

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
15 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.
- 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 Pacific Ocean and possibly into the Western Hemisphere by the end of Week-2.
- The MJO may contribute to continued broad suppression across the Western Hemisphere especially during week-2, reducing the chances for continued early season tropical cyclone (TC) 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 East Pacific is anticipated. Should the intraseasonal signal become more coherent as suggested by the ECMWF, conditions could become very favorable for TC genesis in the East Pacific by Week-3.

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

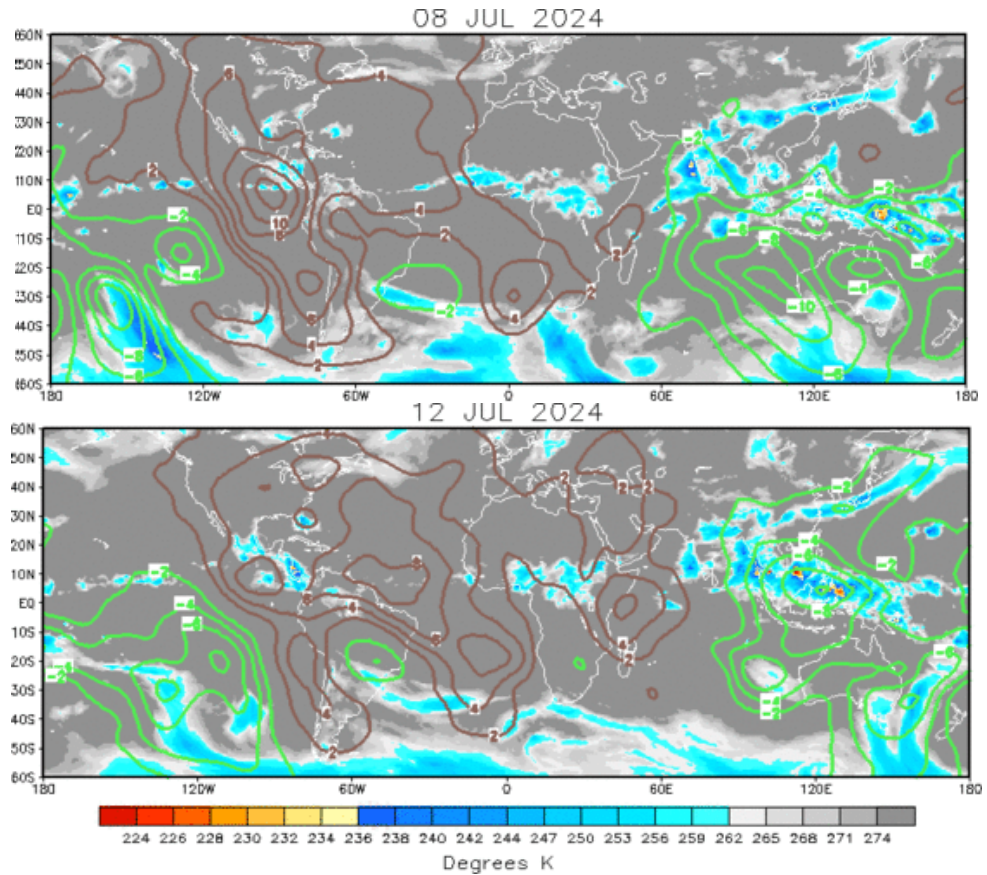
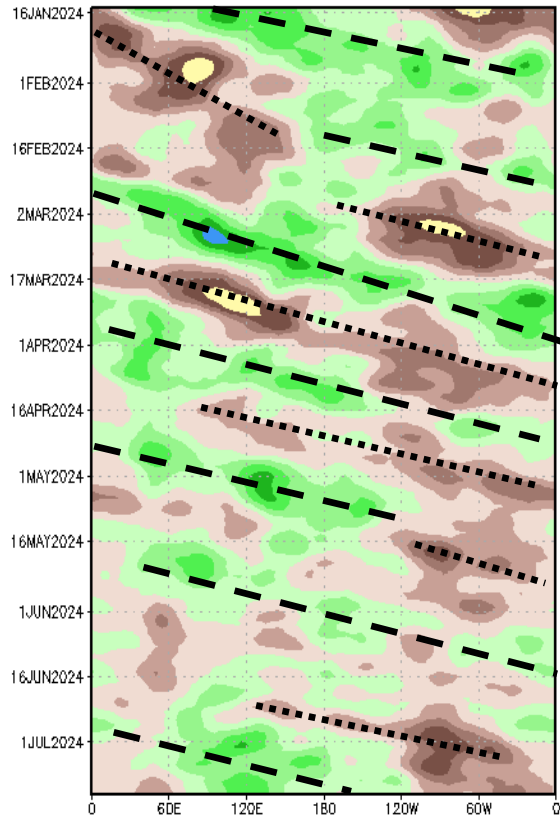
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

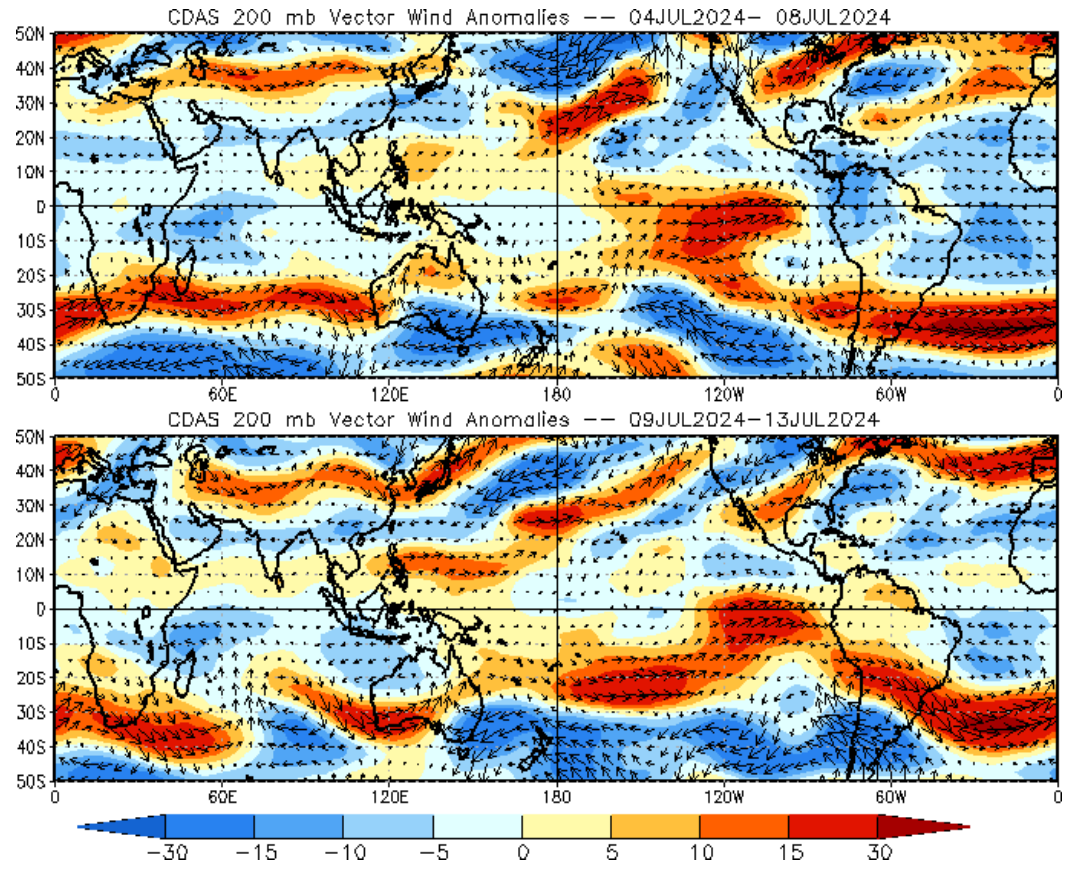
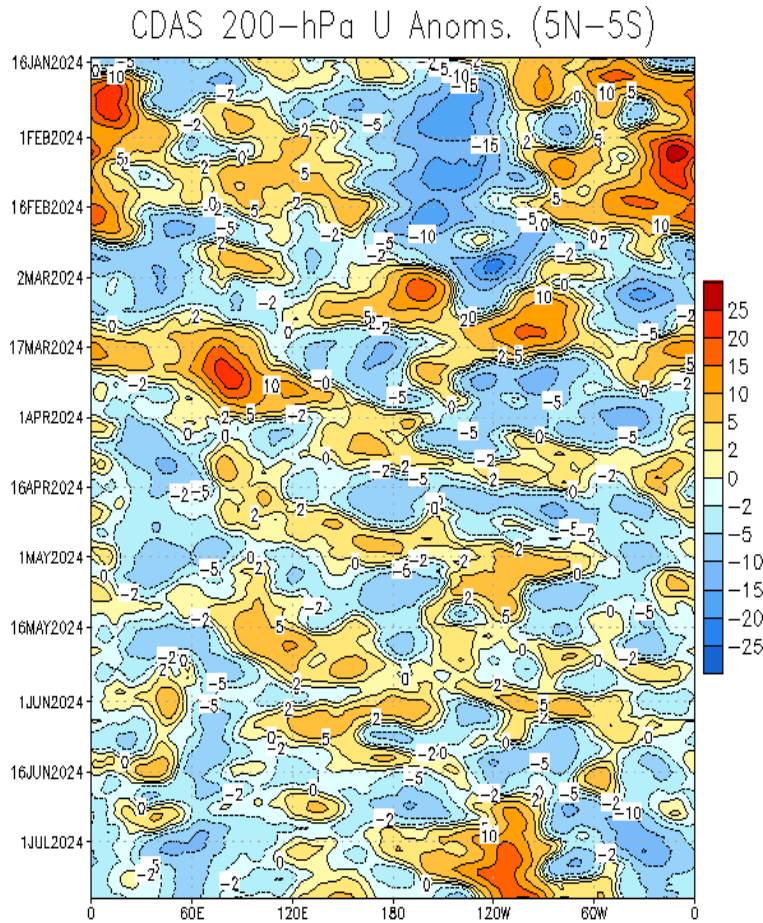
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The upper-level velocity potential anomaly field remains coherent, with a robust Wave-1 structure and broad-scale convergence (divergence) aloft over the Americas and Africa (Indian Ocean 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

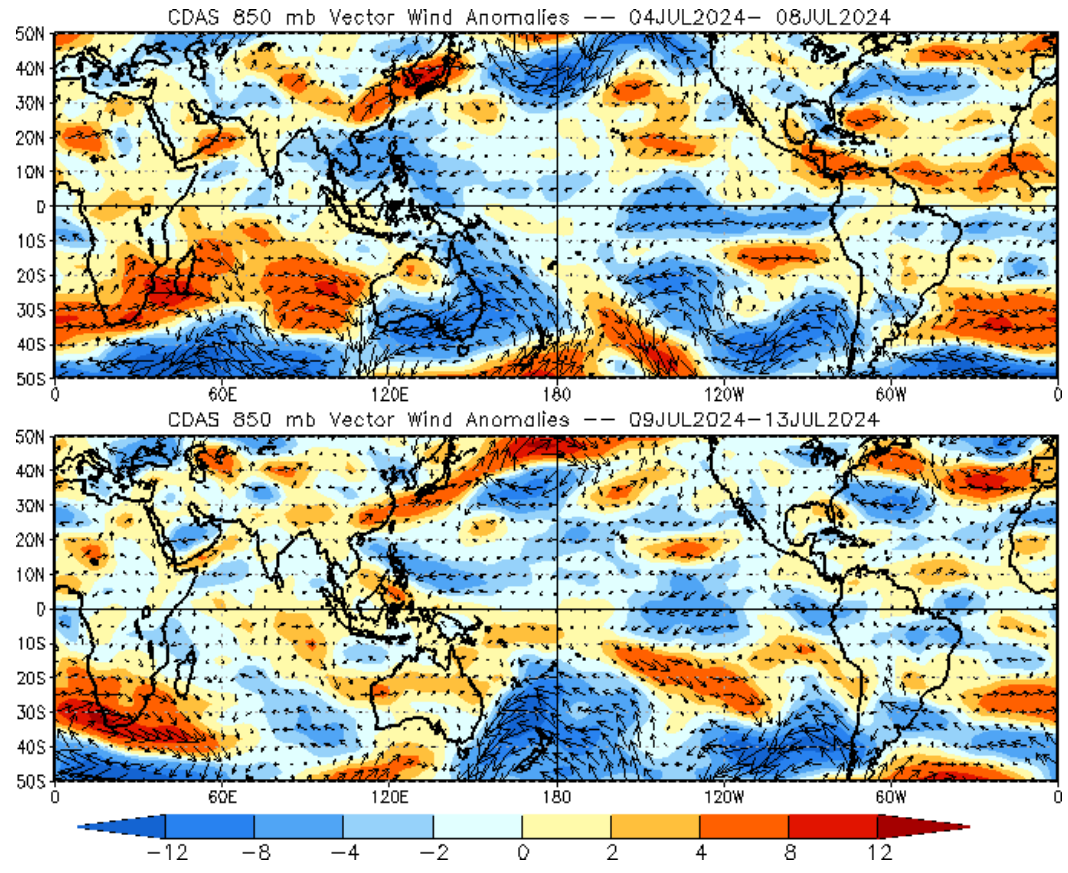
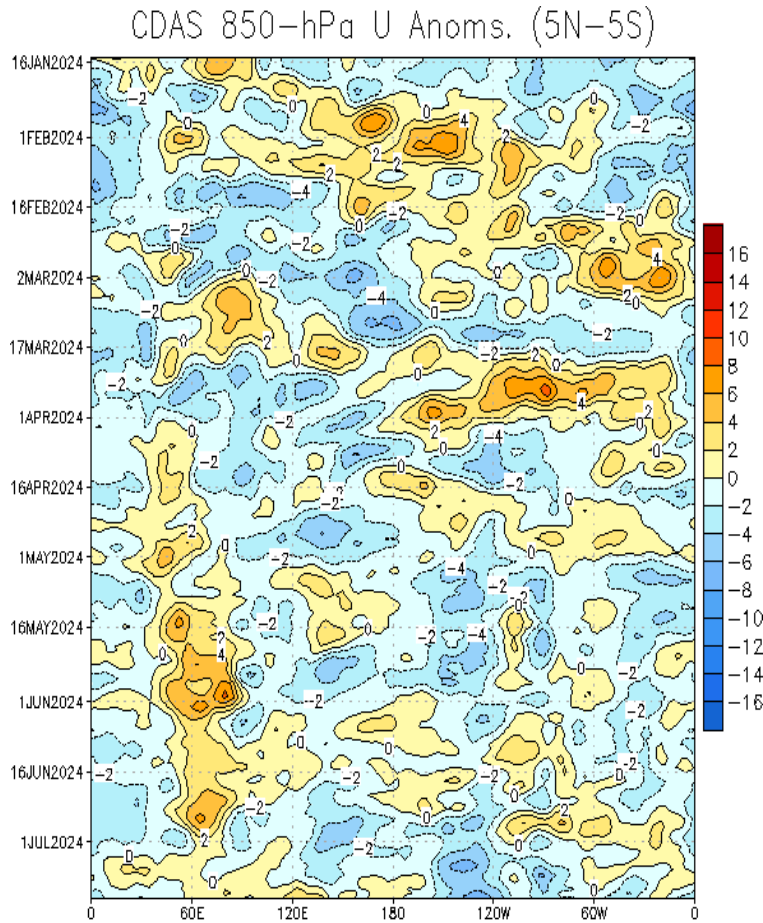
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Easterly anomalies have been subsiding over the tropical Atlantic and Caribbean.
- Westerly anomalies over the eastern equatorial Pacific have become less widespread, now confined east of 120W.
- Easterlies (westerlies) over the eastern Indian Ocean (Western Pacific) promote a broadly divergent pattern aloft over the Maritime Continent.

850-hPa Wind Anomalies

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

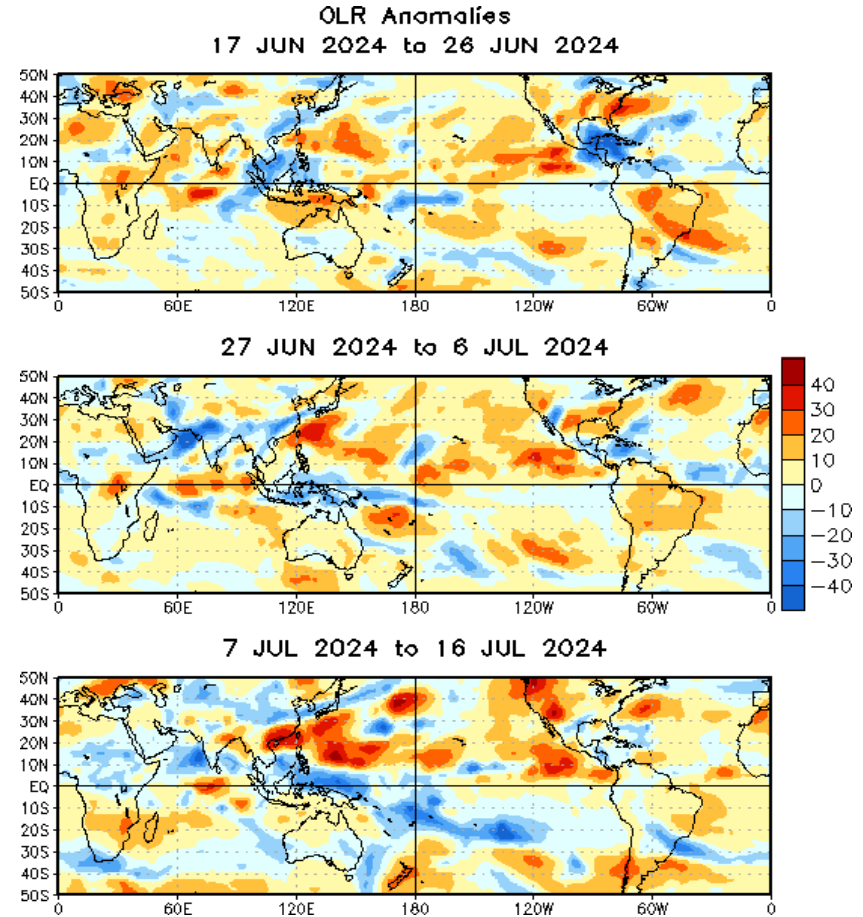
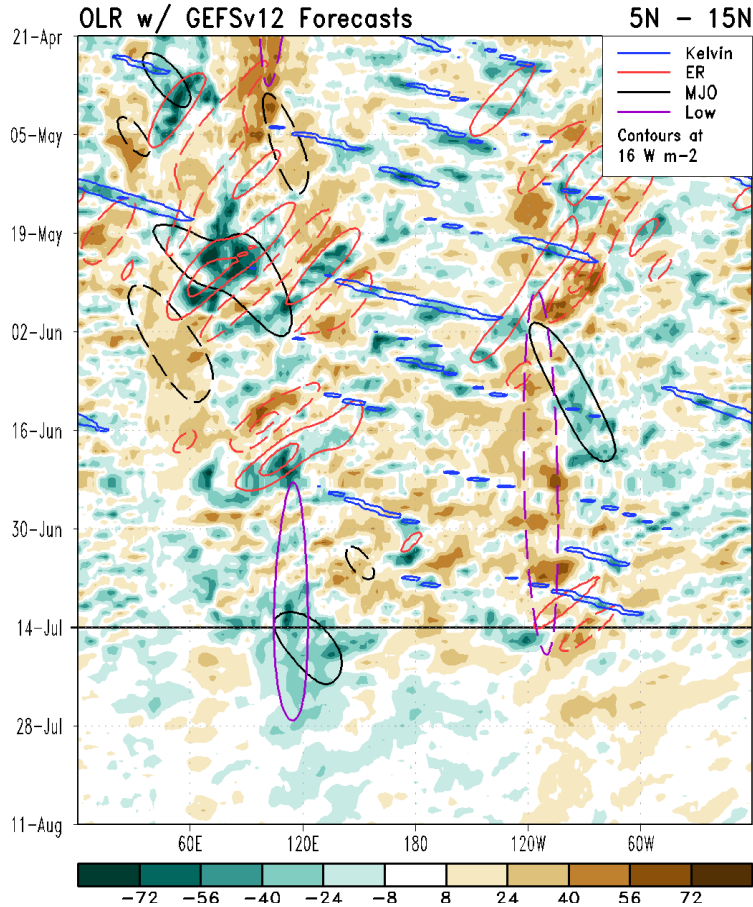


- Anomalous westerlies are weaker but persist over the western Indian Ocean, suggestive of a low frequency response.
- Westerly anomalies have also weakened after a recent surge across the far East Pacific, Caribbean, and tropical Atlantic.
- Trade winds remain enhanced east of the Date Line, but are currently not ideally located to promote further development of La Nina conditions.

Outgoing Longwave Radiation (OLR) Anomalies

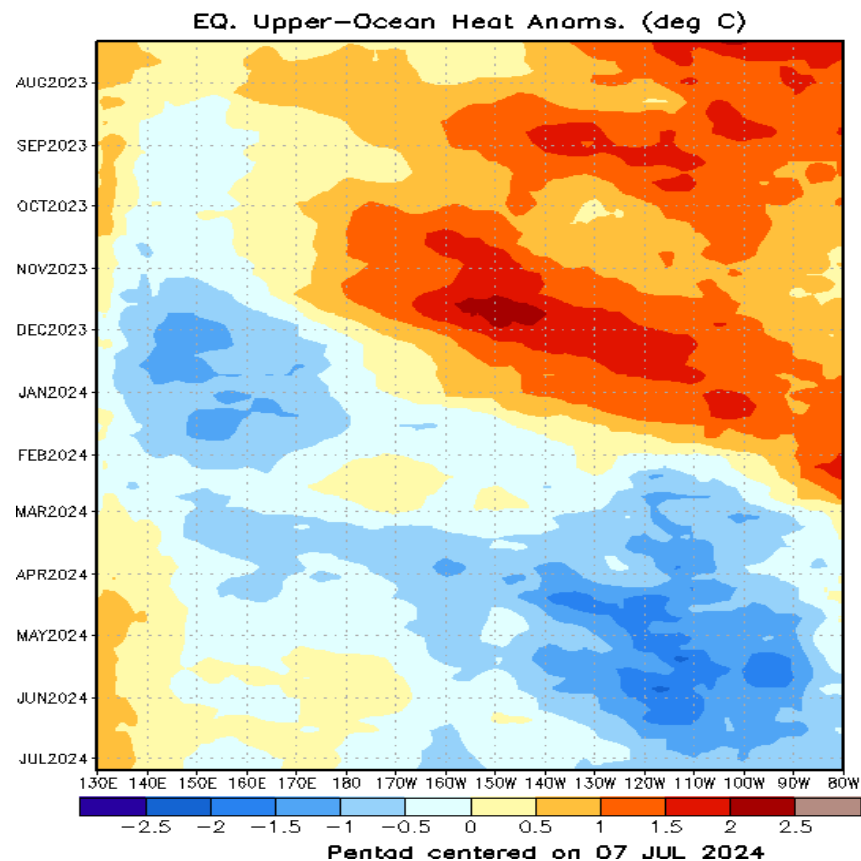
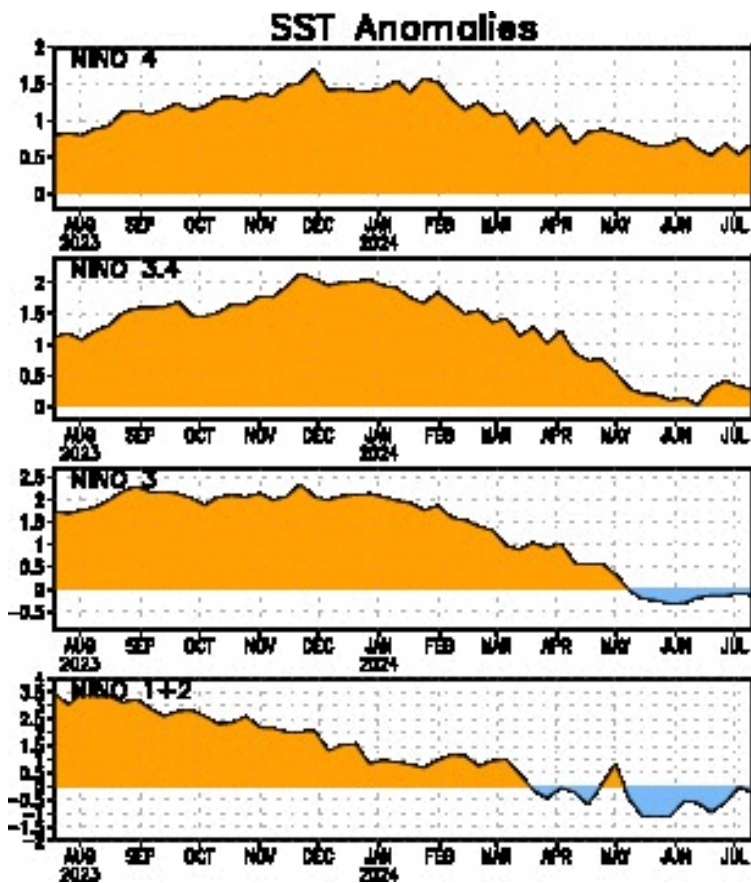
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Some structure is emerging in the OLR field after a largely disorganized period across the global tropics, with increased convection over the Maritime Continent and suppressed conditions downstream.
- GEFS forecasts indicate the potential for increased MJO activity with eastward propagation of relatively coherent enhanced and suppressed convection, although at weaker amplitude than current anomalies.

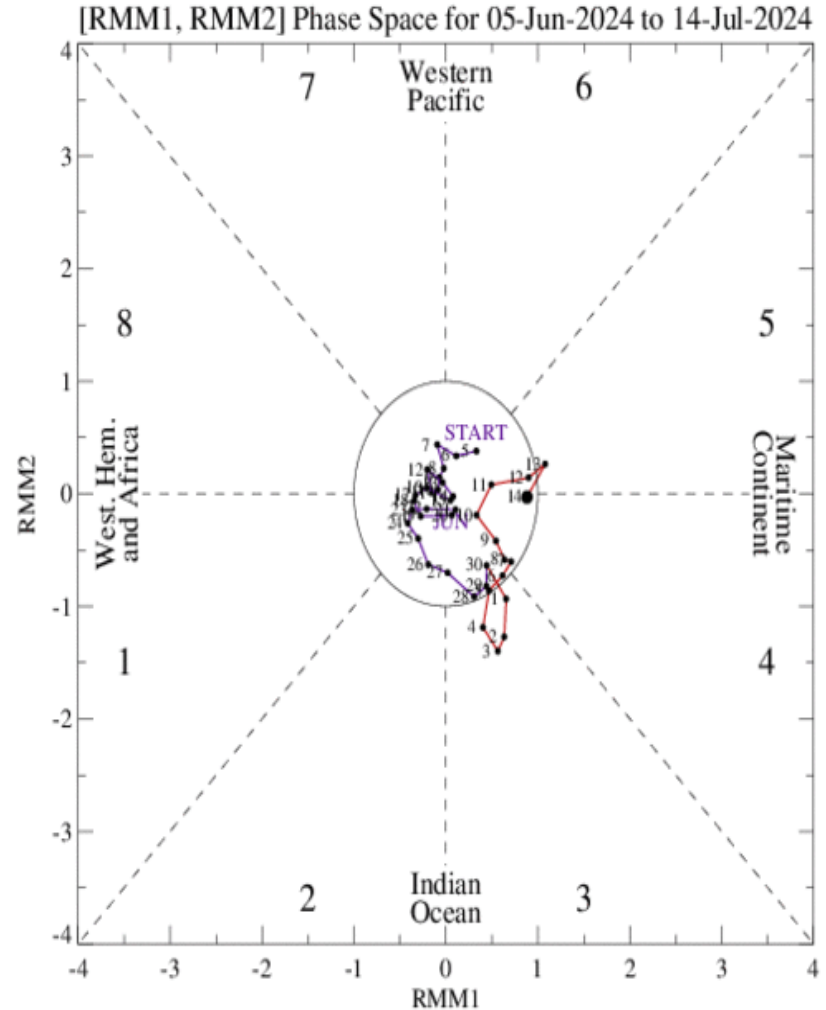
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs remain below average across the easternmost Niño monitoring regions, though the downward trend has recently abated for all regions.
- 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.

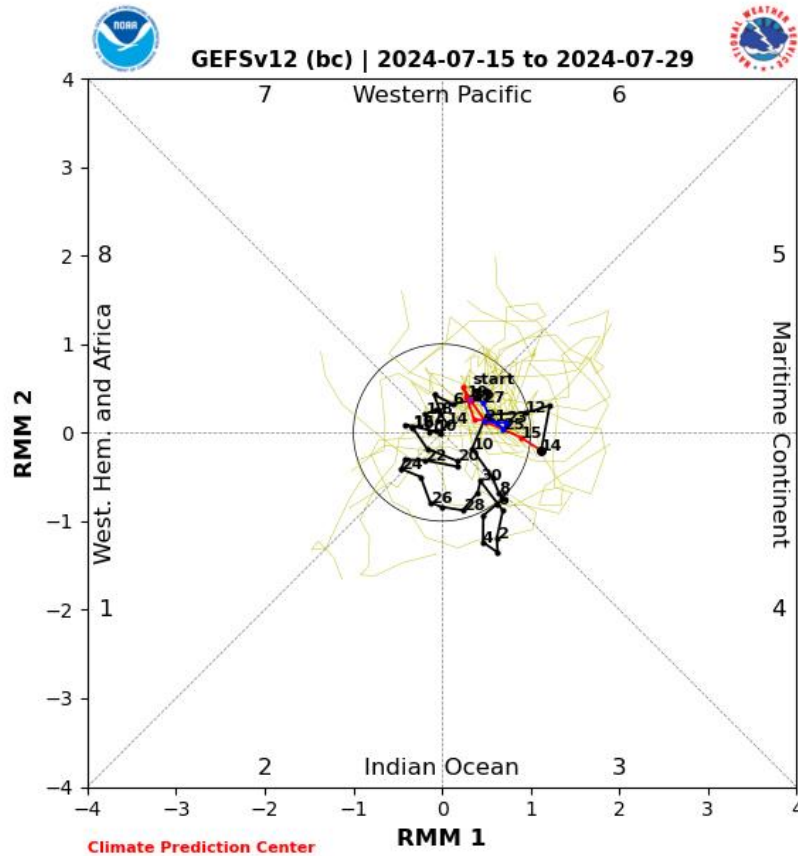
MJO Index: Recent Evolution

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

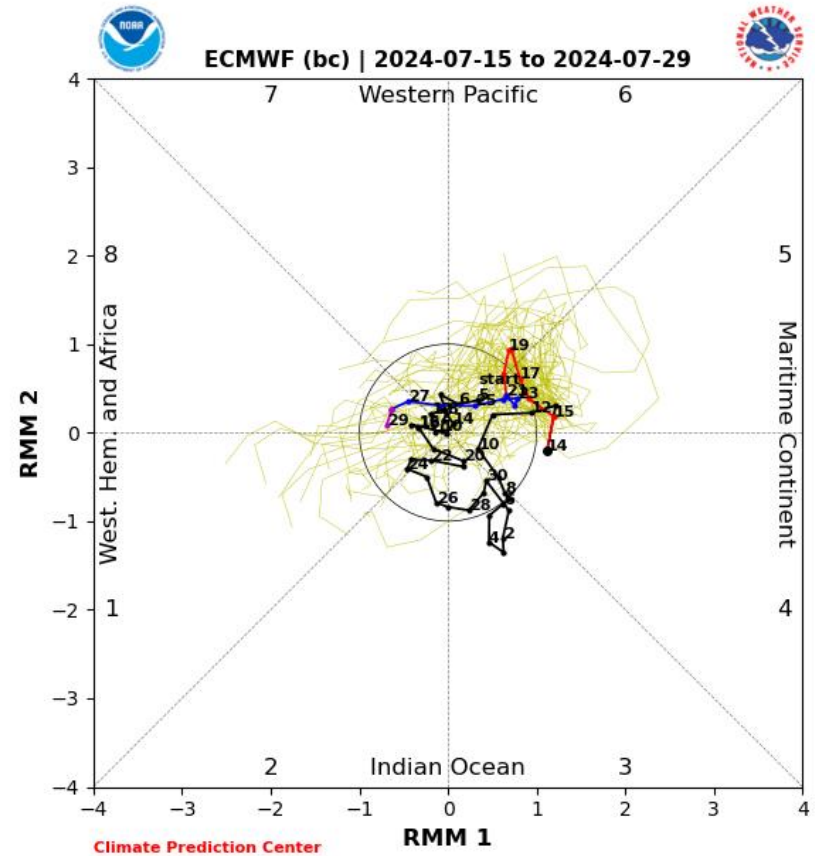


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



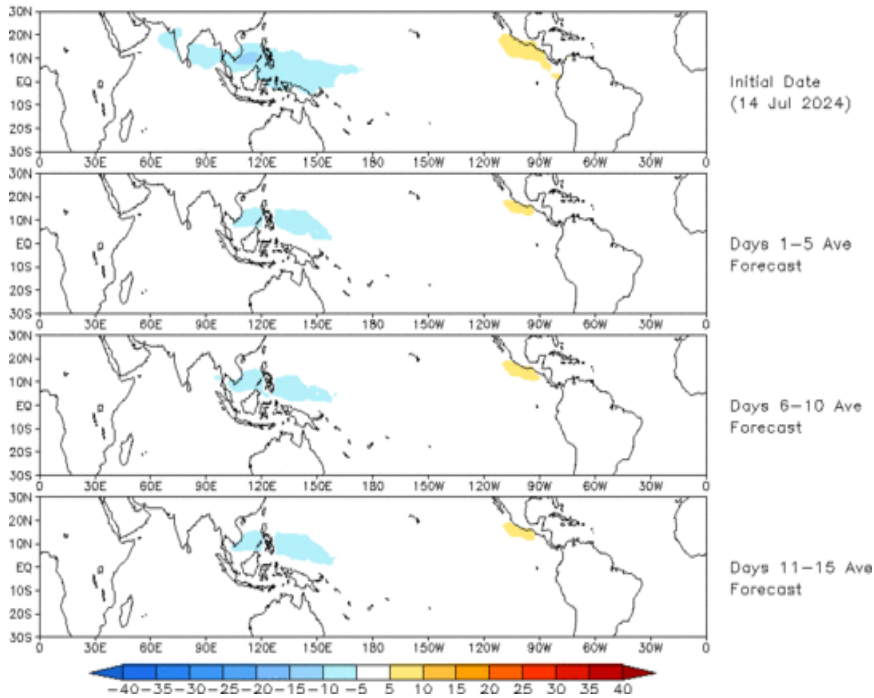
ECMWF Forecast

- The GEFS depicts continuing low-amplitude activity and poor propagation during the next two weeks.
- The ECMWF features a more coherent signal, steadily moving the RMM index from the Maritime Continent across the Pacific and into the Western Hemisphere over the next 3 weeks.

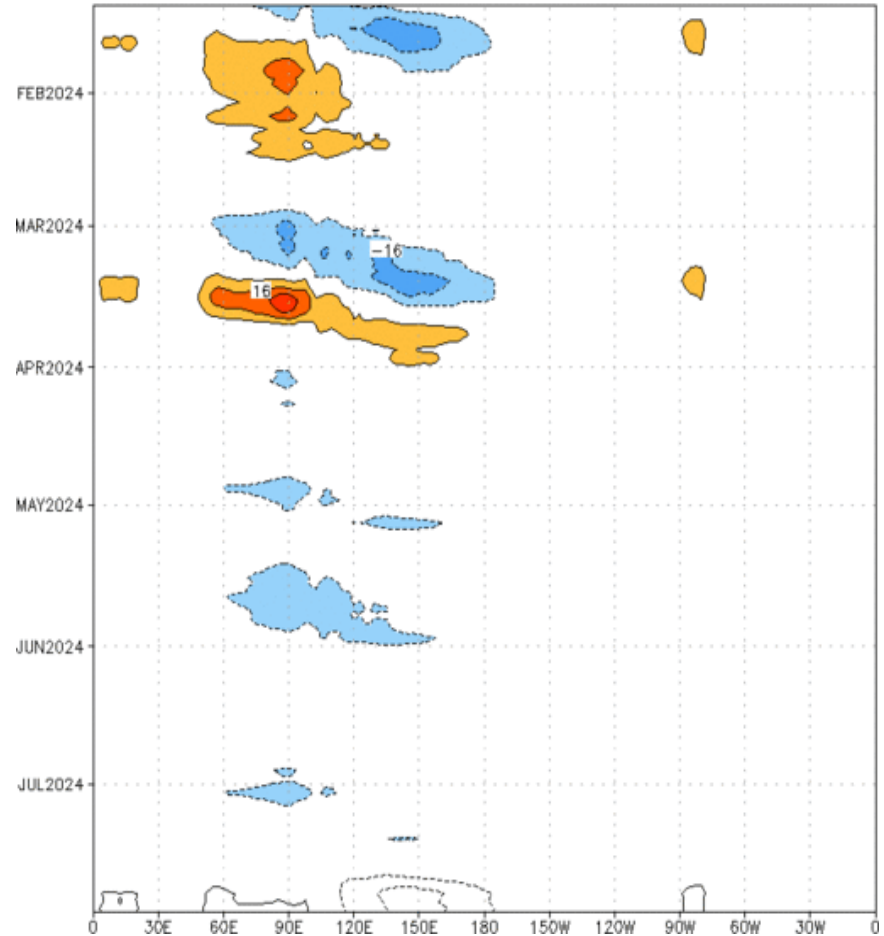
MJO: GEFS Forecast Evolution

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: 14 Jul 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:13-Jan-2024 to 14-Jul-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

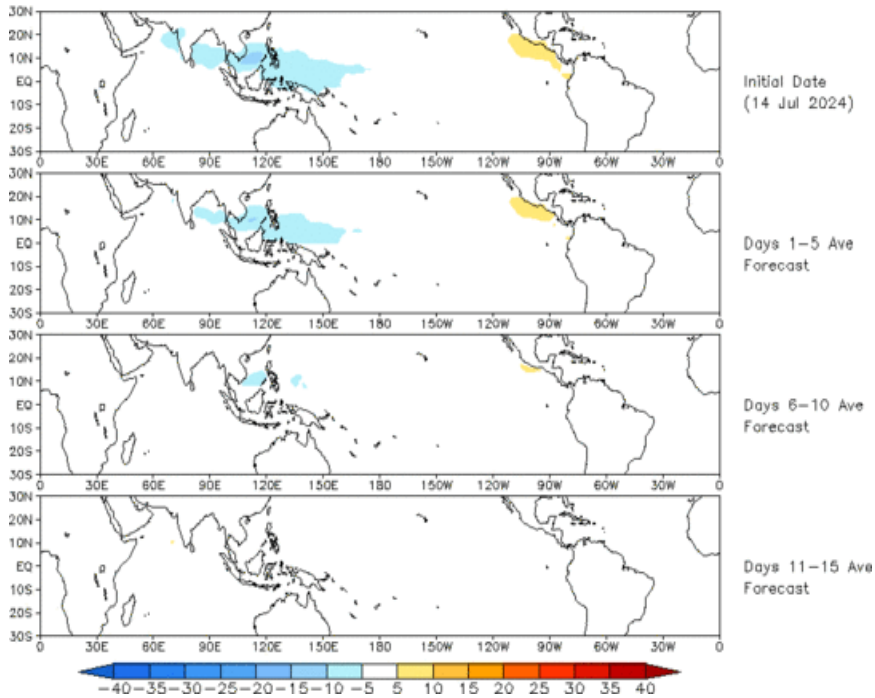


- With a low amplitude RMM-index projection in the GEFS, the associated OLR anomaly field is quite weak.

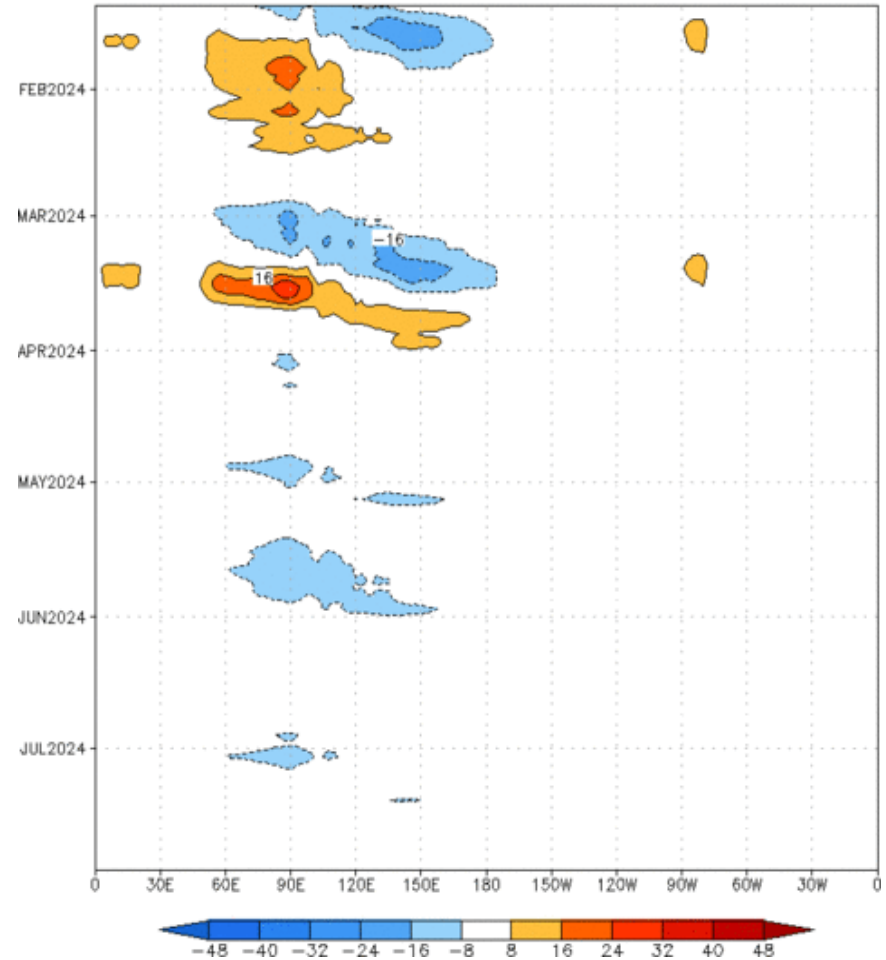
MJO: Constructed Analog Forecast Evolution

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 (14 Jul 2024)



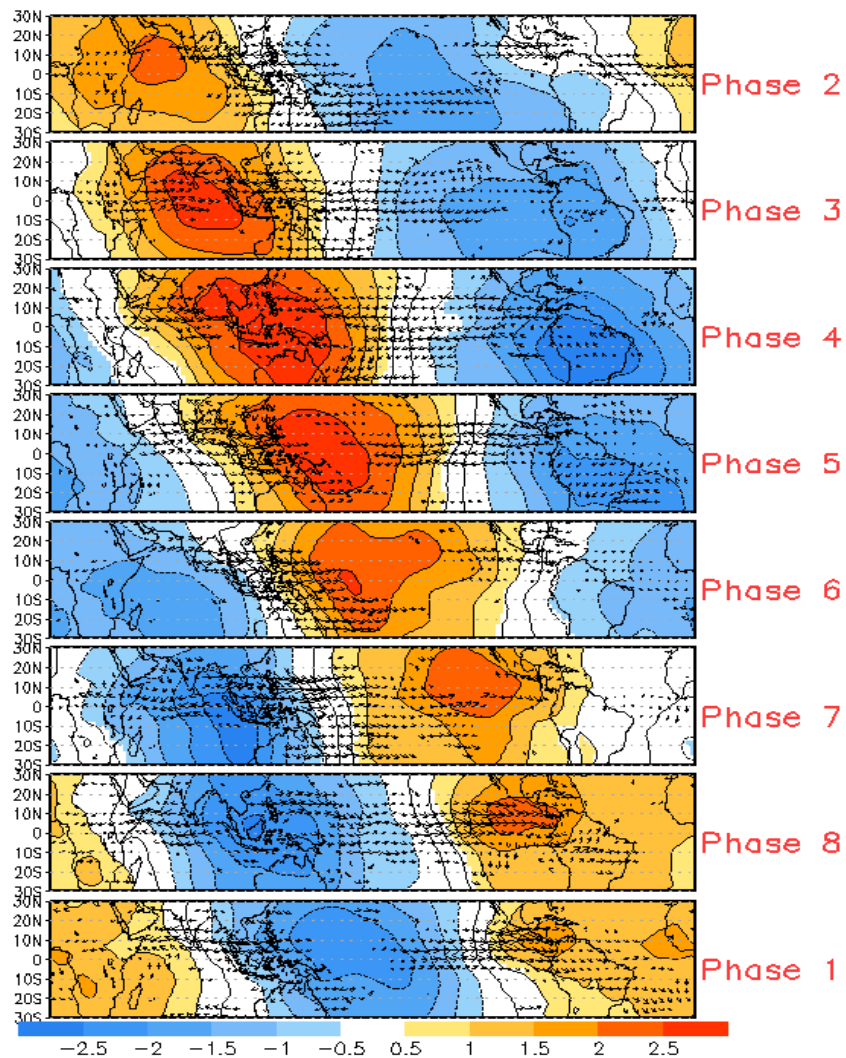
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:13-Jan-2024 to 14-Jul-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



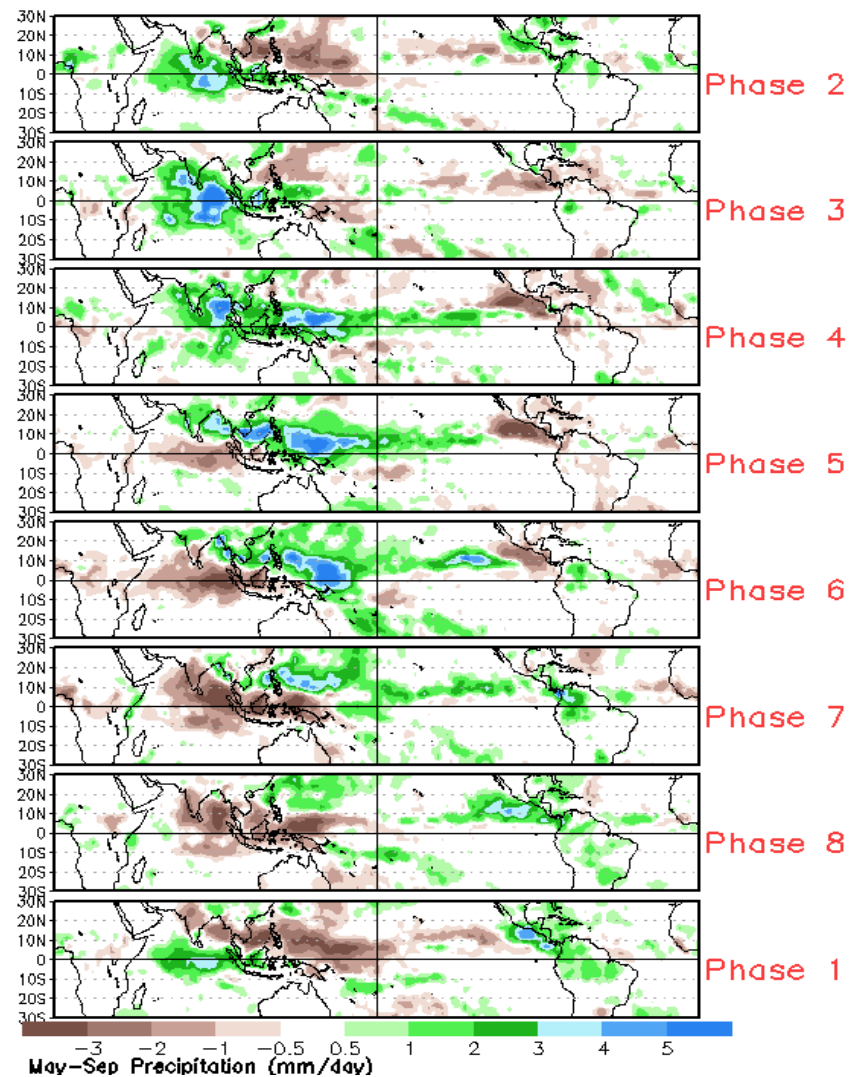
- The constructed analog tool like the GEFS shows very weak MJO-related anomalies, approaching climatology by the end of week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



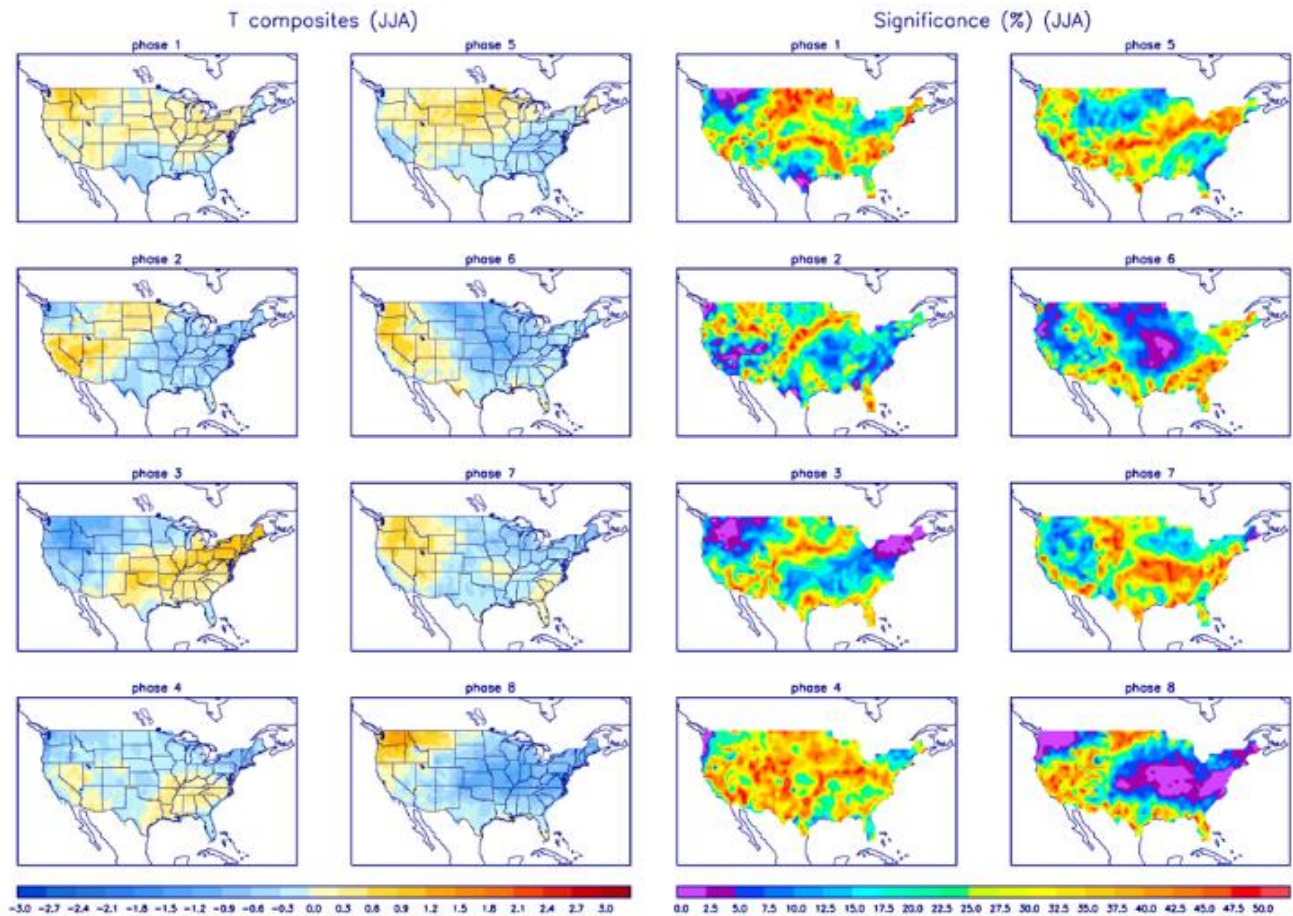
Precipitation Anomalies



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.

