

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



**Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
31 July 2023**

Overview

- Although the MJO remains relatively weak, the upper-level velocity potential field depicts a more robust signal with an enhanced (suppressed) phase over the Western (Eastern) Hemisphere.
- Dynamical model MJO index forecasts reflect a continued low-amplitude MJO signal.
- Based on a weak MJO propagating eastward over the Western Hemisphere, El Nino, and model guidance, multiple tropical cyclones are forecast across the East Pacific prior to week-2.
- By weeks 2 and 3, there remains an elevated chance of tropical cyclone development for the East Pacific while the Atlantic basin typically becomes more active later in August. However, El Nino may offset this climatology.

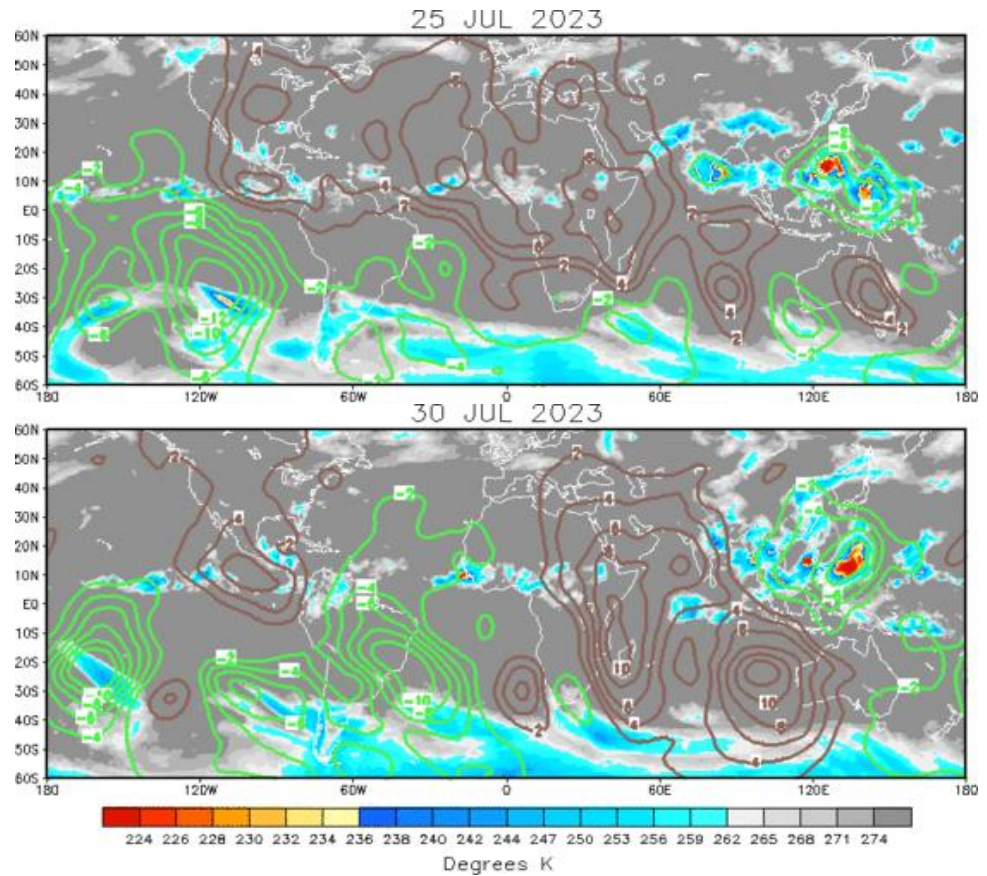
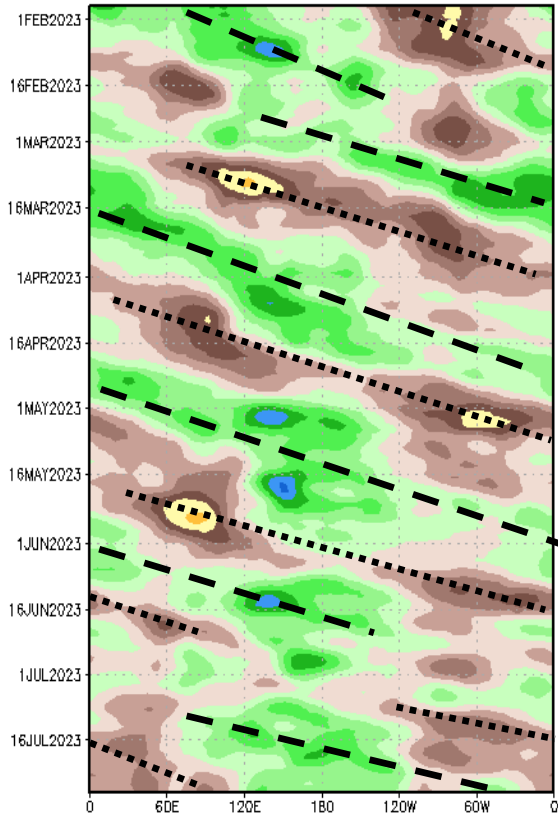
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

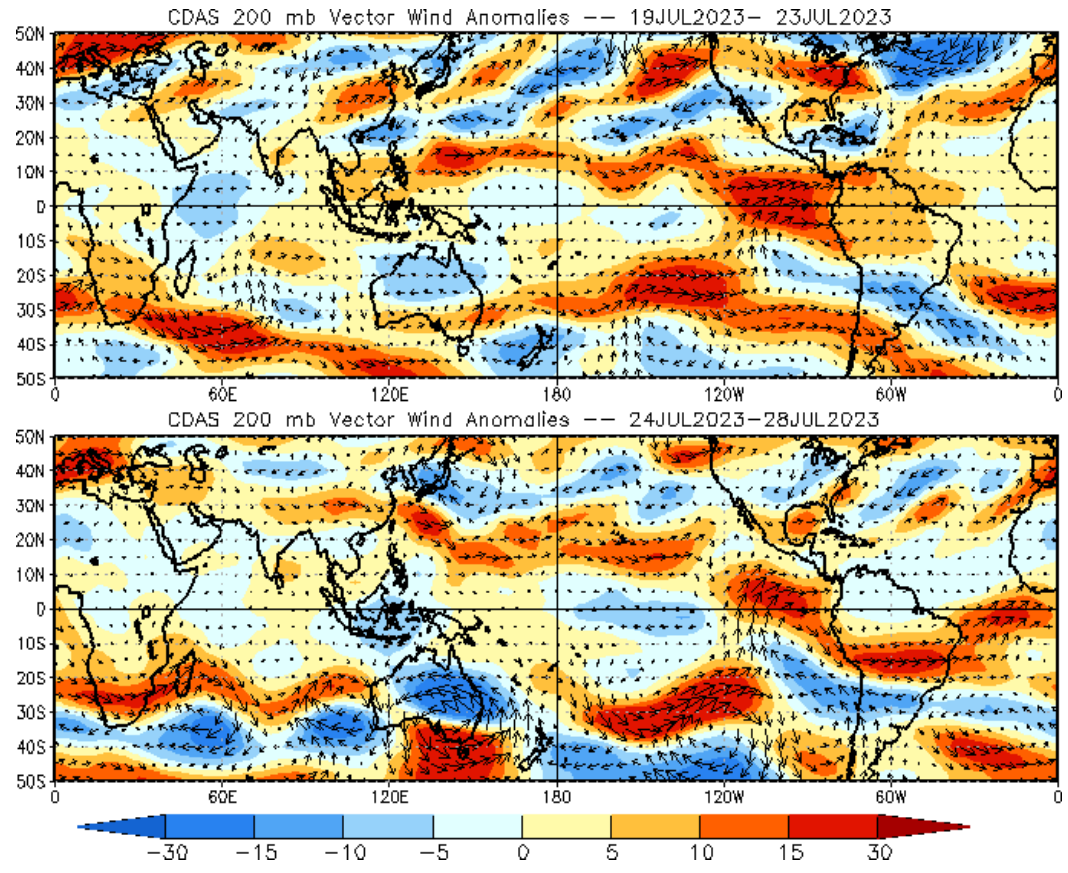
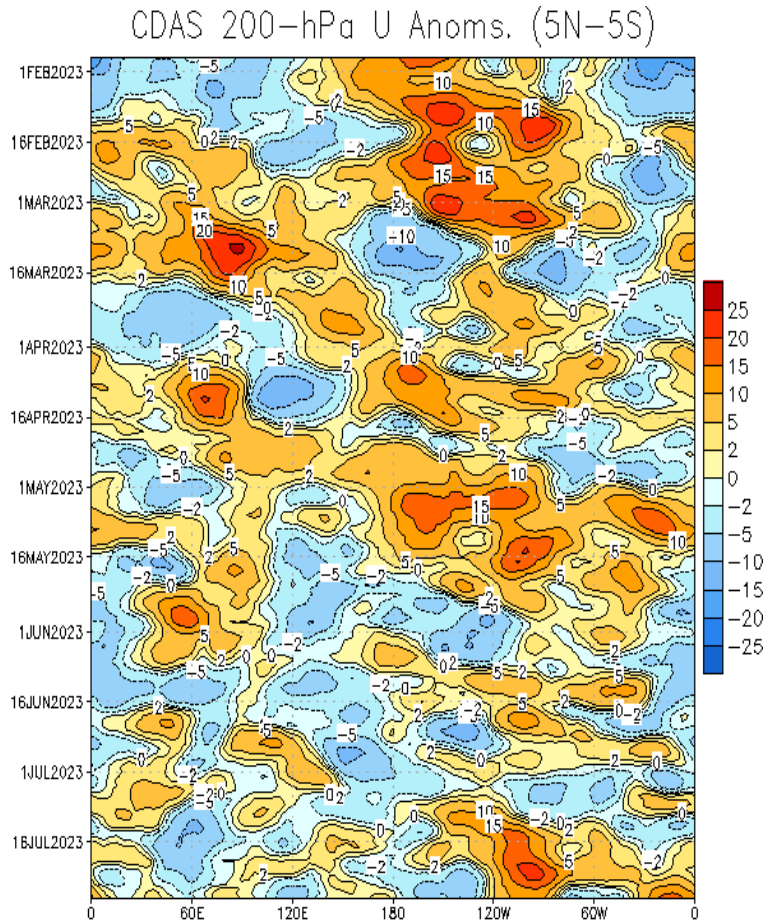
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- By late July, a more discernable wave-1 pattern emerged with the enhanced convective envelope over the Maritime Continent.
- Although there was recent eastward propagation of anomalous upper-level convergence from the Americas and Africa to the Indian Ocean, the enhanced convective envelope became less coherent.

200-hPa Wind Anomalies

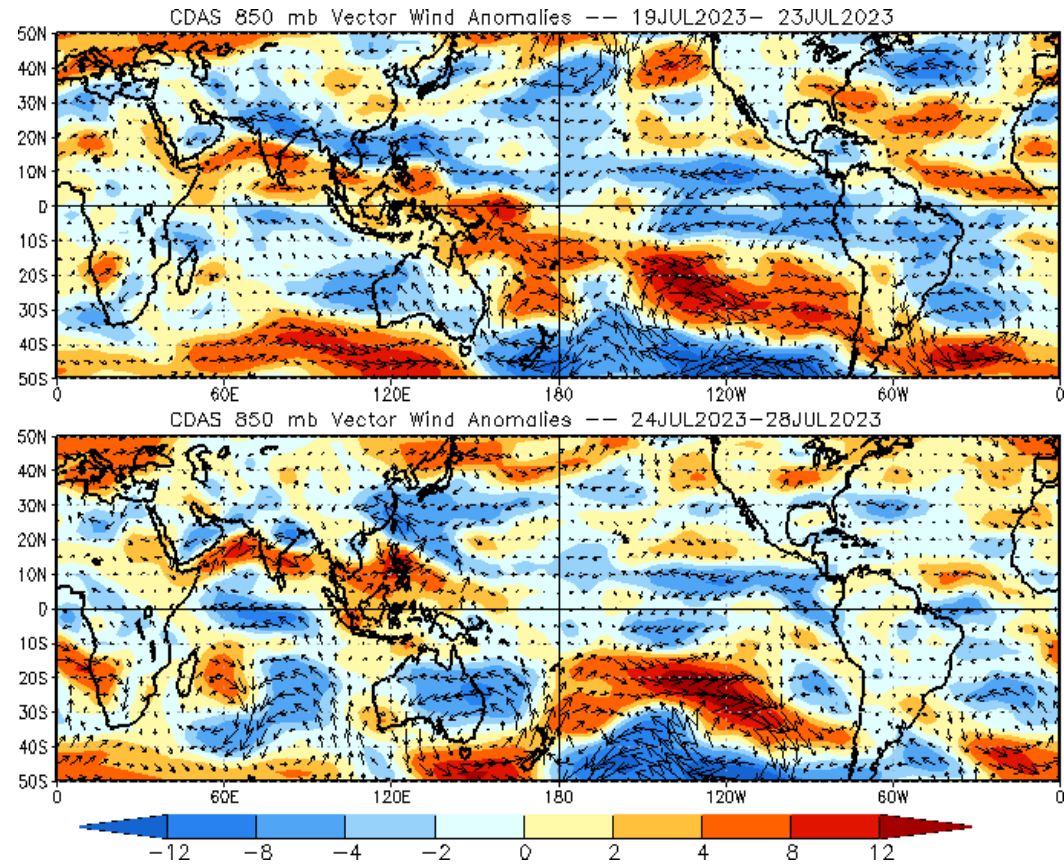
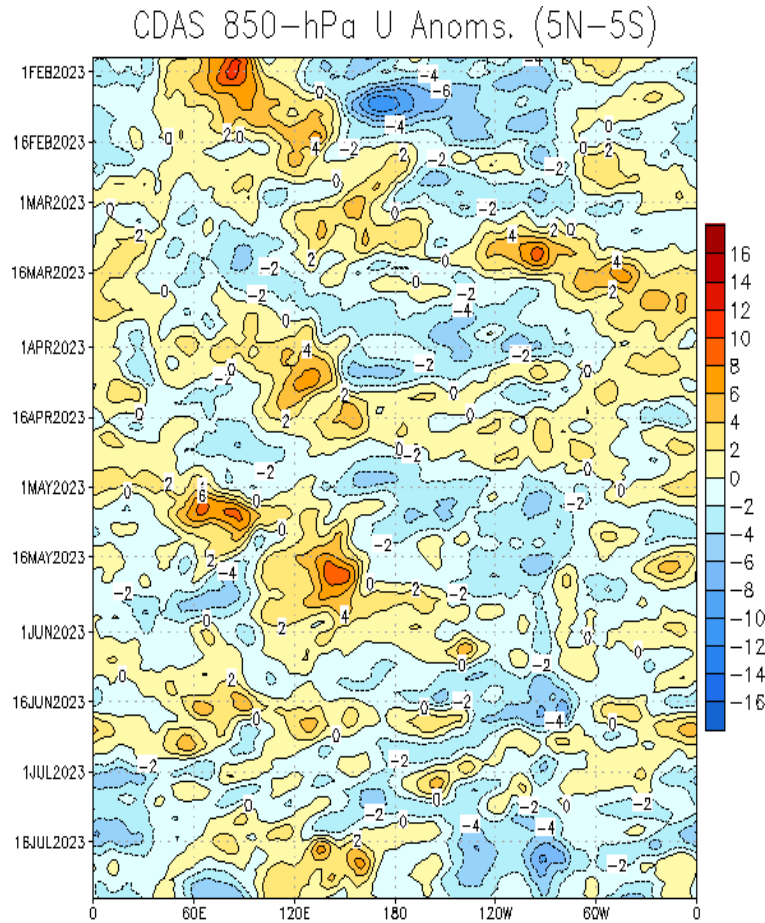
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- The upper-level zonal wind field remains weak or incoherent across much of the global tropics.
- Anomalous upper-level westerlies continue over much of the East Pacific which seems to be related to cross equatorial flow from the Southern Hemisphere.

850-hPa Wind Anomalies

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

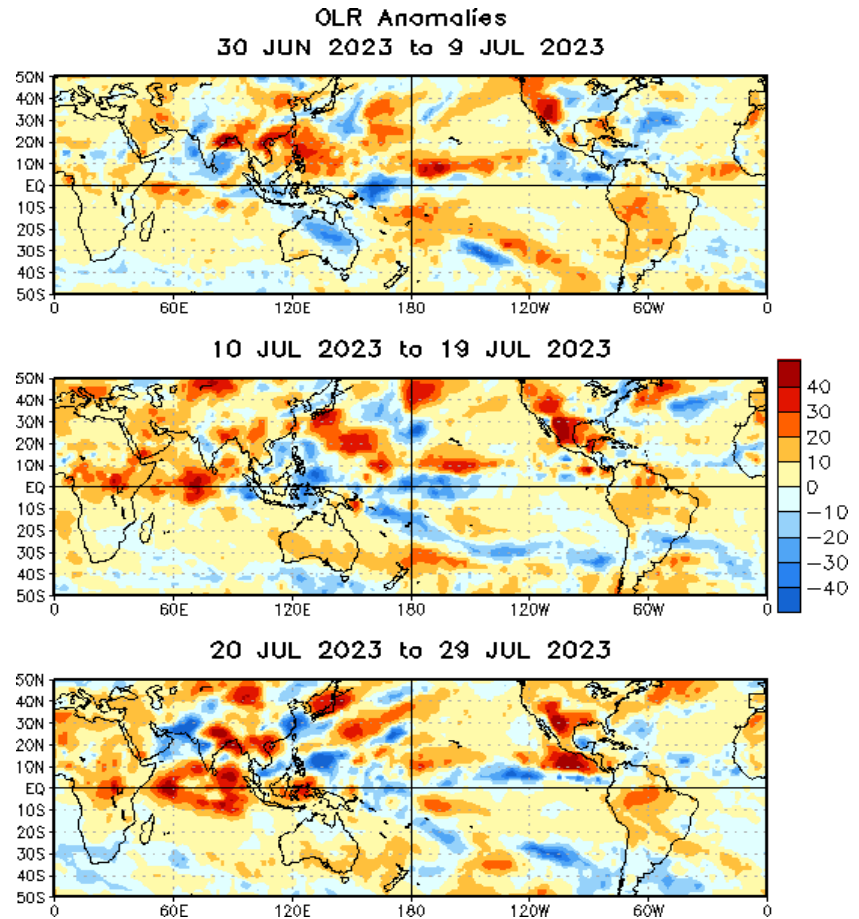
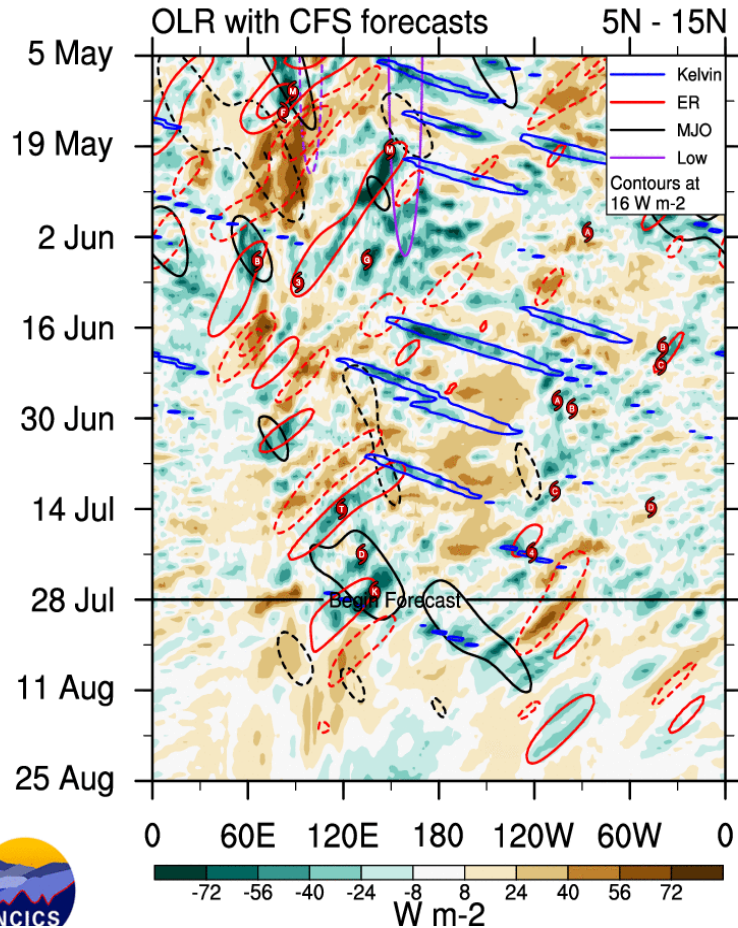


- During mid to late July, a robust monsoon trough became established with a northwest to southeast tilt extending from southern Asia through the Maritime Continent.
- A strong, equatorially centered westerly wind burst was observed recently northeast of New Guinea.
- Trade winds are close to average across the central Pacific, but remain enhanced across the East Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

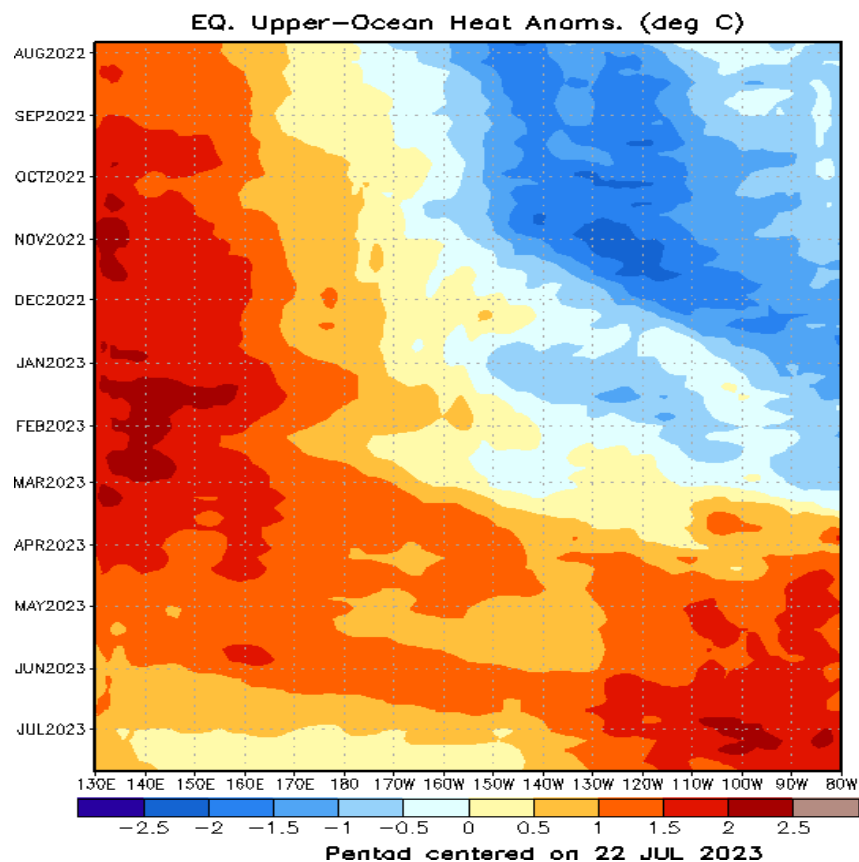
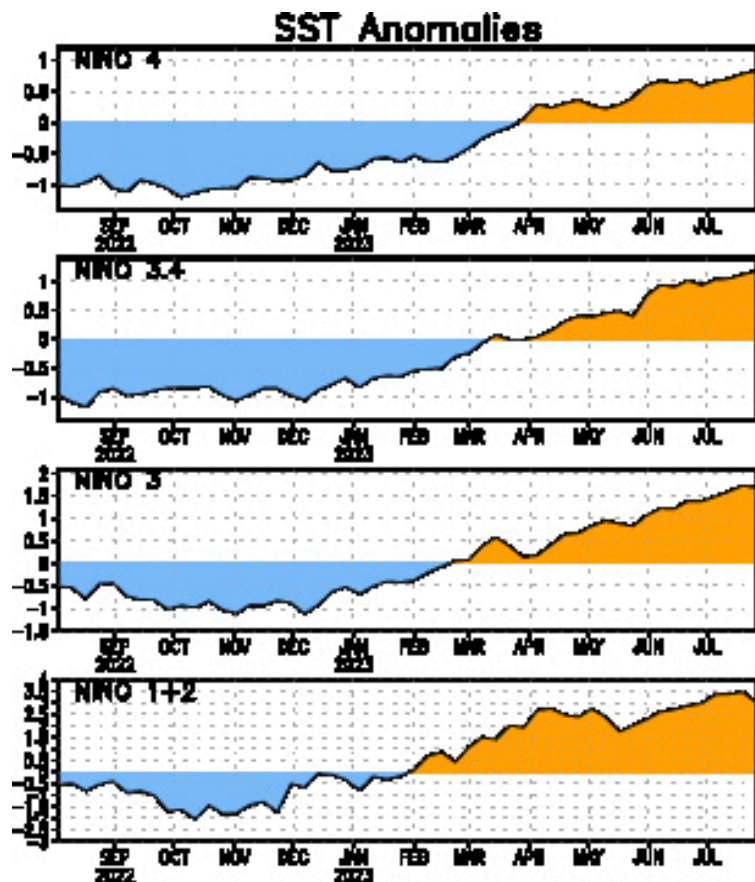
Brown shades: Anomalous subsidence (dryness)



- Enhanced convection (including tropical cyclone activity) returned to portions of the West Pacific and South China Sea during mid to late July.
- Although enhanced convection is observed near the Date Line, anomalies are relatively small.
- Suppressed convection strengthened across Africa and the Indian Ocean by late July.



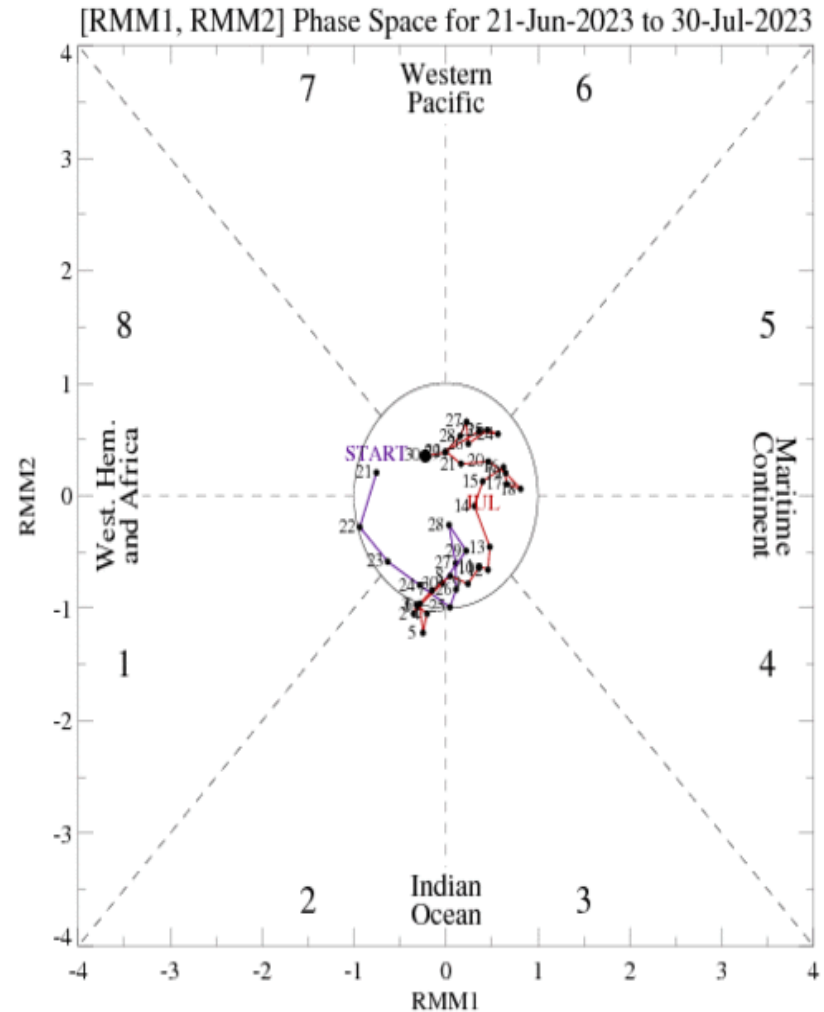
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- El Niño conditions are now present across the equatorial Pacific as SST anomalies continue to climb throughout the Niño regions.
- Above-normal oceanic subsurface temperatures are present across the entire equatorial Pacific, with the largest positive anomalies (>1.5 degrees C) between 110W and 100W.
- Upper-ocean heat content anomalies in the Pacific Warm Pool recently declined to the west of the Date Line.

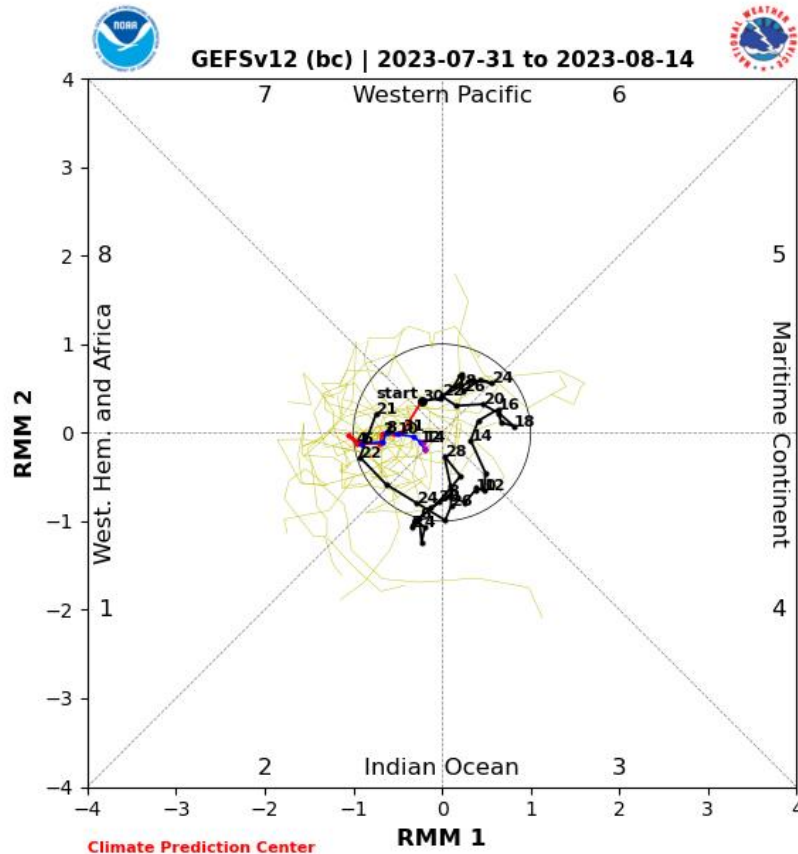
MJO Index: Recent Evolution

- The RMM index continues to reflect a weak MJO amplitude, though eastward propagation is noted from the Maritime Continent to the West Pacific during the latter half of July.

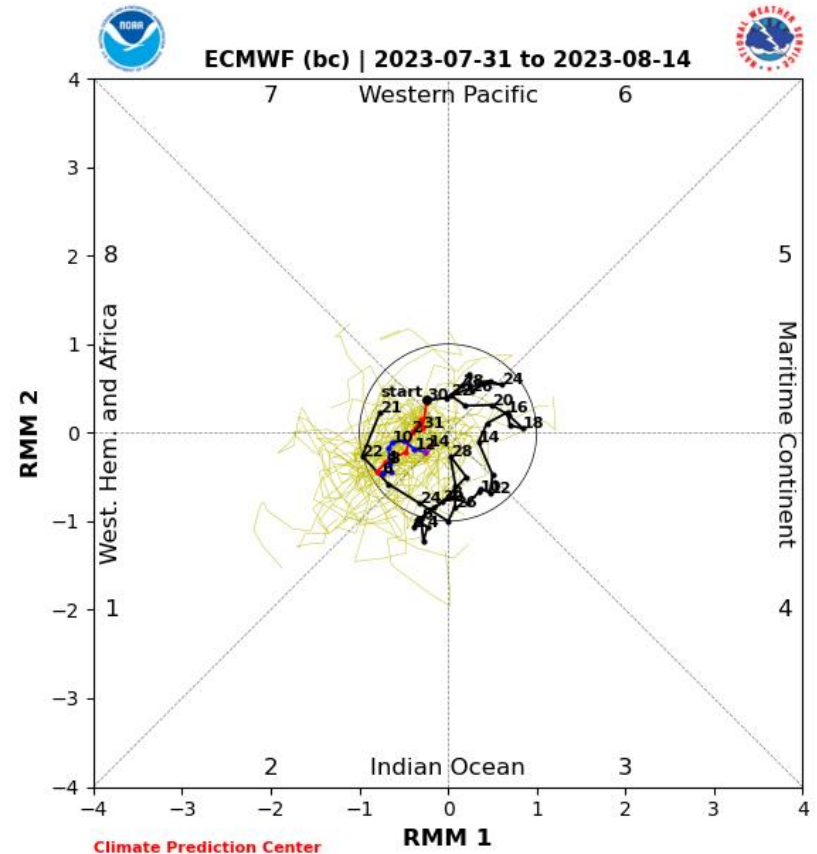


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



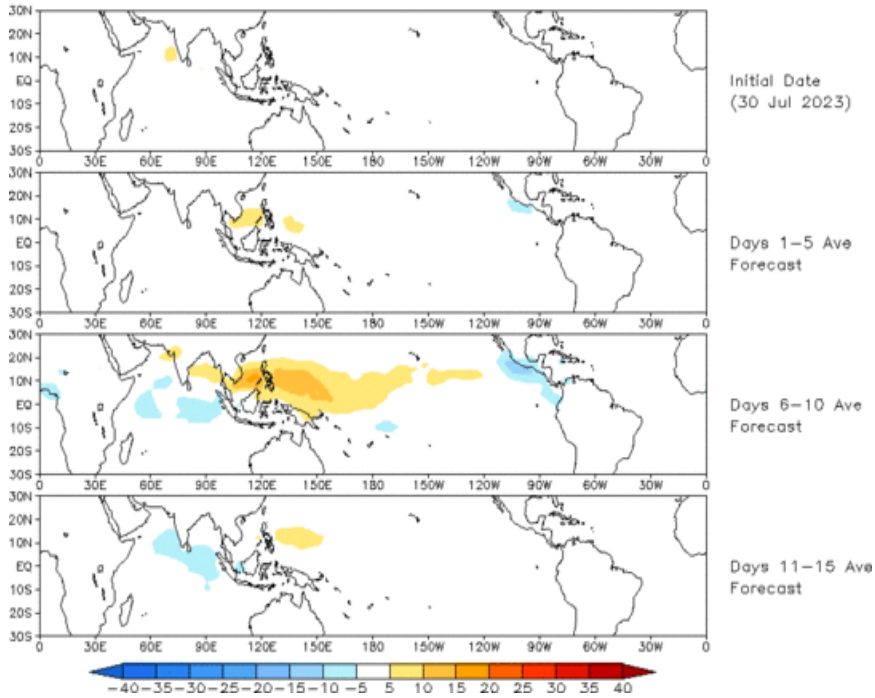
ECMWF Forecast

- Dynamical model MJO index forecasts reflect a continued low-amplitude signal.
- However, similar to late July, the ensemble means depict eastward propagation from the Western Hemisphere to the Indian Ocean.

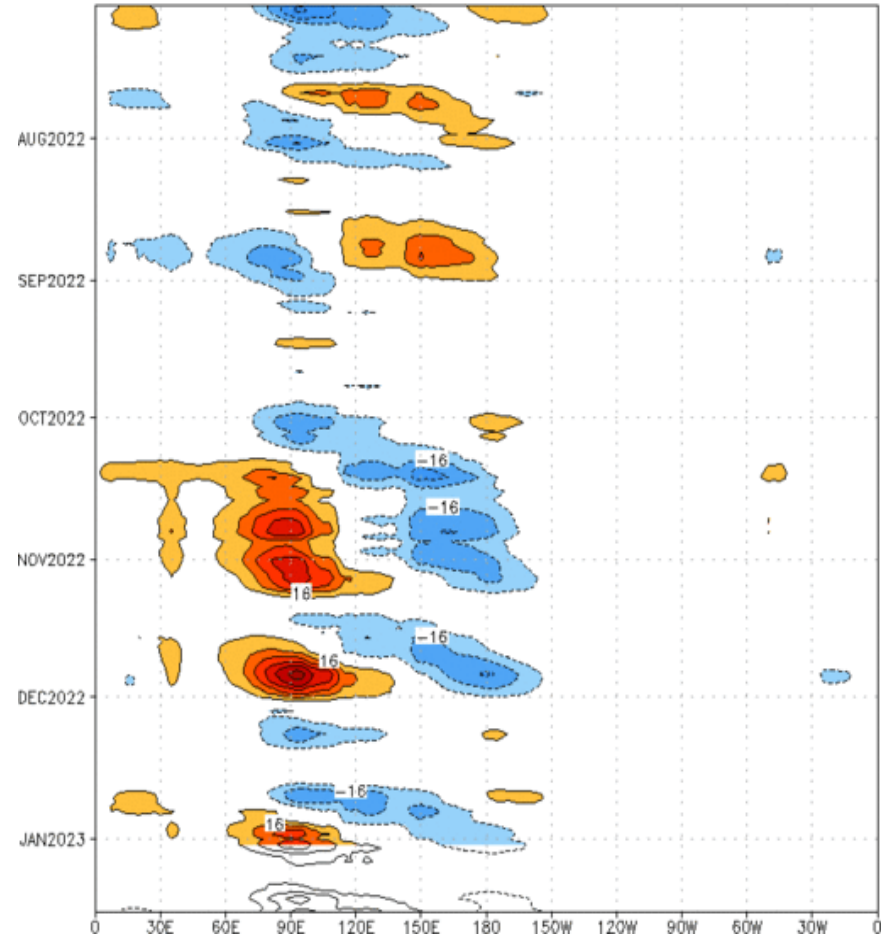
MJO: GEFS Forecast Evolution

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: 30 Jul 2023
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:03-Jul-2022 to 02-Jan-2023
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

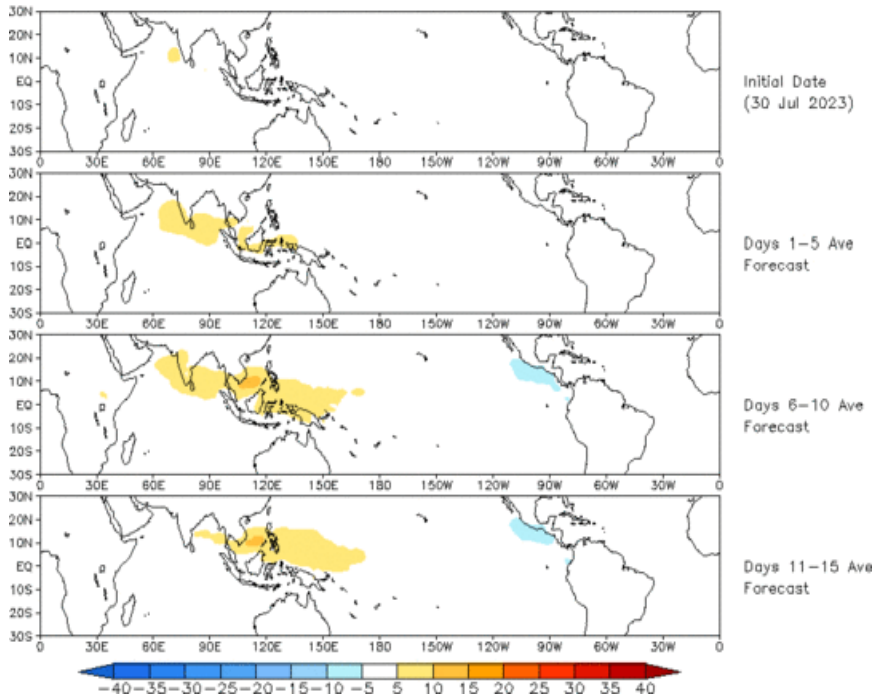


- The GEFS RMM-based OLR forecast shows suppressed convection increasing briefly during the 6-10 day time period.

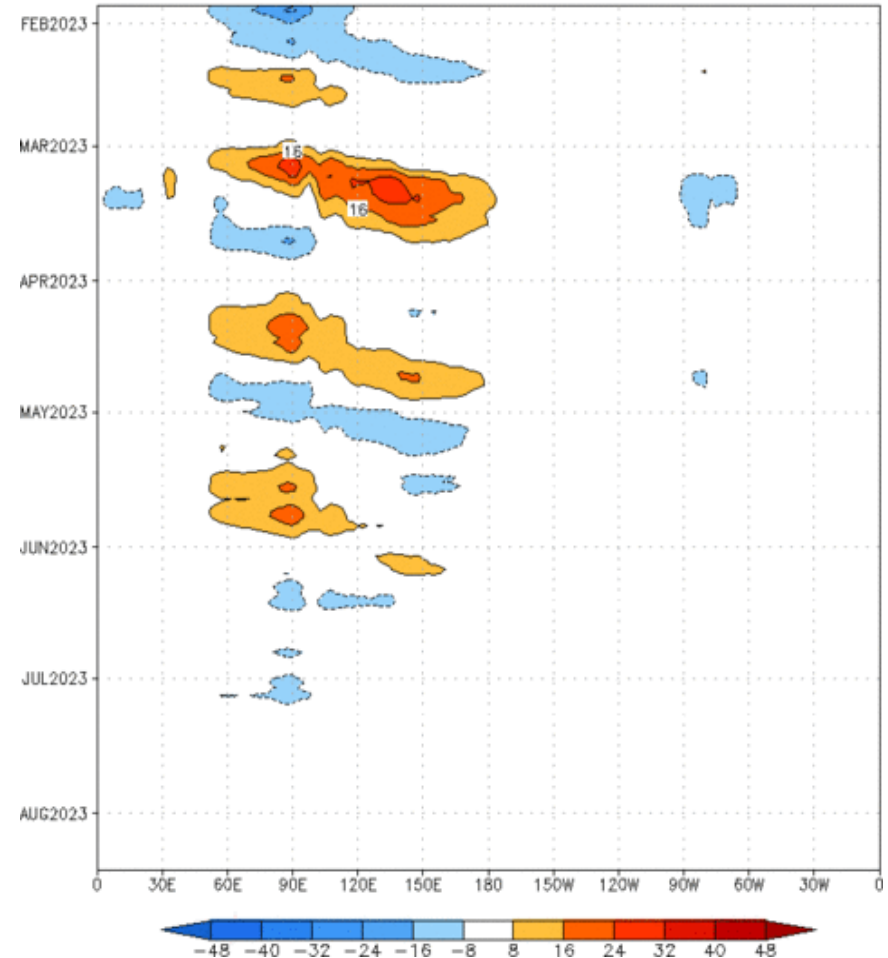
MJO: Constructed Analog Forecast Evolution

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 (30 Jul 2023)



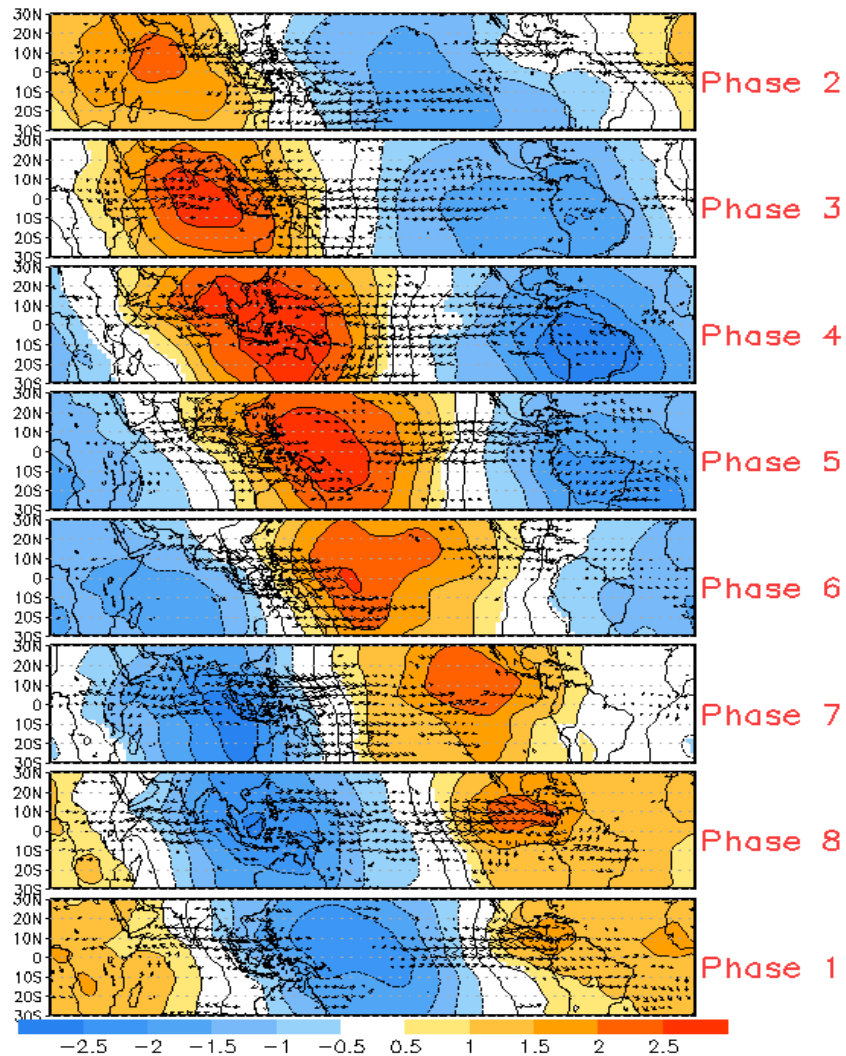
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:28-Jan-2023 to 30-Jul-2023
The unfilled contours are CA forecast reconstructed anomaly for 15 days



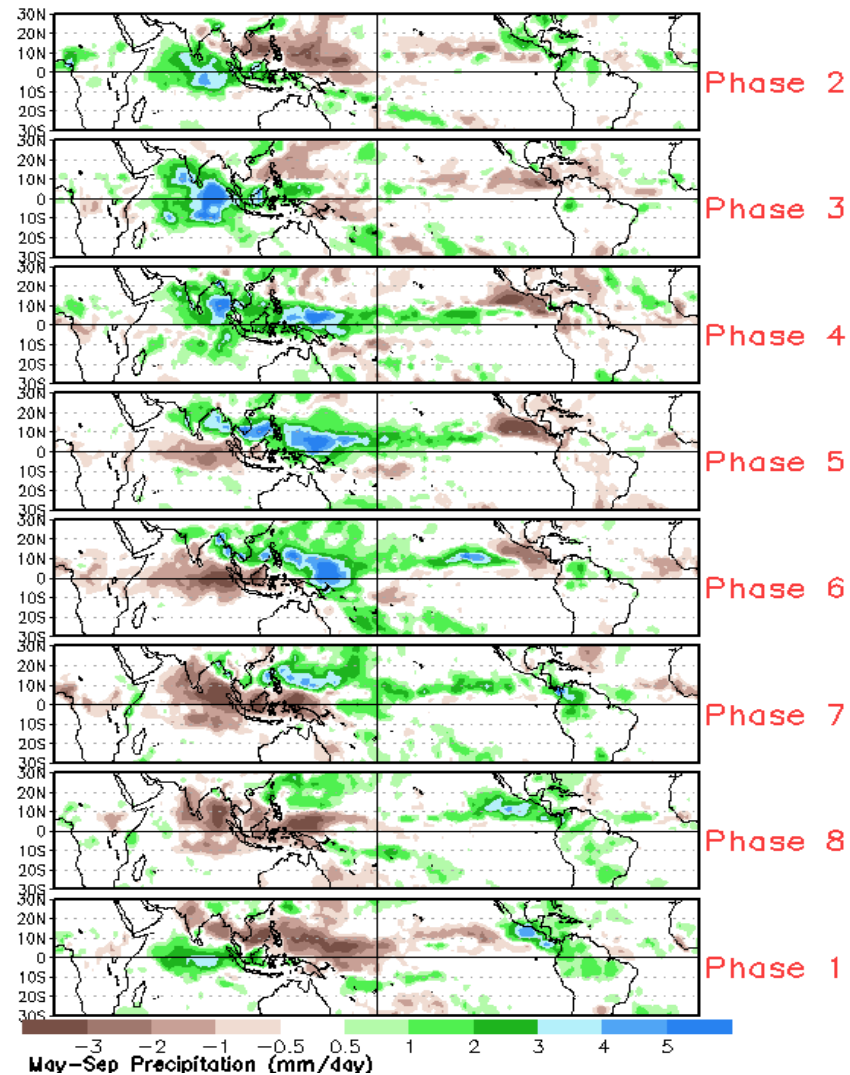
- The constructed analog RMM-based forecast reflects a slight dry signal overspreading Southeast Asia and the West Pacific during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



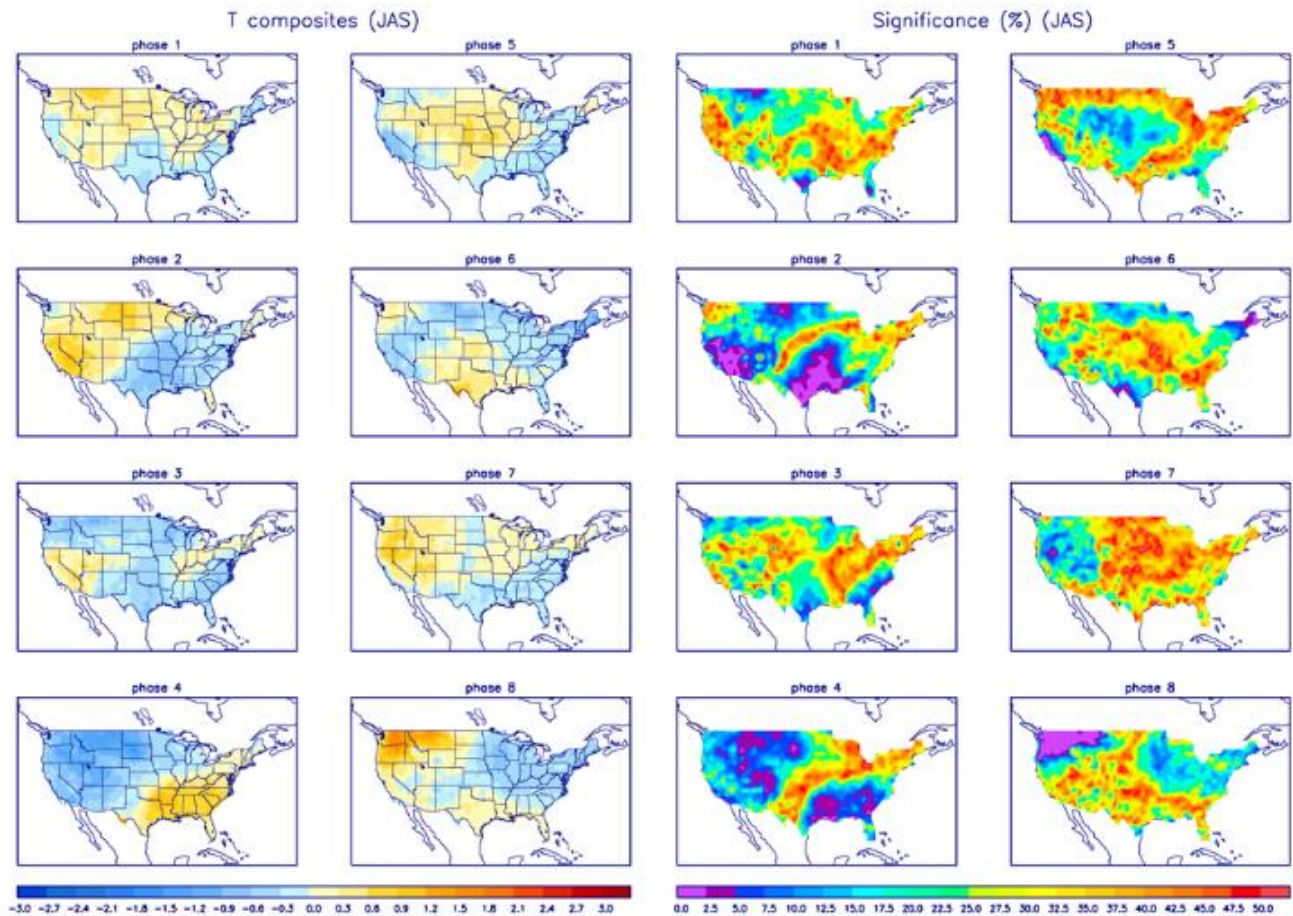
Precipitation Anomalies



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.

