

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



**Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
12 August 2024**

Overview

- RMM observations continue to show signs of renewed, eastward propagating MJO activity over the western Hemisphere.
- There has been good continuity in the dynamical models advertising robust MJO activity developing over the Indian Ocean and Maritime Continent during the next several weeks in both RMM and upper-level velocity potential anomaly space.
- In addition to a more canonical MJO event unfolding, constructively interfering Kelvin and Rossby wave activity favored over Africa and the Indian Ocean also look to contribute to more favorable conditions for additional Tropical Cyclone (TC) development in the Atlantic, in-line with an increasingly active climatology later in August and heading into September.
- Tropical cyclogenesis is also possible in the Indian Ocean on both sides of the equator tied to a Westerly Wind Burst (WWB) favored near 70-80E.
- With an enhanced trade regime expected to overspread the Maritime Continent and equatorial Pacific tied to the suppressed phase of the MJO, there are decreased chances for TC 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:

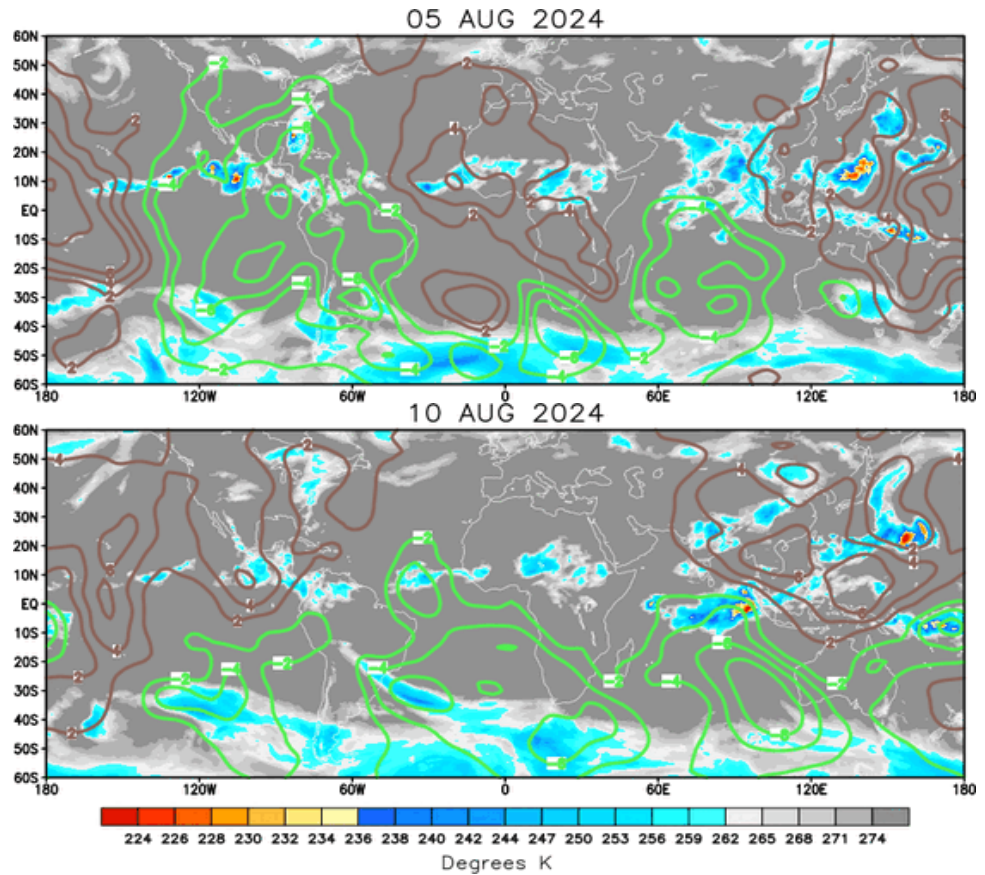
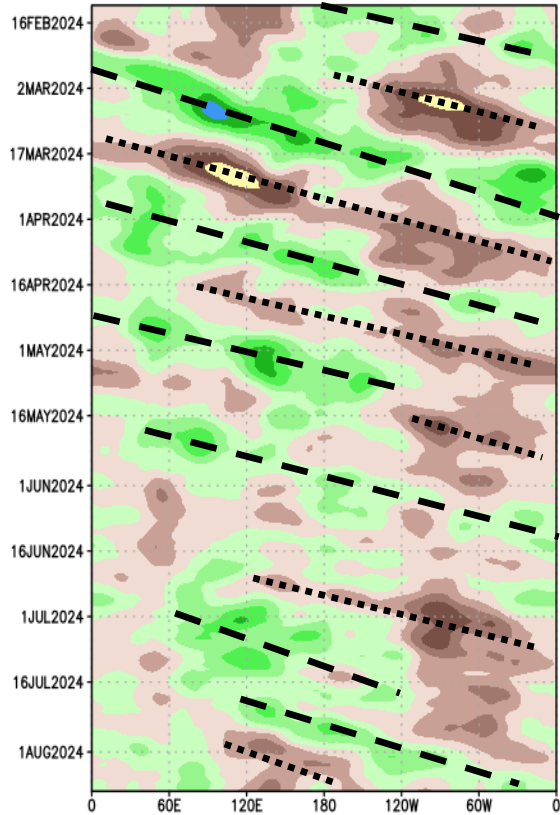
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

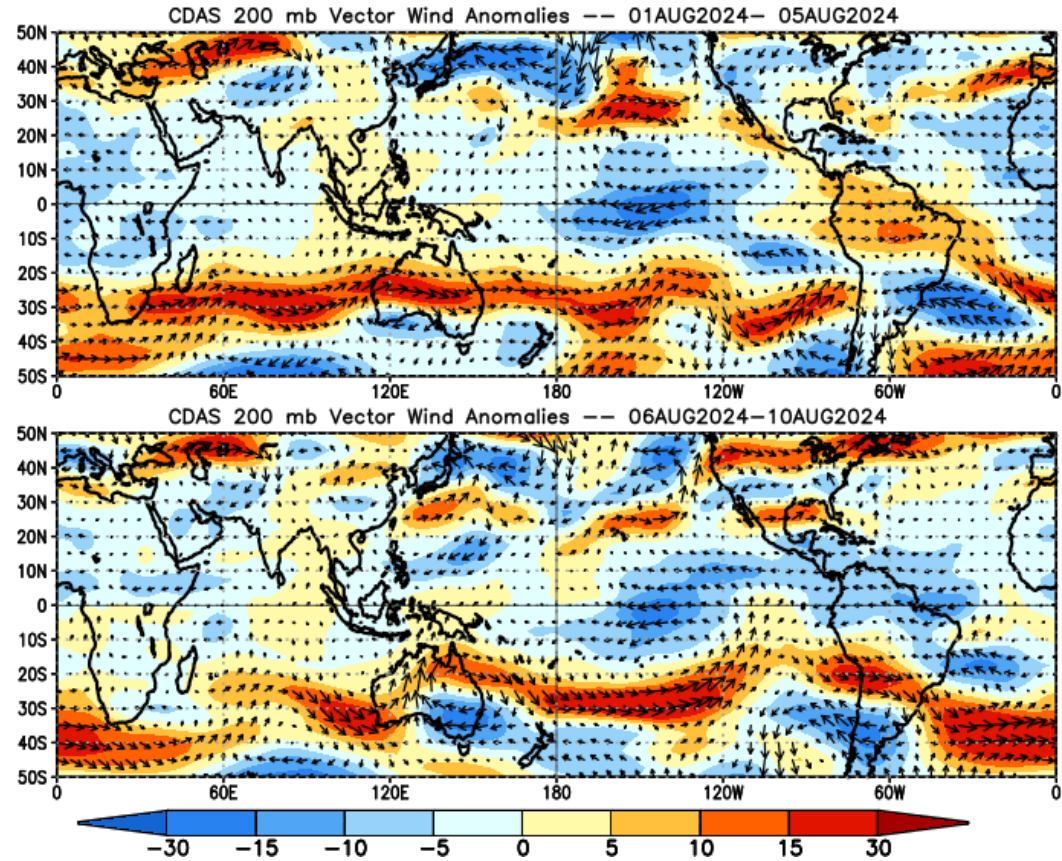
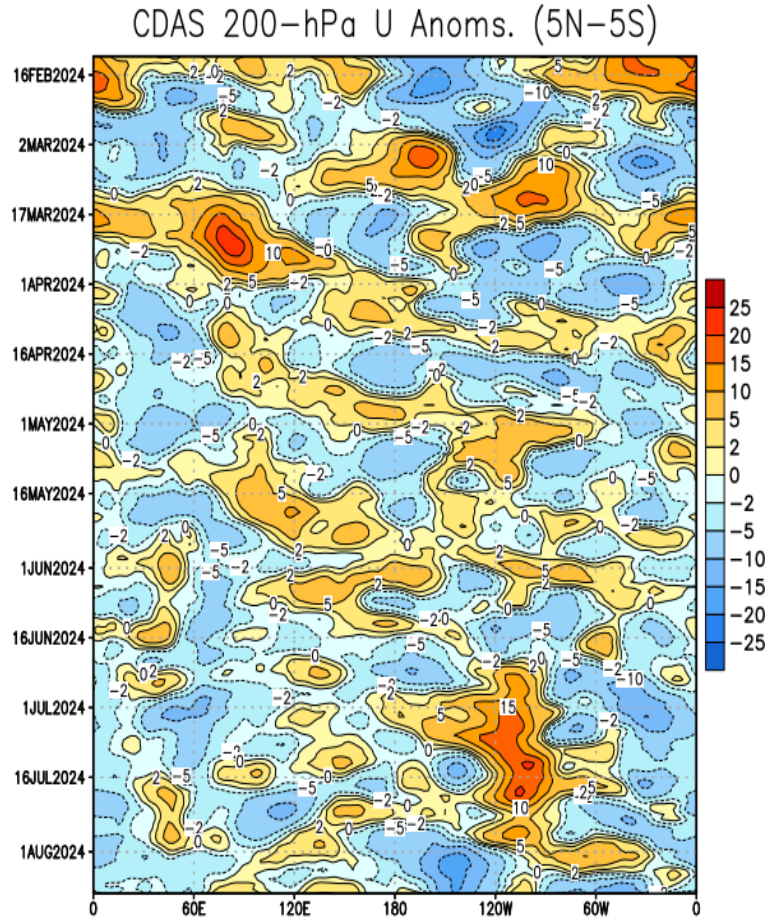
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Spatially, upper-level velocity potential anomalies reveal less of wave-2 pattern compared to earlier in August, though much of the enhanced divergence aloft is expressed south of the equator.
- The time/longitude plot shows an eastward propagating feature was able to break through a suppressed low frequency footprint over the tropical Americas, and likely contributed to the development of four Tropical Cyclones in the eastern Pacific since late July.

200-hPa Wind Anomalies

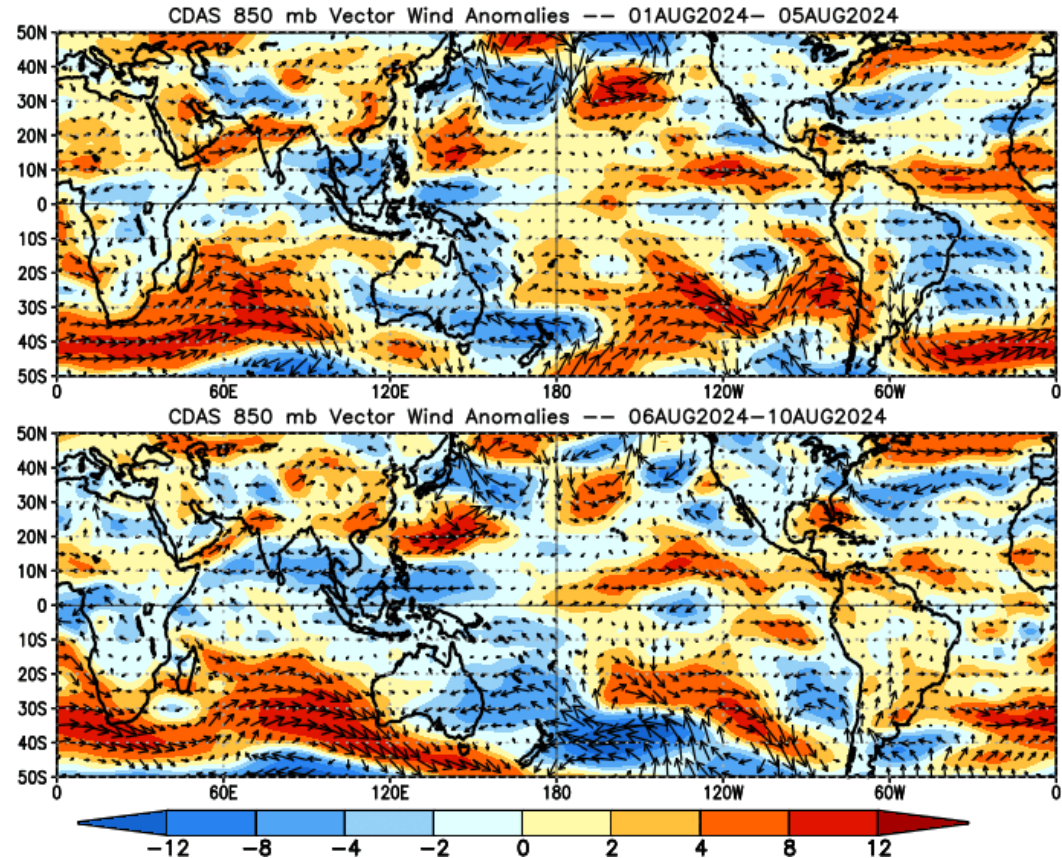
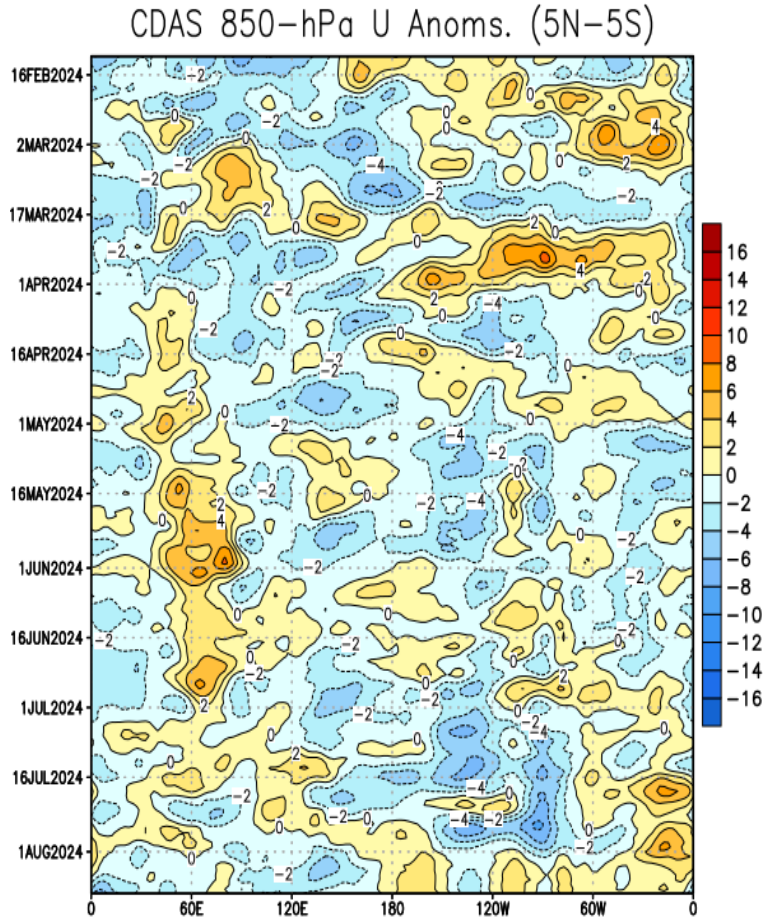
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Upper-level easterly anomalies strengthened across the east-central Pacific, helping to reduce shear across the East Pacific. These easterlies continued to shift into the tropical Atlantic, providing a more favorable environment for TC genesis in the tropical Atlantic.
- Although weak, anomalous westerlies developed over the equatorial Indian Ocean, suggestive of more coherent intraseasonal activity.

850-hPa Wind Anomalies

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

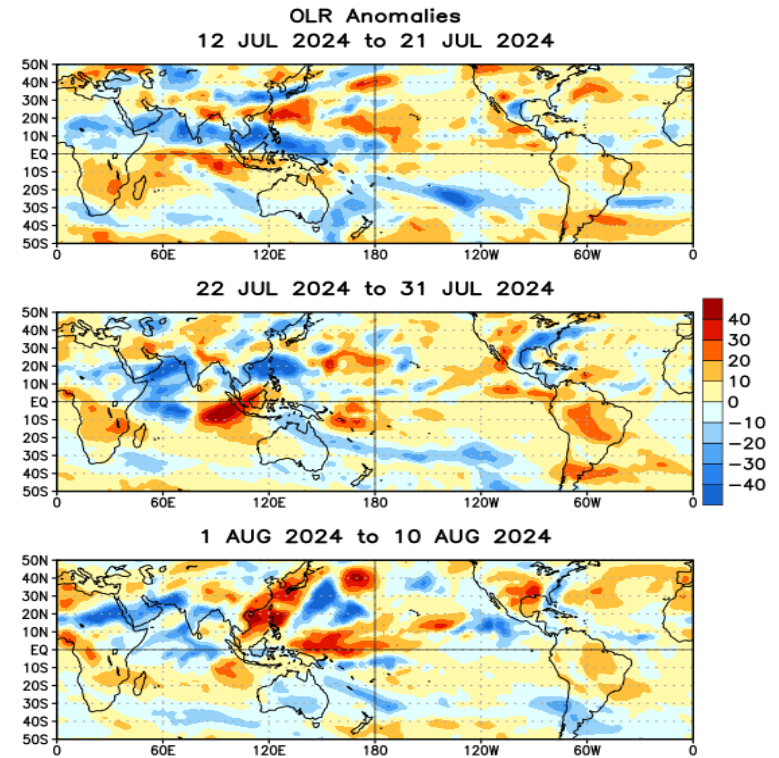
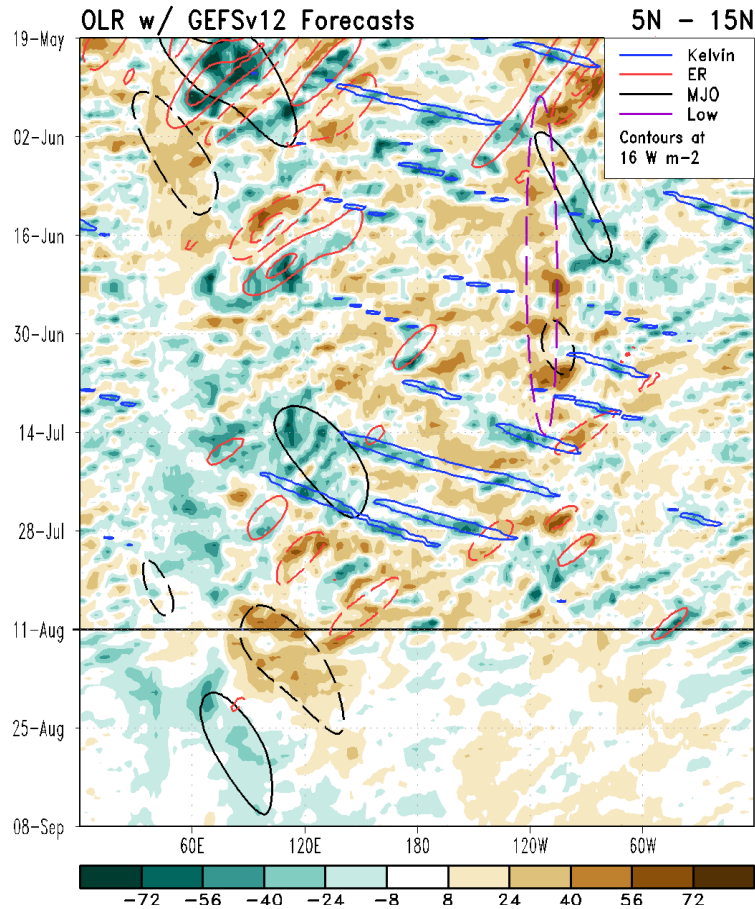


- Strongly anomalous westerlies continued across the western Hemisphere and extending into sub-Saharan Africa
- Anomalous easterlies strengthened over the Indian Ocean while shifting into the Maritime Continent.
- A wave train is observed over the northern Pacific, likely tied to continued Tropical Cyclone activity in the Philippine Sea.

Outgoing Longwave Radiation (OLR) Anomalies

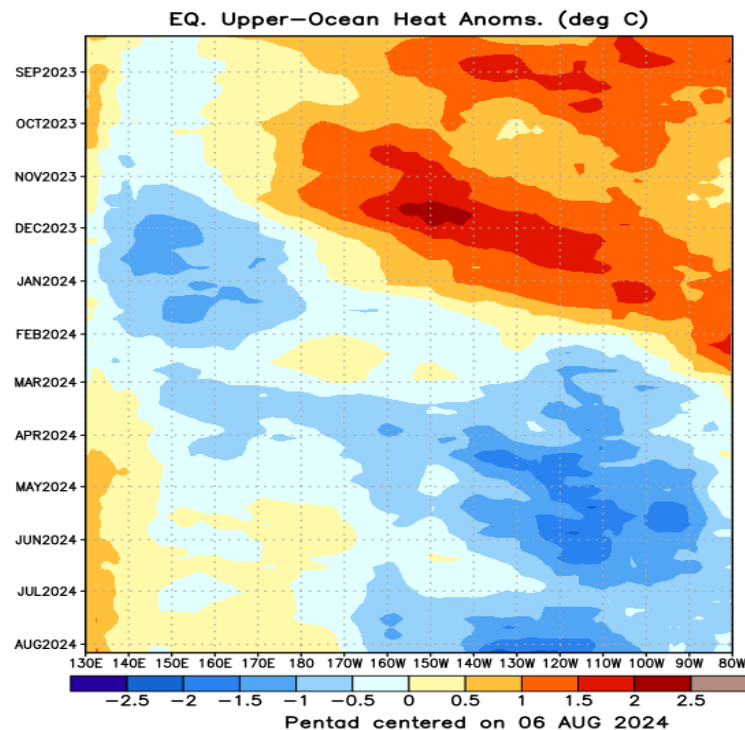
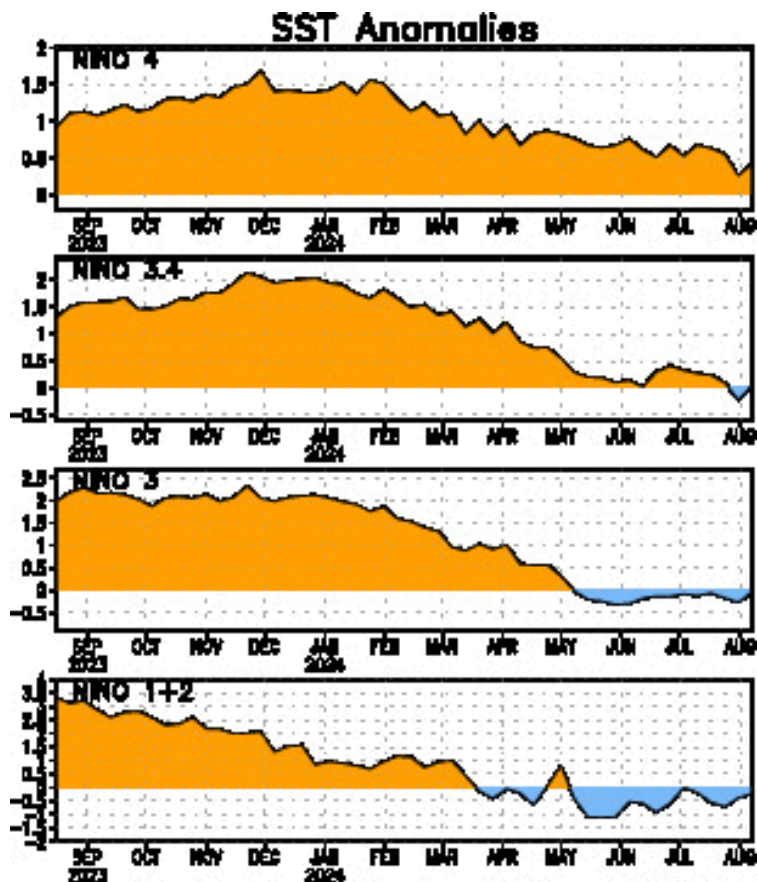
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Enhanced convection returned over the eastern Pacific, following a period of where convection was largely suppressed since late May
- More MJO activity is coming through the filtering compared to previous OLR analyses, with enhanced convection favored to return to the eastern Hemisphere during the forecast period .

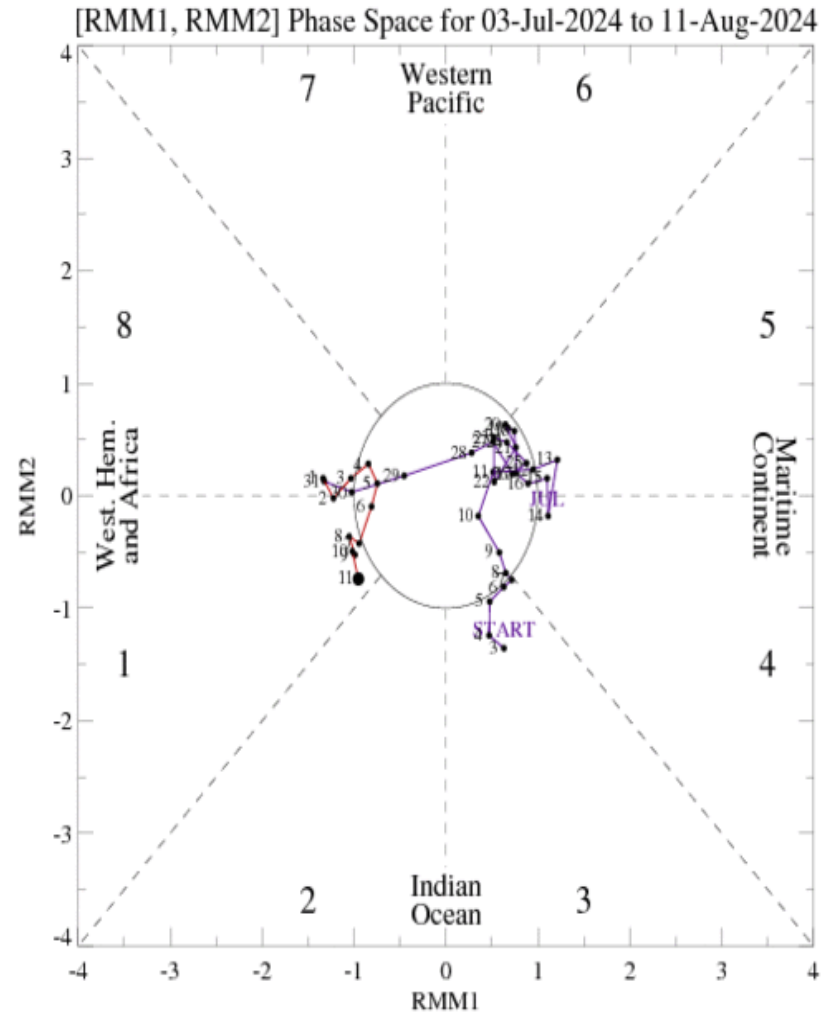
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Since early summer, SST anomalies continue to trend downward, where Niño 3.4 is now registering below-normal. Positive anomalies remain in the Niño 4 region.
- Subsurface anomalies depict a better defined dipole, where below normal oceanic heat anomalies continue to strengthen over the eastern Pacific.

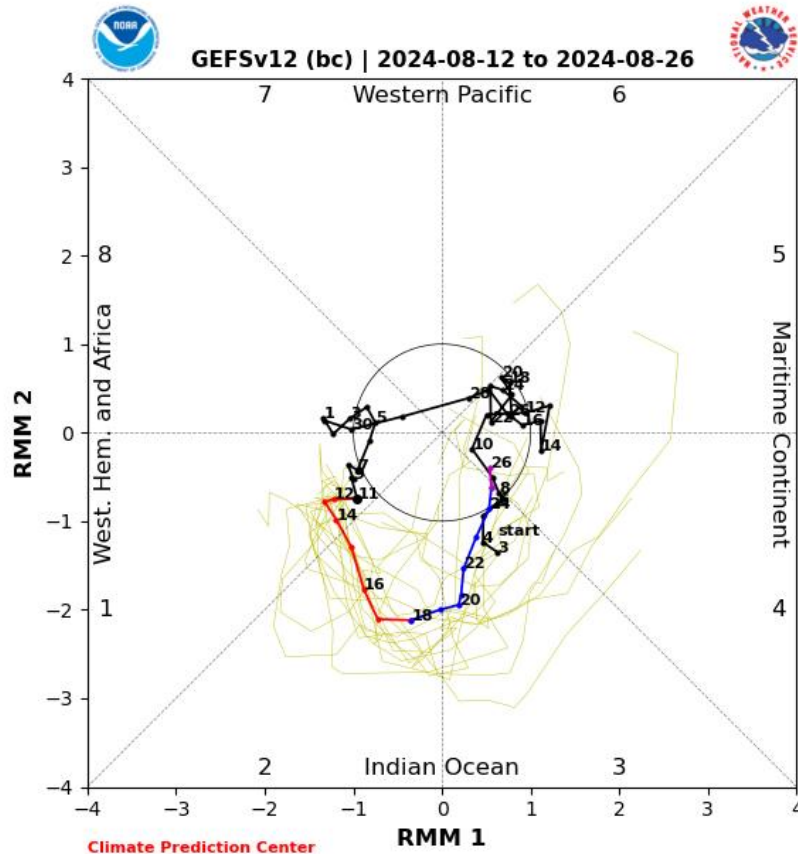
MJO Index: Recent Evolution

- During the past week, the RMM MJO index depicts an eastward propagating signal that has gradually gained amplitude over the Western Hemisphere.

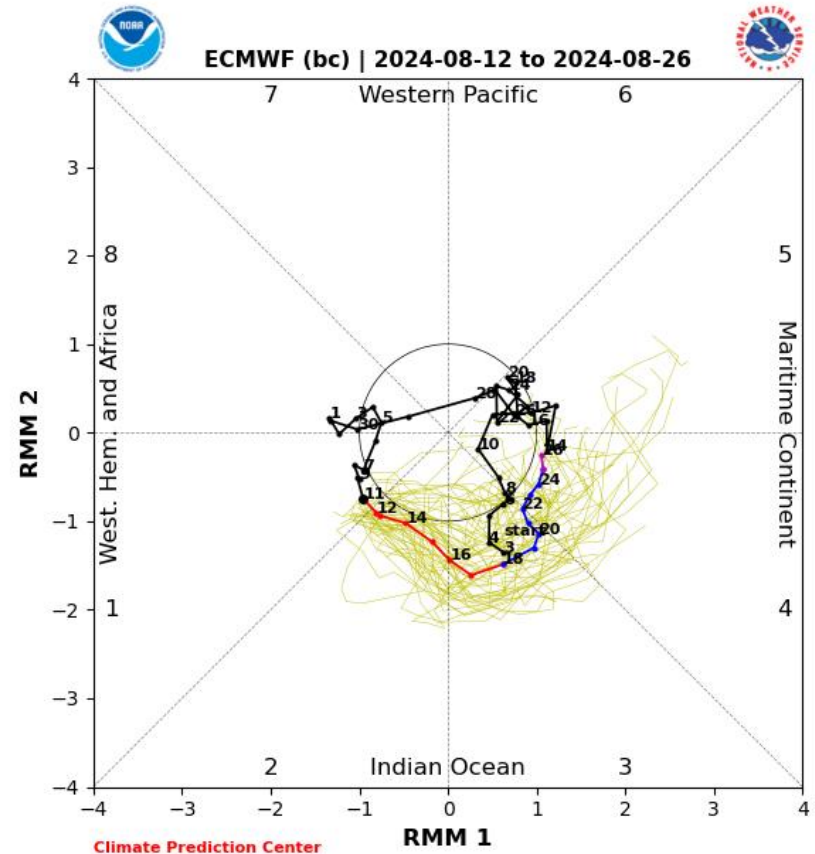


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



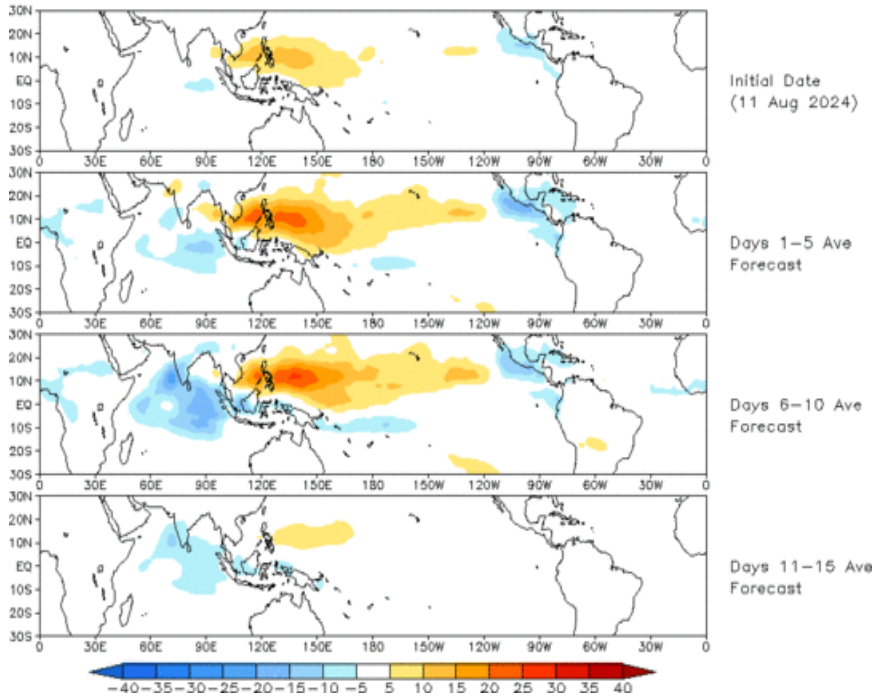
ECMWF Forecast

- There has been good continuity in the dynamical models favoring a stronger MJO signal over the Western Hemisphere while propagating eastward into the Maritime Continent later in August.
- Any model disagreement pertains to the potential amplitude of the event. Regardless, any reemerging MJO activity is likely to provide increasingly favorable conditions for TC development in the tropical Atlantic.

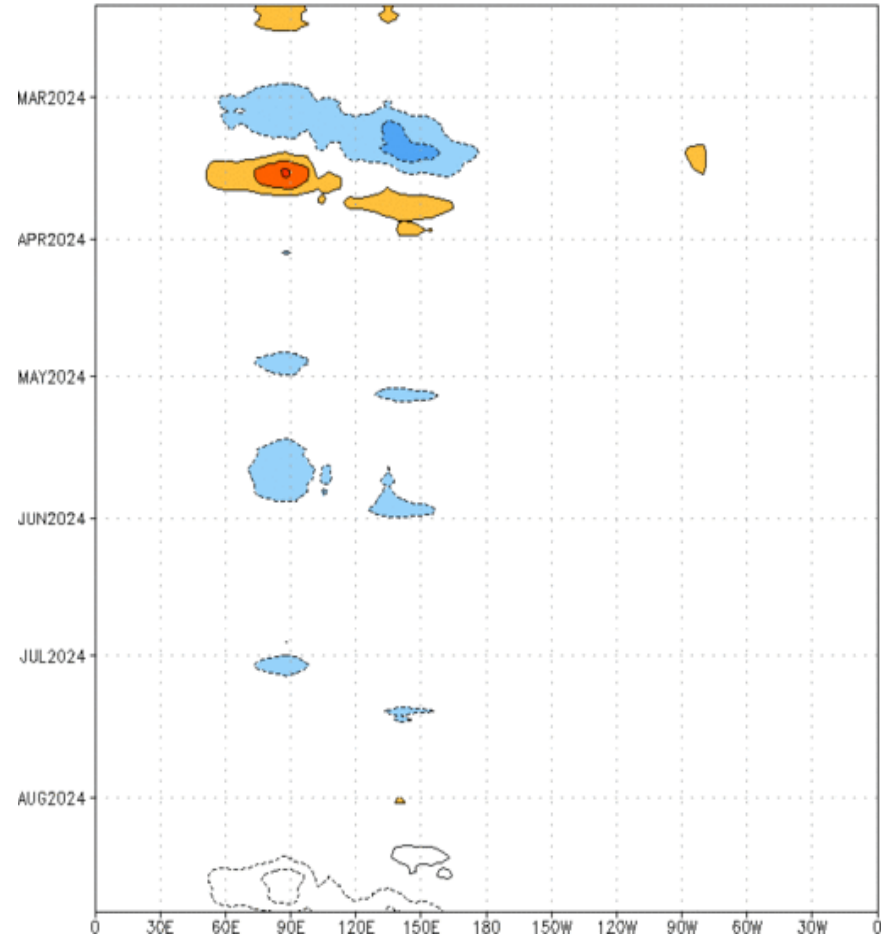
MJO: GEFS Forecast Evolution

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: 11 Aug 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 10-Feb-2024 to 11-Aug-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

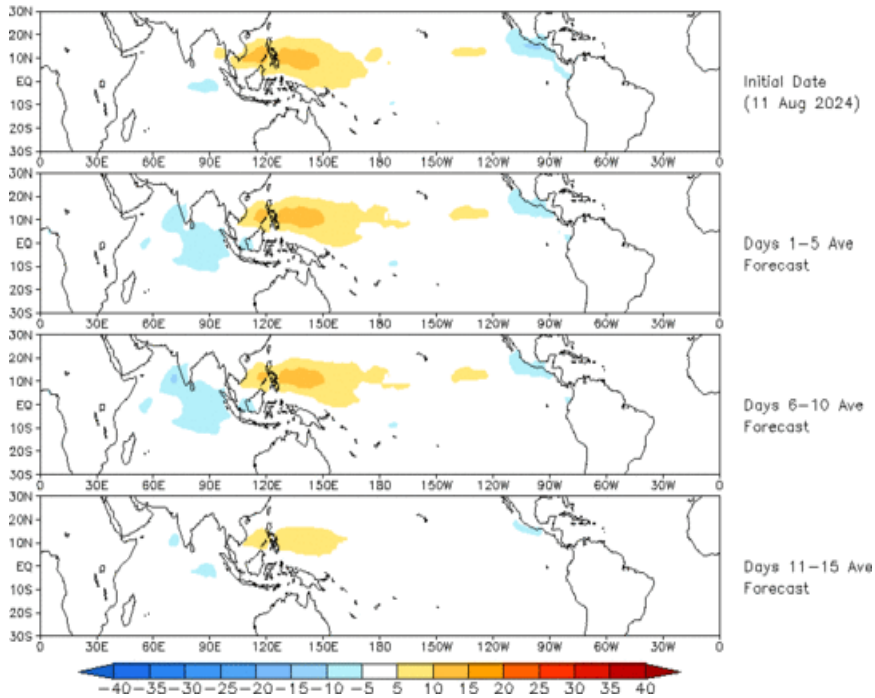


- The OLR anomaly evolution based on the GEFS RMM index shows more coherent MJO activity with enhanced (suppressed) convection developing over the tropical Americas (western Pacific).

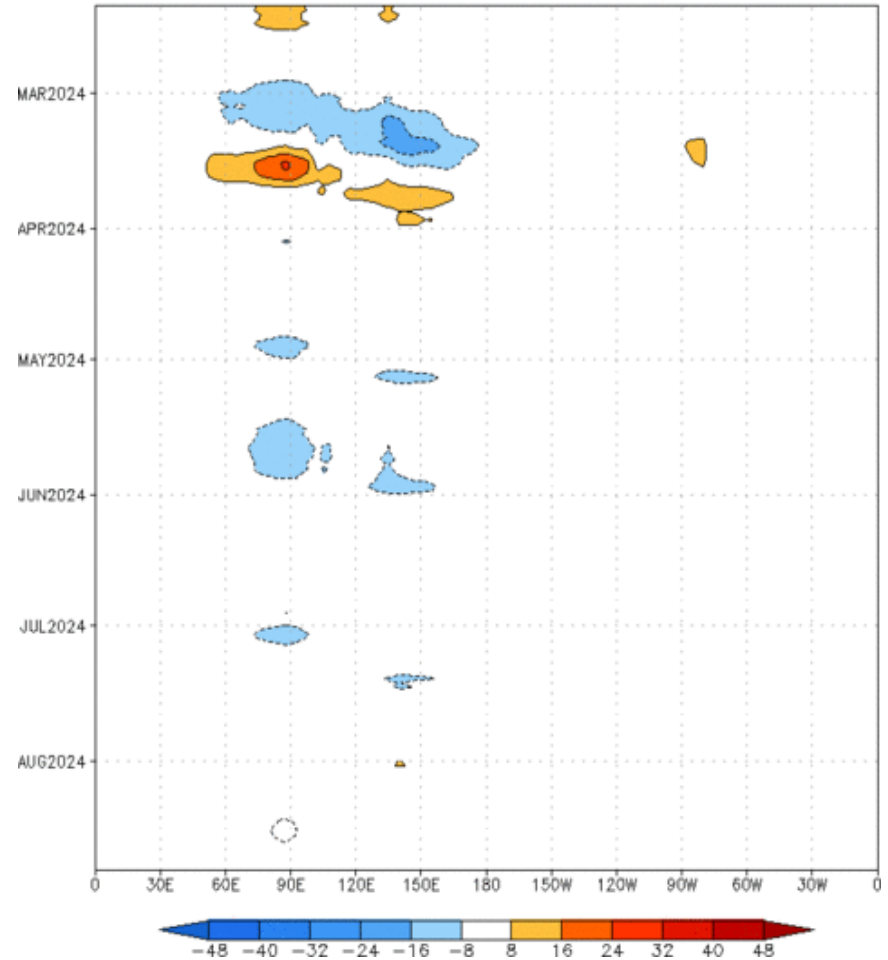
MJO: Constructed Analog Forecast Evolution

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 (11 Aug 2024)



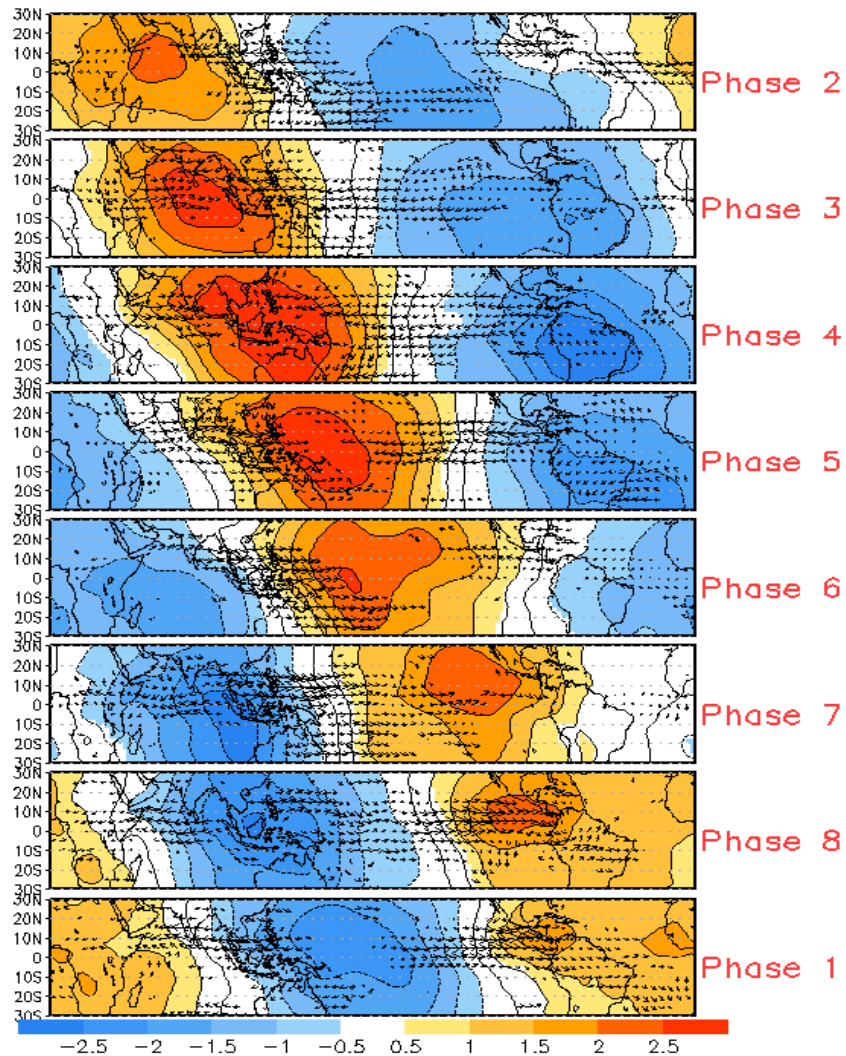
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:10-Feb-2024 to 11-Aug-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



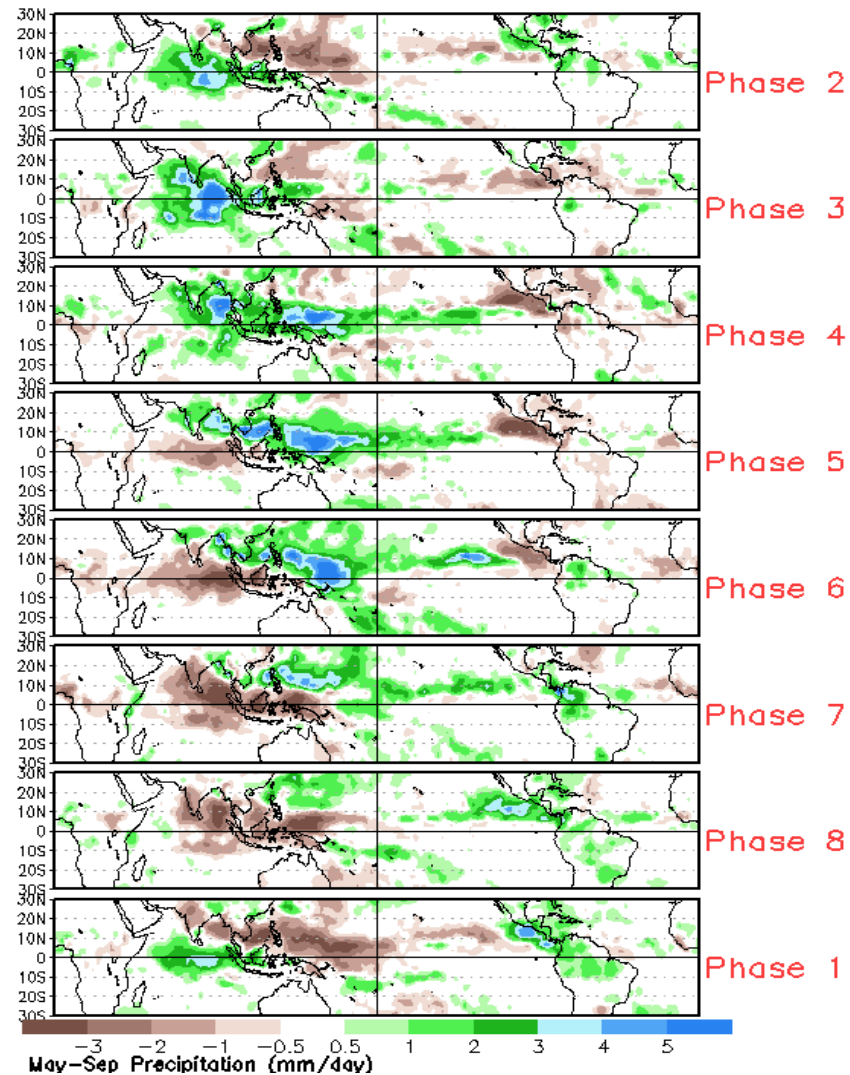
- The constructed analog is similar to the GEFS, with a slightly decreased amplitude.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



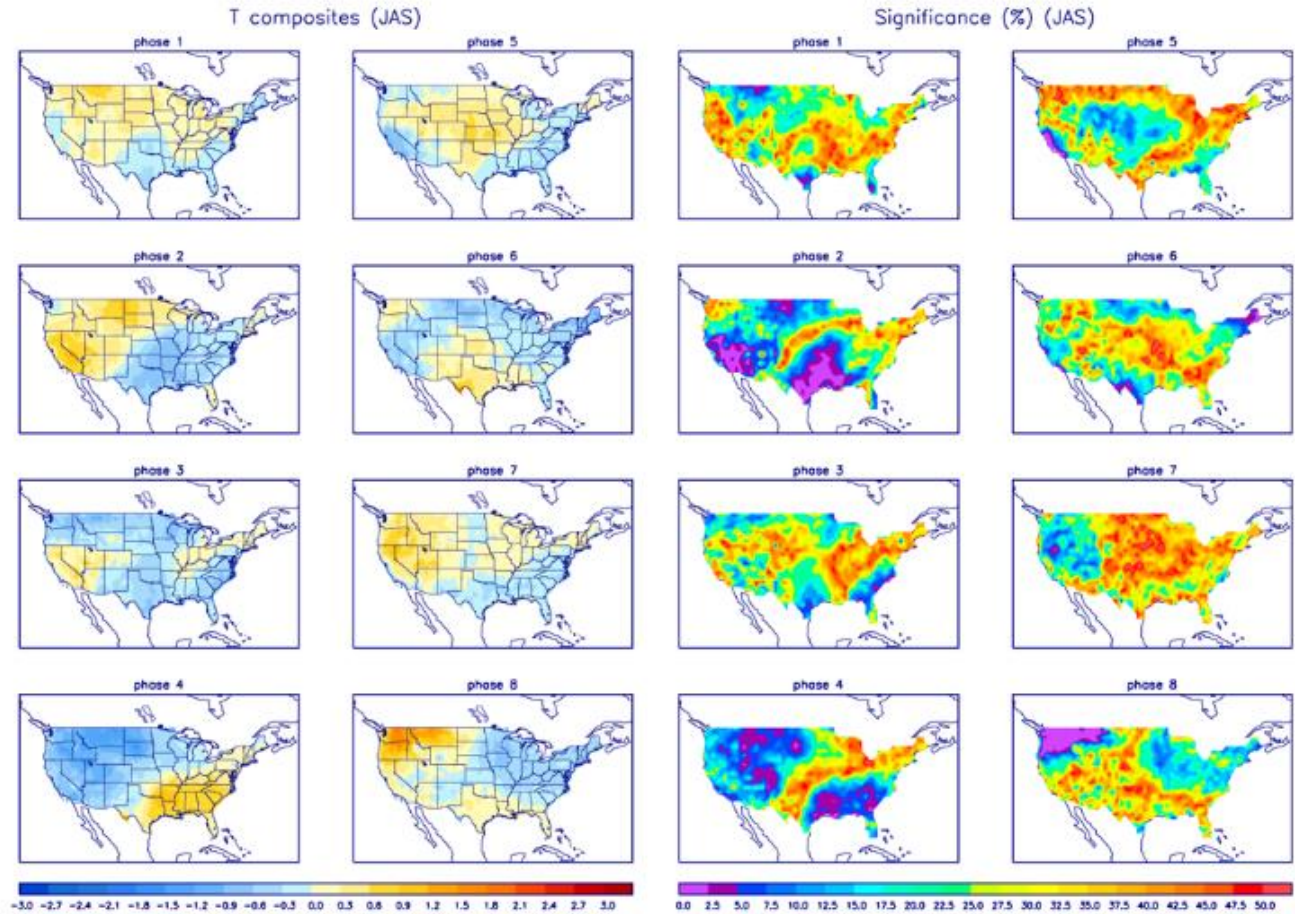
Precipitation Anomalies



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.

