

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



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

Overview

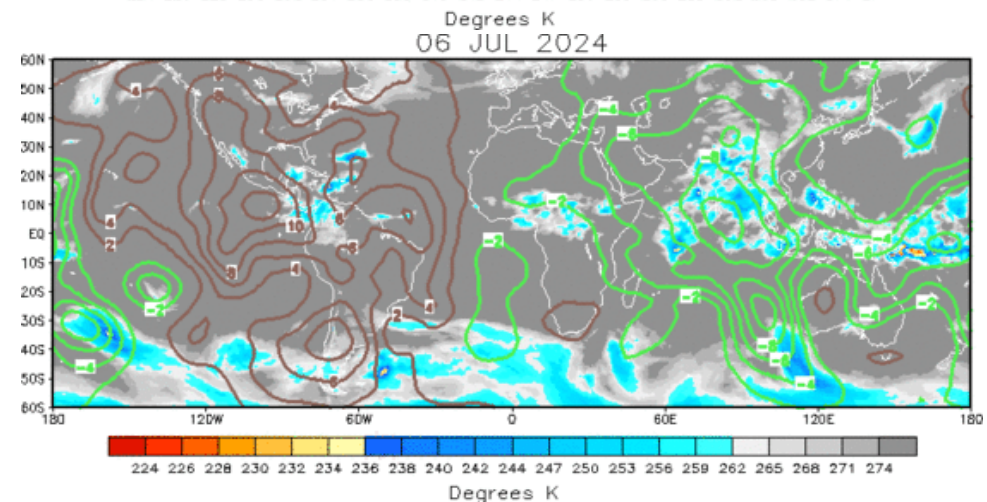
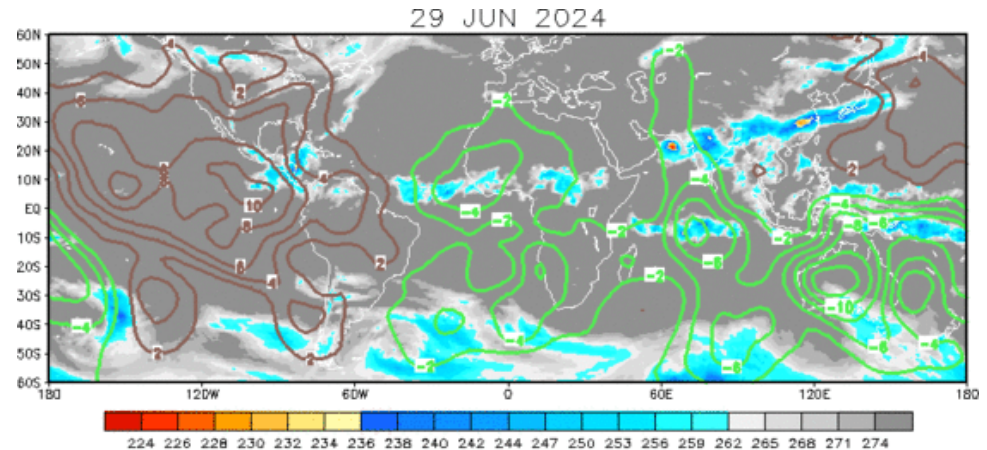
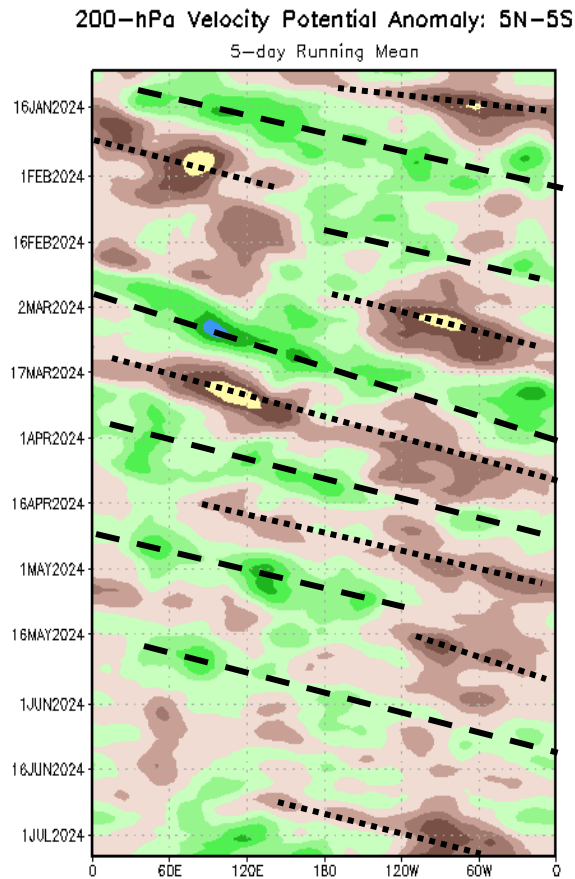
- While the upper-level velocity potential pattern retained a coherent Wave-1 structure during the past week, there was little eastward propagation of the signal, and the OLR field remains broadly disorganized.
- An increasingly suppressed signal has overspread the Western Hemisphere; however, easterly anomalies aloft which reduced shear and much above-normal SSTs in the Caribbean helped promote the development of a small core but extremely intense Category-5 Hurricane Beryl.
- Dynamical model MJO index forecasts are mixed, with the GEFS depicting a return to a weak pattern similar to June, while the ECMWF shows eastward propagation of a more coherent signal across the Maritime Continent and possibly to the West Pacific by the end of Week-2.
- The MJO may contribute to continued broad suppression across the Western Hemisphere, reducing the chances for continued early season tropical cyclone activity across the Atlantic basin. Extremely warm SSTs present a significant reservoir for additional activity, however, should shear weaken in the vicinity of any disturbance or easterly wave.
- A favorable environment for tropical cyclogenesis across the West Pacific is anticipated. Should the intraseasonal signal become more progressive, a window of favorability could open across the East Pacific as well as early as Week-3.

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)

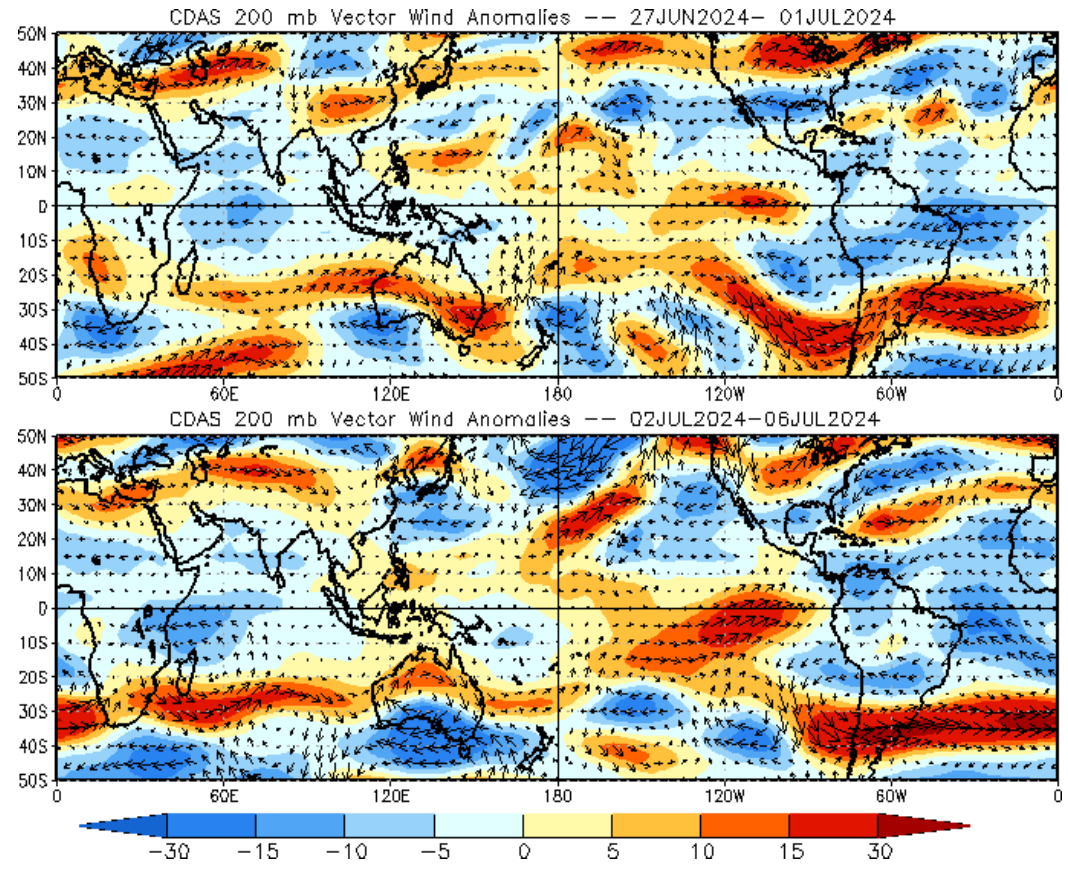
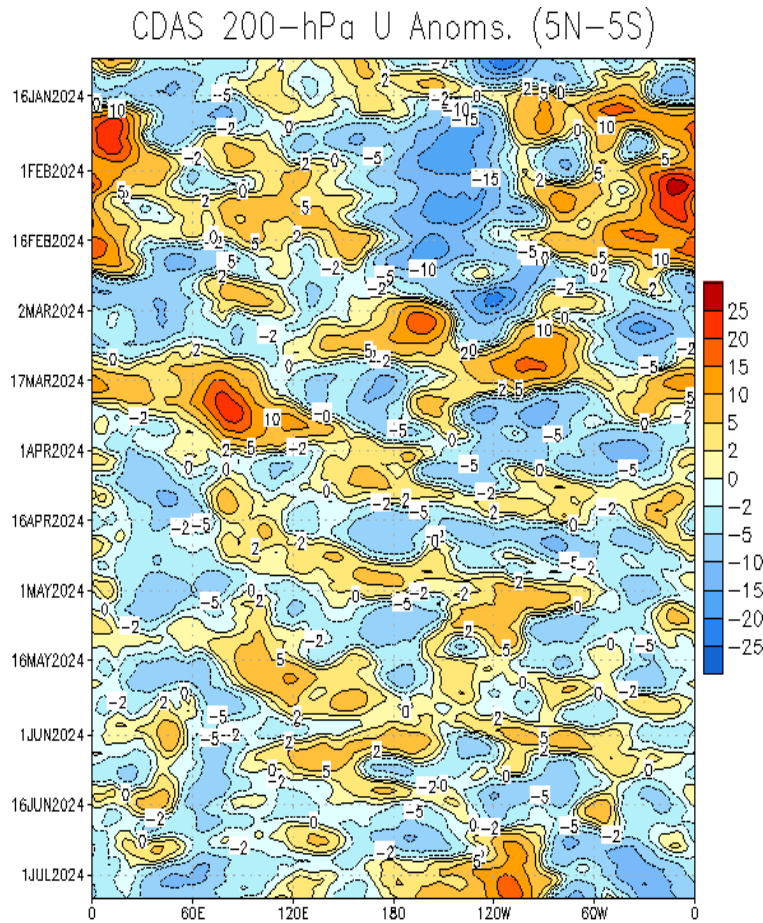
Brown shades: Anomalous convergence (unfavorable for precipitation)



- The upper-level velocity potential anomaly field remains coherent, with a robust Wave-1 structure and broad-scale convergence (divergence) aloft over the East Pacific and Western Hemisphere (Africa through the central Pacific).
- Little eastward propagation was observed during late June and early July, due in part to Rossby wave interference.

200-hPa Wind Anomalies

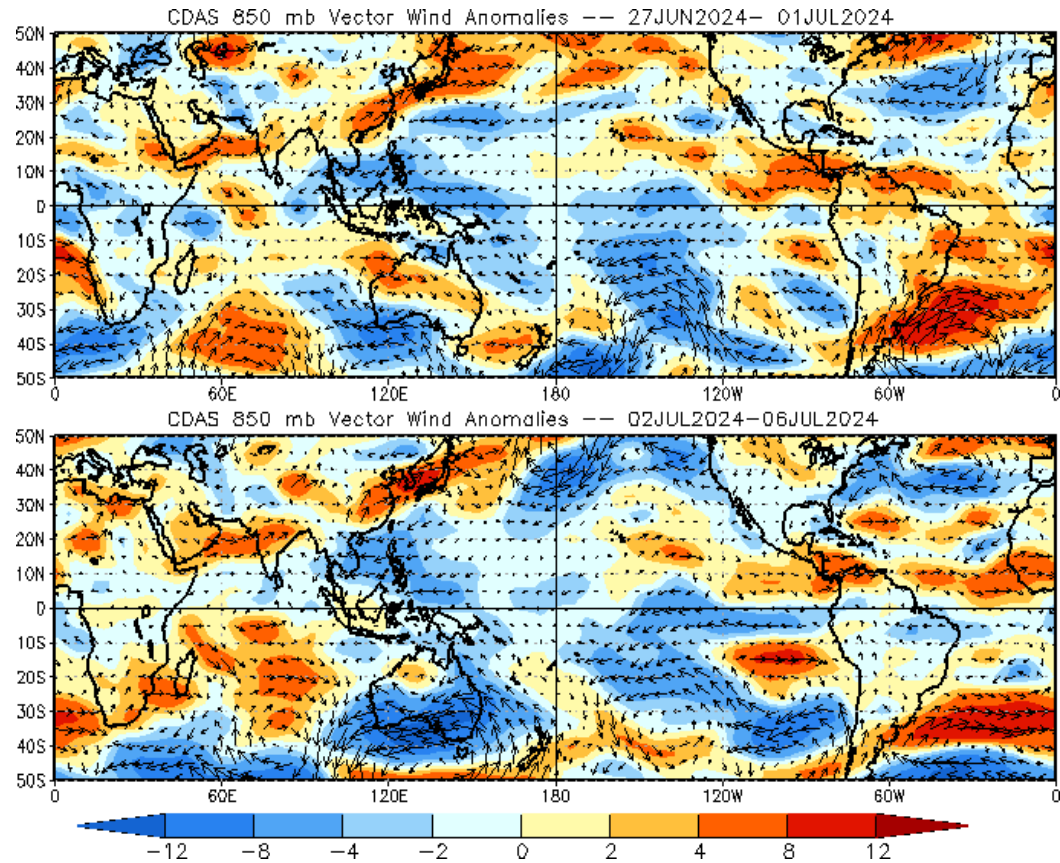
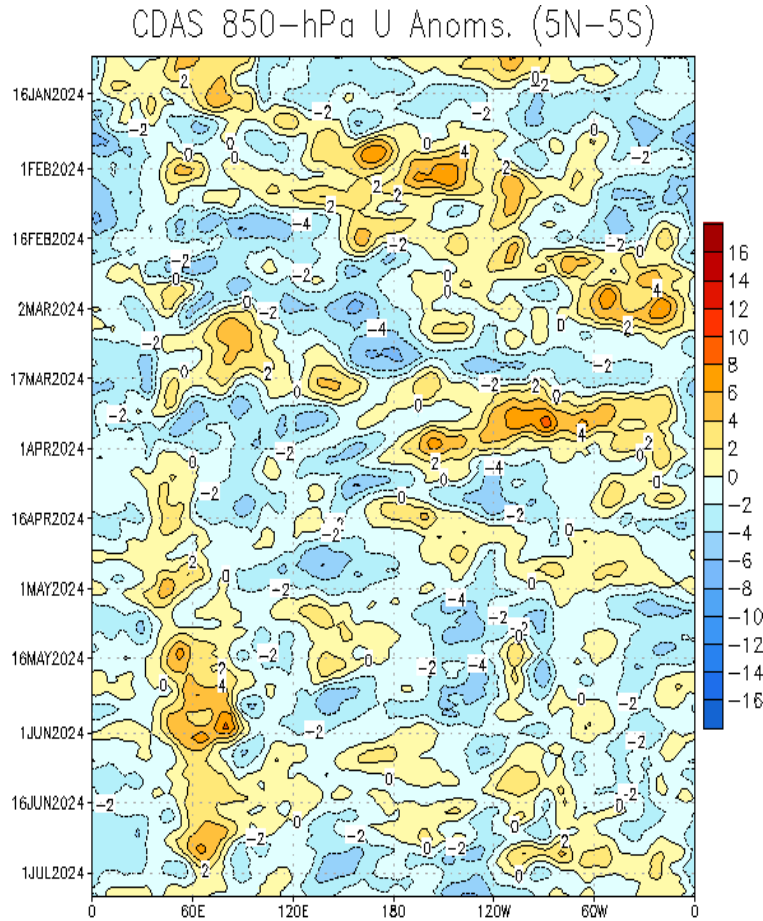
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Easterly anomalies persisted across the tropical Atlantic and Caribbean, which helped produce the low-shear environment in which Category-5 Hurricane Beryl developed.
- Westerly anomalies strengthened across the east-central Pacific.
- Easterlies (westerlies) over the western Indian Ocean (Maritime Continent) promote a broadly divergent pattern aloft over the Indian Ocean.

850-hPa Wind Anomalies

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

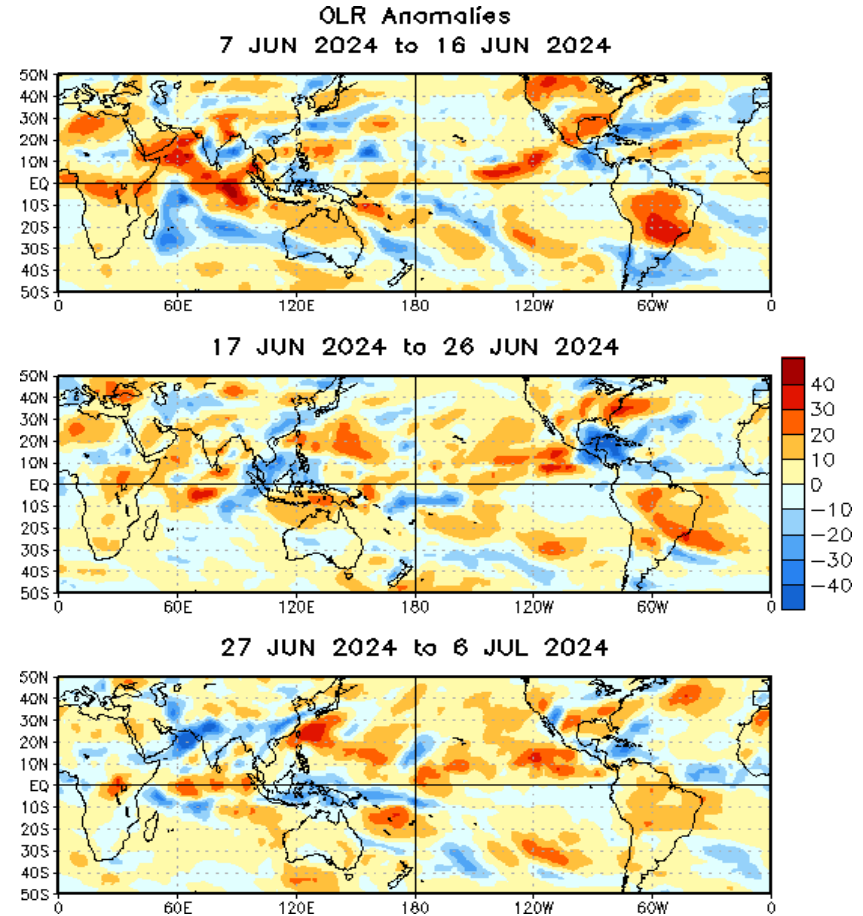
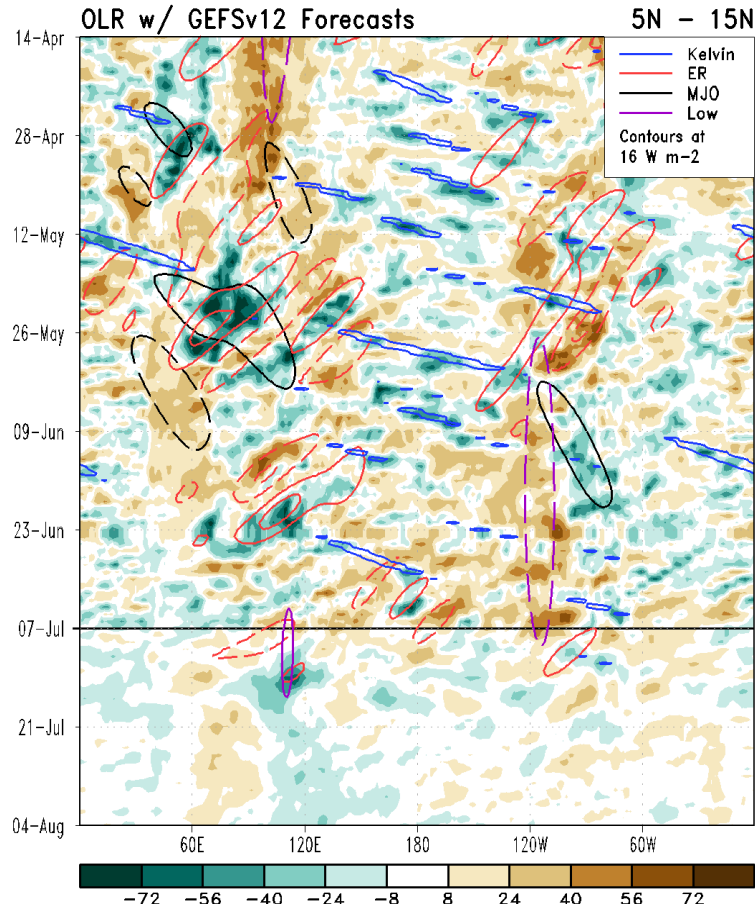


- Anomalous westerlies persist over the western Indian Ocean, suggestive of a low frequency response.
- Westerly anomalies continue across the far East Pacific, Caribbean, and tropical Atlantic.
- Trade winds remain enhanced across much of the Pacific, and have strengthened over the East Pacific south of the Equator.

Outgoing Longwave Radiation (OLR) Anomalies

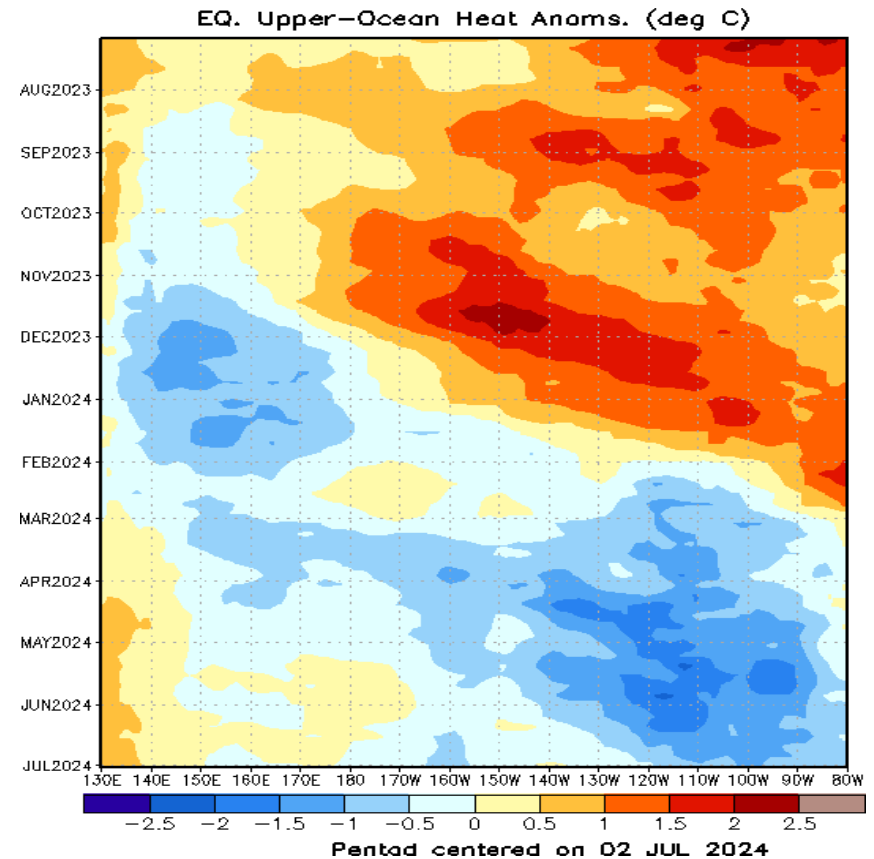
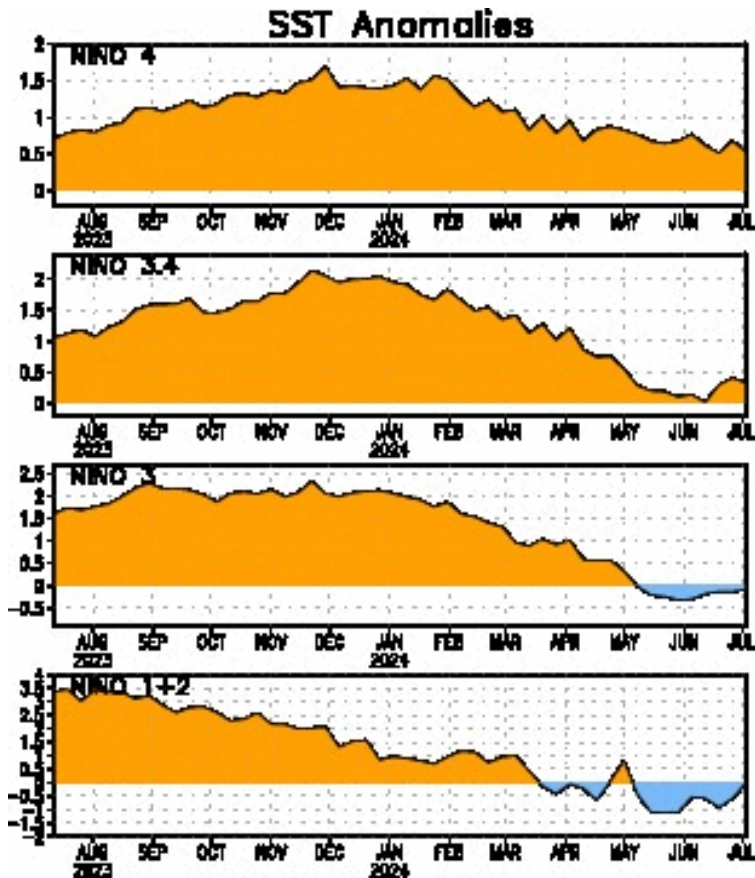
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- The OLR field remains largely disorganized across the global tropics, with no broad regions of enhanced or suppressed convection typical during robust MJO events.
- GEFS forecasts depict a continuation of the weak anomaly field overall, with some indications of persistent suppressed (enhanced) convection over the central Indian Ocean (Maritime Continent) during the next few weeks.

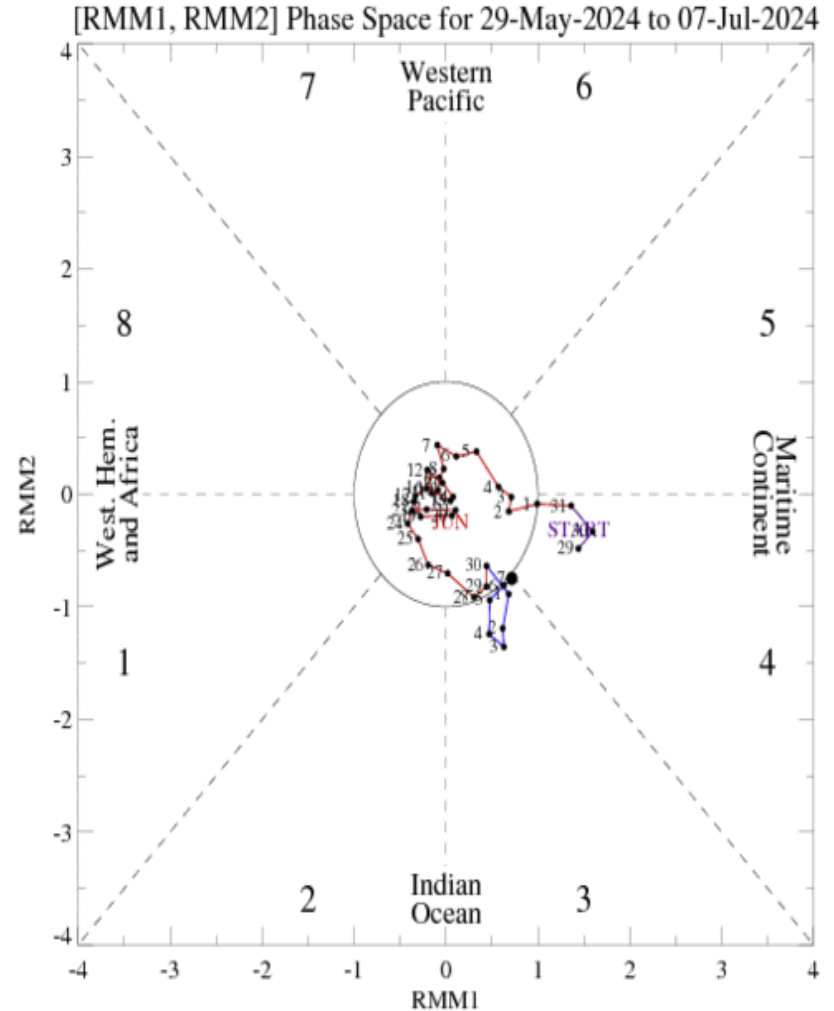
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs remain below average across the easternmost Niño monitoring regions, though the downward trend has recently abated.
- Negative anomalies in the upper-oceanic heat content have decreased from west to east across the central Pacific, possibly indicative of a downwelling Kelvin wave moving through the basin.

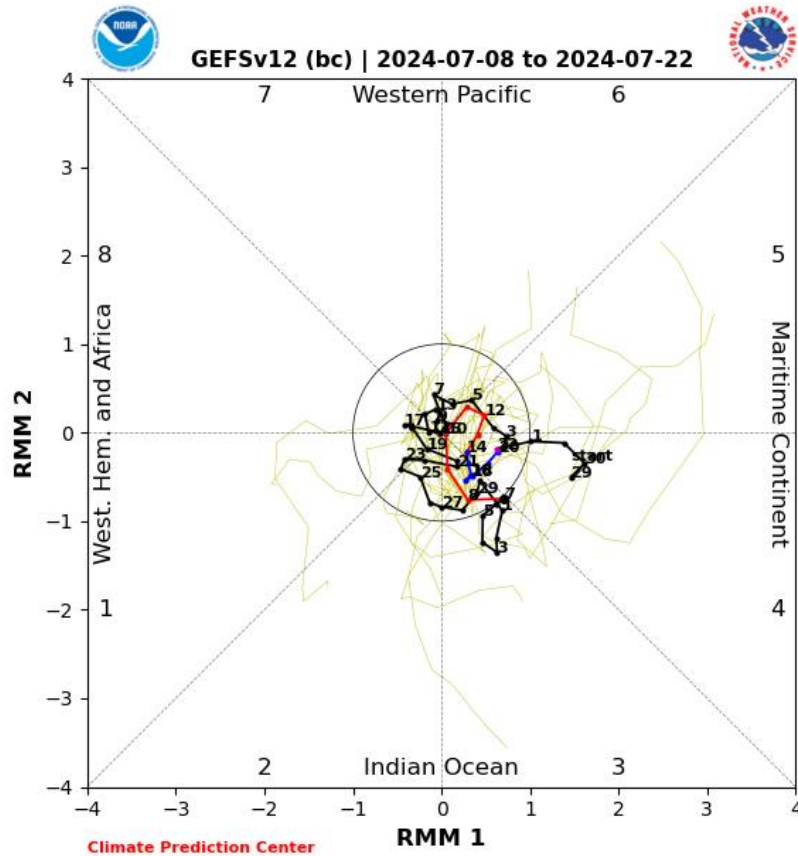
MJO Index: Recent Evolution

- The RMM index gained amplitude in early July, then weakened again with little eastward propagation.
- The tight “looping” of the index over the past few days may be indicative of Rossby wave interference.

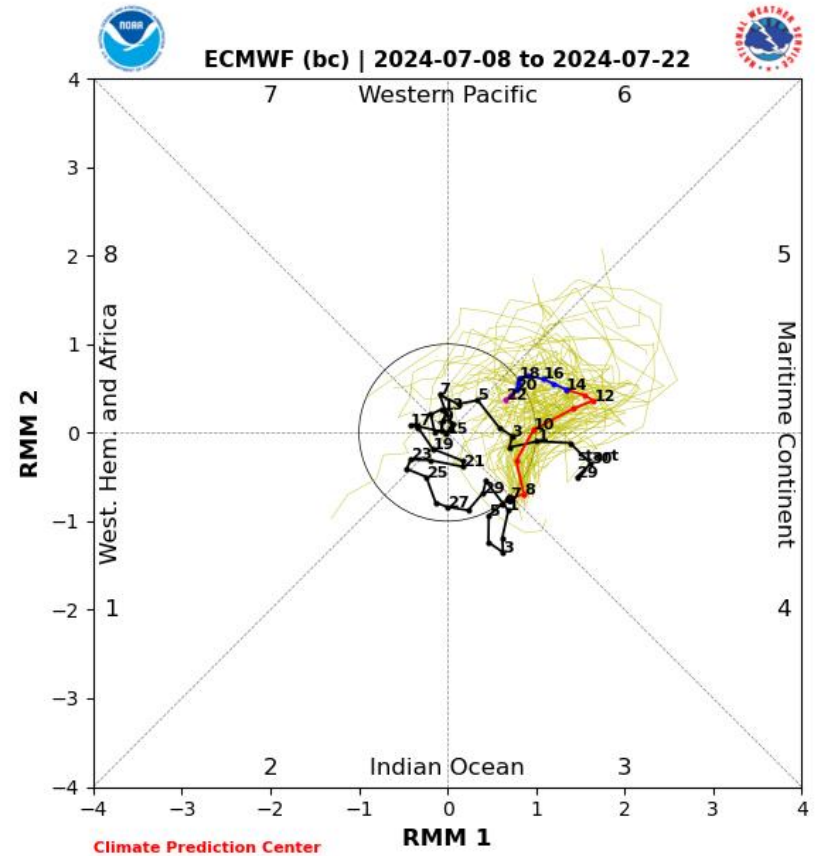


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



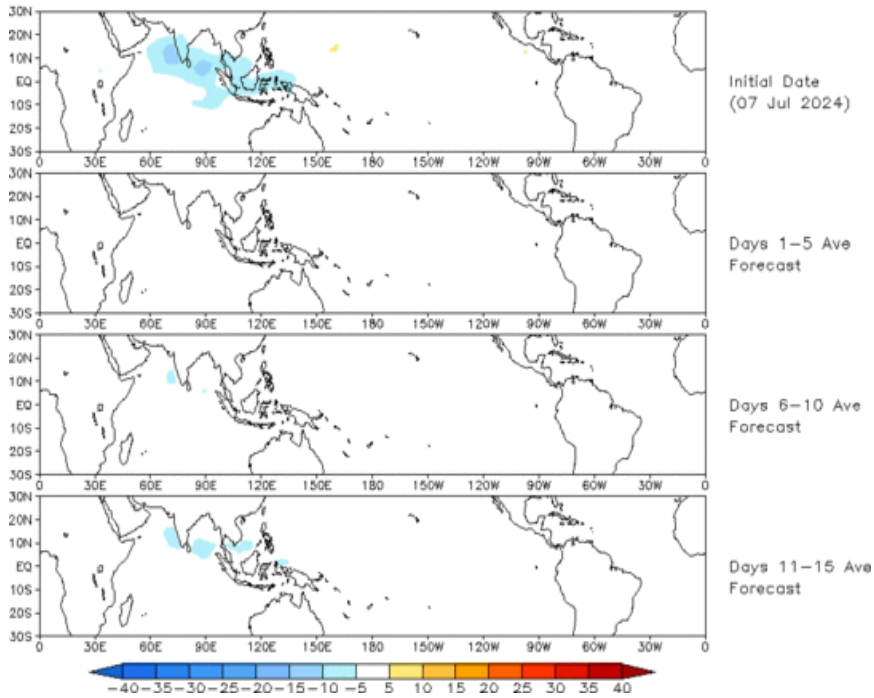
ECMWF Forecast

- The GEFS depicts a return to low-amplitude activity during the next two weeks.
- The ECMWF features a more robust signal, with a quick transition to the Maritime Continent, possibly as Rossby wave interference wanes, followed by a slower evolution during Week-2. Some ensemble members are high amplitude and depict the signal reaching the far western Pacific by the end of Week-2.

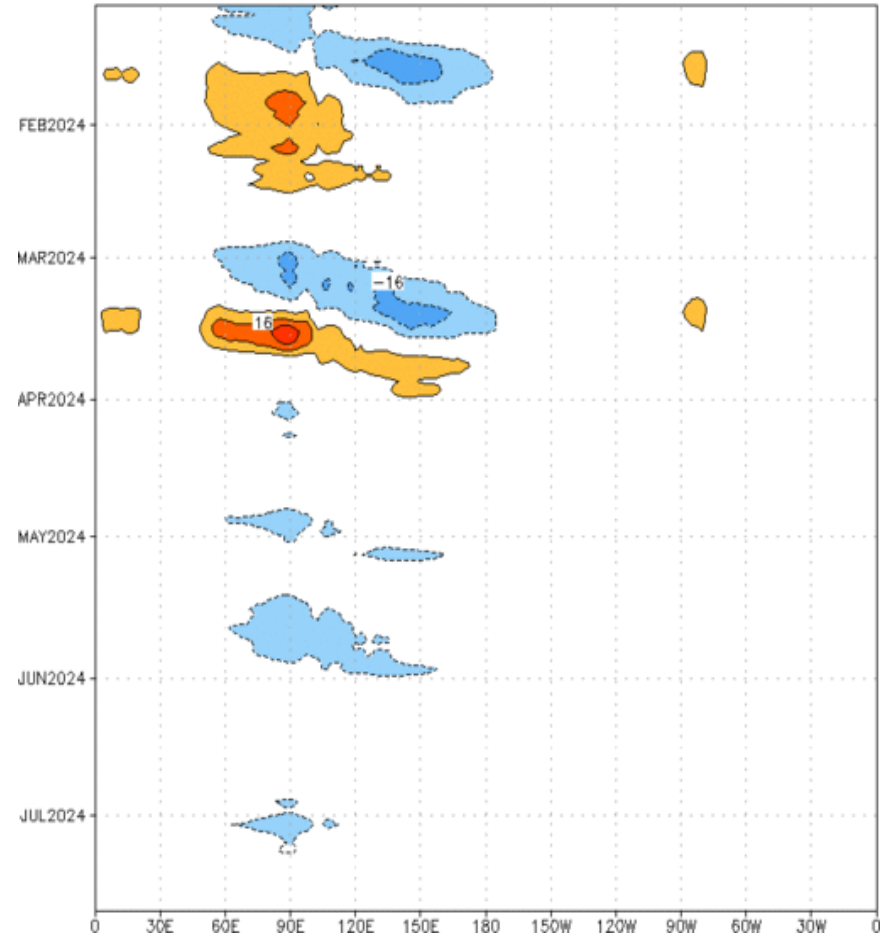
MJO: GEFS Forecast Evolution

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: 07 Jul 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:06-Jan-2024 to 07-Jul-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

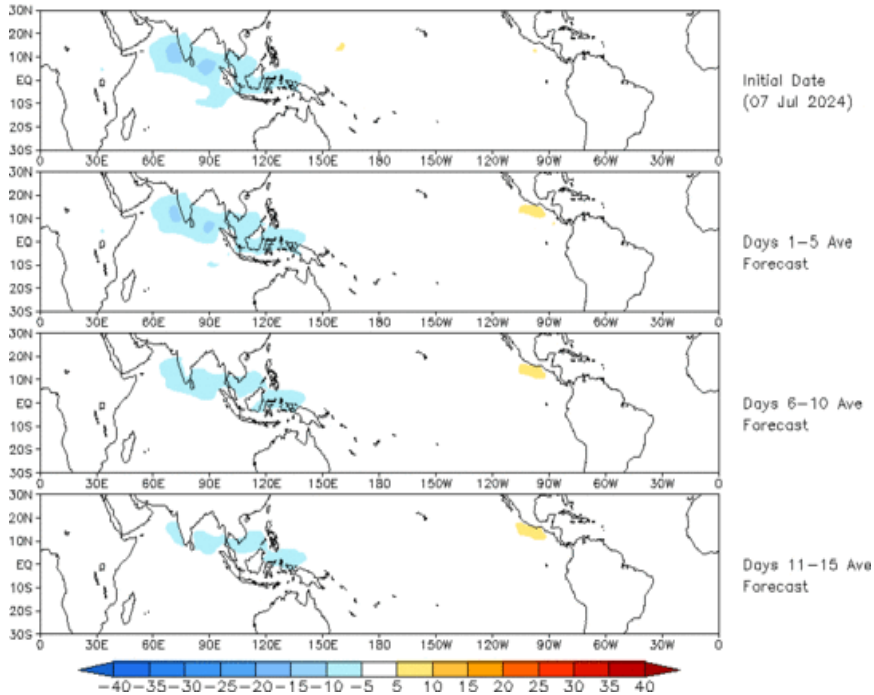


- With a low amplitude RMM-index projection in the GEFS, the associated OLR anomaly field is quite weak.

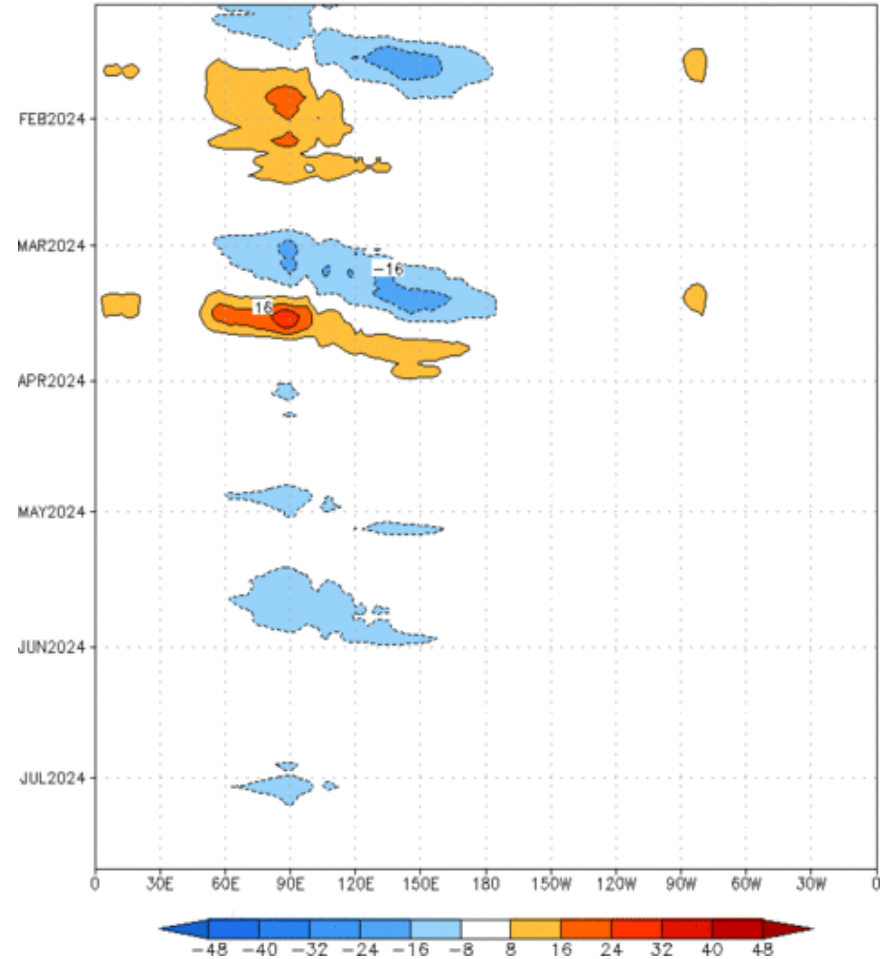
MJO: Constructed Analog Forecast Evolution

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 (07 Jul 2024)



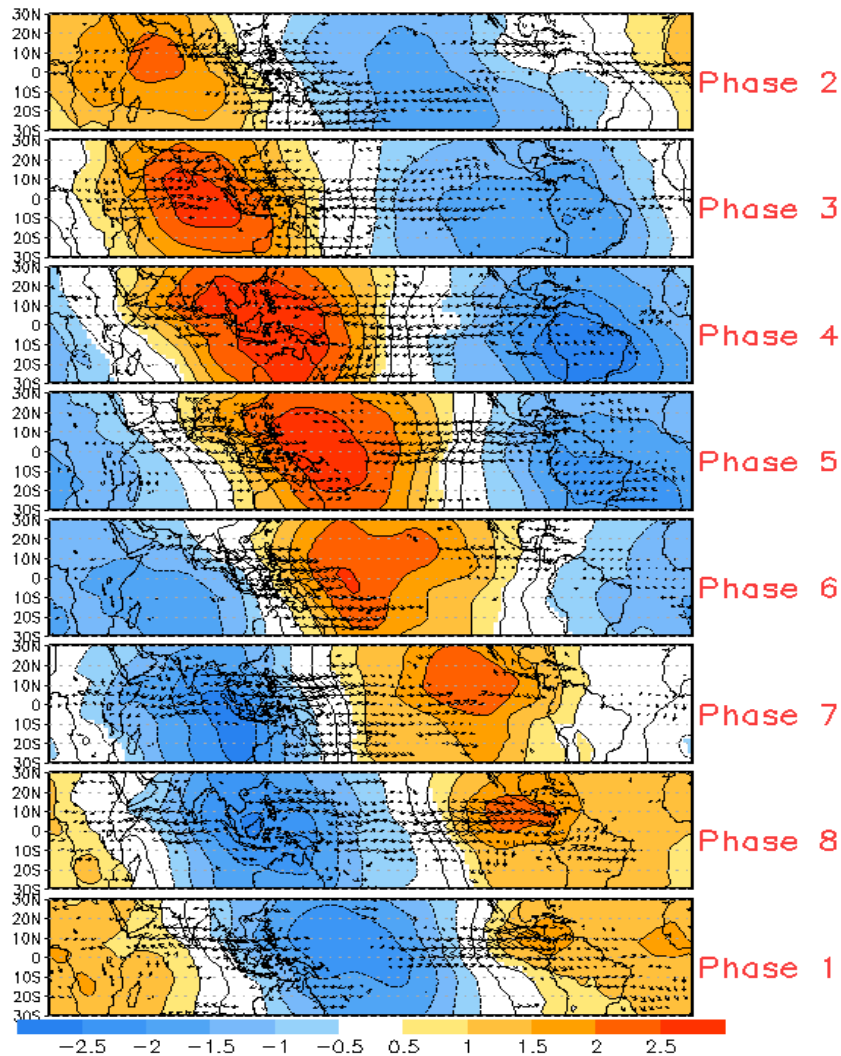
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:06-Jan-2024 to 07-Jul-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



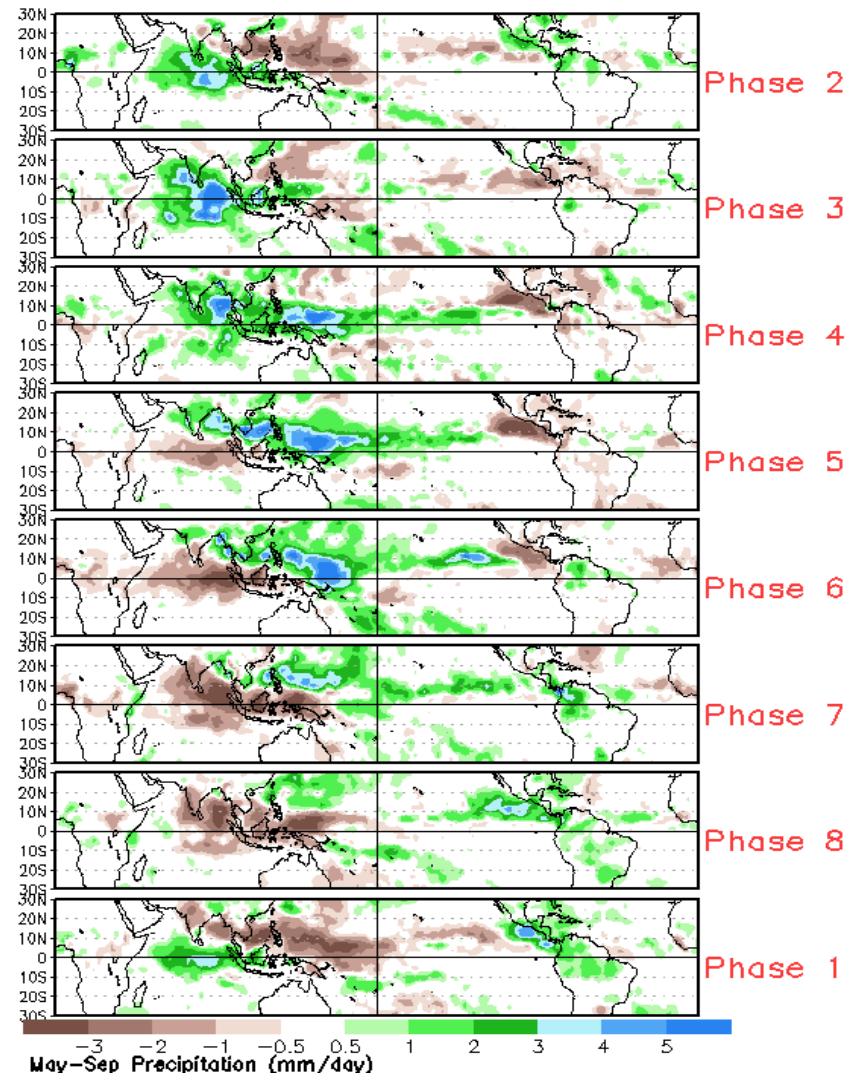
- The constructed analog tool depicts a slightly more enhanced pattern compared to the GEFS, but with very little eastward propagation.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



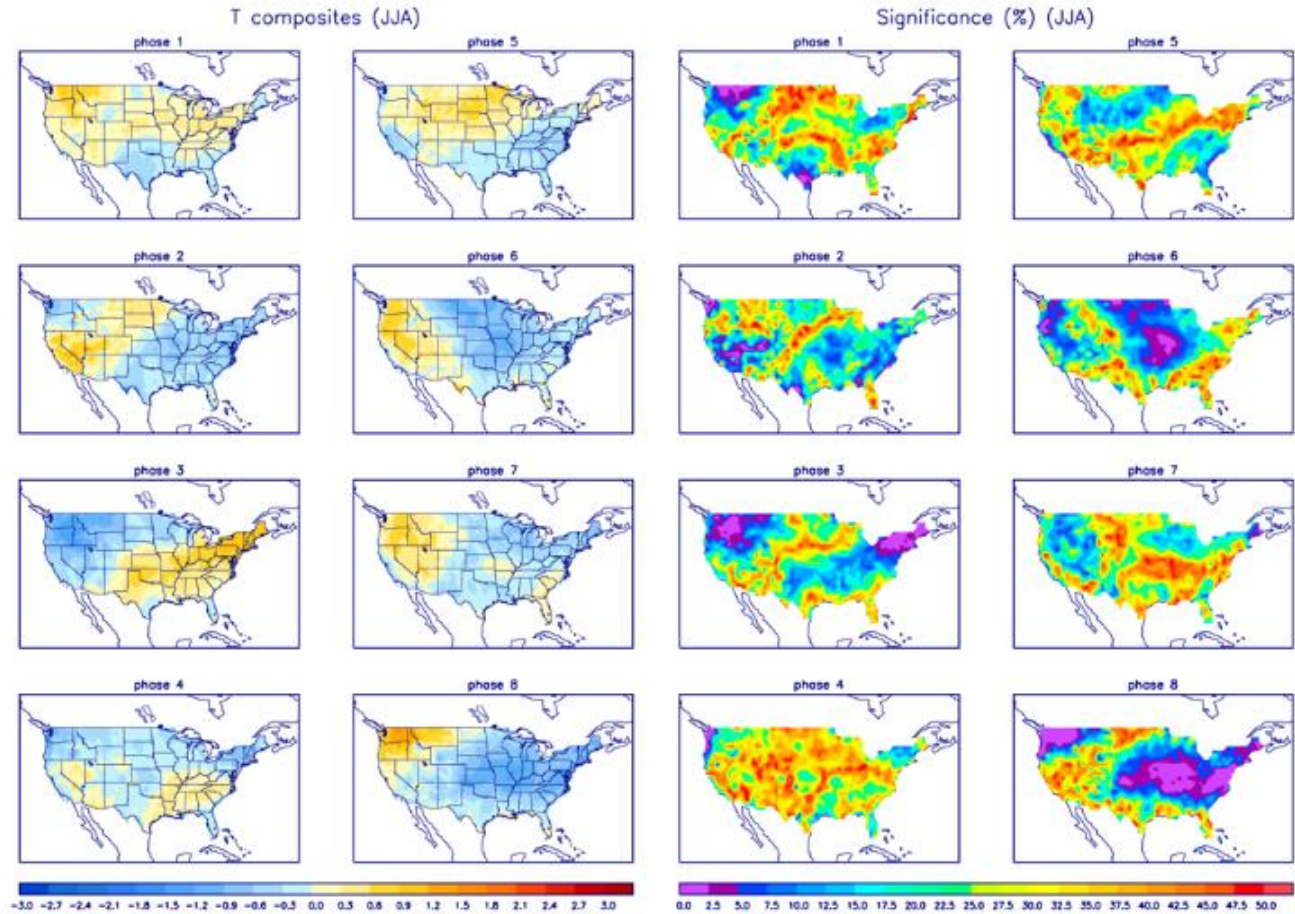
Precipitation Anomalies



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.

