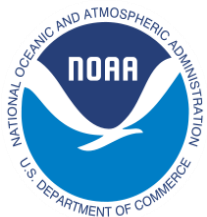


Madden-Julian Oscillation: Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
9 October 2023

Overview

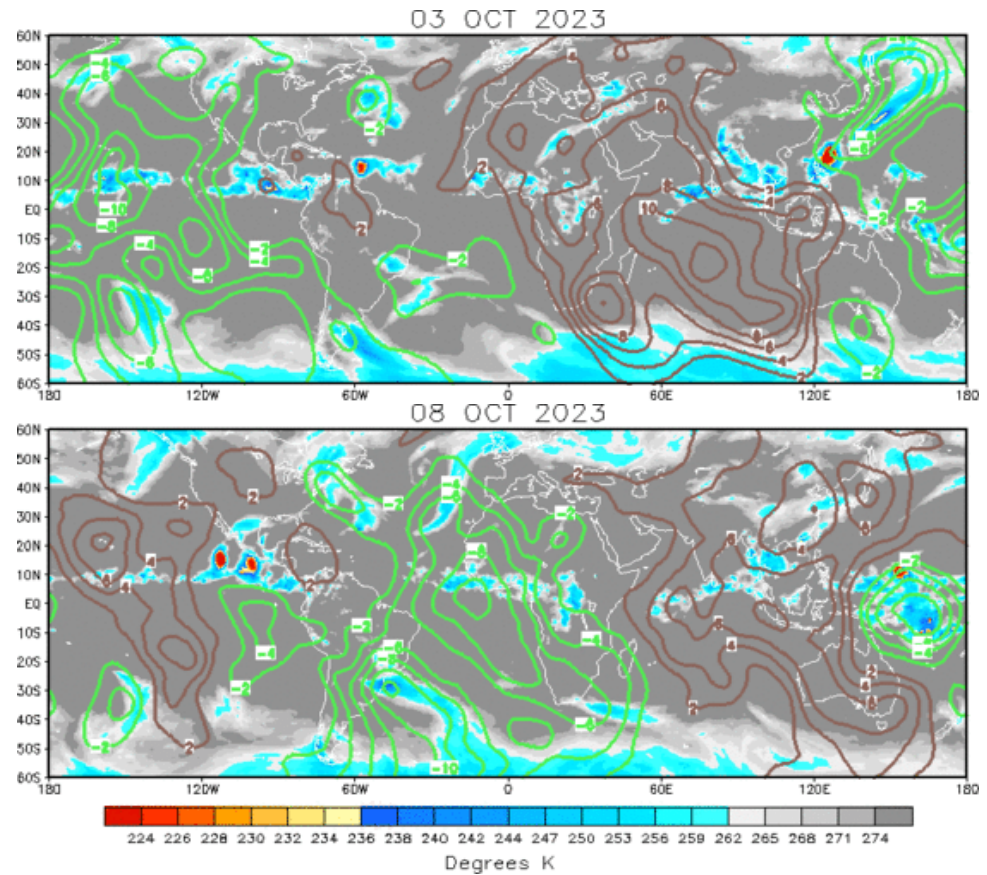
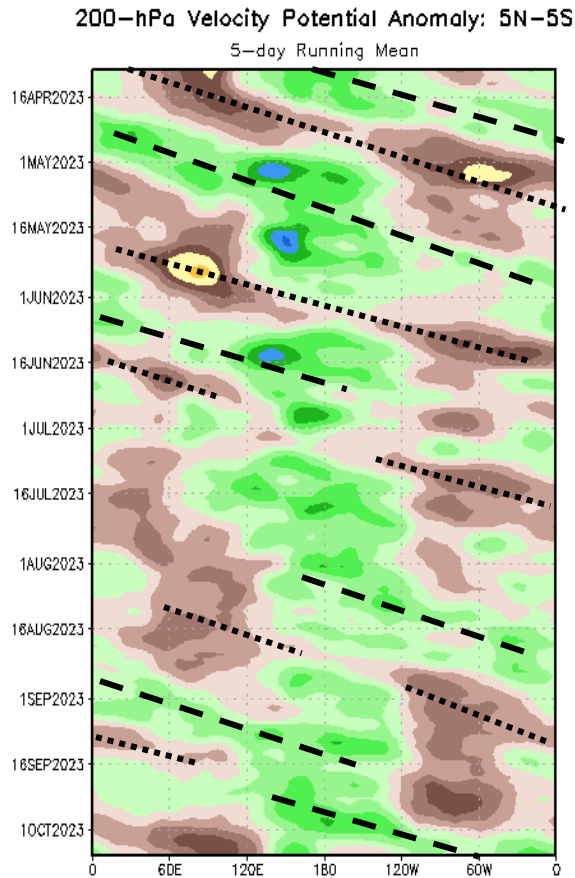
- The MJO remained active during the past week, with the enhanced convective signal crossing the Western Hemisphere.
- The atmospheric response to ongoing El Niño conditions remains robust, with enhanced convection persisting near and west of the Date Line, and an enhanced subtropical jet extending across the northeastern Pacific and southern CONUS.
- Destructive interference between these two signals is favored to increase as the MJO signal approaches the Indian Ocean. Dynamical model MJO forecasts show an increasingly incoherent signal over the next few weeks.
- A tropical cyclone currently in the vicinity of Guam is forecast to intensify and recurve over the northern Pacific, which may strongly influence the midlatitude pattern over North America.
- Despite a climatological reduction of Atlantic MDR tropical cyclone activity during October, the basin may remain unusually active due both to MJO influences and above-normal SSTs.

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)

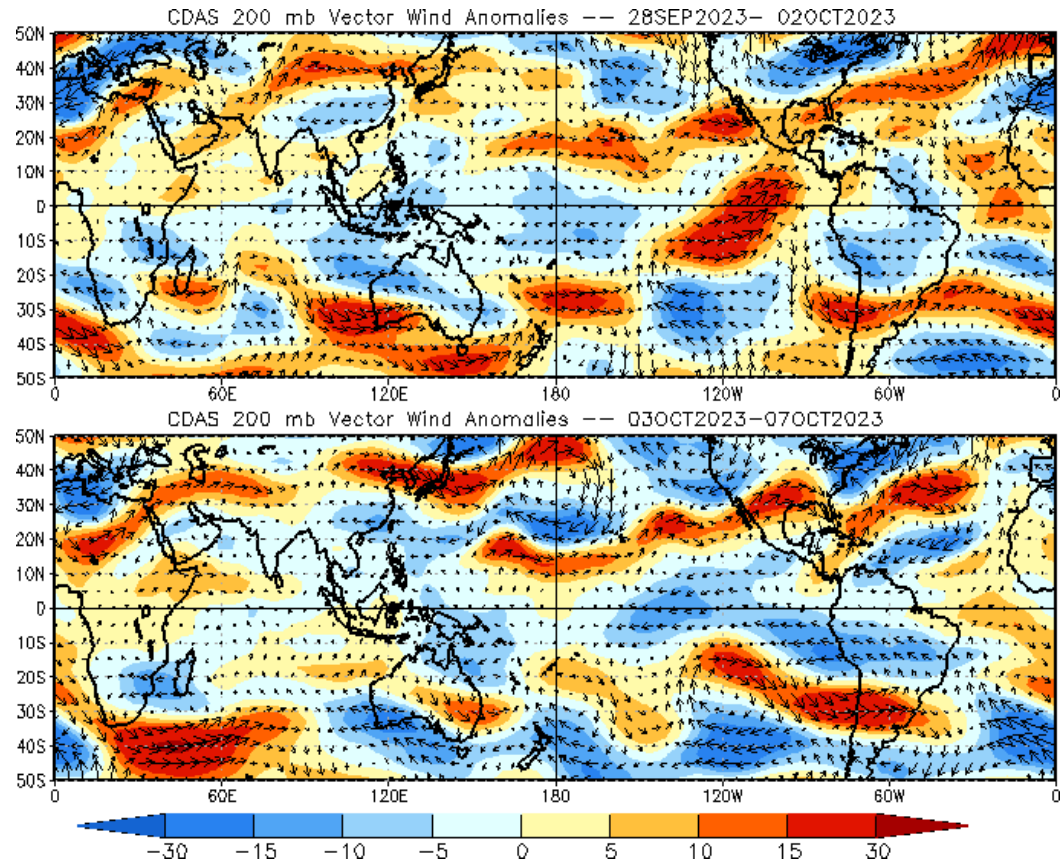
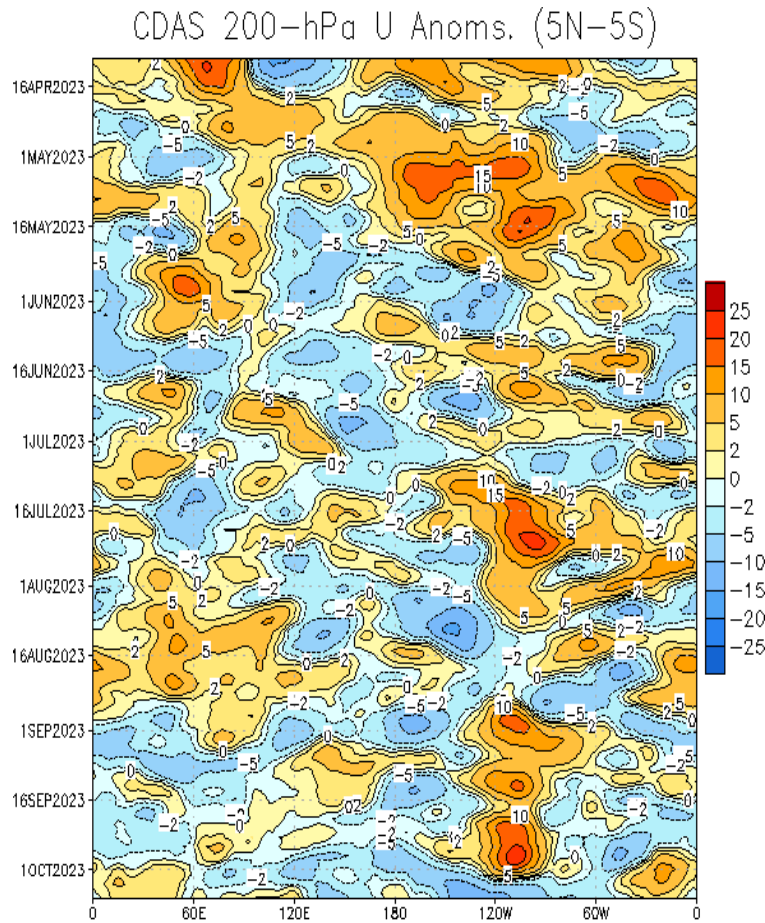
Brown shades: Anomalous convergence (unfavorable for precipitation)



- The MJO remains active, with the enhanced convective phase now crossing the Western Hemisphere.
- The phase speed of the intraseasonal signal is on the fast end of the typical 30-60 day window.
- Influence from the El Niño base state remains apparent, with a large region of anomalous divergence aloft persisting west of the Date Line.

200-hPa Wind Anomalies

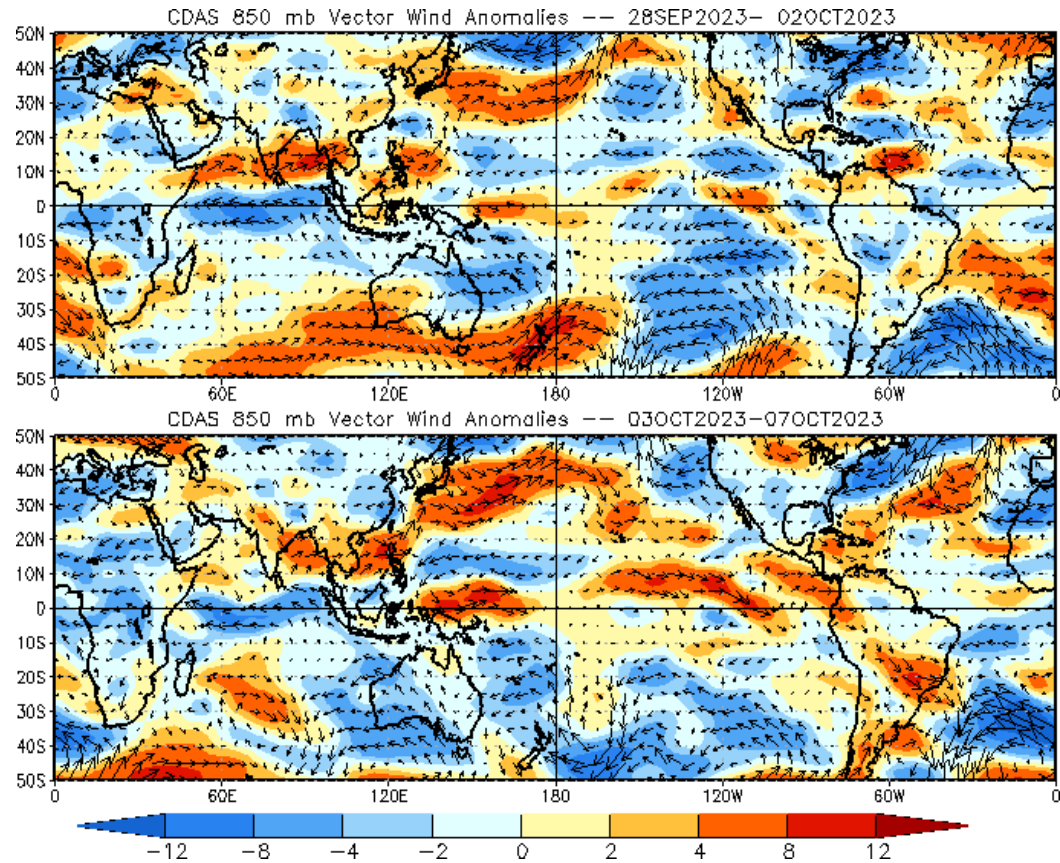
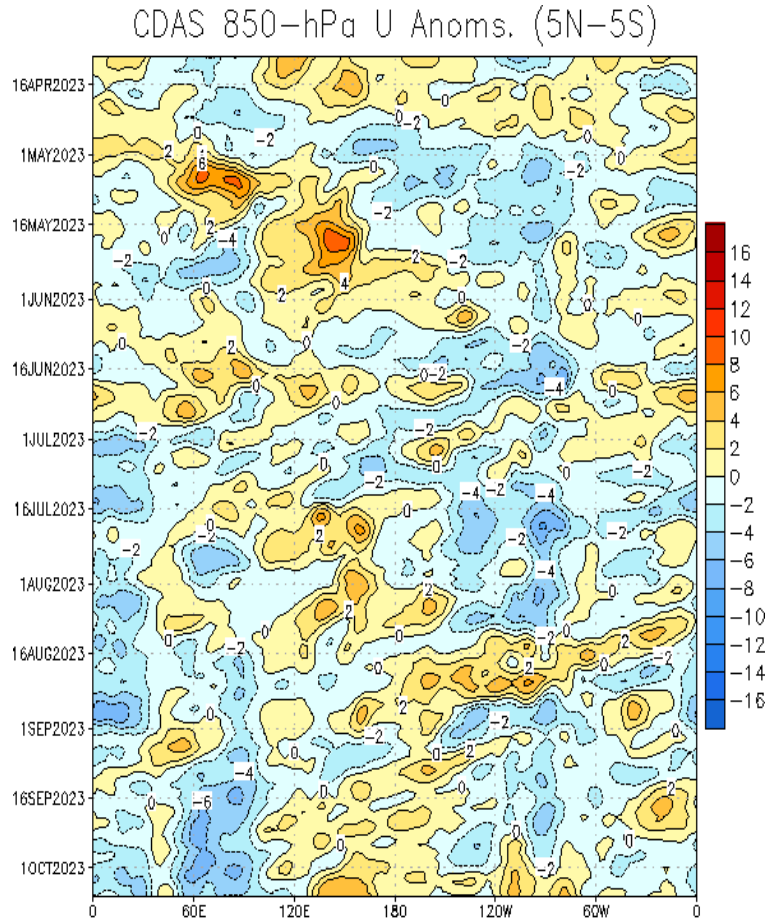
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- An active subtropical jet has persisted over the northeastern Pacific into the southern tier of the CONUS, which is consistent with an atmospheric response to El Niño conditions.
- MJO activity helped break down the persistent pattern of strong upper-level westerlies over the East Pacific, with easterly anomalies now in place.

850-hPa Wind Anomalies

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

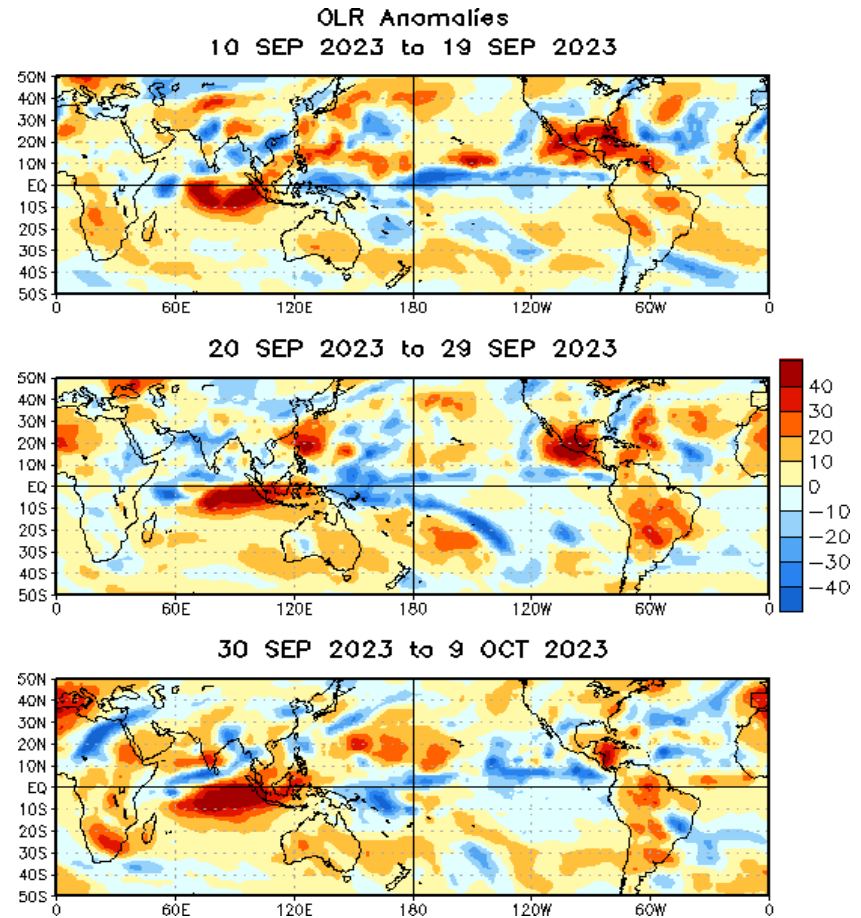
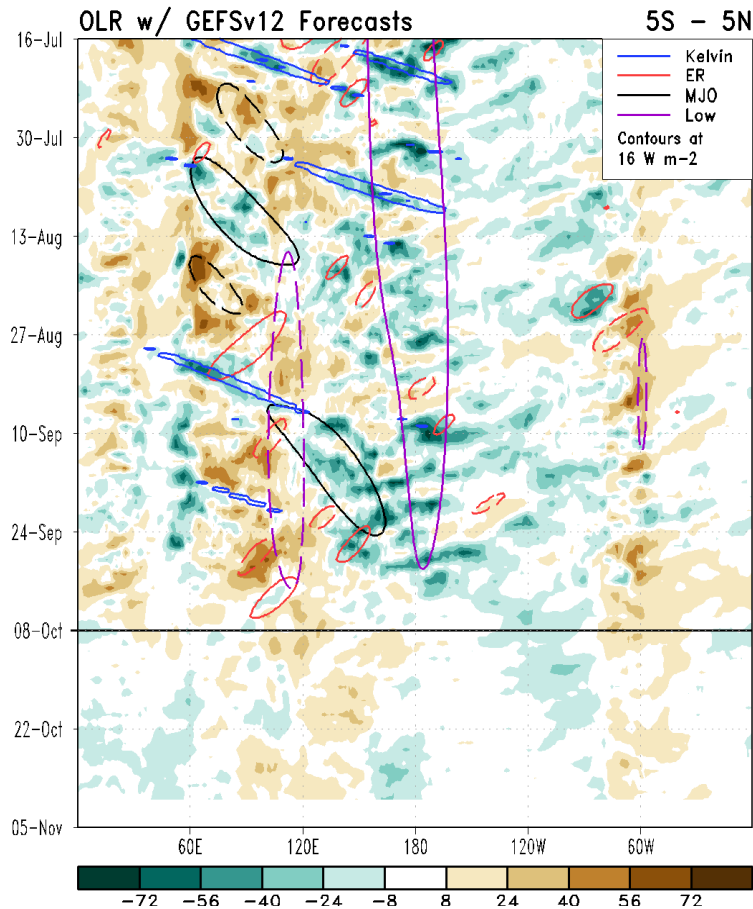


- Broad troughing with embedded tropical cyclone activity over the West Pacific has helped generate a large-scale westerly wind burst centered over the Equator.
- Low-level westerlies over the Caribbean and western Atlantic are partly associated with recent MJO activity.

Outgoing Longwave Radiation (OLR) Anomalies

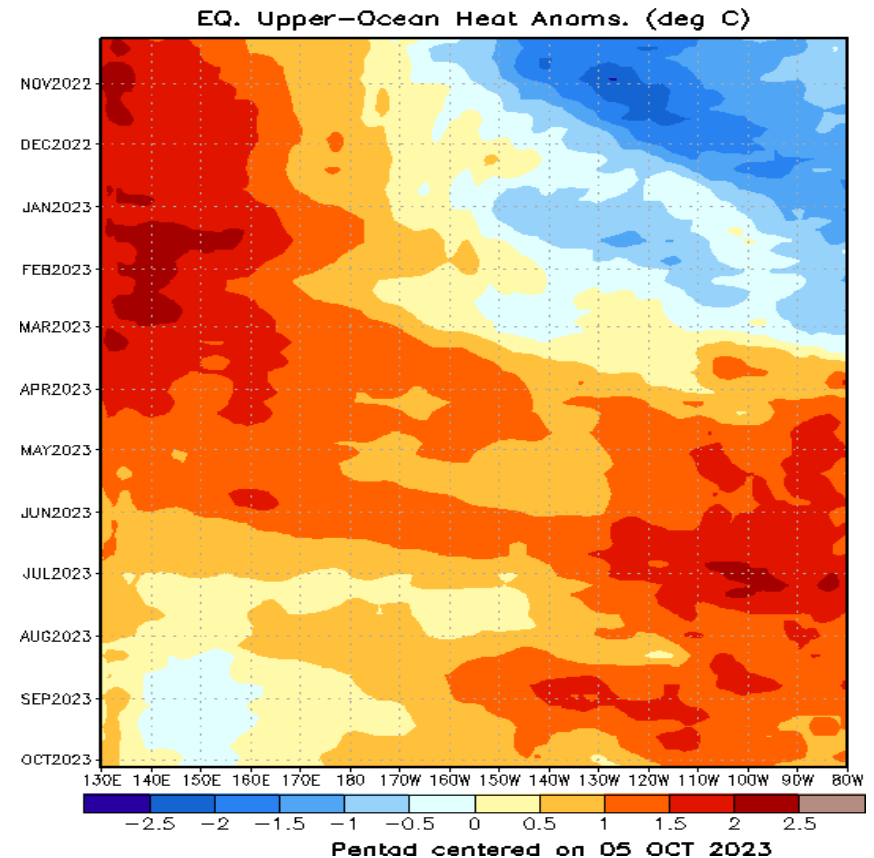
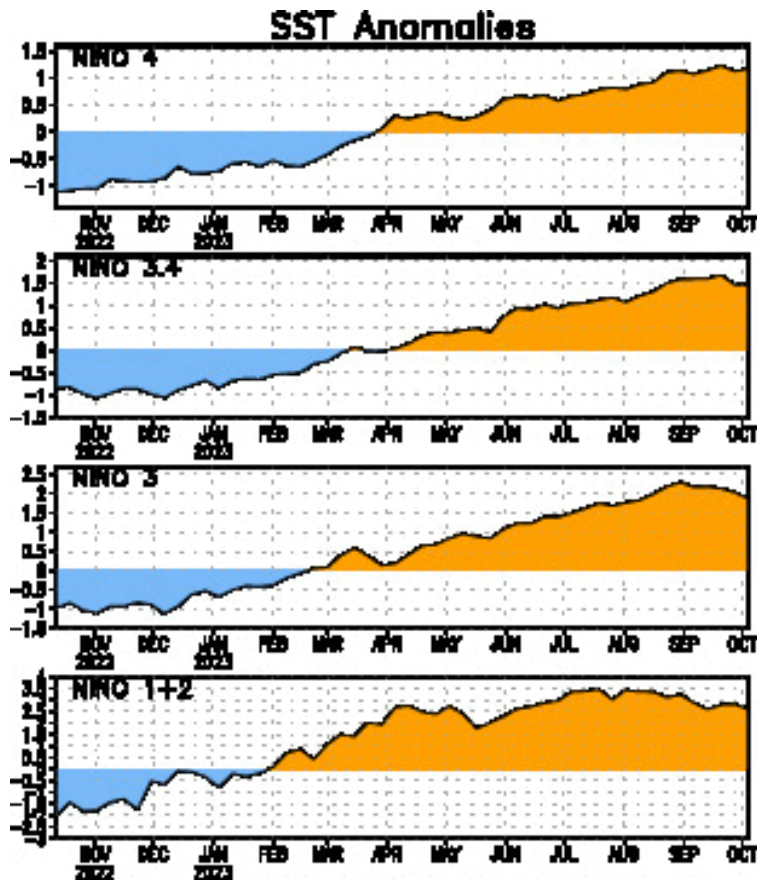
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Although the MJO activity was not analyzed by the objective filtering algorithm, eastward propagation of negative (enhanced) anomalies is apparent on the Hovmoller plot, crossing the Pacific to the Western Hemisphere during early October.
- El Niño related activity remains apparent, with an enhanced signal persisting near and west of the Date Line.

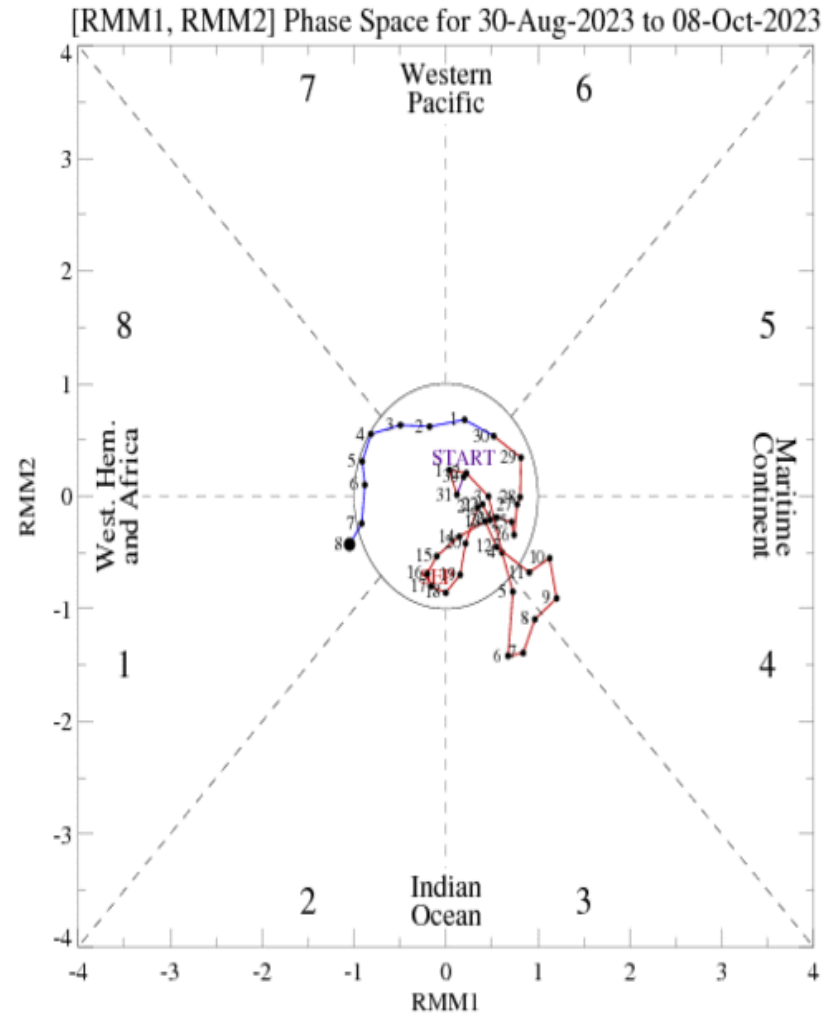
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- El Niño conditions are present across the equatorial Pacific as SST anomalies remain strongly positive in all of the Niño basins, although the upward trend appears to have leveled off for all but Niño 4.
- Negative heat content anomalies observed in the West Pacific Warm Pool persist after a westerly wind burst and associated downwelling oceanic Kelvin wave pushed warmer water across the Equatorial Pacific.

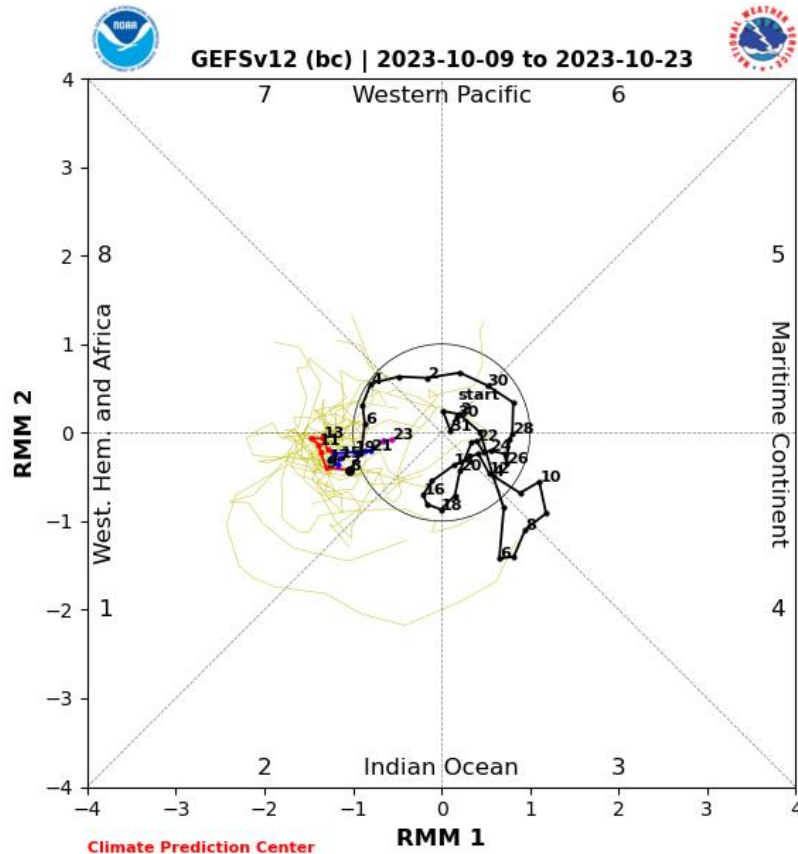
MJO Index: Recent Evolution

- The amplitude of the RMM-index has increased, and is now outside of the unit circle. Eastward propagation of the signal from the Pacific across the Western Hemisphere is well established.

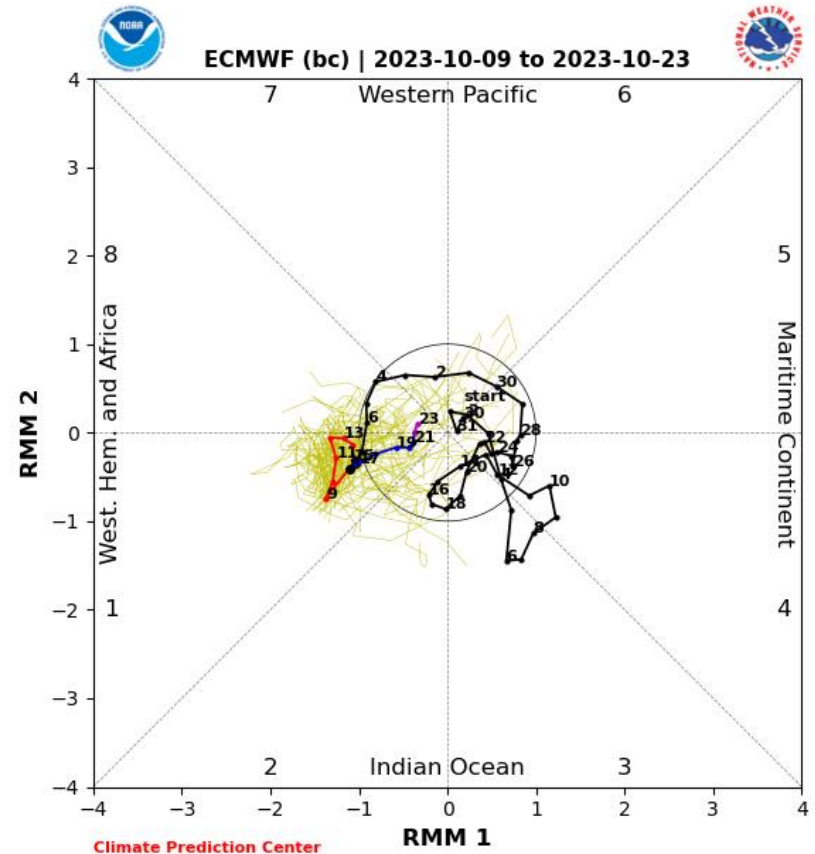


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



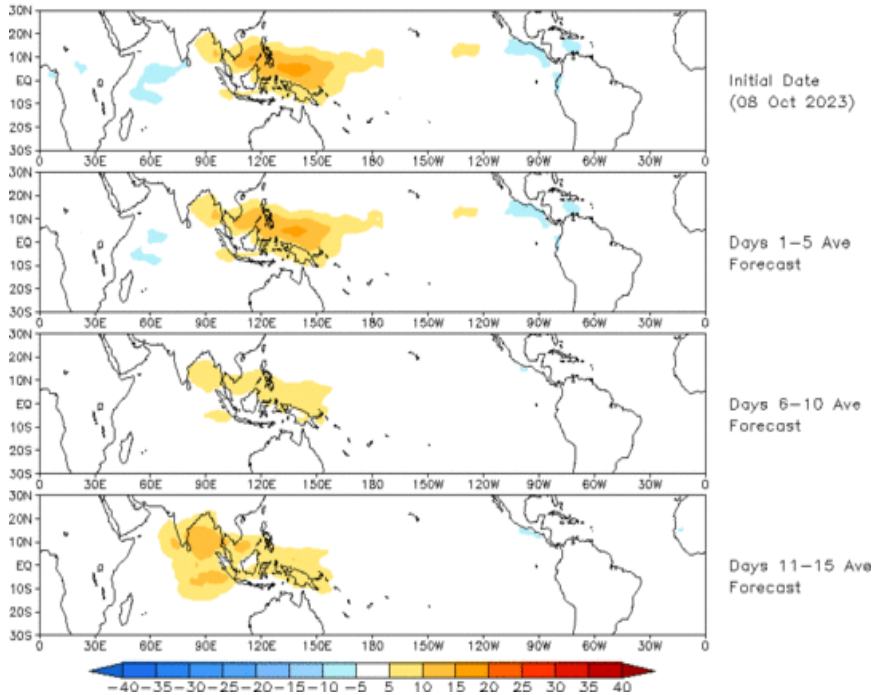
ECMWF Forecast

- While a few GEFS and ECMWF ensemble members depict continued robust MJO activity reaching the Indian Ocean, most ensemble members depict a slowdown of the signal over the Western Hemisphere as other modes interfere with the pattern.
- The EMCWF is generally more progressive with the signal than the GEFS, but depicts weak activity, likely due to destructive interference between the MJO and ENSO activity.

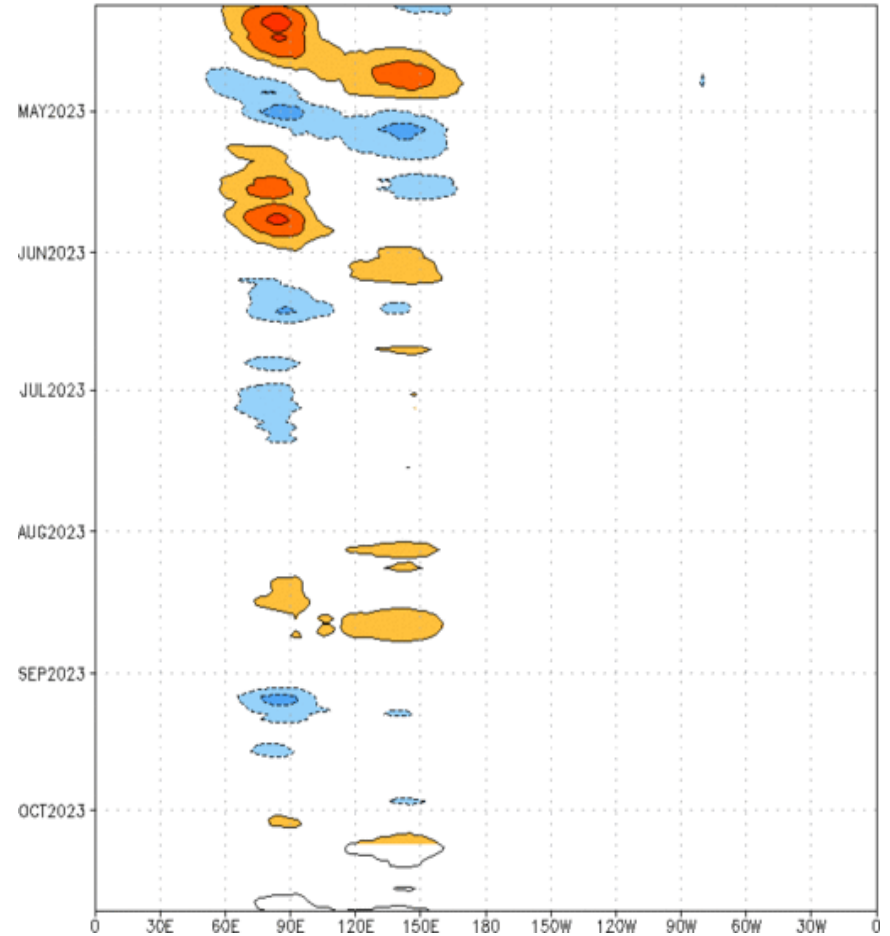
MJO: GEFS Forecast Evolution

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: 08 Oct 2023
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] (cont: 4Wm^{-2}) Period: 08-Apr-2023 to 08-Oct-2023
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

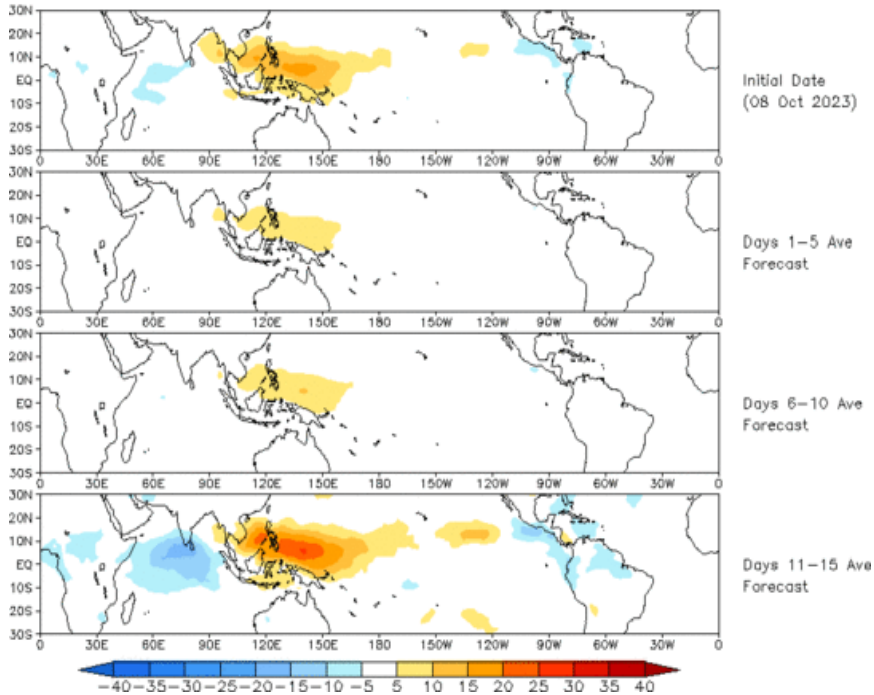


- The GEFS RMM-based OLR forecast depicts a fairly stationary signal, with the suppressed convective envelope over the eastern Indian Ocean and Maritime Continent much stronger than the enhanced convective envelope.

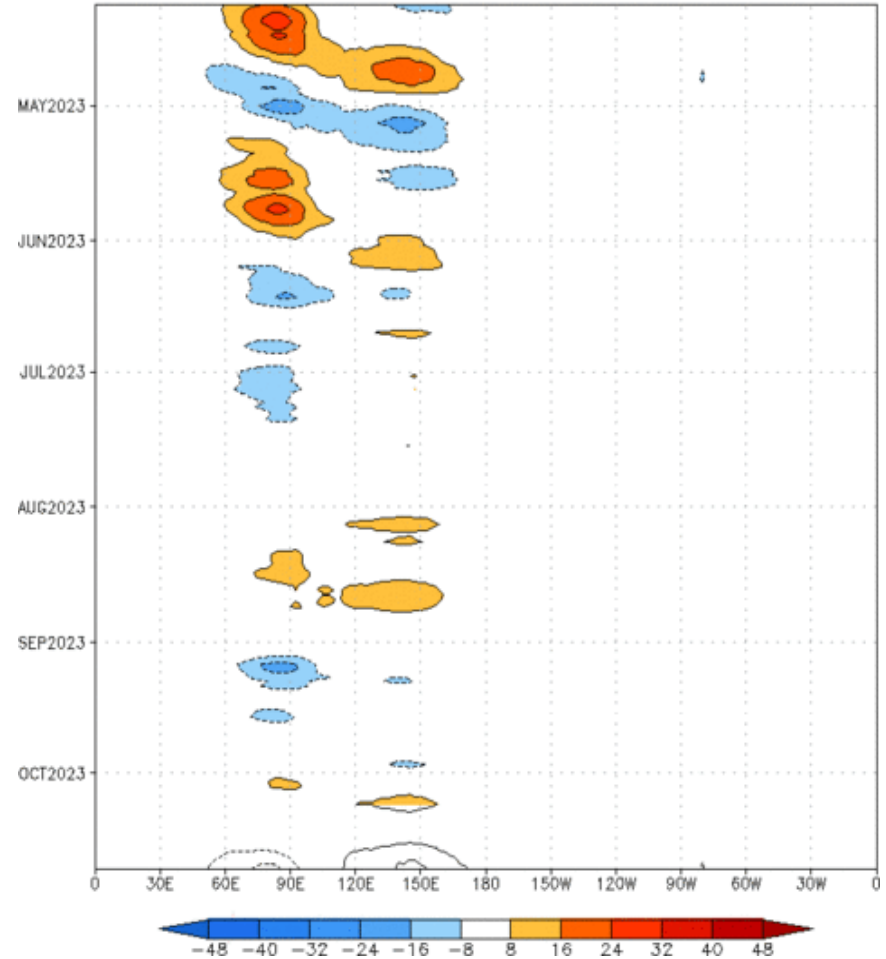
MJO: Constructed Analog Forecast Evolution

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 (08 Oct 2023)



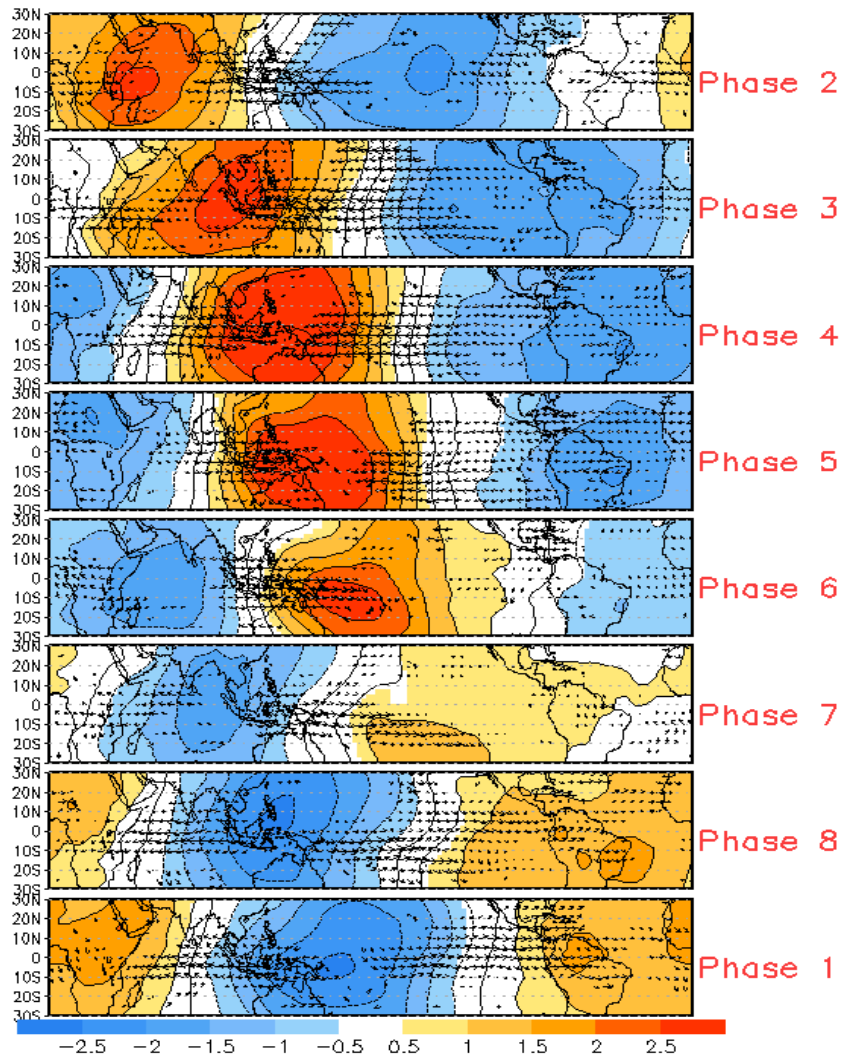
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:08-Apr-2023 to 08-Oct-2023
The unfilled contours are CA forecast reconstructed anomaly for 15 days



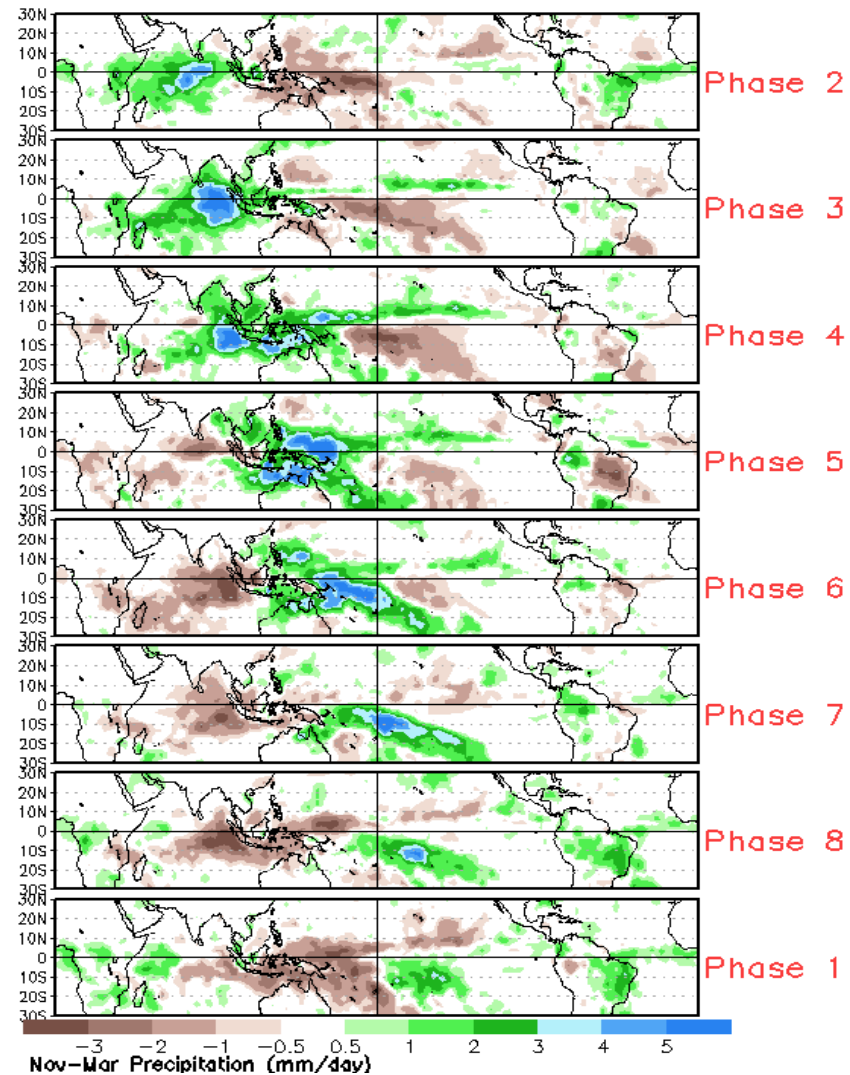
- The constructed analog RMM-based forecast attenuates the signal during much of the forecast period, but then depicts a robust Indian Ocean event towards the end of Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



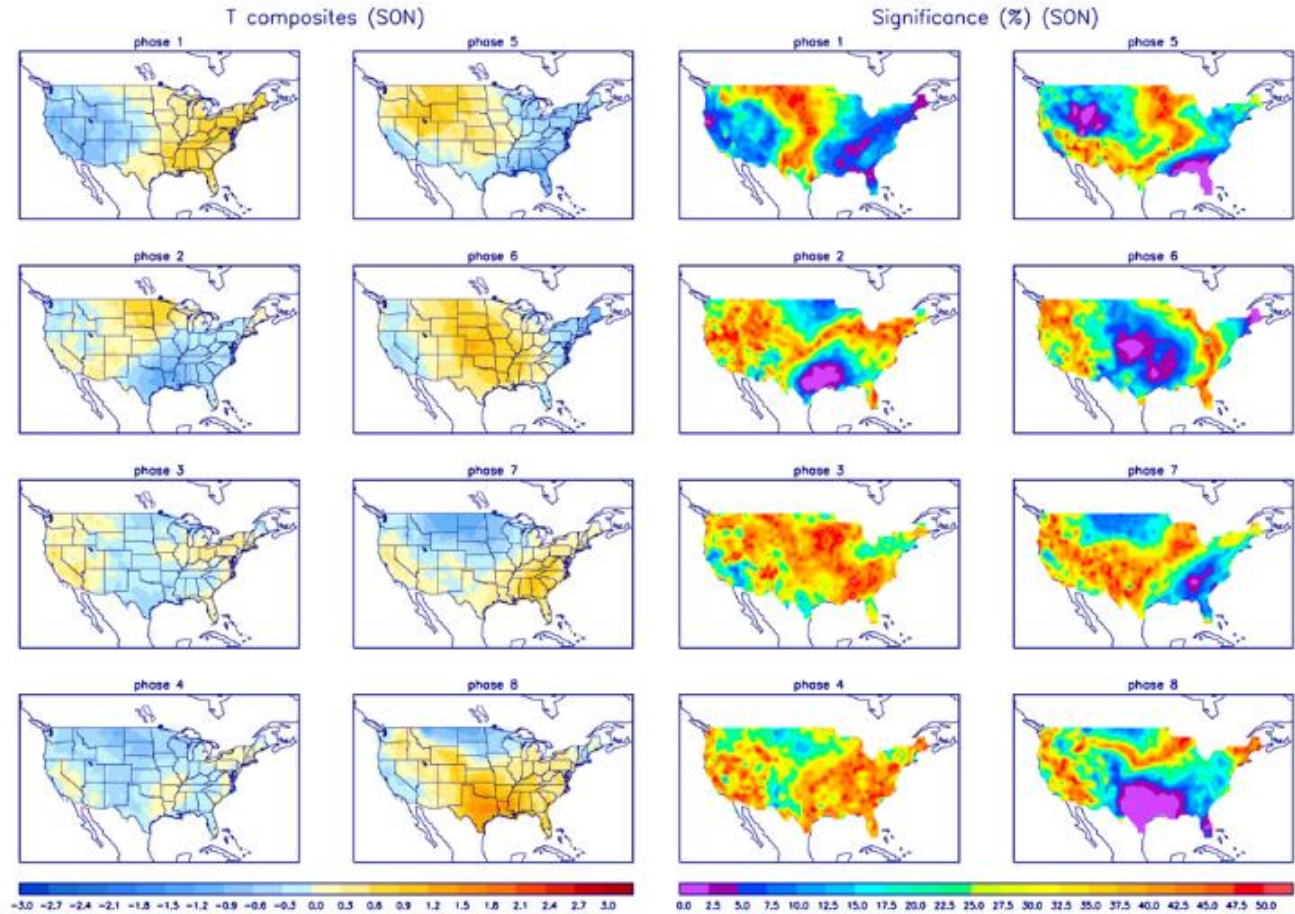
Precipitation Anomalies



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.

