

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



**Update prepared by the Climate Prediction Center  
NWS / NCEP / CPC  
24 April 2023**

# Overview

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- Well organized MJO activity continued during the past week, with the enhanced convective phase having crossed the Western Hemisphere and into Africa.
- RMM forecasts continue to point to a less coherent MJO in the outlook, however this is at odds with upper-level velocity potential guidance from the dynamical models. These solutions favor a well defined wave-1 pattern remaining established across the global tropics, where the enhanced phase shifts eastward across the Indian Ocean and into Maritime Continent towards the middle of May.
- Atmospheric responses associated with the long-lived La Nina continue to wane, as the MJO is expected to be the dominant driver of tropical convective anomalies, and eventually provide an environment conducive for tropical cyclone (TC) development in the Indian Ocean and West Pacific later in May.
- Extratropical linkages become less clear during boreal spring, however there is some support for Maritime Continent MJO events leading to increased mid-level heights and above-normal temperatures over the central and eastern U.S. during May.

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

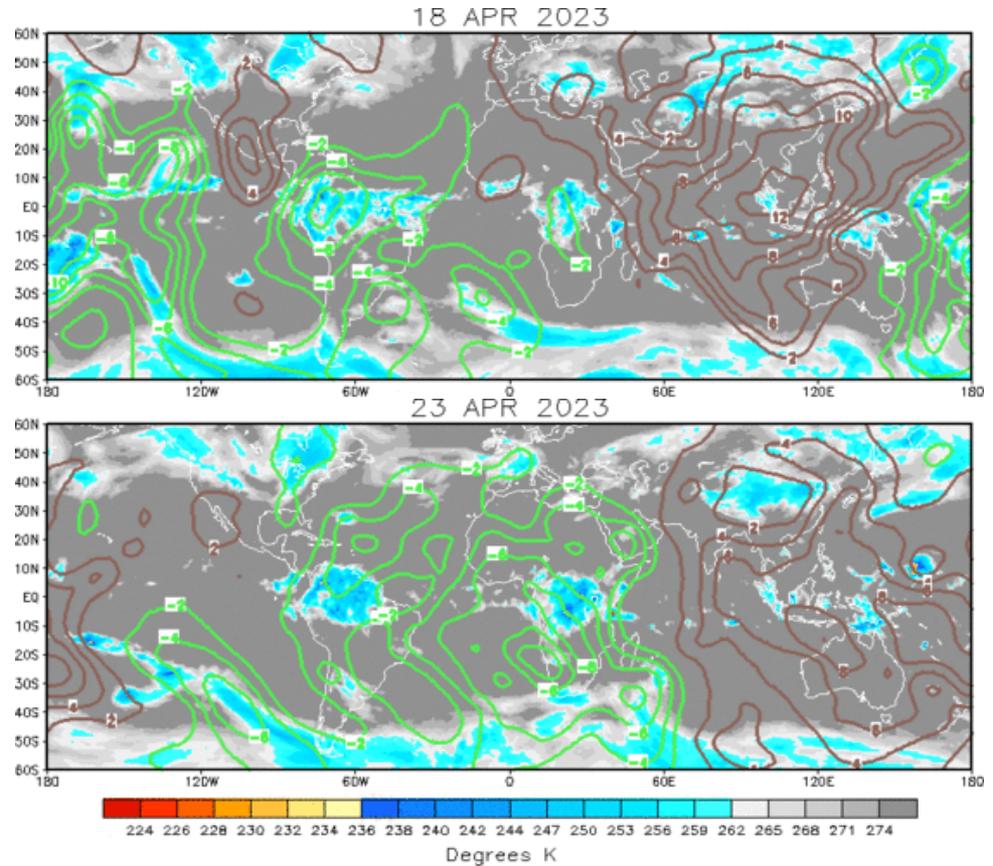
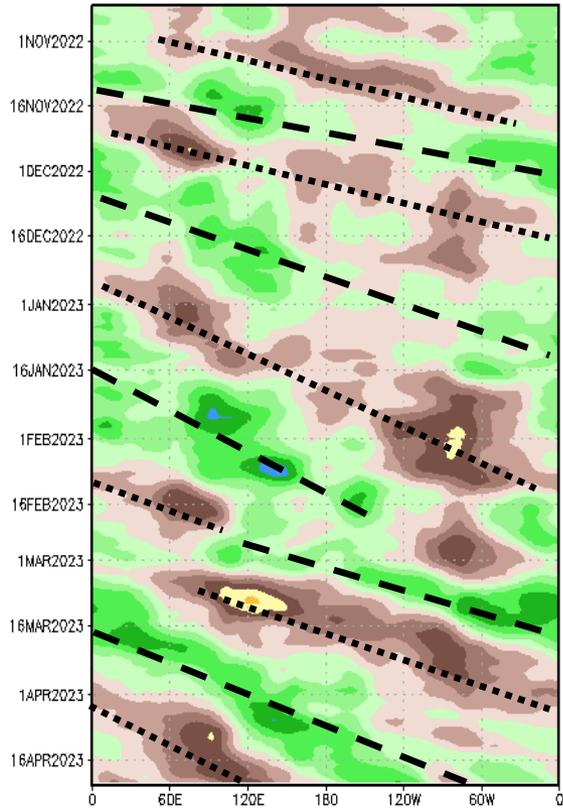
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

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

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

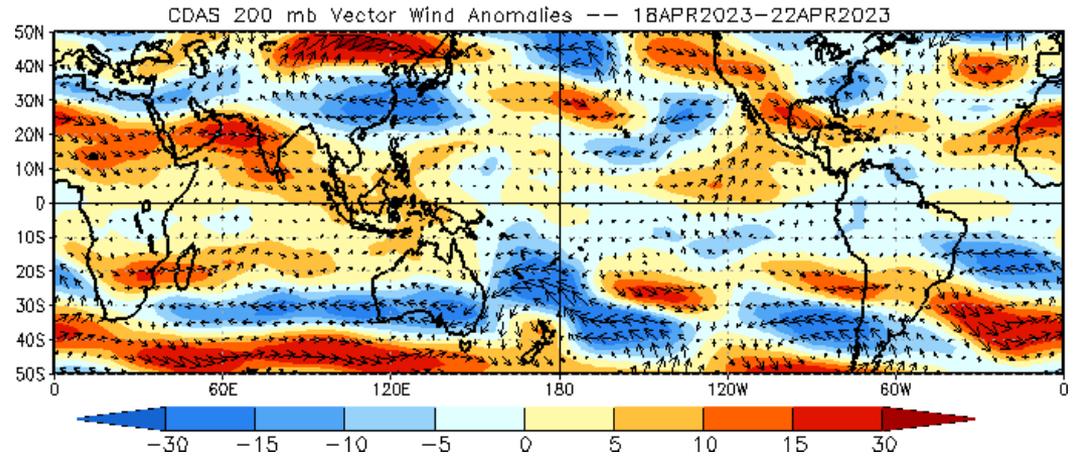
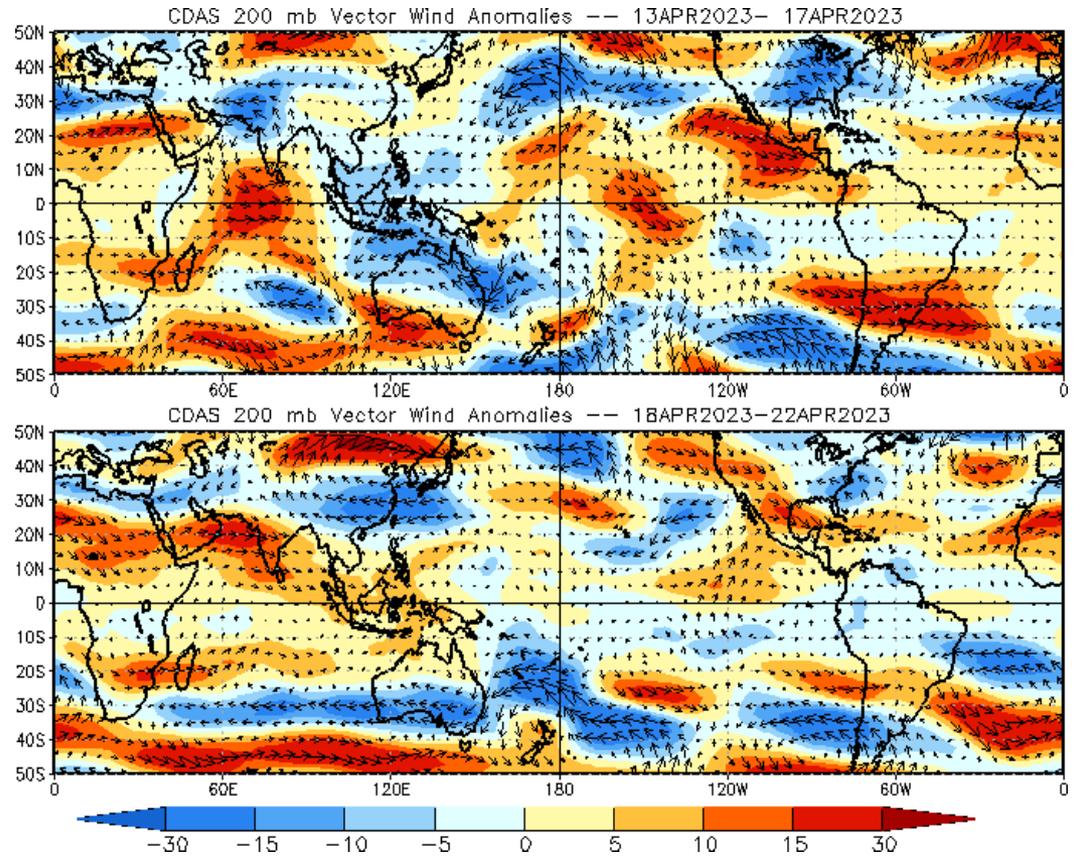
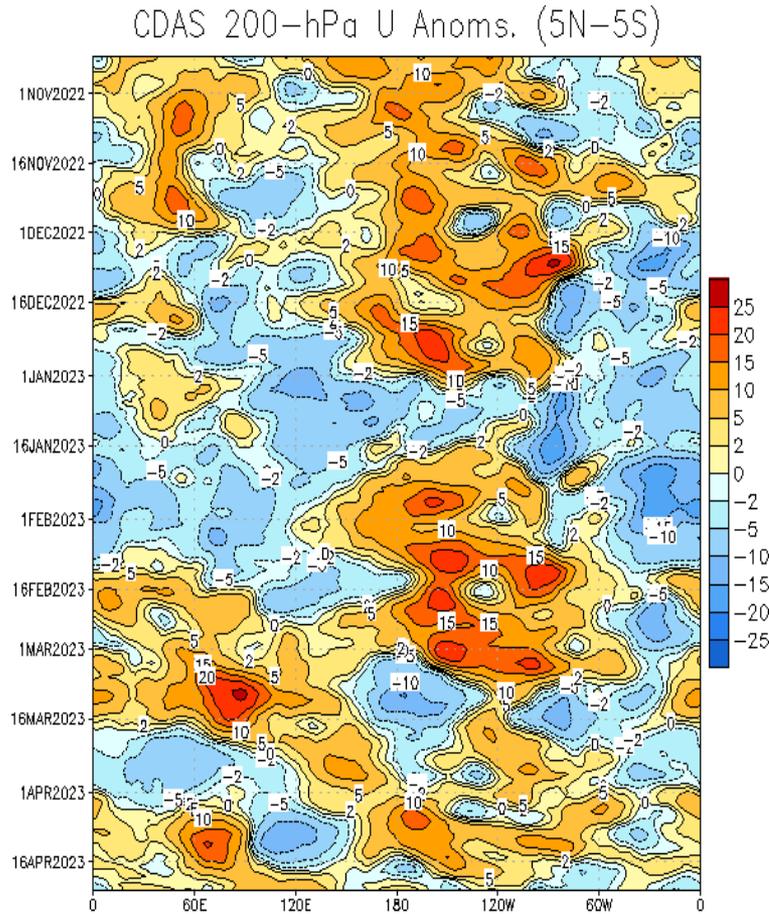
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- Coherent MJO activity remains evident in the upper-level velocity potential anomaly fields, where the leading edge of the enhanced convective envelope has crossed the Prime Meridian during the past week.
- Following a slowly evolving suppressed phase over the Indian Ocean earlier in April, strong anomalous upper-level convergence has overspread much of the Maritime Continent and western Pacific.

# 200-hPa Wind Anomalies

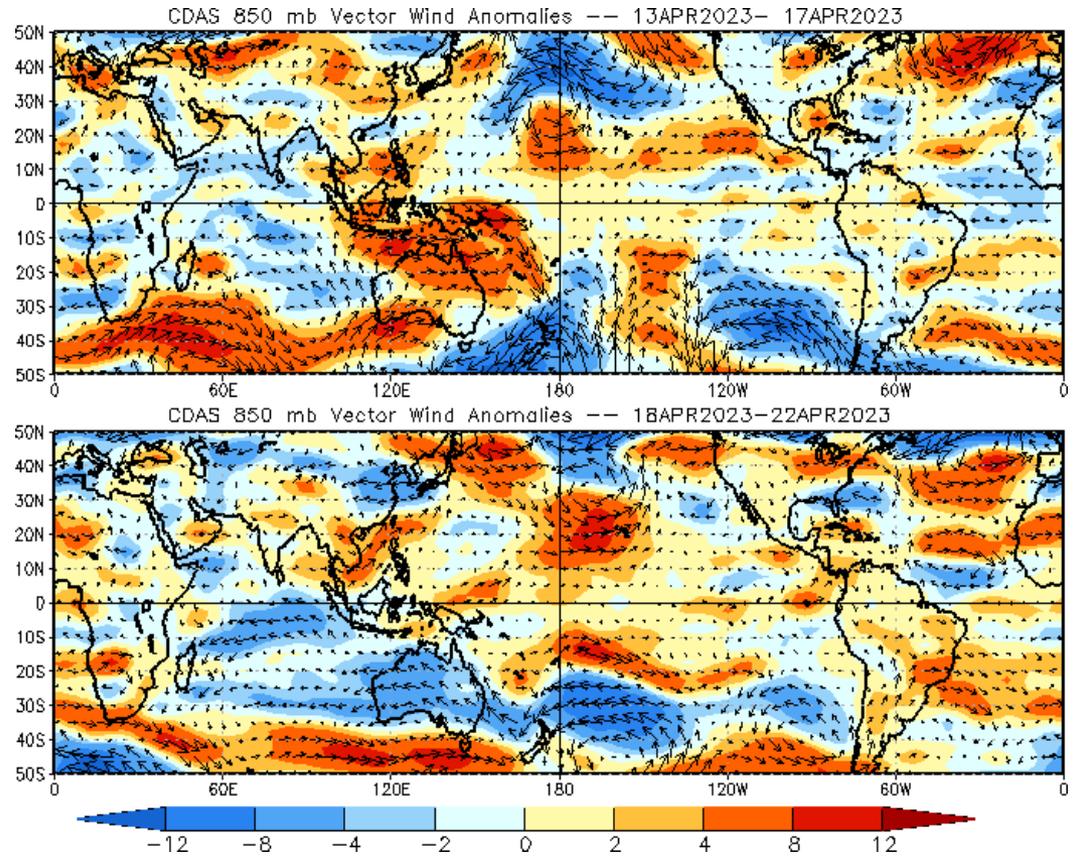
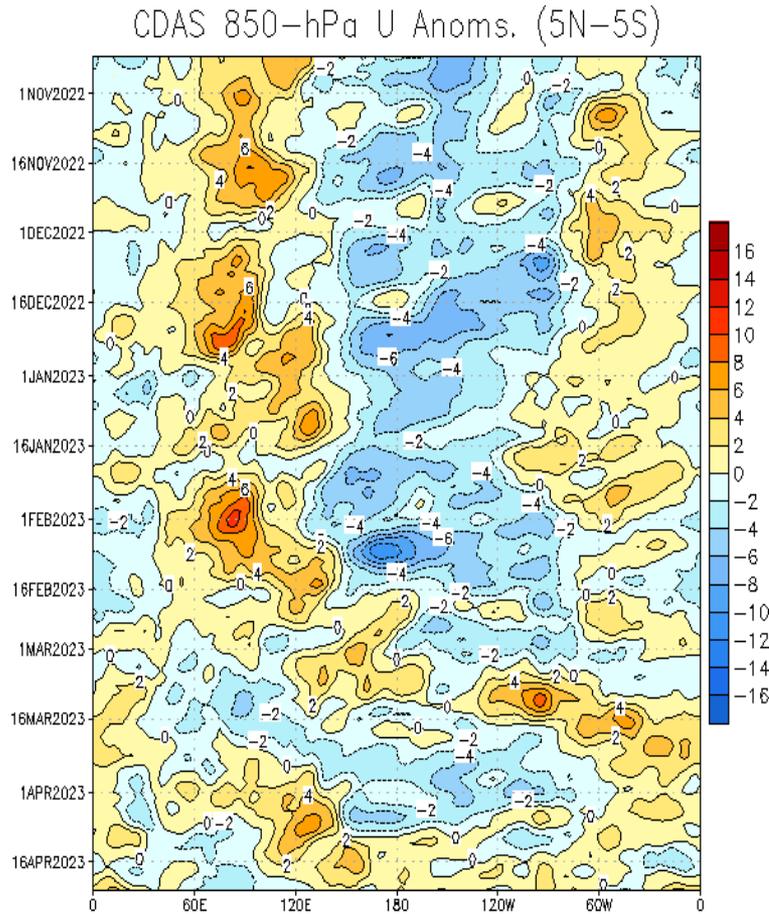
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Consistent with the evolution of the suppressed phase of the MJO, much of the enhanced easterlies focused near 120E rapidly flipped direction during the past week, with anomalous westerlies now extending into the western Pacific.
- Anomalous easterlies developed along and to the east of the Date Line, but its eastern extent is limited by a band of anomalous westerlies tied to an anomalous cyclonic circulation aloft in the eastern Pacific.

# 850-hPa Wind Anomalies

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

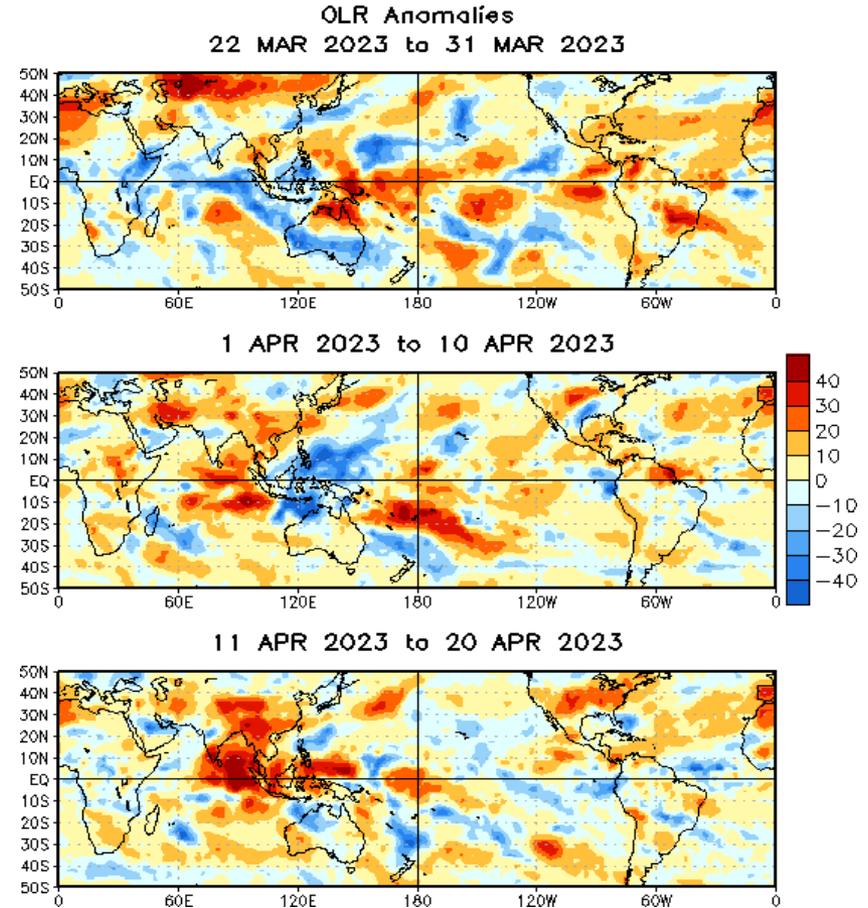
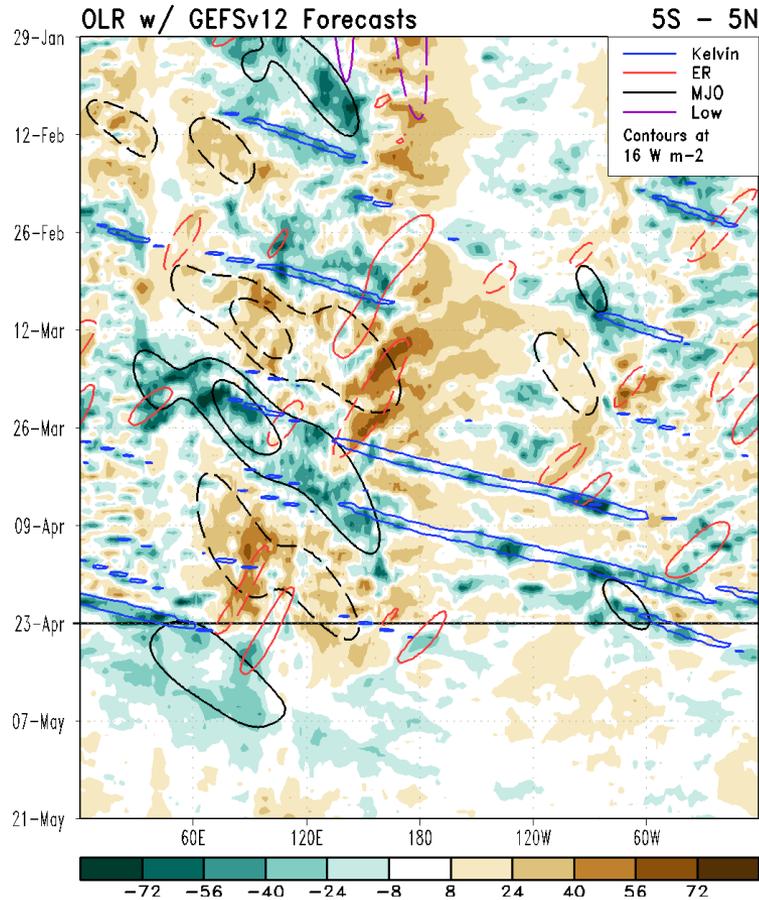


- Similar to the previous MJO event over the Pacific last month, anomalous westerlies disrupted the enhanced trade wind regime tied to the outgoing La Nina circulation, and have overspread parts of the equatorial eastern Pacific and Americas .
- Anomalous easterlies strengthened over the equatorial Indian Ocean, resulting in enhanced lower-level divergence over the Maritime Continent.

# Outgoing Longwave Radiation (OLR) Anomalies

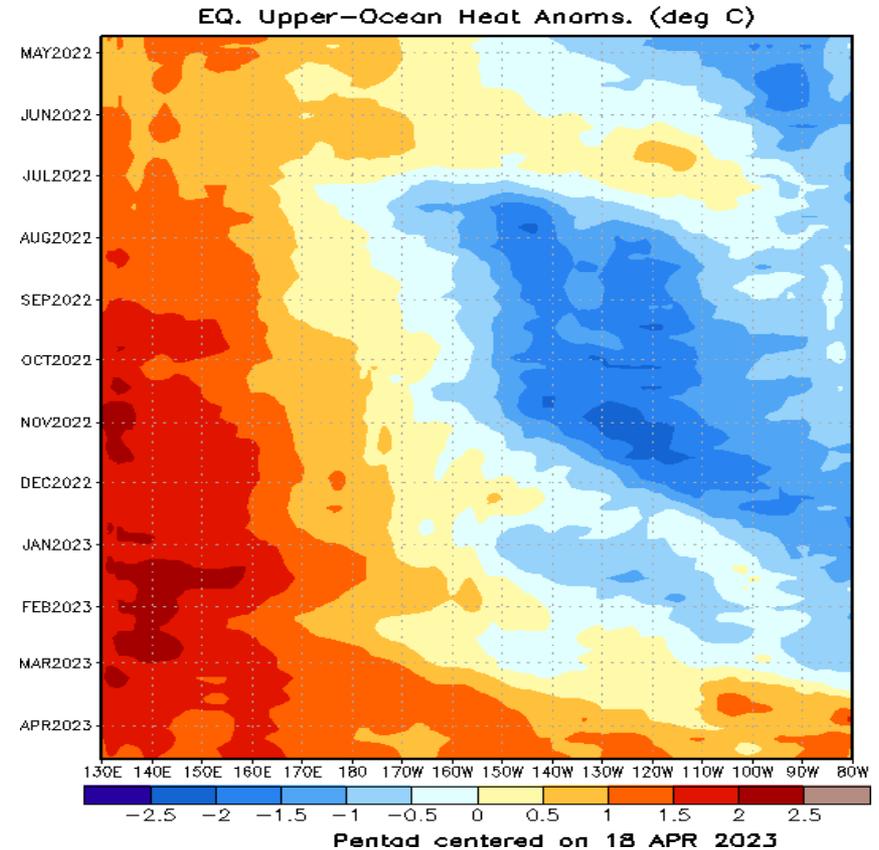
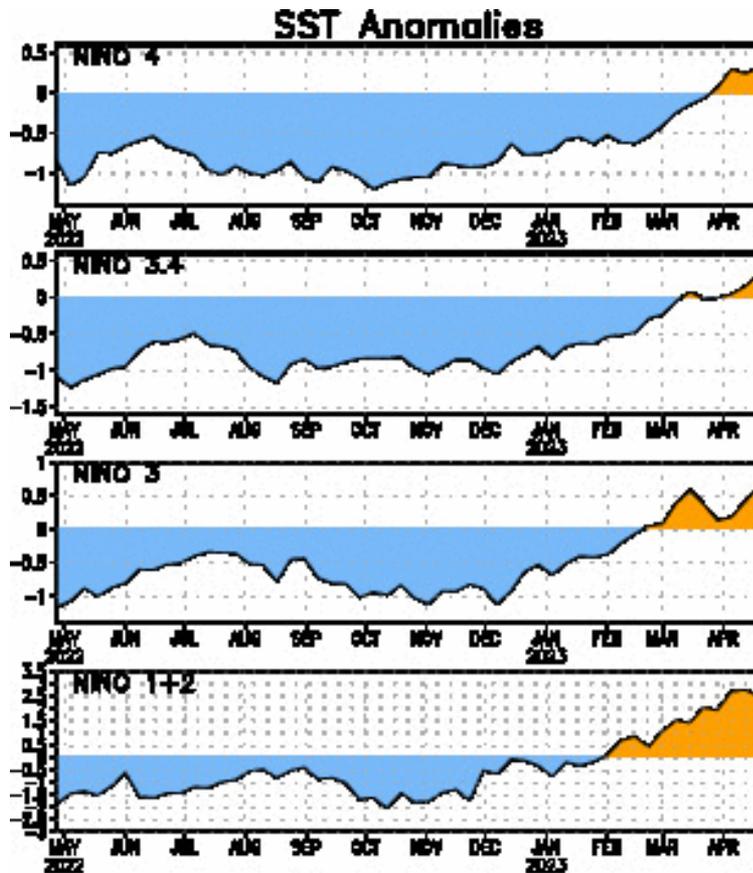
**Green shades:** Anomalous convection (wetness)

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



- The suppressed phase of the MJO is clearly evident over the Indian Ocean and Maritime Continent during mid-April.
- The suppressed convective low frequency footprint along the Date Line continues to wane, and OLR forecasts from the GEFS favor enhanced convection emerging and possibly persisting over this region during May, with MJO activity also coming through the filtering.

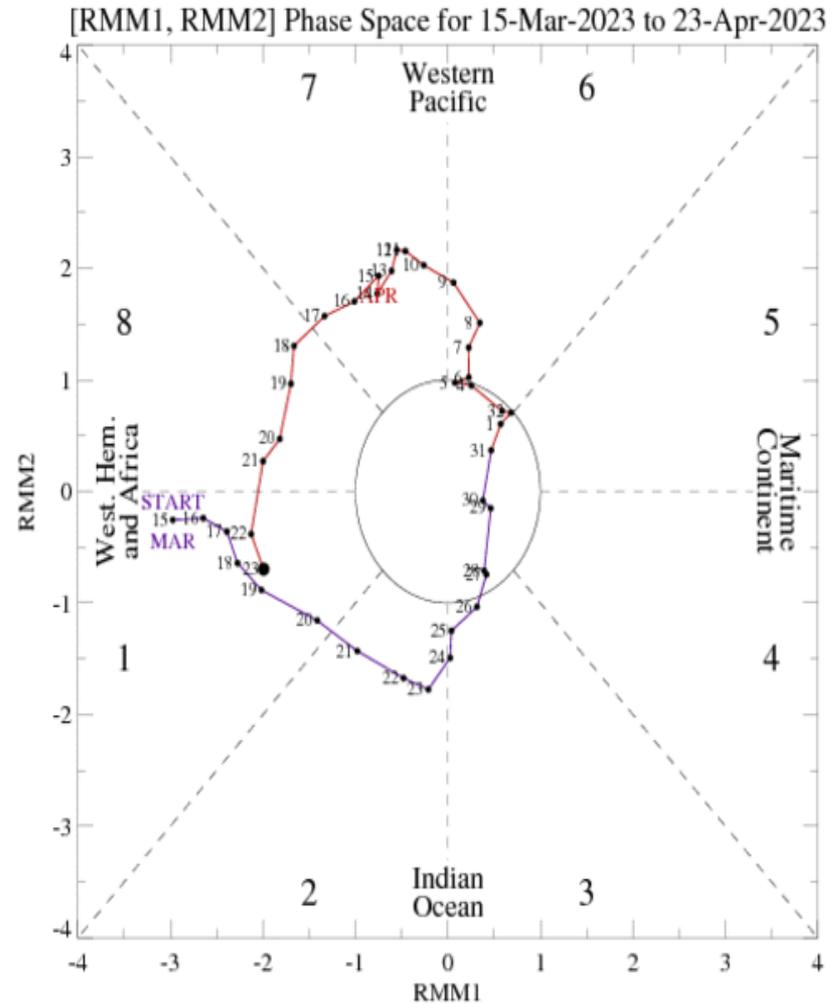
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- MJO activity helped generate a series of downwelling oceanic Kelvin waves, bringing warm water from the strongly enhanced West Pacific warm pool across the entire basin. These subsurface anomalies have continued to grow warmer this spring.
- SSTs in all of the Niño basins are now above normal, reflecting the end of the long lasting La Niña event.

# MJO Index: Recent Evolution

- While not as prolific as its last passage over the Western Hemisphere last month, the RMM index continues to indicate coherent MJO activity as it recently entered phase 1 during the past few days.
- Many forecasts from last week under forecast the amplitude of the MJO as it propagated across the western Hemisphere.



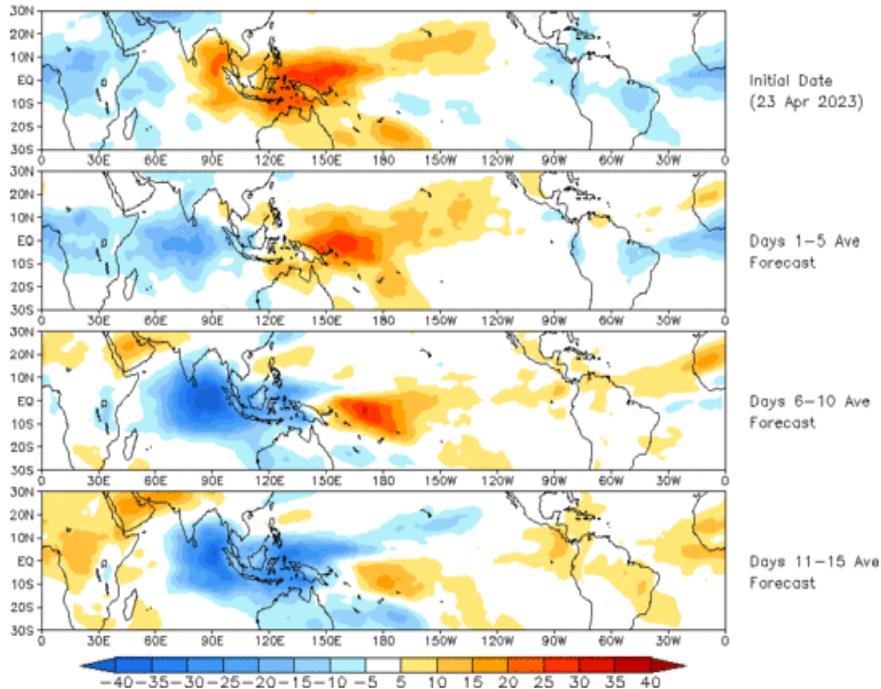
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



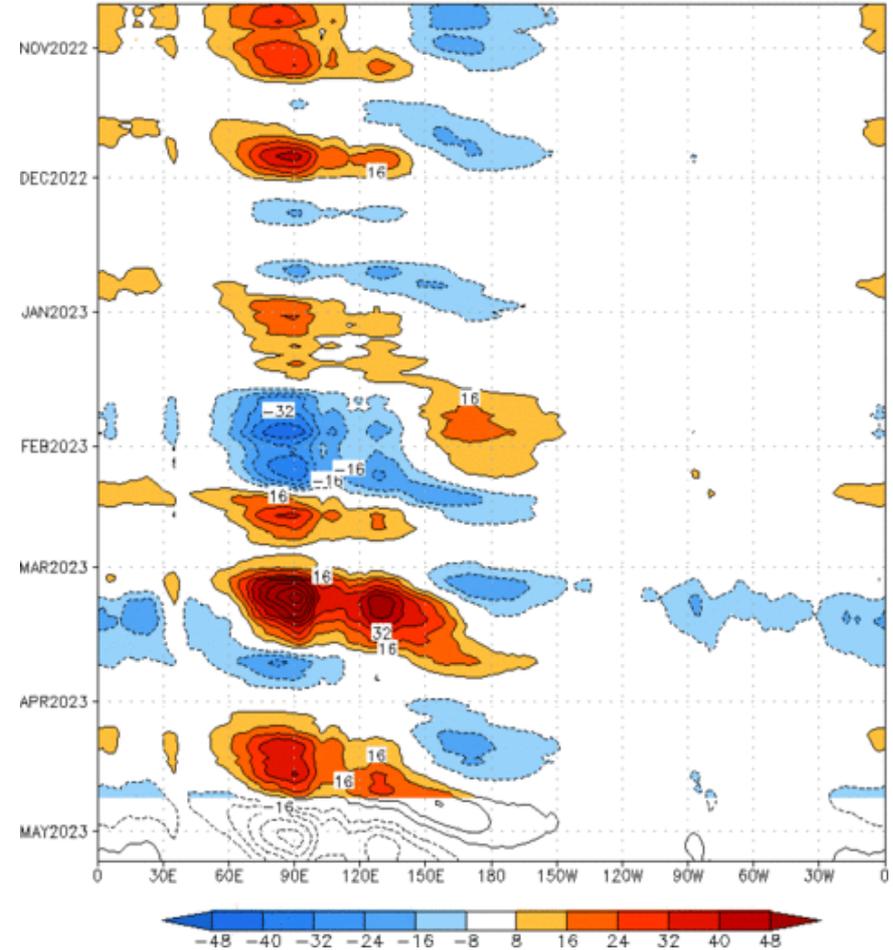
# MJO: Constructed Analog Forecast Evolution

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 (23 Apr 2023)



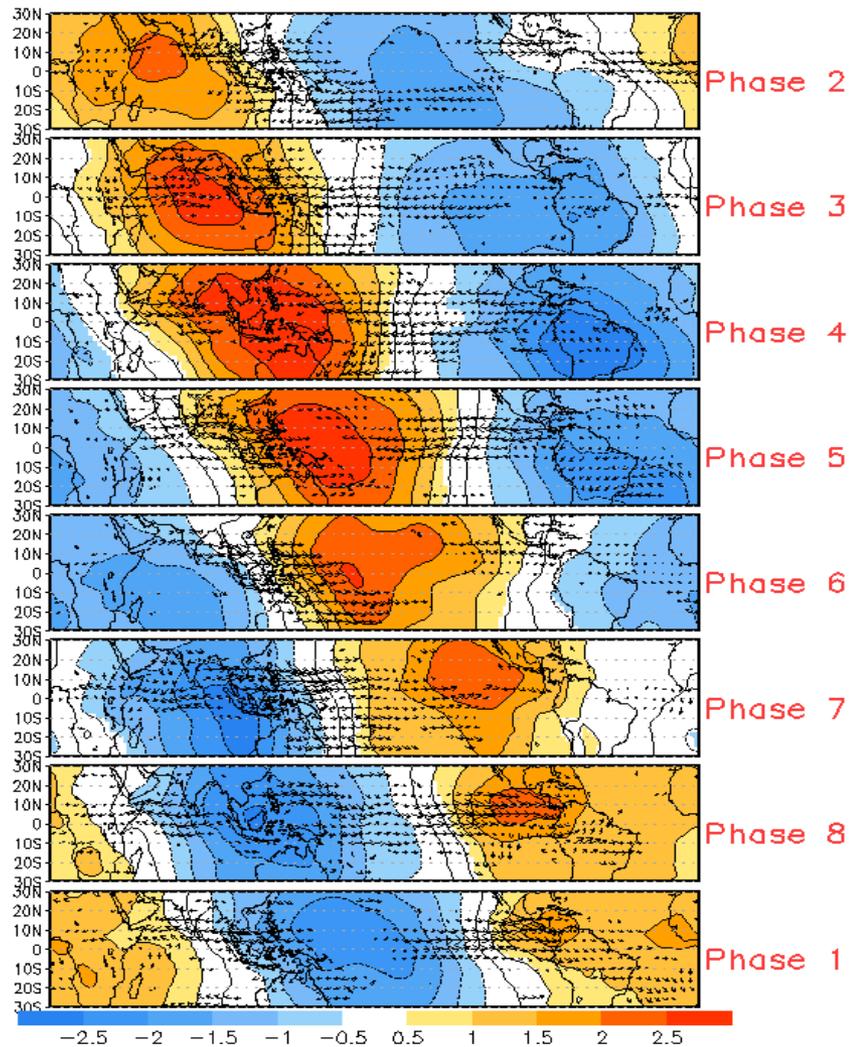
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:22-Oct-2022 to 23-Apr-2023  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



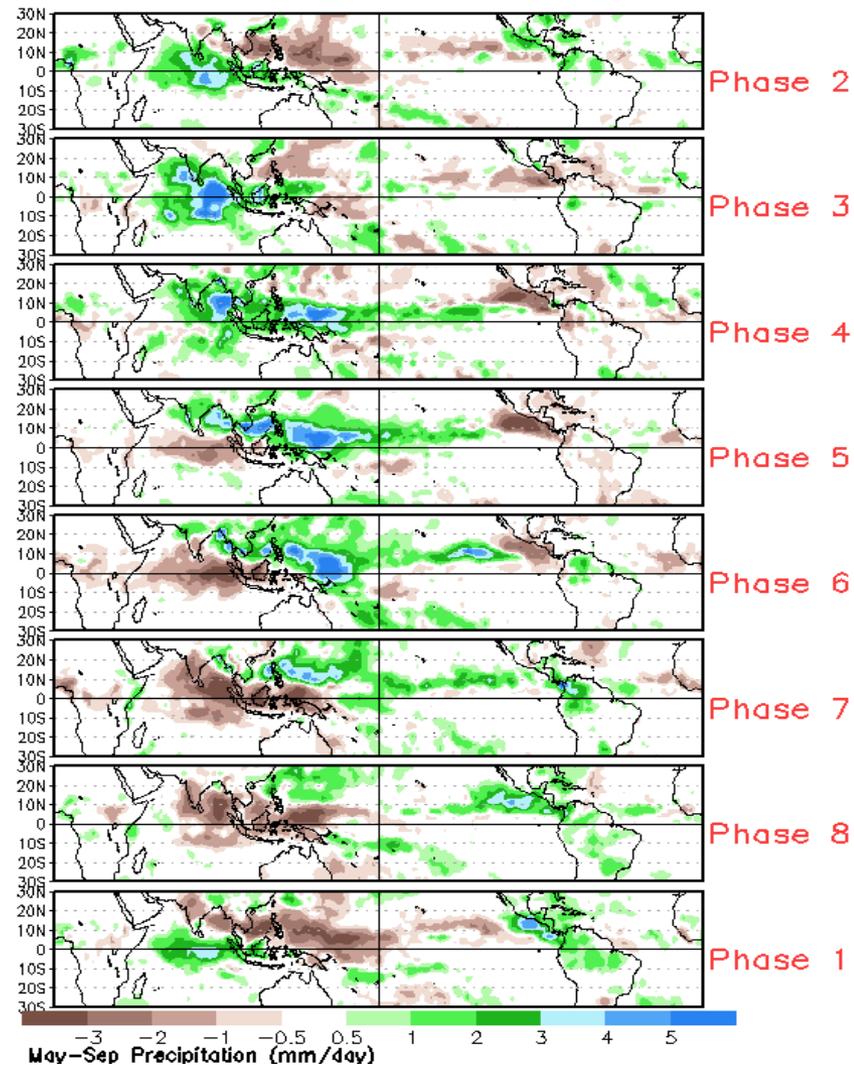
- The constructed analog RMM-based forecast reflects strong MJO activity, with an enhanced convective envelope that strengthens and shifts eastward into the western Pacific with time.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



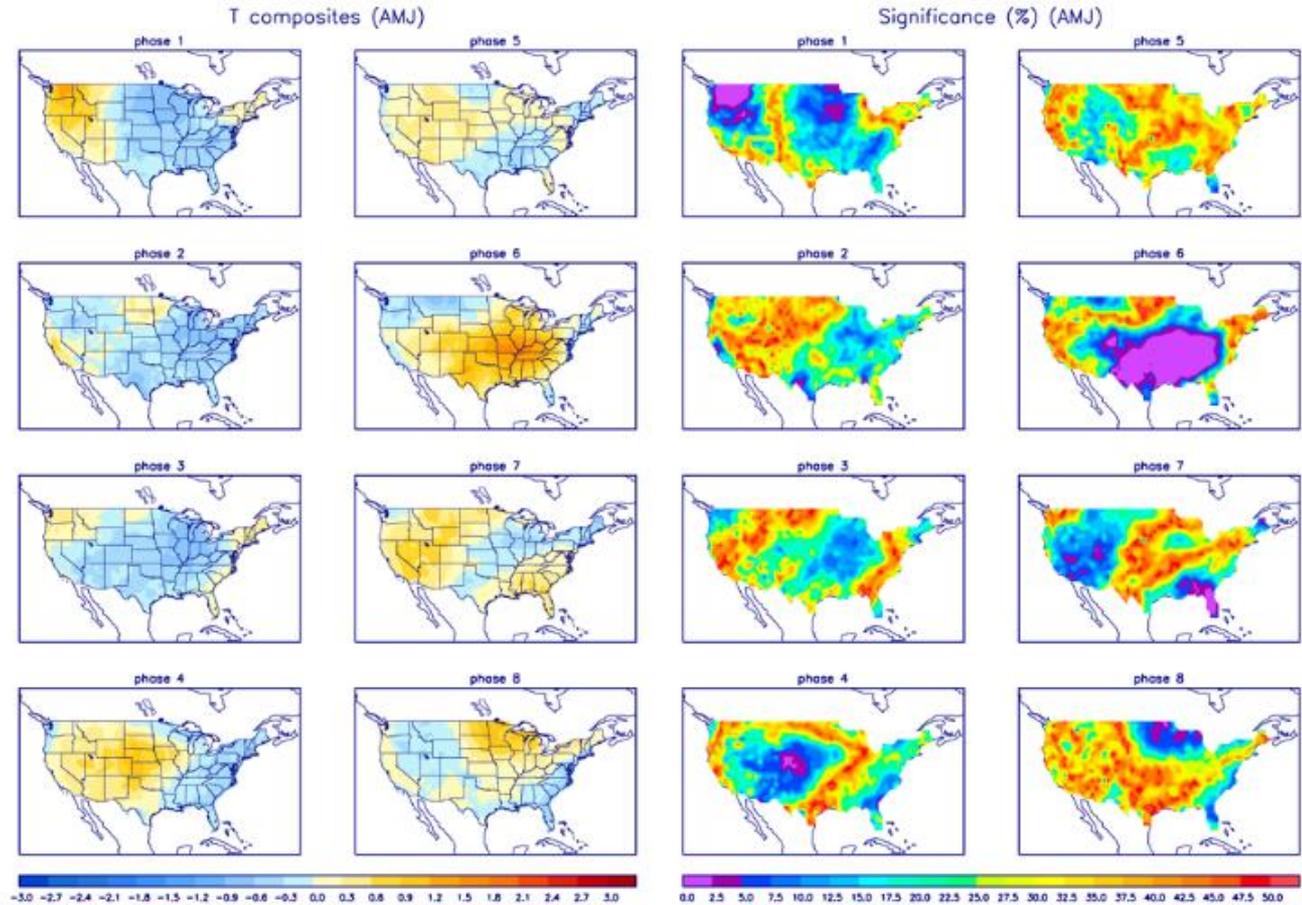
## Precipitation Anomalies



# 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.

