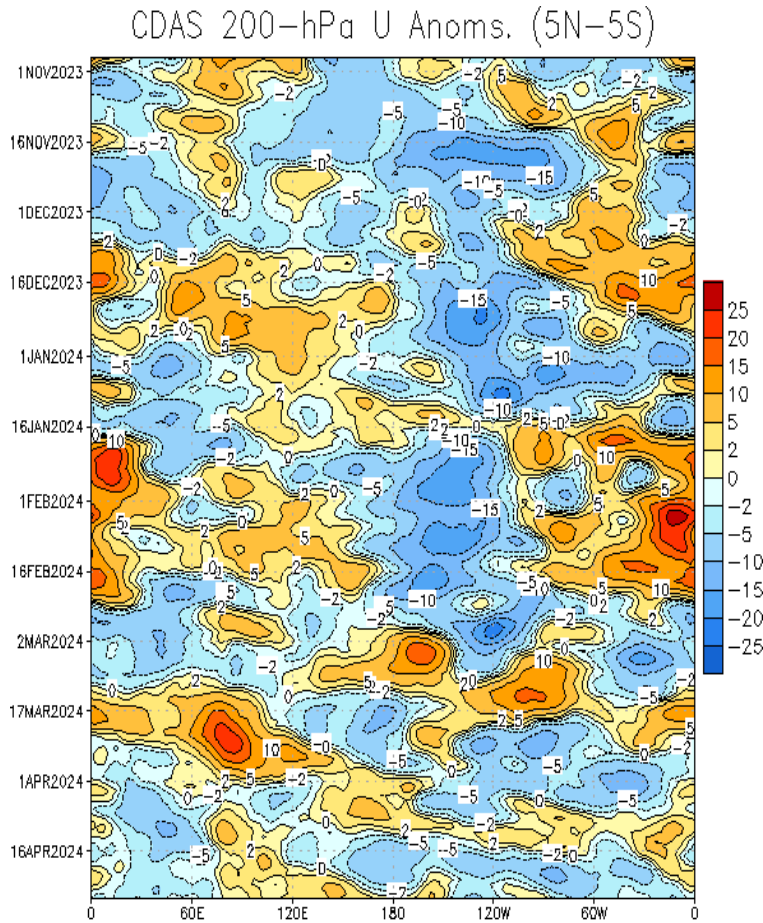
**Brown shades: Anomalous convergence (unfavorable for precipitation)**



- An expanding area of anomalous upper-level divergence is noted across eastern Africa and the Indian Ocean consistent with the MJO and low-frequency convective signal.
- Elsewhere, the pattern is more incoherent, although there could be signs of a wave-1 asymmetry developing with consolidating areas of anomalous upper-level convergence across the eastern Pacific and South America.

# 200-hPa Wind Anomalies

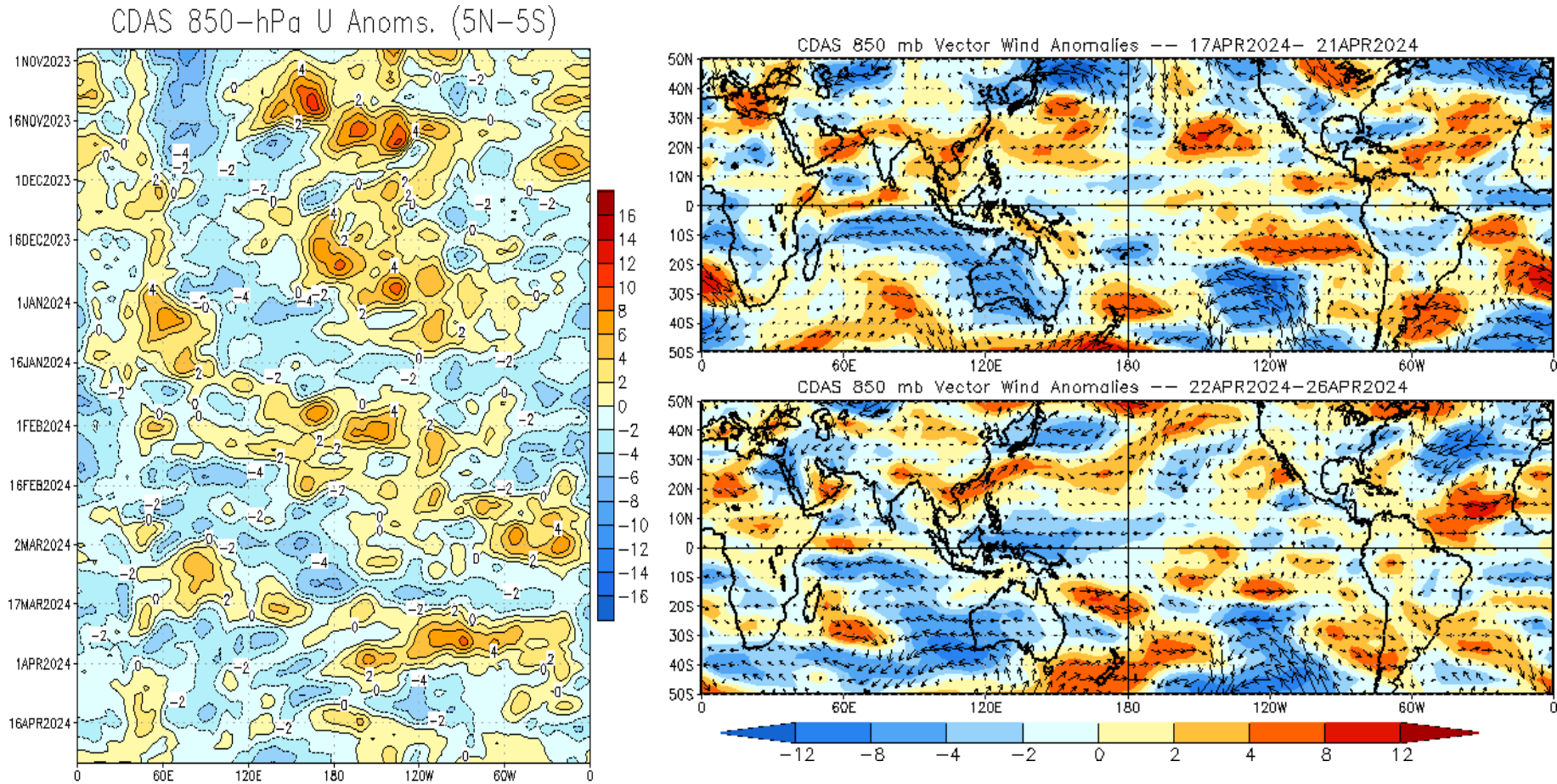
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Following a brief resurgence of anomalous upper-level easterlies, anomalous upper-level westerlies are beginning to return over the equatorial Pacific.
- An enhanced subtropical jet remains evident across the southern Asia, the South Pacific, and southern North America, although extratropical features lead to periodic interruptions of the overall flow.
- Strong upper-level anti-cyclonic flow is noted across South America.

# 850-hPa Wind Anomalies

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

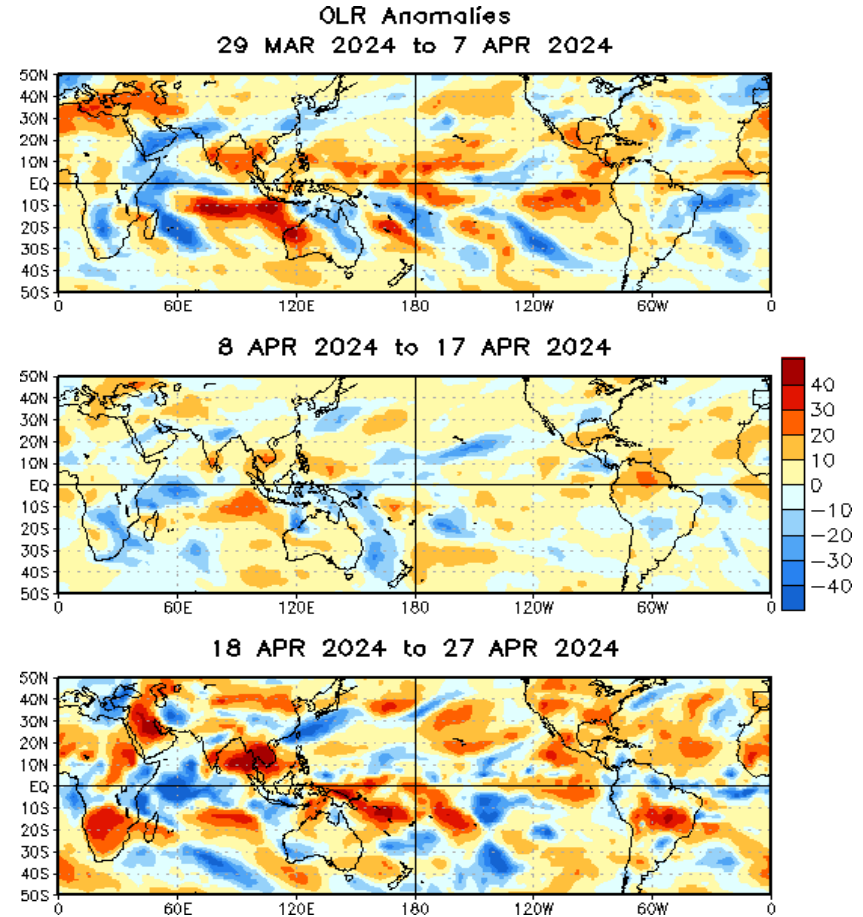
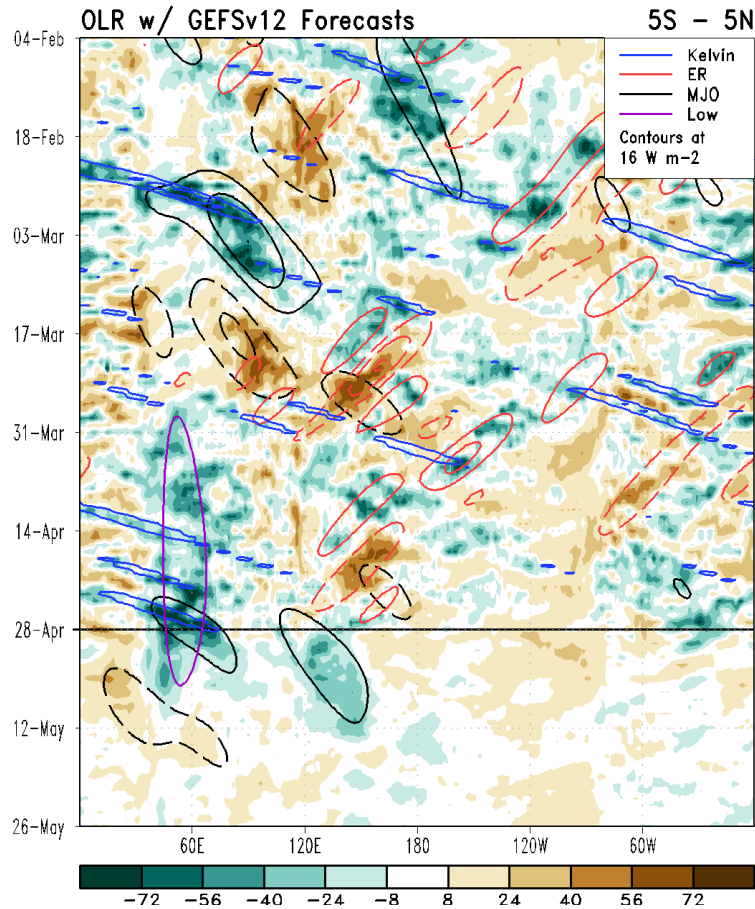


- Anomalous low-level easterlies are increasing over the equatorial Western Pacific as the MJO builds upstream.
- Decreased trades are currently observed across the eastern Pacific.
- Cyclonic flow near the eastern U.S. resulted in a relatively cooler pattern during the past week, which has since been replaced by much warmer temperatures.

# Outgoing Longwave Radiation (OLR) Anomalies

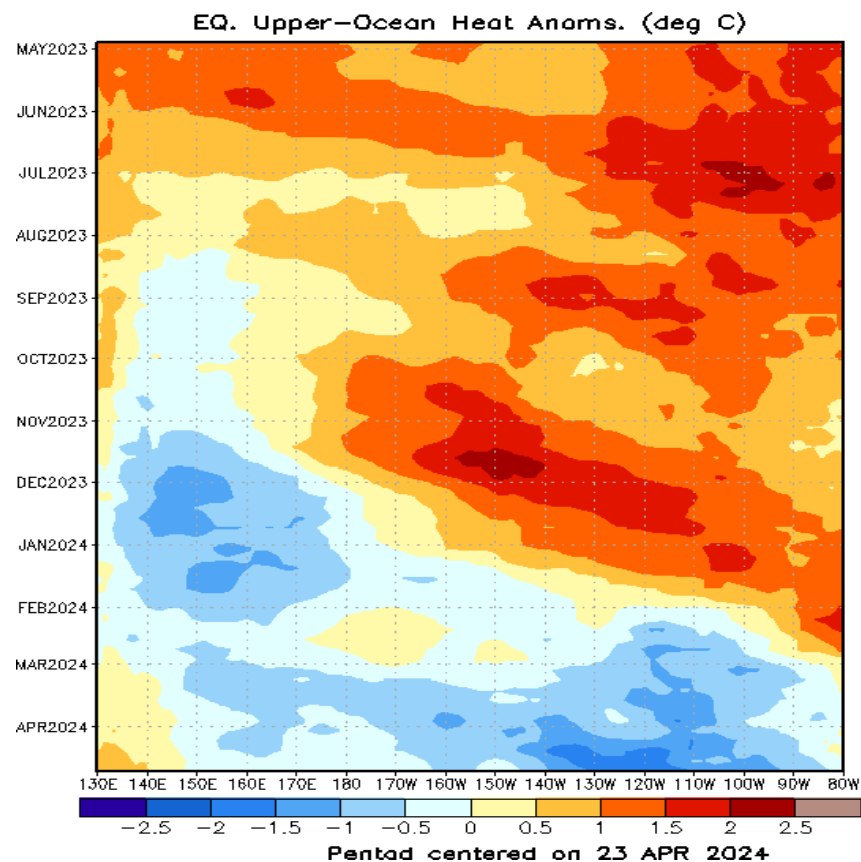
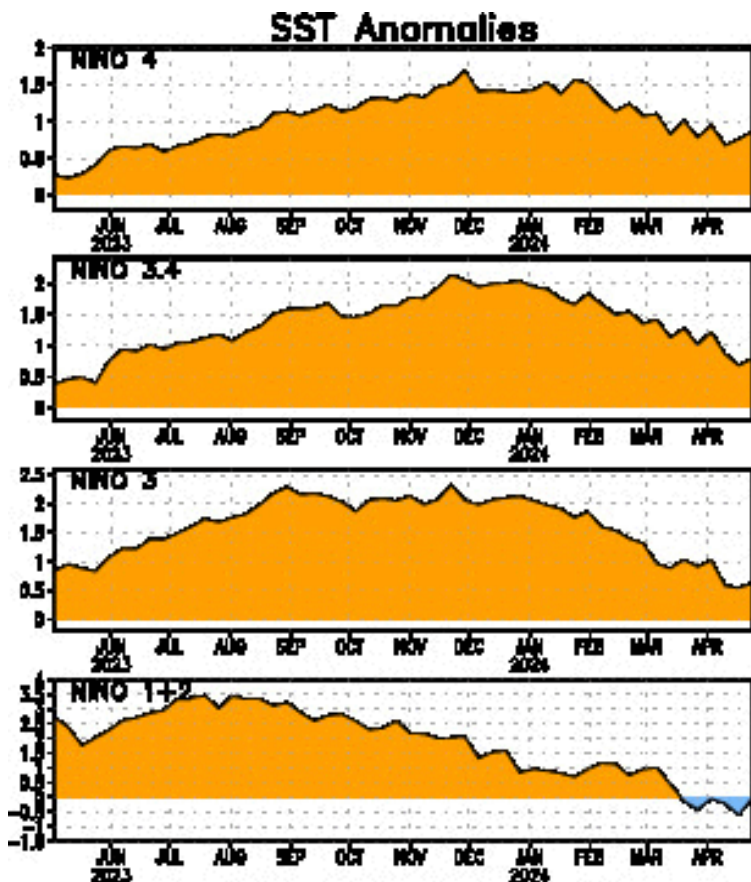
**Green shades: Anomalous convection (wetness)**

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



- Constructive interference between low frequency activity over the western Indian Ocean and the MJO has led to strongly negative OLR anomalies across the region.
- The GEFS forecast depicts an eastward movement of these negative OLR anomalies into the Maritime Continent and Western Pacific during the next 1-2 weeks.
- Elsewhere, the spatial OLR anomaly field is rather incoherent, with positive OLR anomalies across many areas.

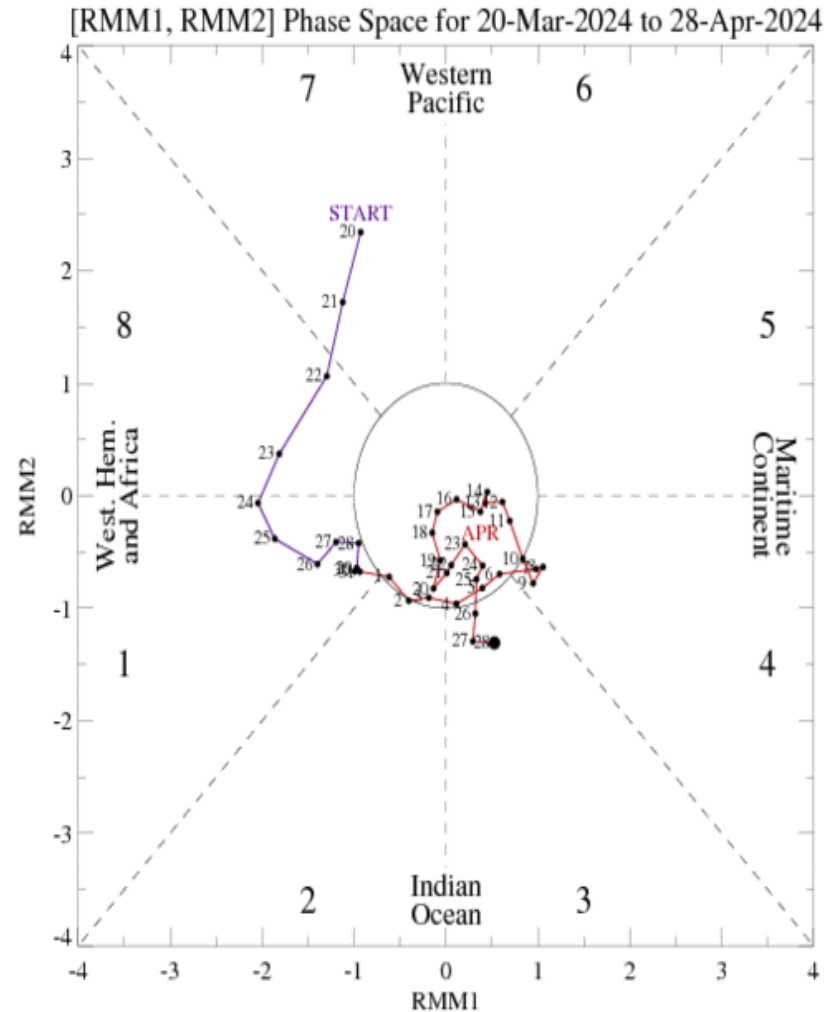
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs in all NINO regions have trended downward over the past 2 months, with a flip to negative SST anomalies during late March and April across NINO 1+2. This is indicative of a decaying El Niño.
- Negative subsurface temperature anomalies continue to be observed across nearly the entire Pacific, with increasing negative anomalies across the eastern Pacific.

# MJO Index: Recent Evolution

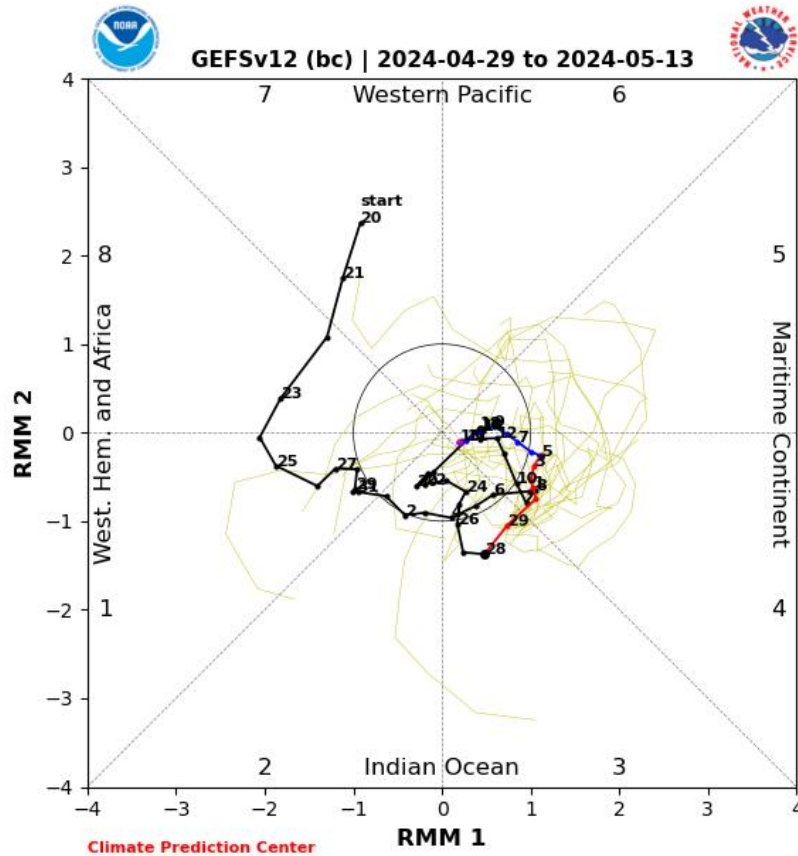
- During mid- to late-April the RMM-based MJO index weakened into the unit circle.
- However, the signal is beginning to increase in amplitude during the past few days, suggestive of a resurgence of the MJO across the Indian Ocean, possibly aided by the low frequency convective signal over the region.



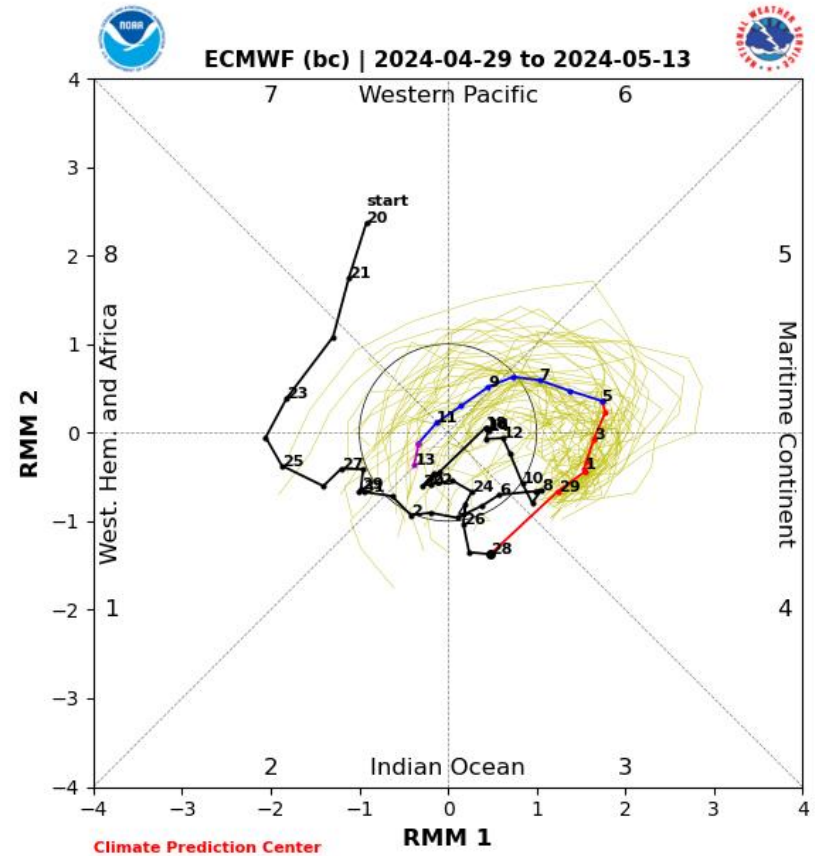
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



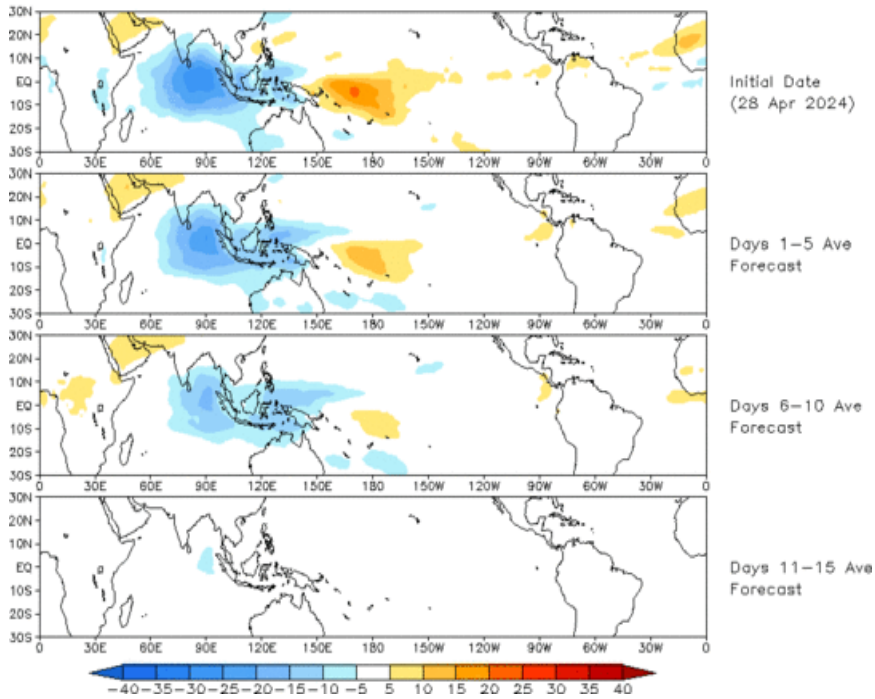
**ECMWF Forecast**

- The GEFS and ECMWF ensemble means depict a strengthening MJO propagating across the Maritime Continent and possibly into the Western Pacific during early May.
- Some ECMWF ensemble members depict continued MJO propagation into the Western Hemisphere, although there is larger ensemble spread in the GEFS.

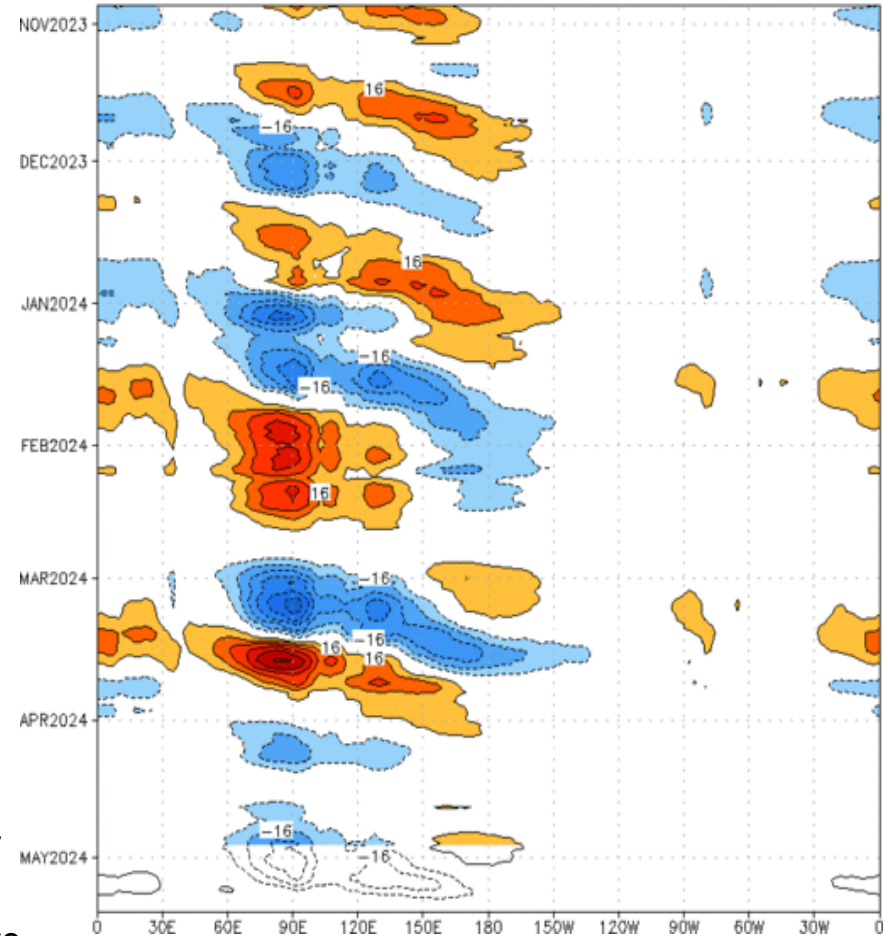
# MJO: GEFS Forecast Evolution

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: 28 Apr 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:28-Oct-2023 to 28-Apr-2024  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

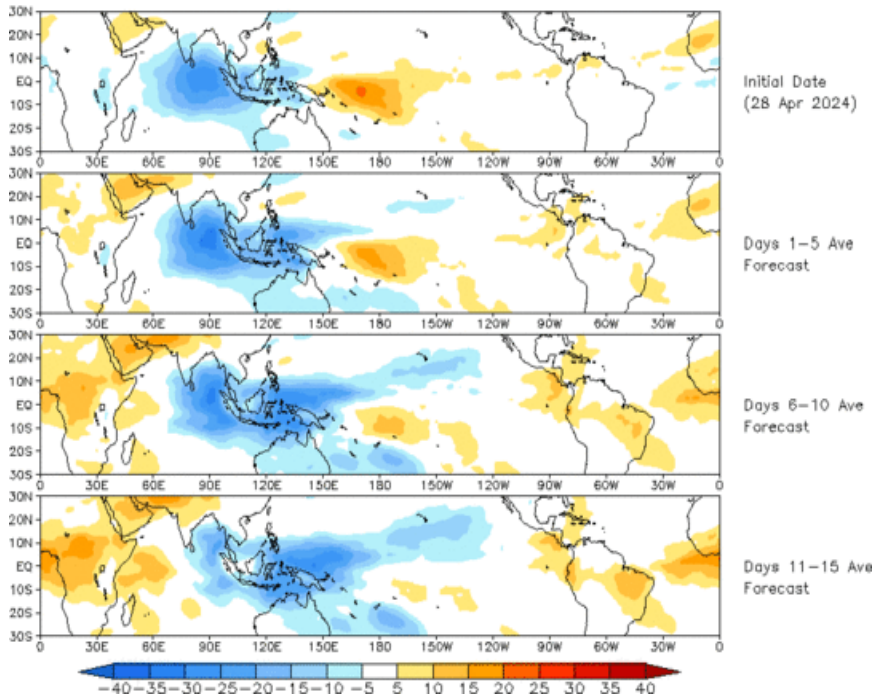


- The GEFS depicts negative OLR anomalies (enhanced convection) over the Indian Ocean and Maritime Continent during week-1 expanding further into the Western Pacific by week-2.
- Positive OLR anomalies (suppressed convection) are predicted to weaken across the central Pacific.

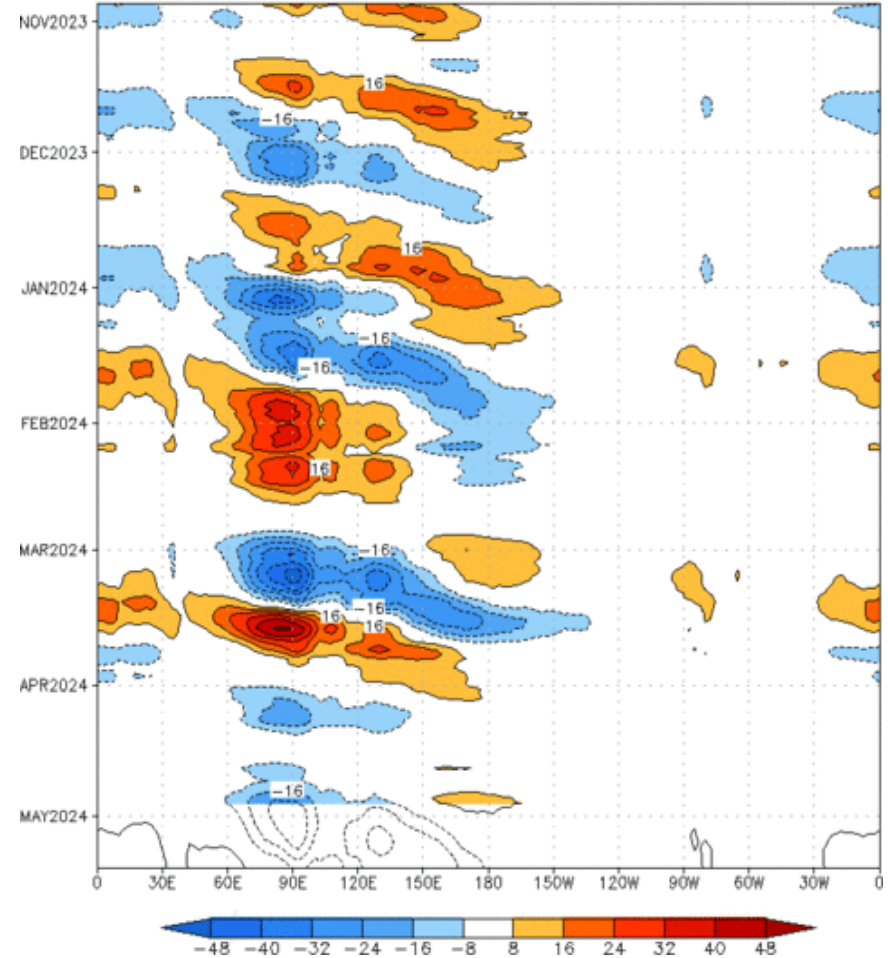
# MJO: Constructed Analog Forecast Evolution

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 (28 Apr 2024)



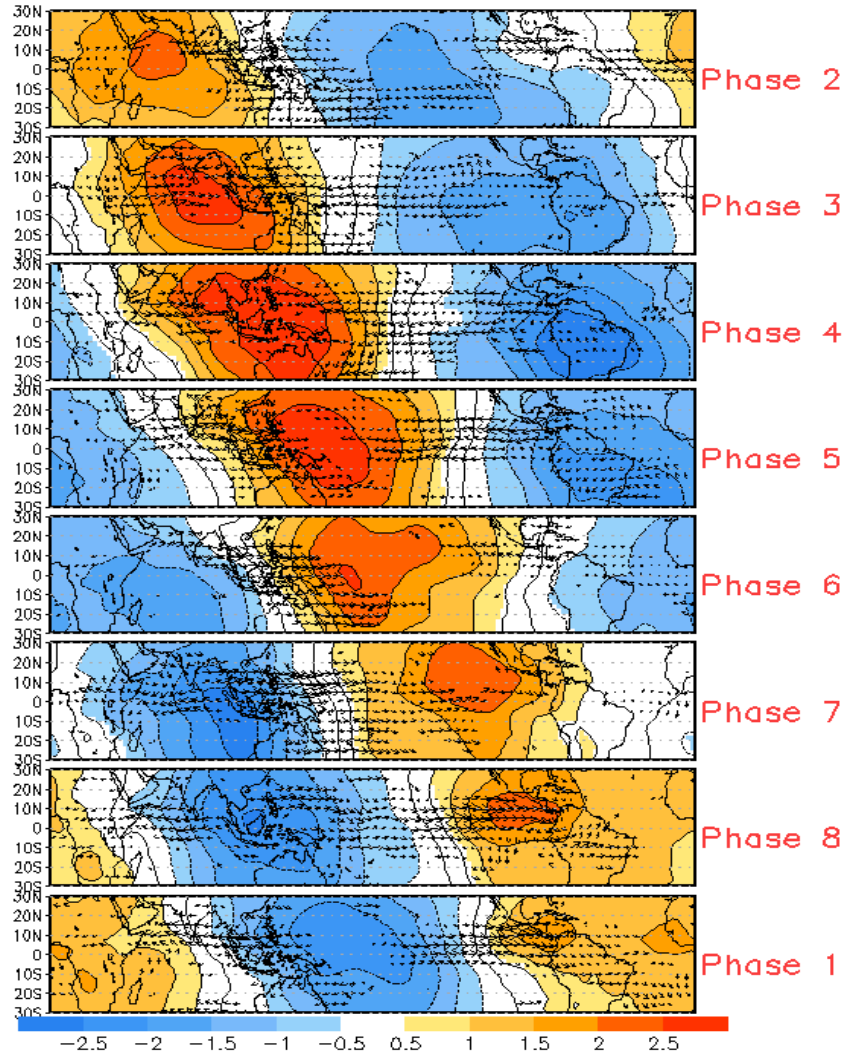
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:28-Oct-2023 to 28-Apr-2024  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



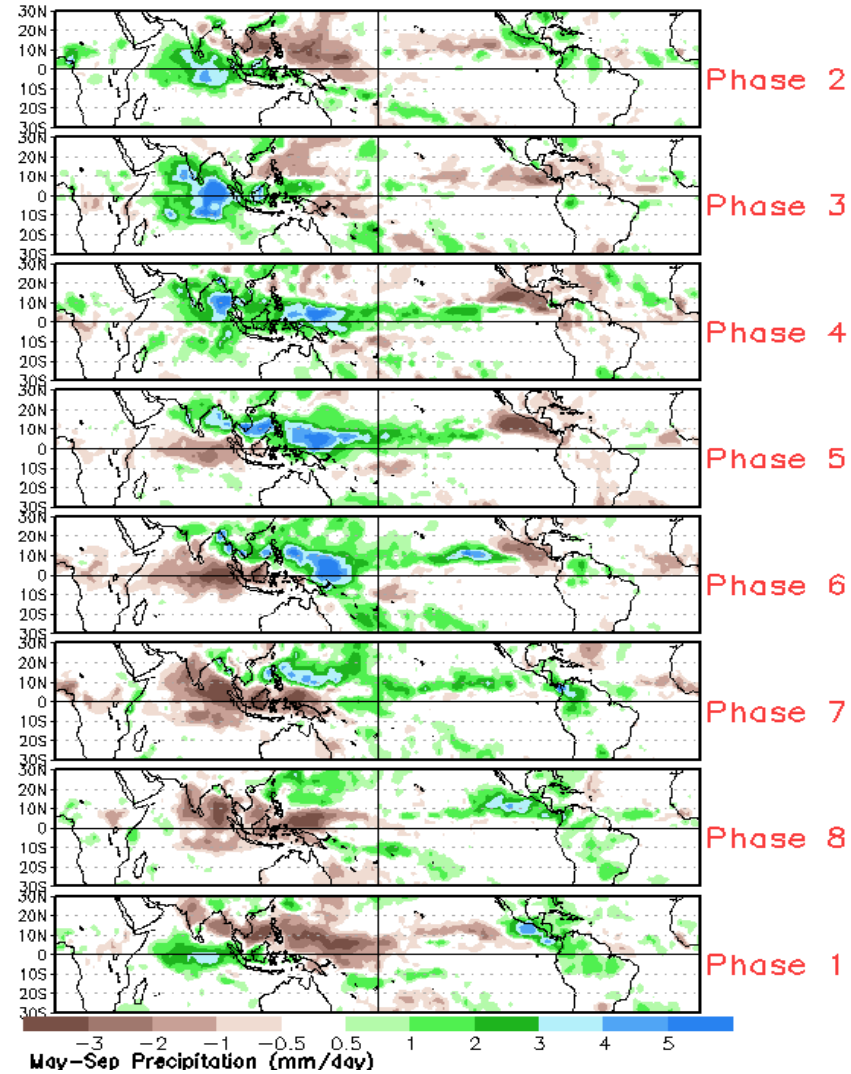
- The constructed analog tool depicts a more robust MJO propagation and negative OLR anomalies expanding across the western and central Pacific by the end of week-2.
- Positive OLR anomalies are predicted to increase over parts of Africa and South America.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



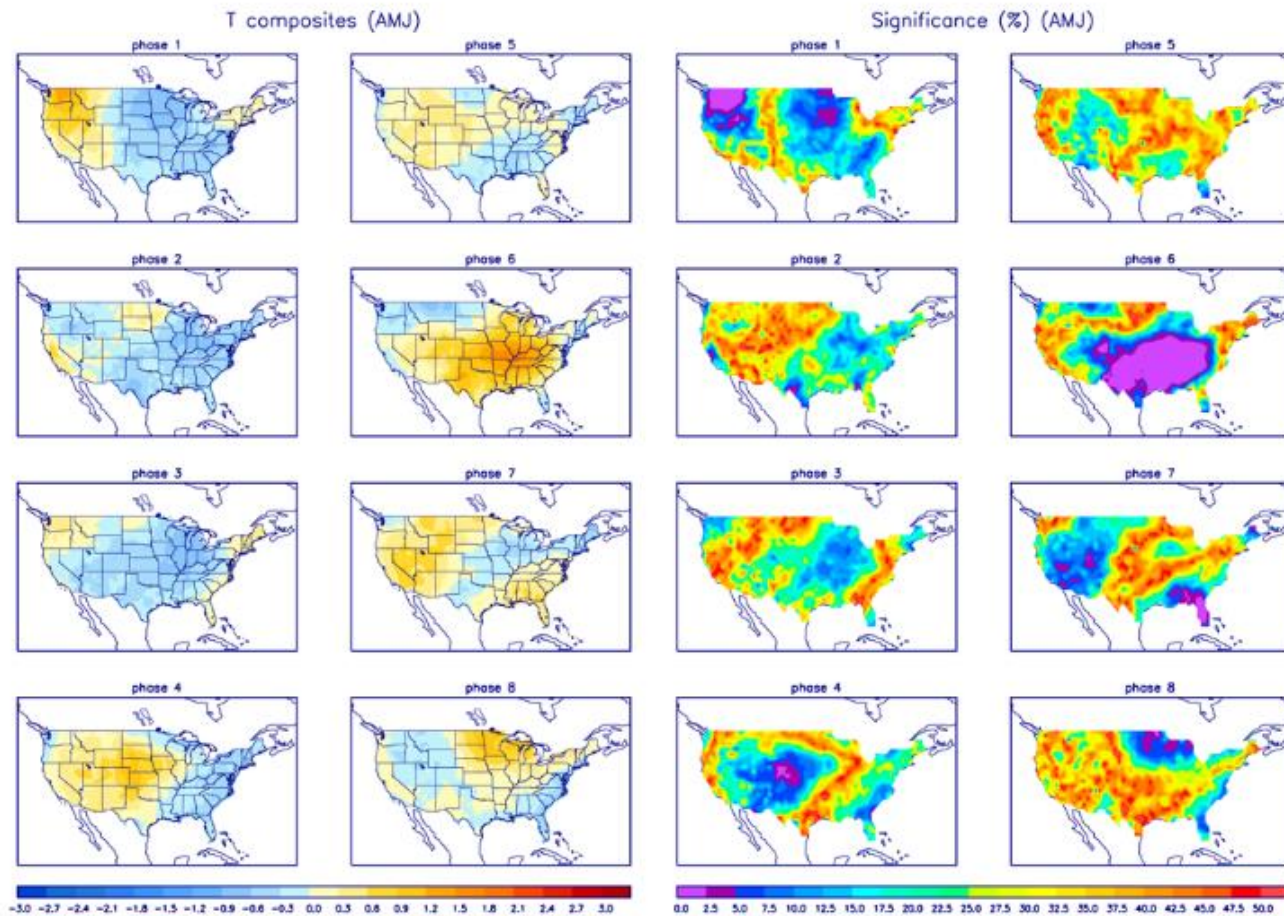
## Precipitation Anomalies



# 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.

