

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



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

Overview

- The RMM based MJO Index and upper-level velocity potential fields reflect a poorly organized and incoherent MJO, as other modes of tropical variability appear to be driving the convective and circulation patterns throughout the global tropics.
- However, RMM forecasts generally favor some renewal of intraseasonal activity, where upper-level velocity potential anomaly forecasts are more supportive of the MJO reorganizing over the Western Hemisphere and propagating eastward into the Indian Ocean later in August.
- Given these trends in the guidance, along with continued equatorial Kelvin Wave activity and climatology, there are increased chances for Tropical Cyclone (TC) development in eastern Pacific and Atlantic basins during the outlook period with decreasing chances of development in the western Pacific.

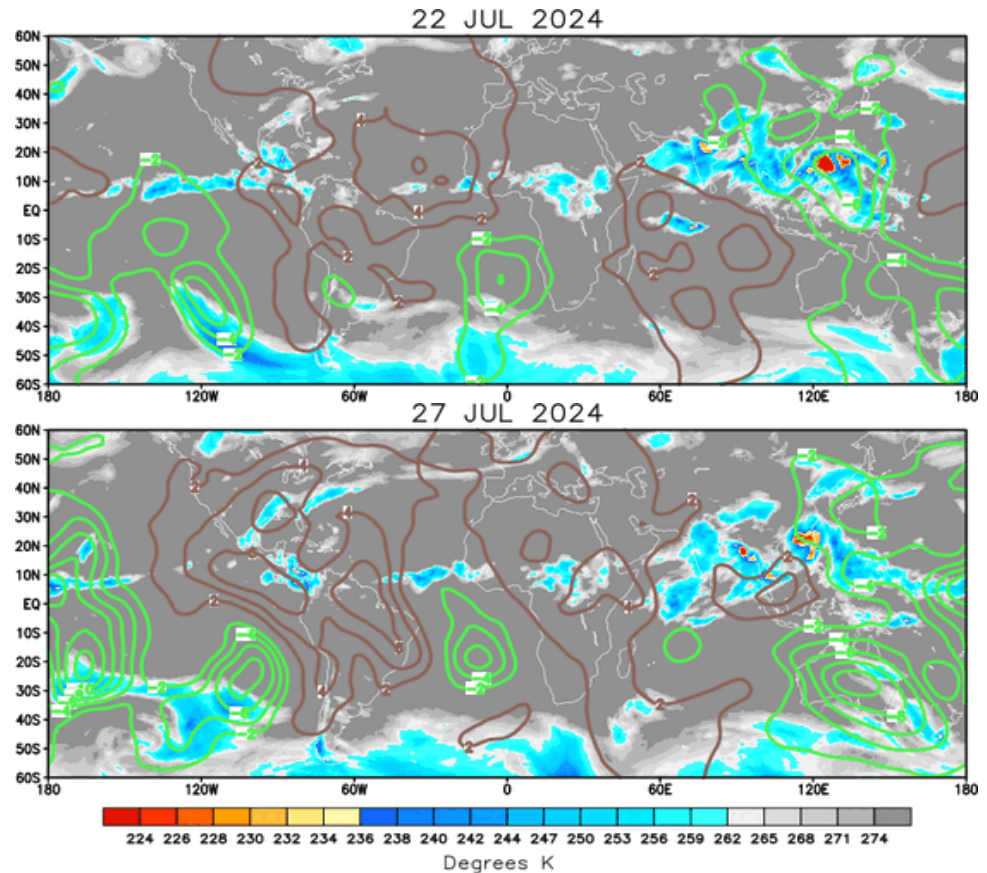
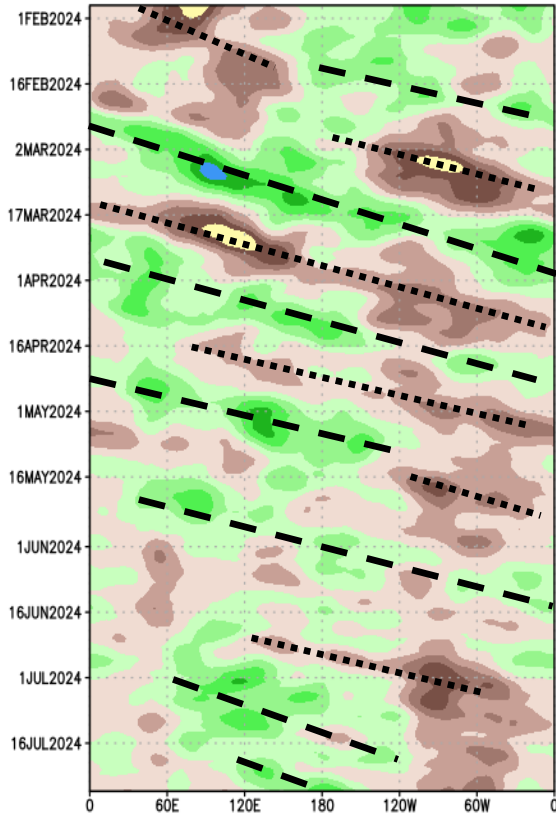
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

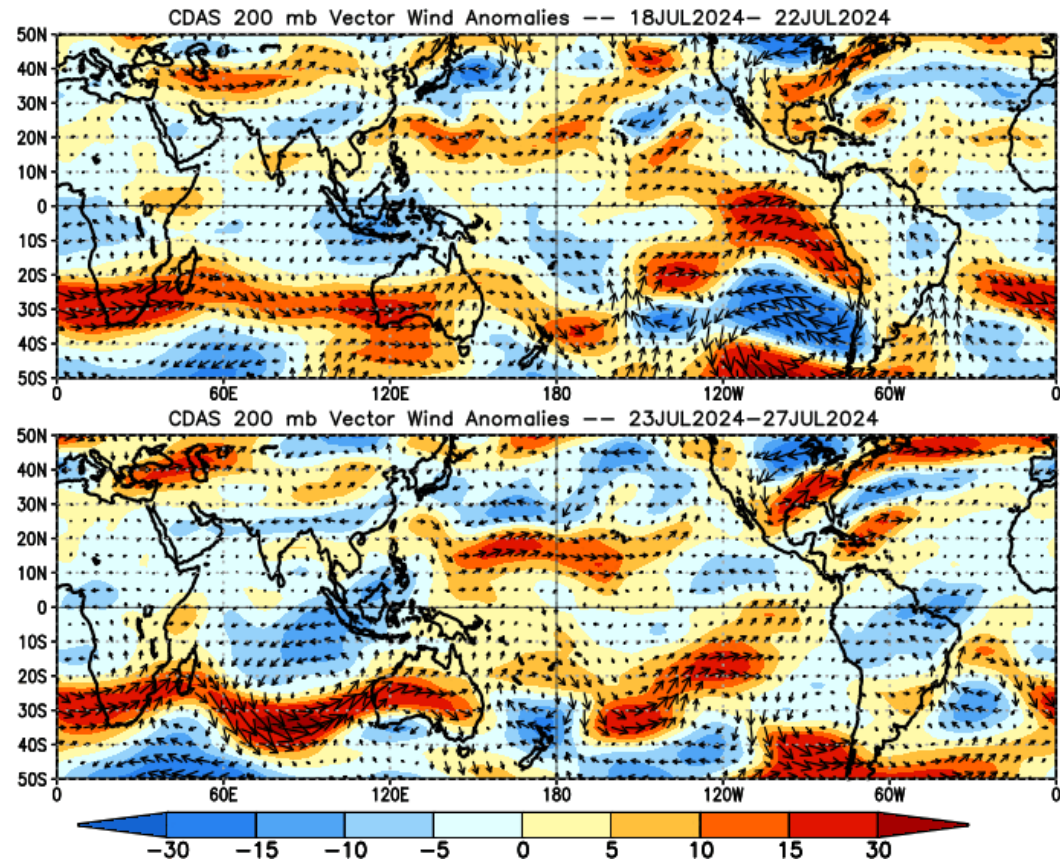
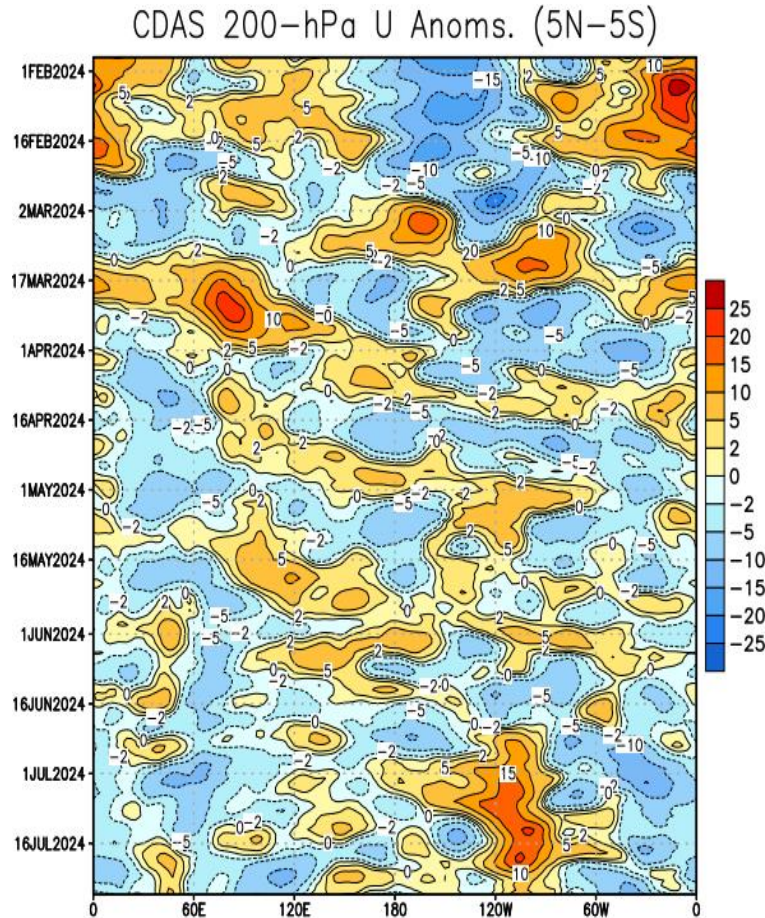
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The time/longitude plot shows an envelope of enhanced divergence aloft propagating eastward across the equatorial Pacific, but was confronted by a low frequency area of suppressed divergence aloft over the eastern Pacific and Americas.
- Spatially, the velocity potential anomaly pattern is incoherent, and suggests other modes of tropical variability prevailing throughout the global tropics during the past week.

200-hPa Wind Anomalies

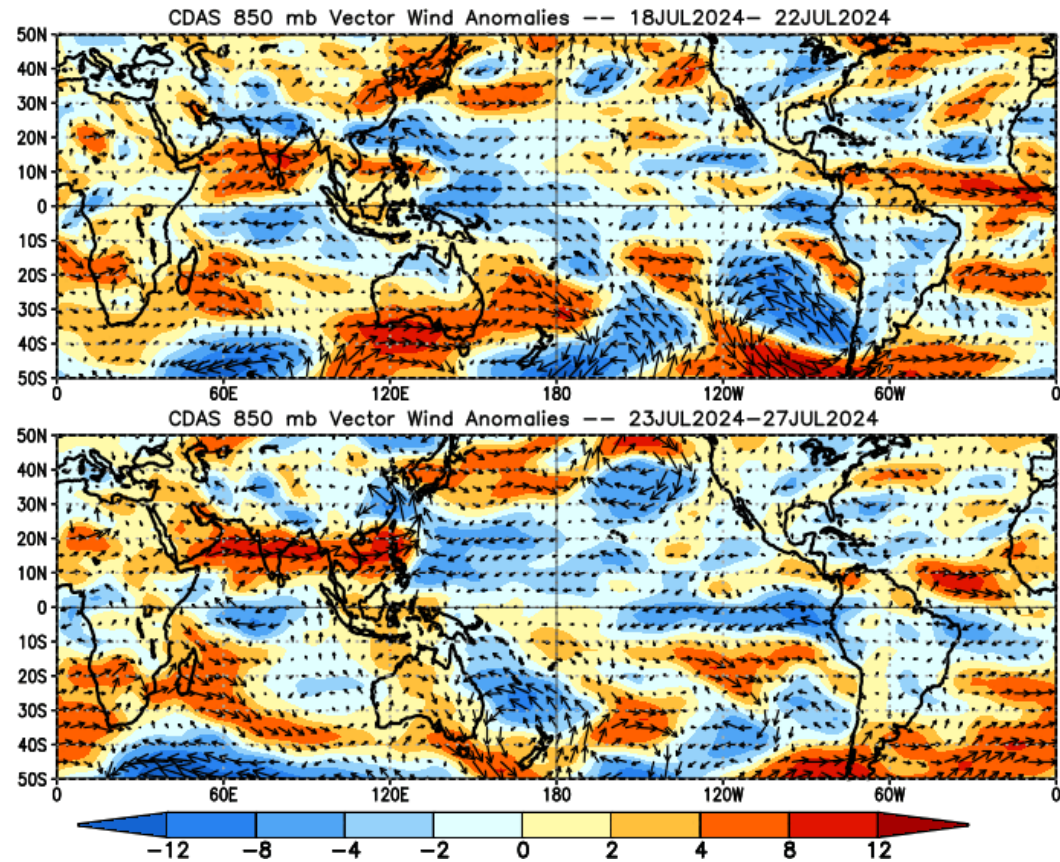
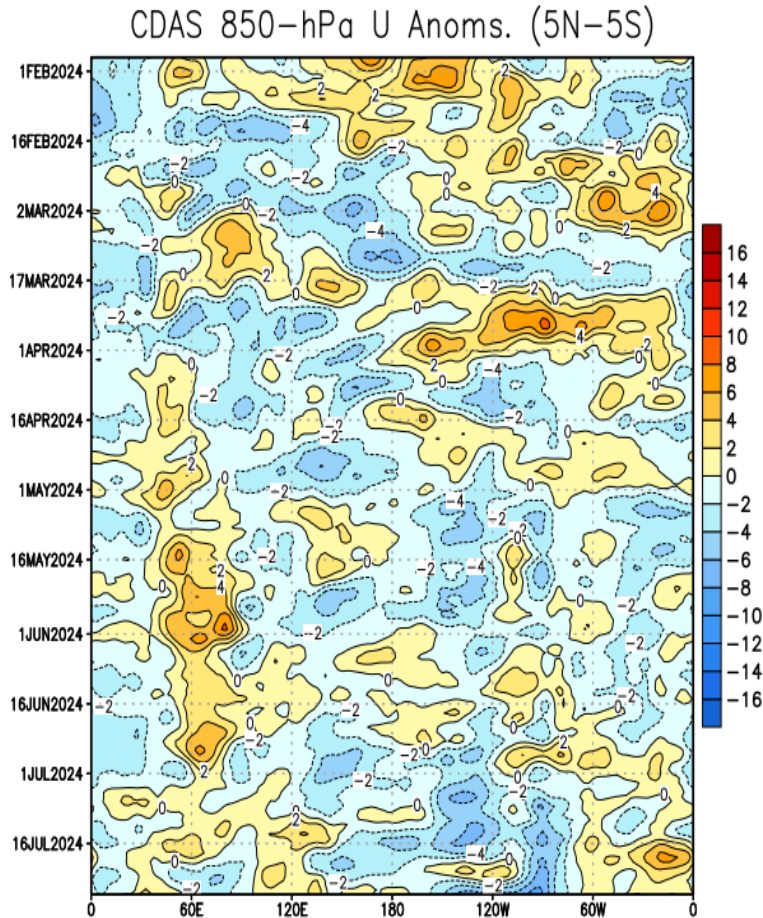
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- A persistent area of anomalous upper-level westerlies over the equatorial eastern Pacific relaxed and flipped sign to the north of the equator, providing more favorable conditions for tropical cyclogenesis in the basin.
- The renewed upper-level velocity potential anomaly signal near 120W was aided by an anomalous anticyclonic circulation associated with a pair of TCs that developed in the West Pacific
- Cyclonic upper-level flow strengthened over the CONUS, ushering in cooler temperatures and bringing relief to areas affected by persistent summer heat.

850-hPa Wind Anomalies

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

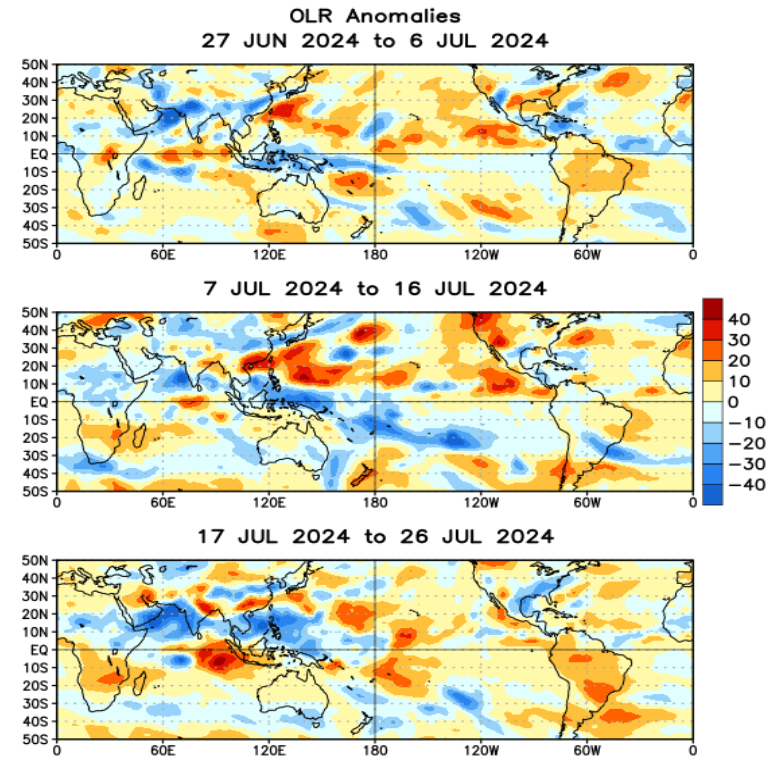
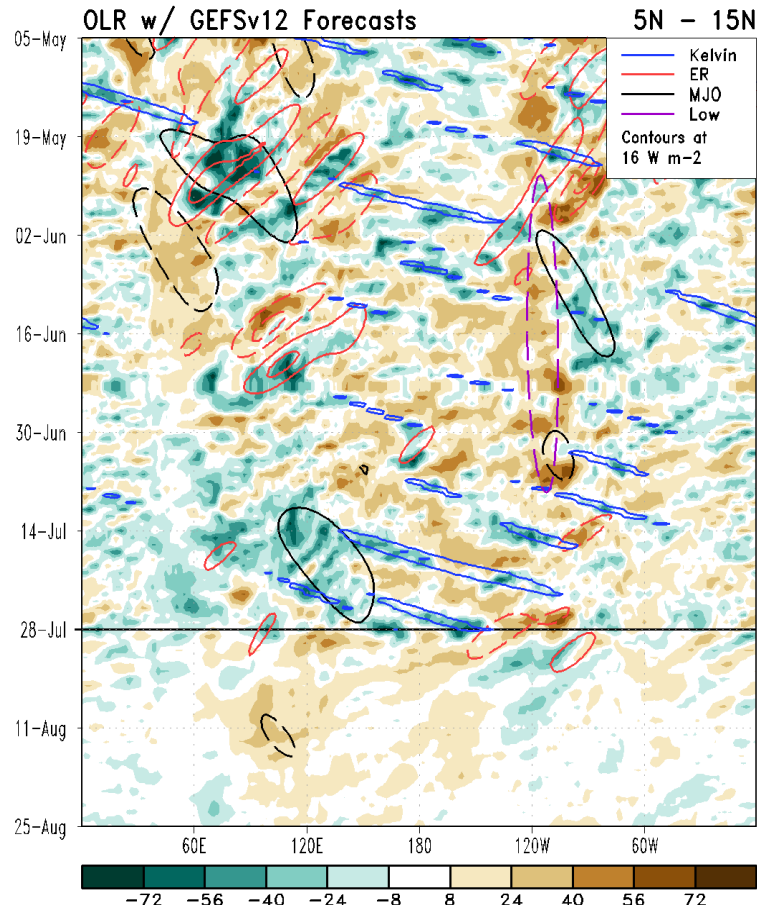


- Enhanced trades weakened throughout the equatorial Pacific, with more anomalous westerlies beginning to overspread the western Pacific.
- North of the equator, a band of anomalous westerlies extending from the Indian Ocean to the West Pacific strengthened.

Outgoing Longwave Radiation (OLR) Anomalies

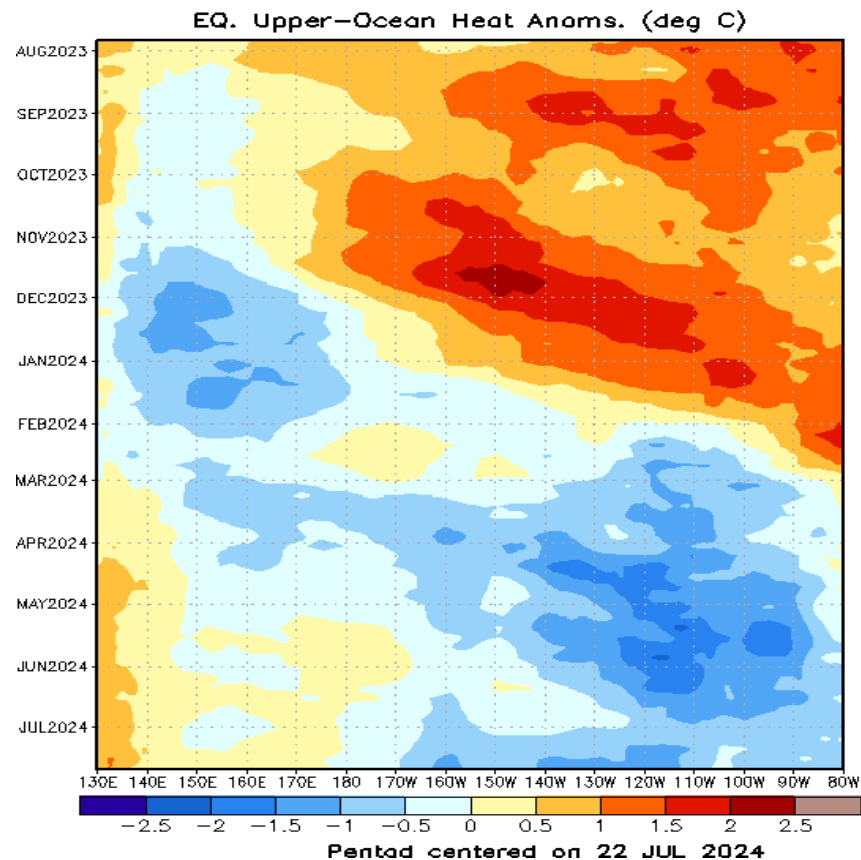
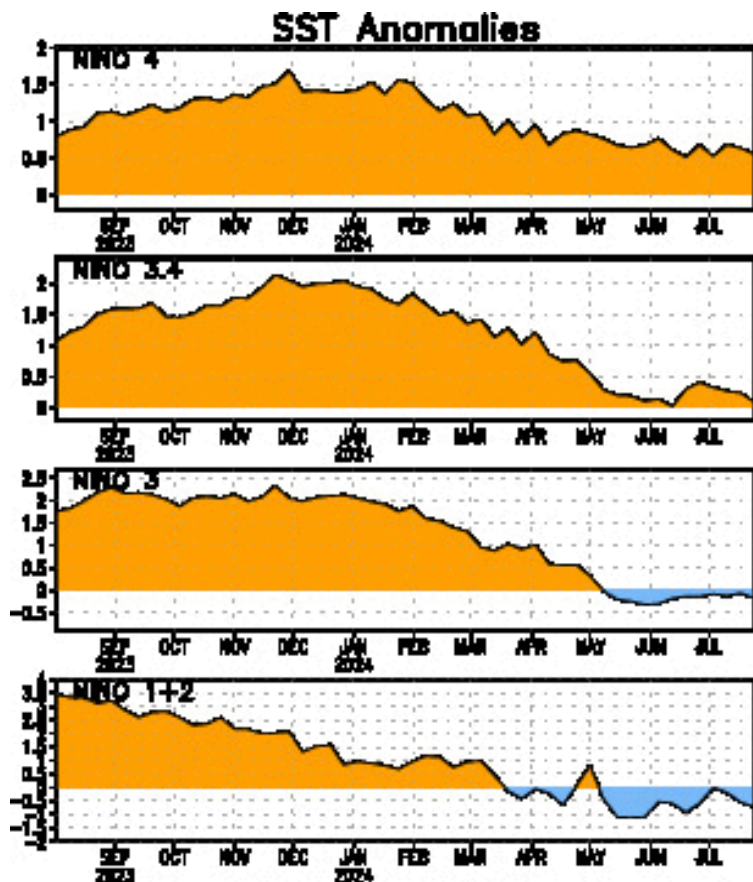
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Tied to the anomalous lower-level westerlies north the equator, enhanced convection was widespread over the northern Indian Ocean and West Pacific.
- While there is some MJO activity coming through the filtering, the observed OLR field suggests higher frequency modes have dominated the tropical landscape for much of July.
- GEFS forecasts favor an uptick in convection near 120W during the next week, with some of the enhanced convection returning to the Indian Ocean later in August.

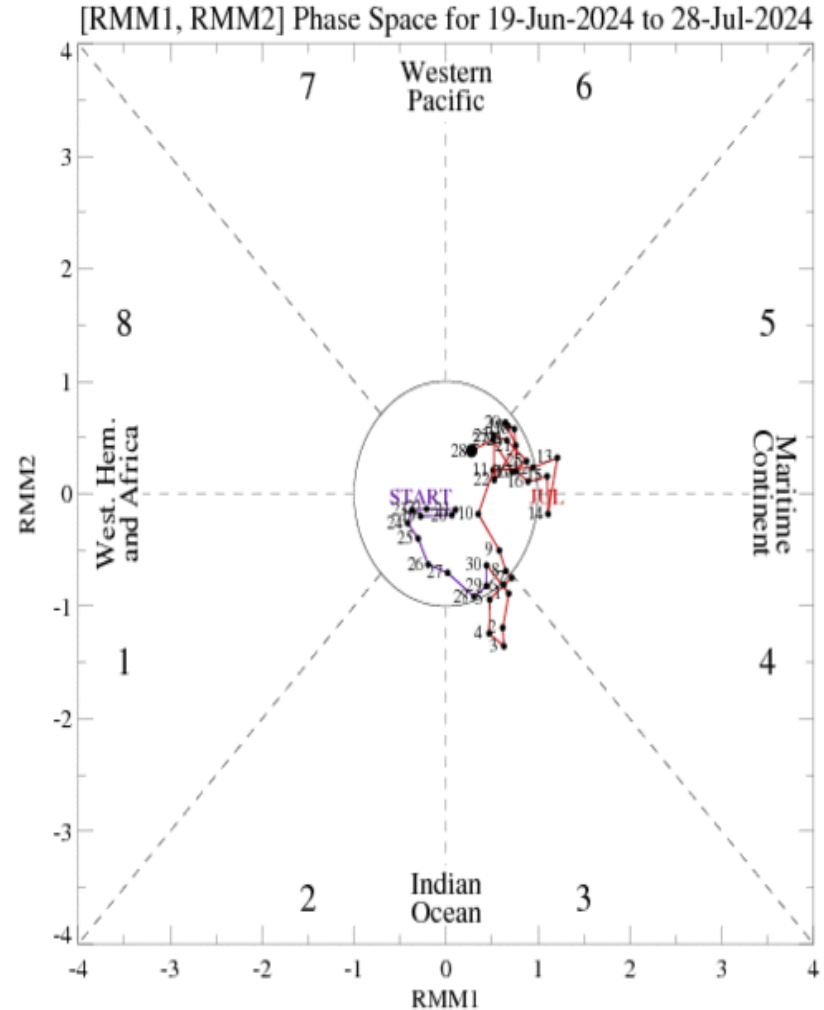
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- The downward trend in SSTs has leveled off in the past month with positive (negative) SST anomalies over the western (eastern) NINO regions.
- Following an oceanic downwelling event, negative oceanic heat content anomalies have gradually strengthened over the eastern half of the Pacific since early July, with cooler subsurface temperatures west of the Date Line more recently.

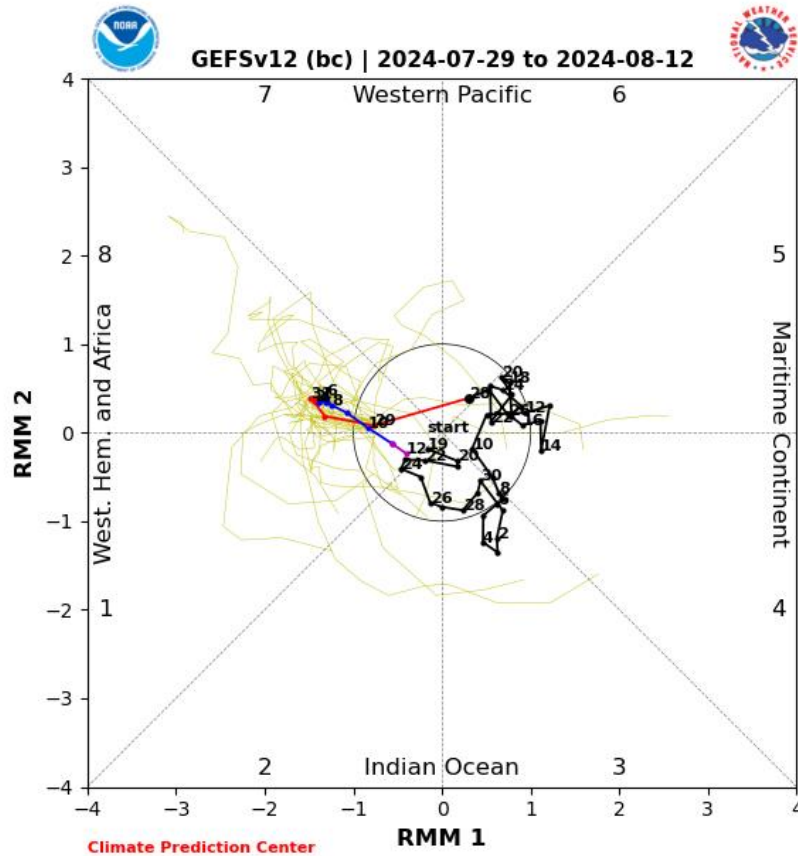
MJO Index: Recent Evolution

- The RMM-based MJO index continues to reflect poorly organized MJO activity, with the signal struggling to propagate eastward out of the Maritime Continent.

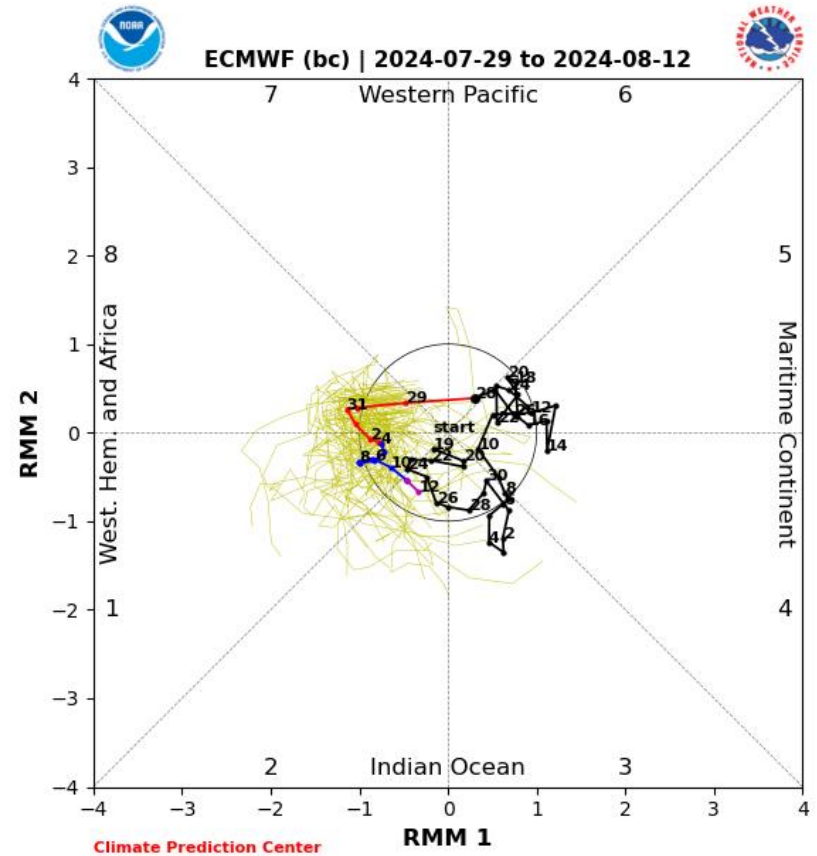


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



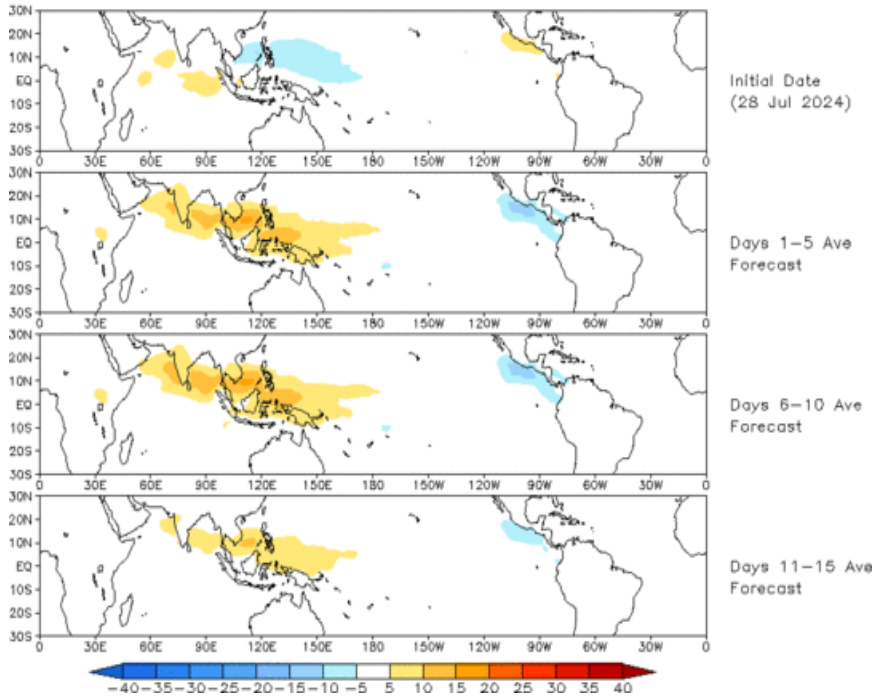
ECMWF Forecast

- There is good agreement in dynamical models depicting an MJO signal darting across the western Pacific, followed by an uptick in amplitude over the Western Hemisphere.
- This behavior may be tied to a fast-moving Convectively-Coupled Kelvin Wave, and some long range solutions have become more supportive with a more organized MJO activity propagating into the Indian Ocean later in August

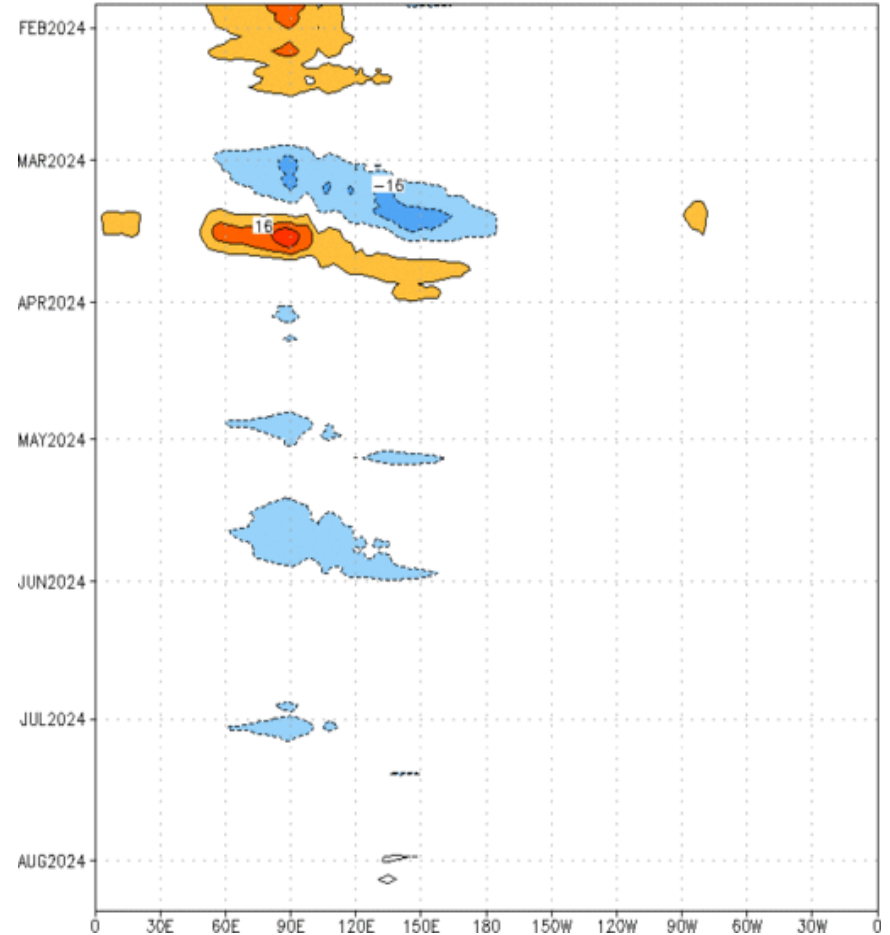
MJO: GEFS Forecast Evolution

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 Jul 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:27-Jan-2024 to 28-Jul-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

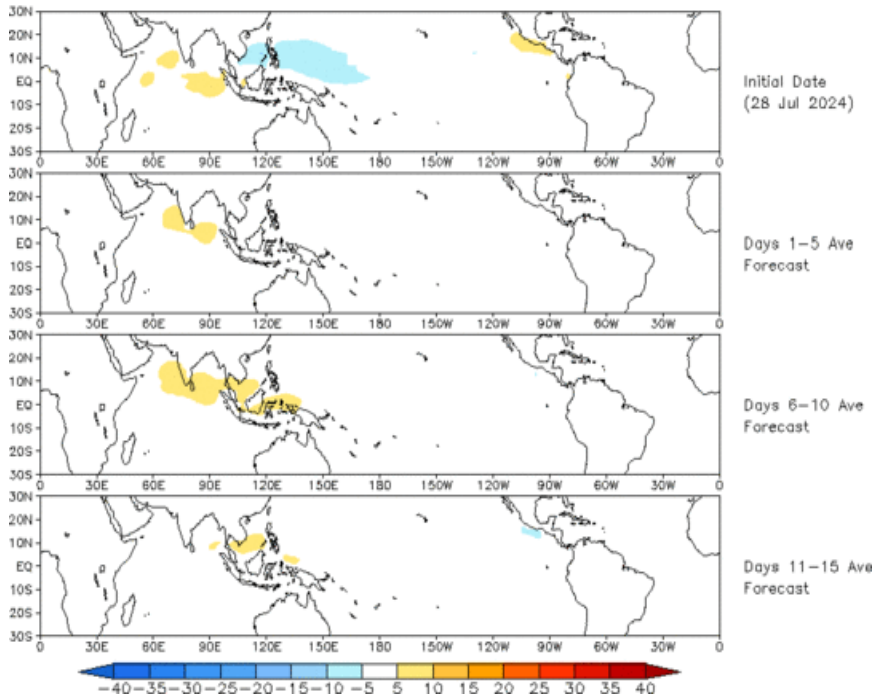


- The GEFS depicts a somewhat progressive anomaly pattern, with enhanced (suppressed) convection developing in the eastern Pacific (Indian Ocean and Western Pacific) during week-1, but stalling during week-2

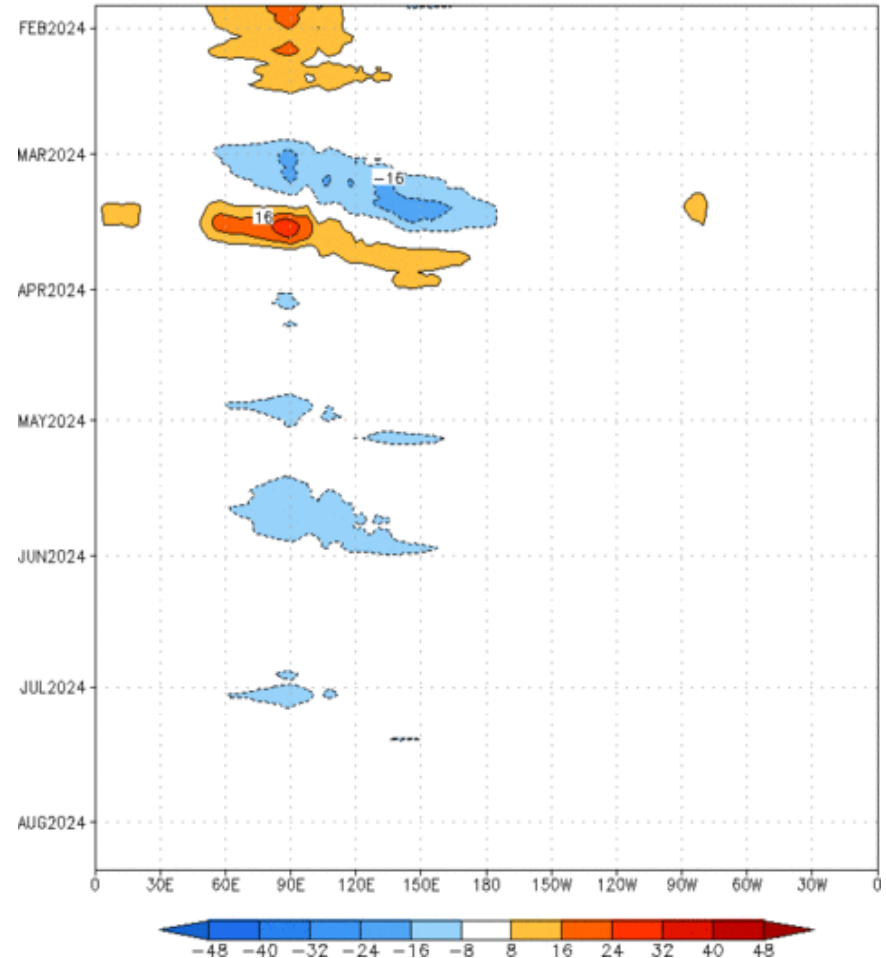
MJO: Constructed Analog Forecast Evolution

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 (28 Jul 2024)



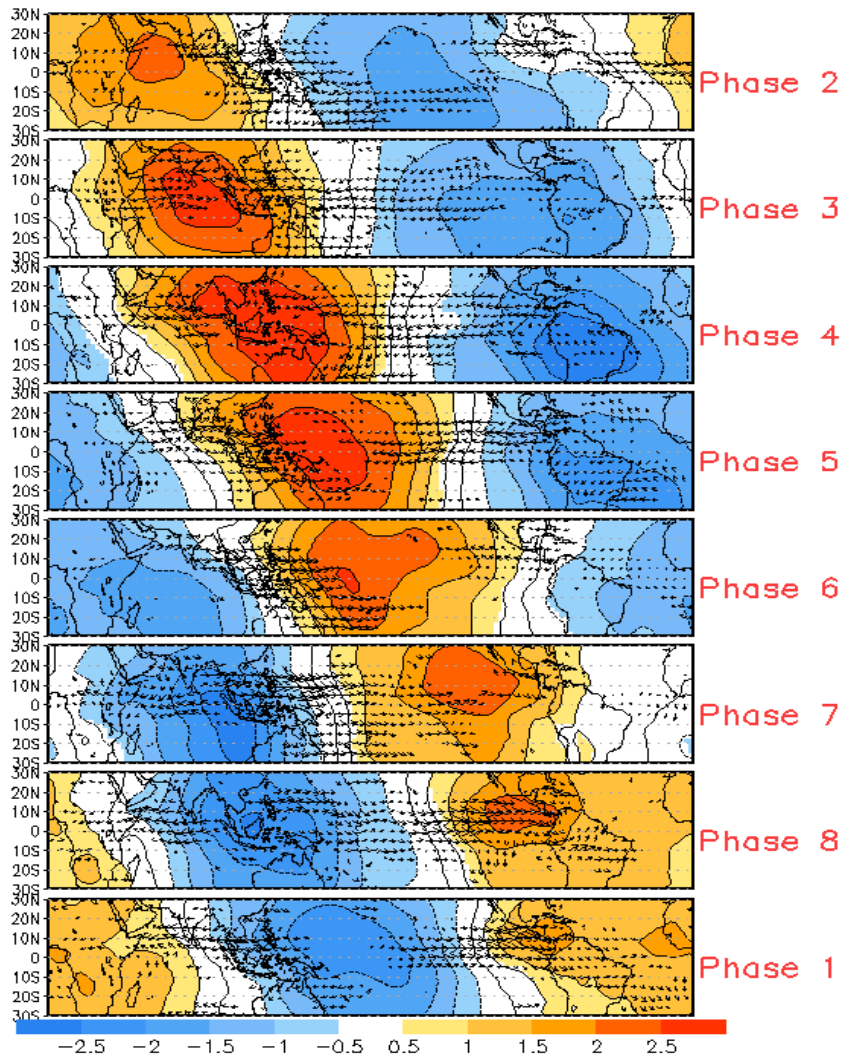
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:27-Jan-2024 to 28-Jul-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



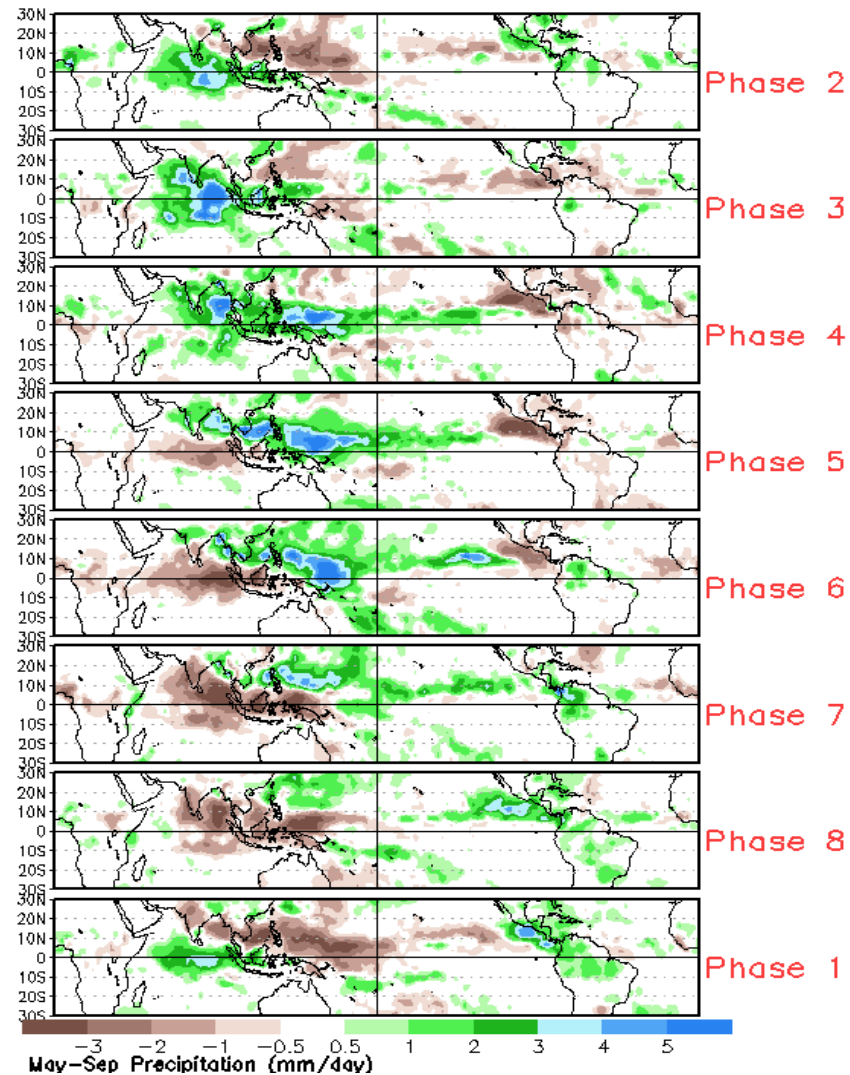
- The constructed analog is similar to the GEFS, but conveys a weaker anomaly pattern during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



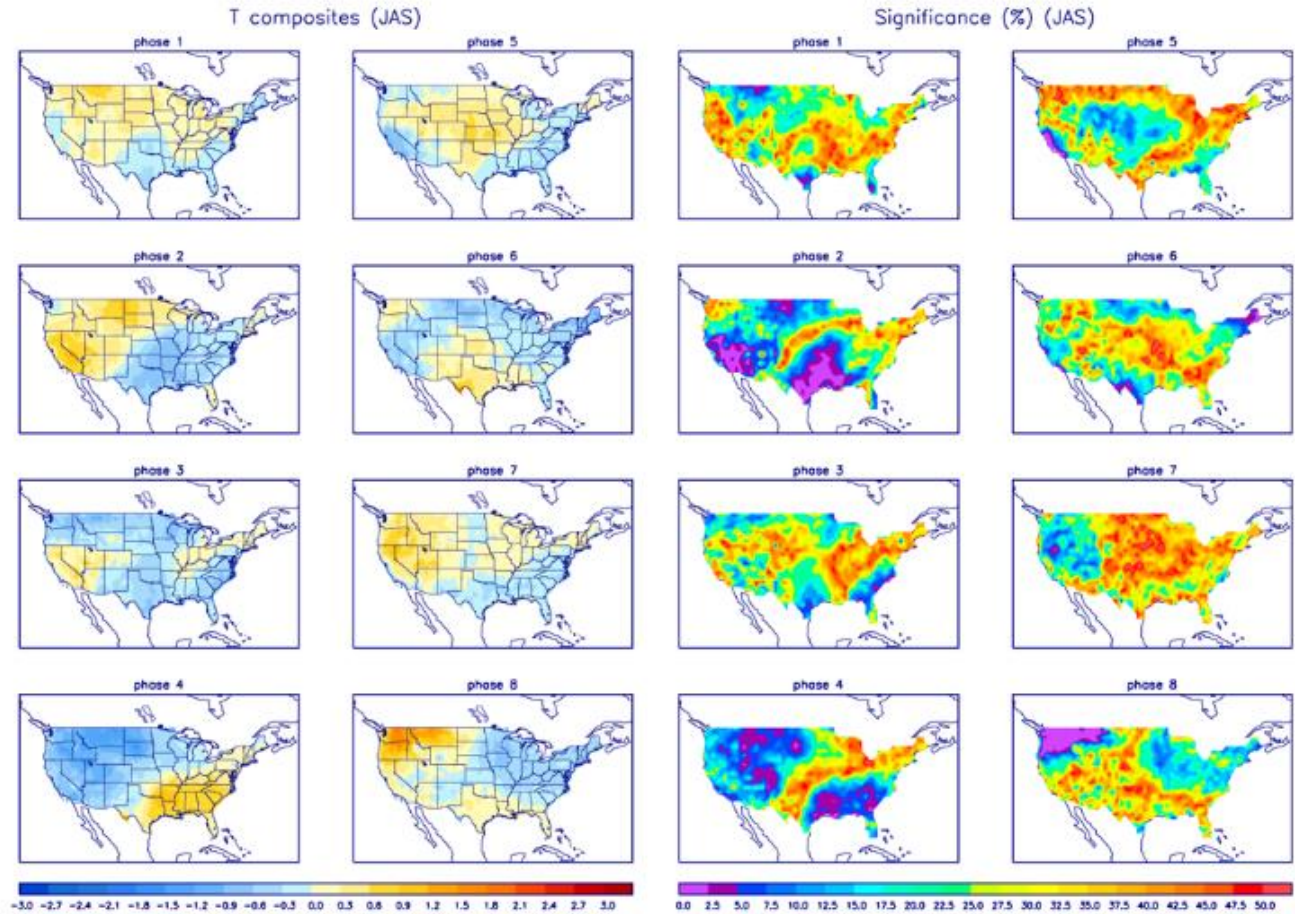
Precipitation Anomalies



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.

