

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
6 November 2023

Overview

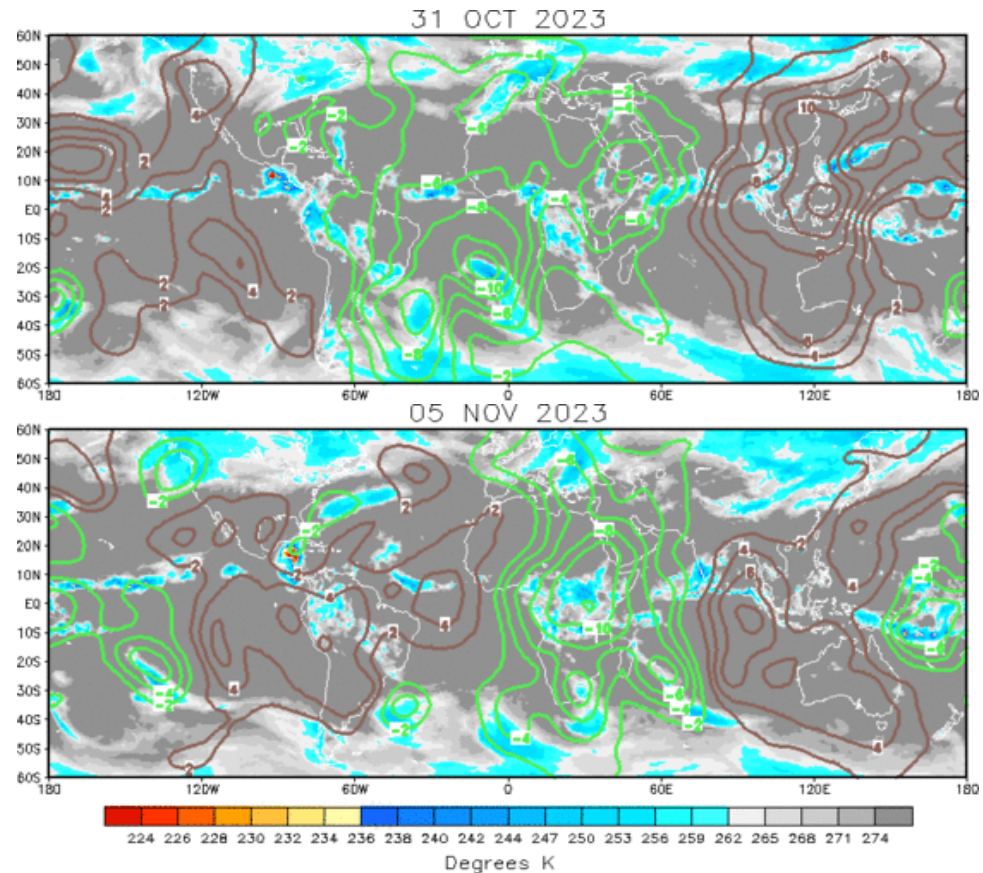
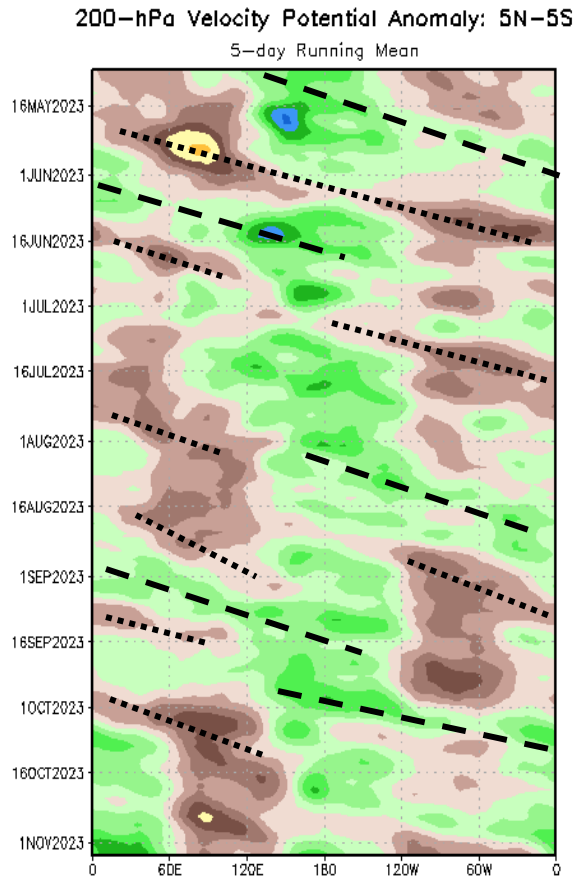
- The global tropical convective pattern remains largely dominated by the low frequency base state: the ongoing El Niño event over the Pacific and the strongly positive Indian Ocean Dipole (+IOD) event over the Indian Ocean.
- A fast eastward propagating signal was observed crossing the Western Hemisphere during late October, with enhanced convection now over the western Indian Ocean. Dynamical models quickly weaken this feature in favor of the ongoing +IOD event, but remnants of the signal may re-emerge over the Pacific during the Weeks 2-3 time frame.
- Rossby wave activity over the Pacific contributed to a new westerly wind burst along the Equator northeast of New Guinea, with a lower amplitude than the mid-October event so far. The GEFS continues to strengthen this feature over the next week or two.
- The suppressed phase of the eastward propagating feature over the Western Hemisphere may help limit the potential for additional tropical cyclogenesis over the East Pacific or Caribbean. Dynamical models show an uptick in potential formations during Weeks 2-3, though climatology is becoming increasingly unfavorable.

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)

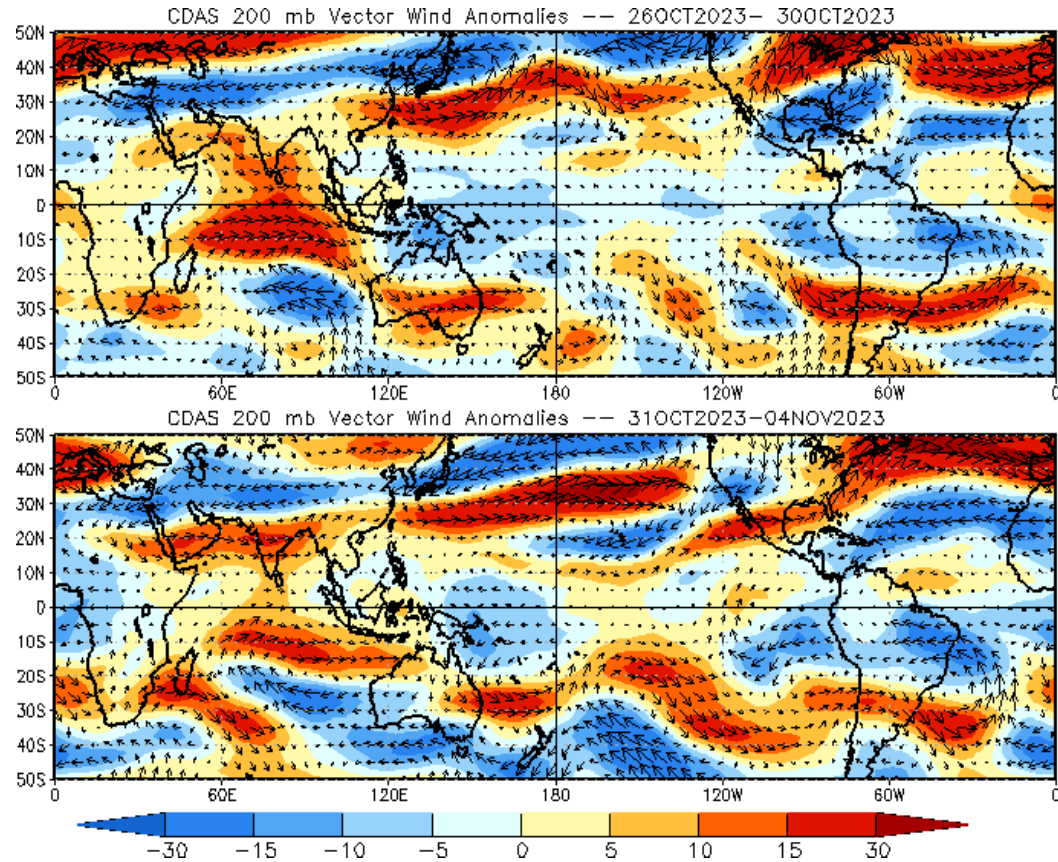
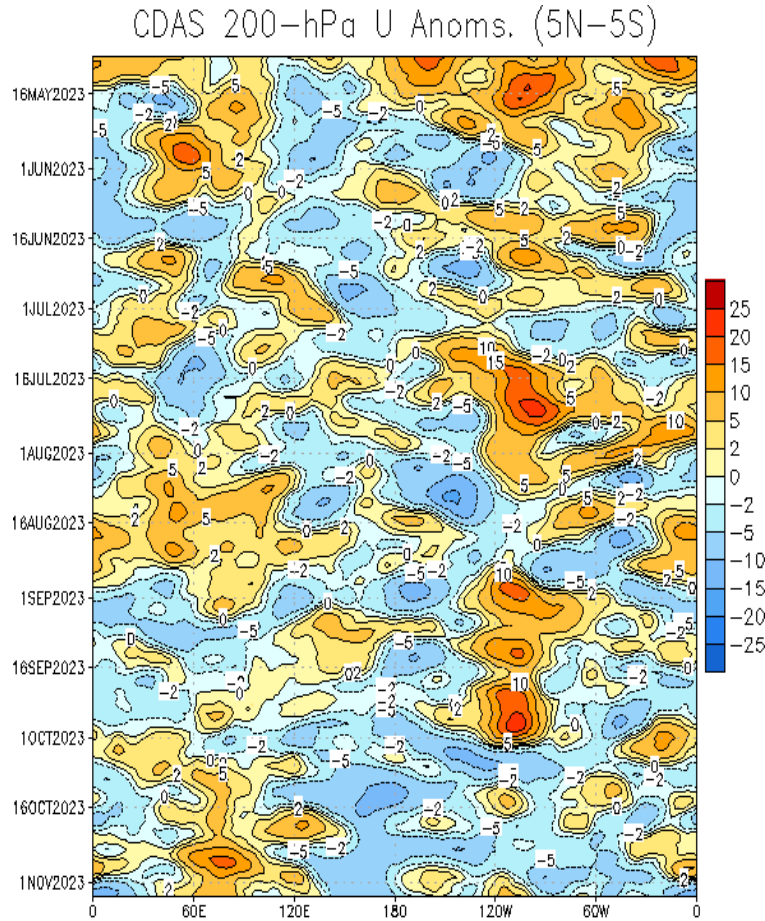
Brown shades: Anomalous convergence (unfavorable for precipitation)



- The large-scale pattern continues to be dominated by low-frequency signals, most notably the ongoing El Niño promoting enhanced divergence (convergence) over the central Pacific (Maritime Continent) and the positive Indian Ocean Dipole event promoting enhanced divergence (convergence) over Africa and the western Indian Ocean (eastern Indian Ocean and Maritime Continent).
- A higher frequency eastward propagating signal appear to be traversing the globe on the fast end of the MJO spectrum.

200-hPa Wind Anomalies

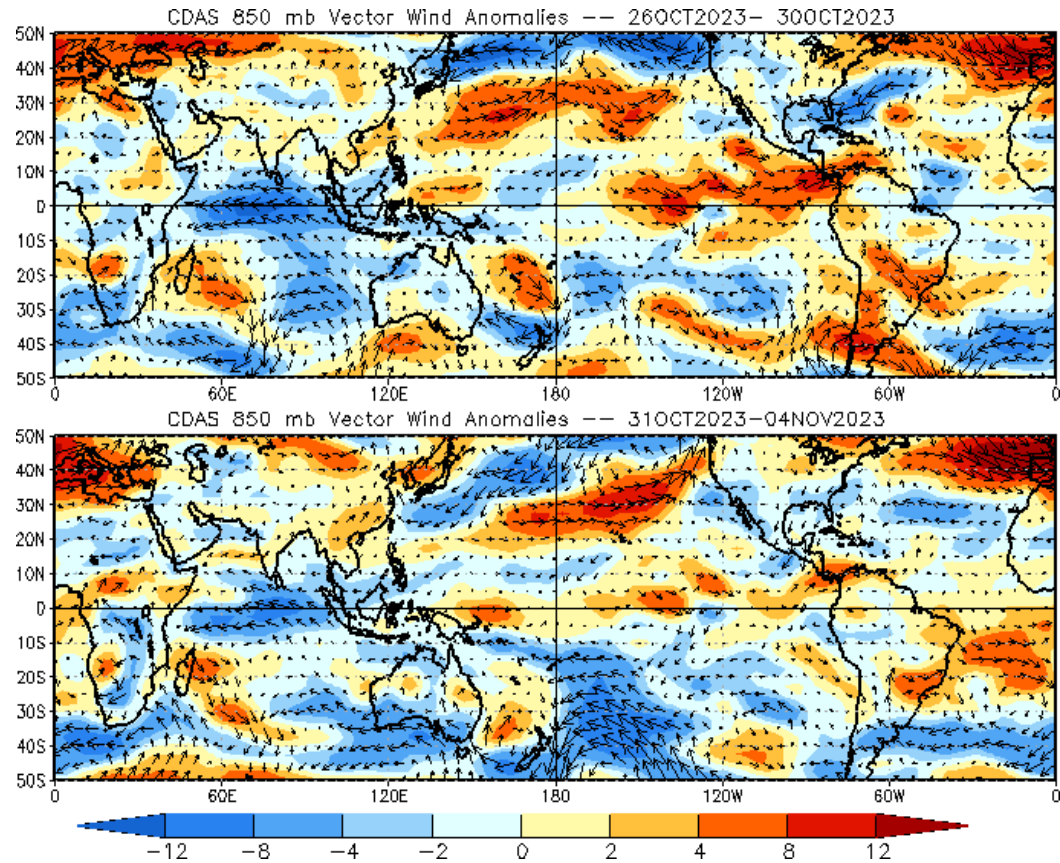
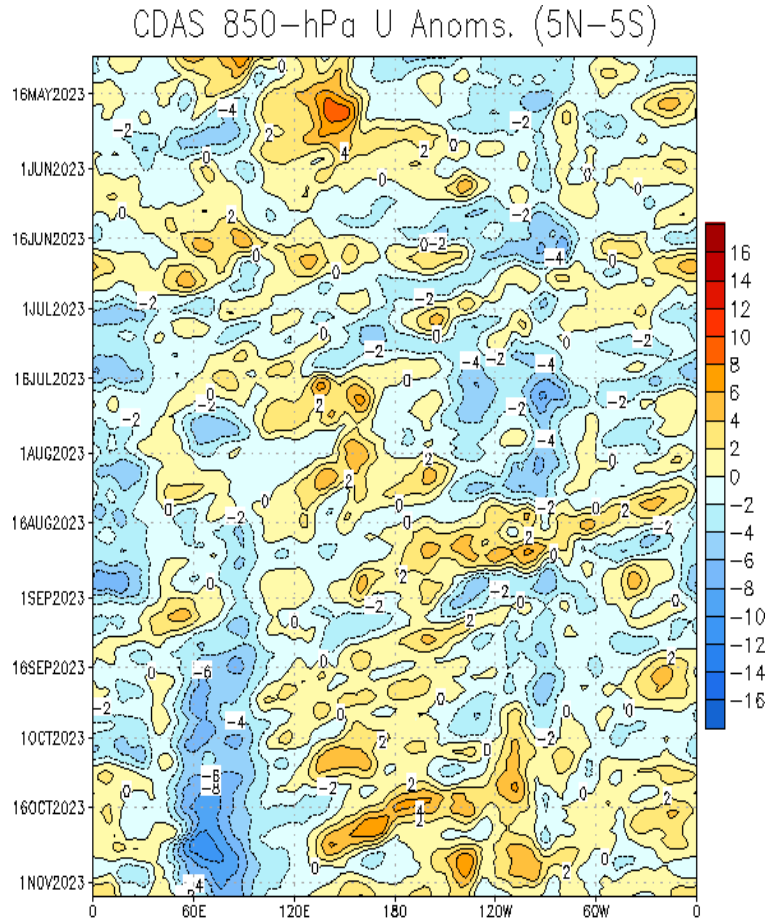
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Easterly anomalies aloft remain entrenched over the western Pacific basin.
- Coincident westerly anomalies across the Indian Ocean are promoting enhanced upper-level convergence over the Maritime Continent and are consistent with a +IOD event.
- Strong ridging overspread much of the CONUS during late October, replaced by northerly flow and a more active southern stream by the beginning of November.

850-hPa Wind Anomalies

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

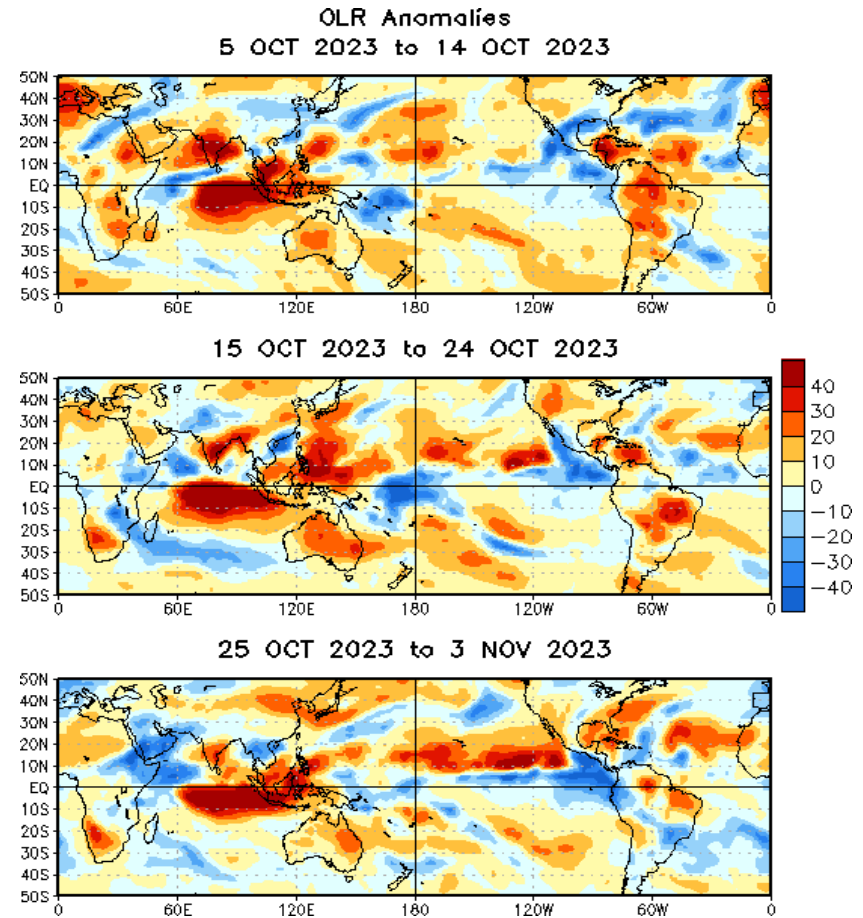
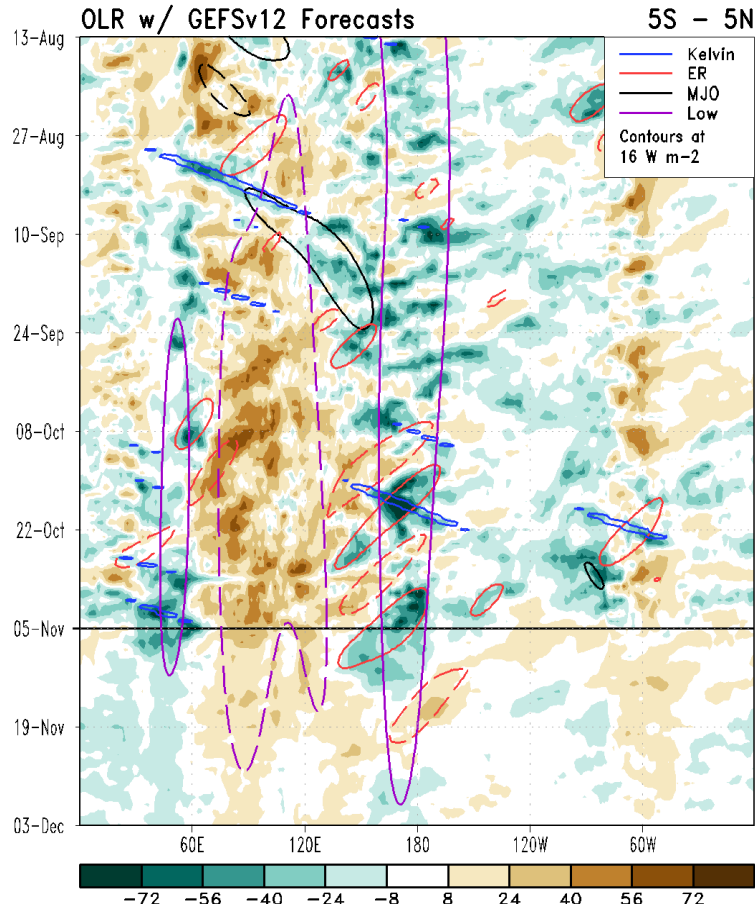


- Easterly anomalies associated with the +IOD event remain robust over the Indian Ocean.
- The trade wind regime over the Pacific remains fairly disrupted, though westerly anomalies across the eastern Pacific in early November are less amplified than in late October.
- Another developing westerly wind burst is evident northeast of New Guinea, centered on the Equator.

Outgoing Longwave Radiation (OLR) Anomalies

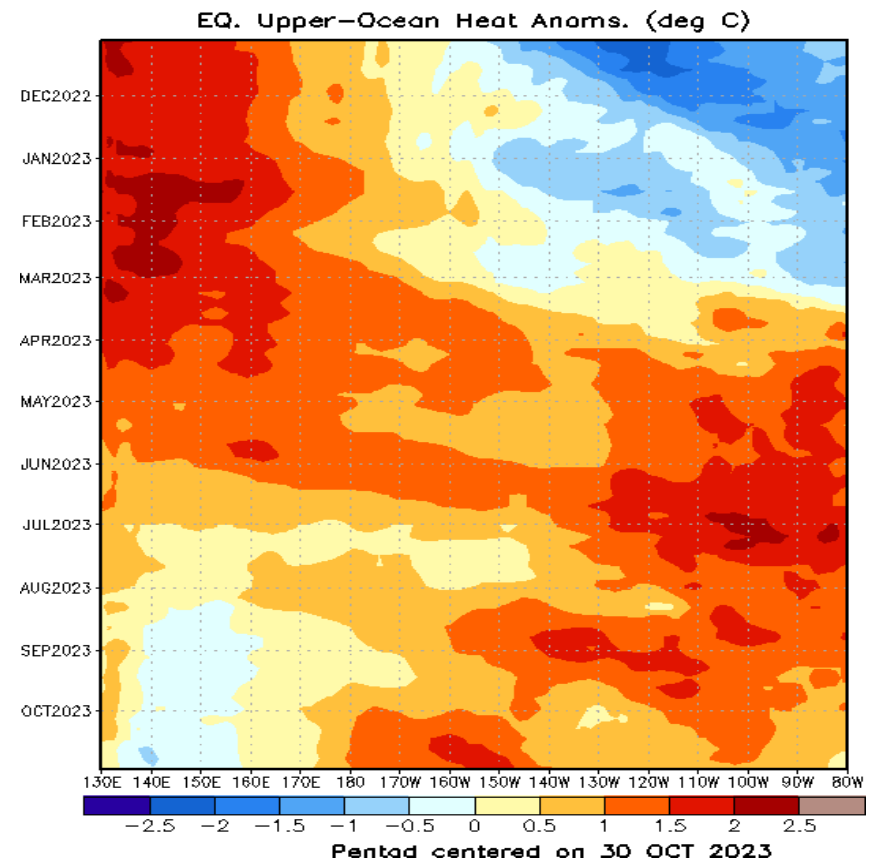
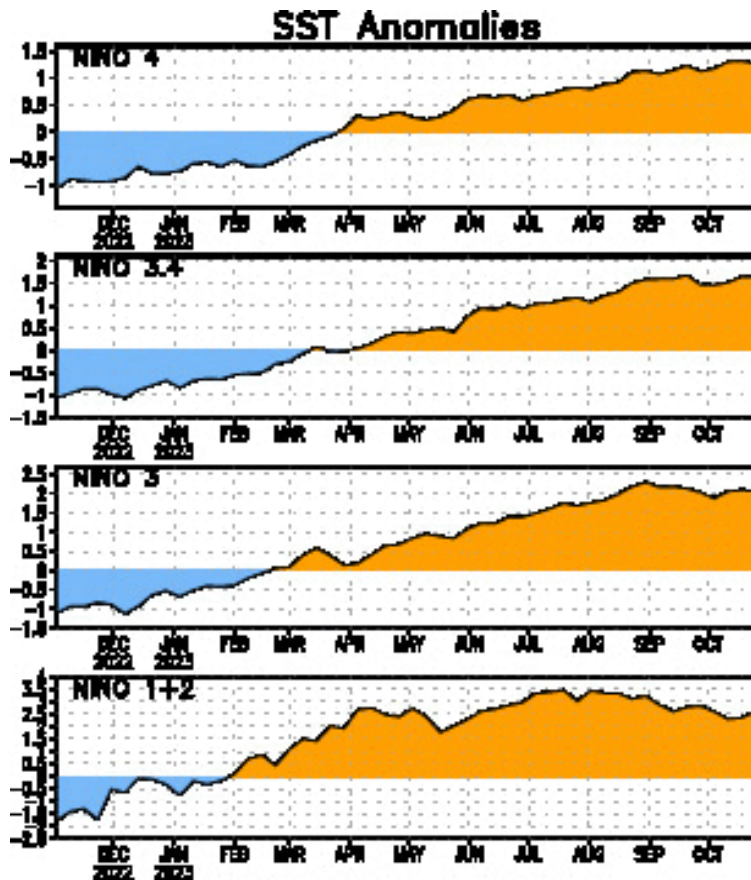
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- The OLR pattern primarily reflects the low frequency base state, modulated by Kelvin and Rossby wave activity.
- Some eastward propagation is coming through the filtering over the western Indian Ocean, but GEFS forecasts show this feature unable to overcome the strong Indian Ocean suppression.
- Enhanced convection in the vicinity of Central America remains primarily focused on the East Pacific basin. Convection over the Caribbean became more enhanced recently.

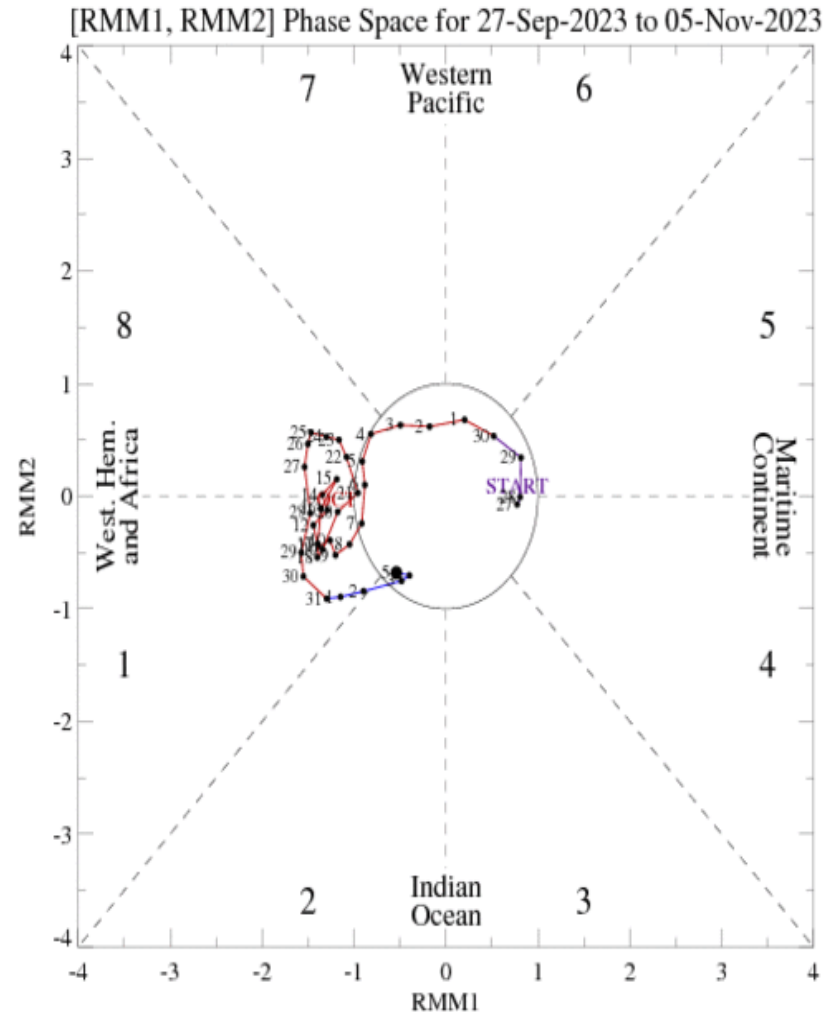
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- El Niño conditions are present across the equatorial Pacific with SST anomalies remaining strongly positive in all of the Niño basins.
- An area of slightly negative upper-ocean heat content anomalies continues across the Western Pacific and appears to have expanded slightly in recent observations.
- A new downwelling oceanic Kelvin wave may have initiated over the Central Pacific during October.

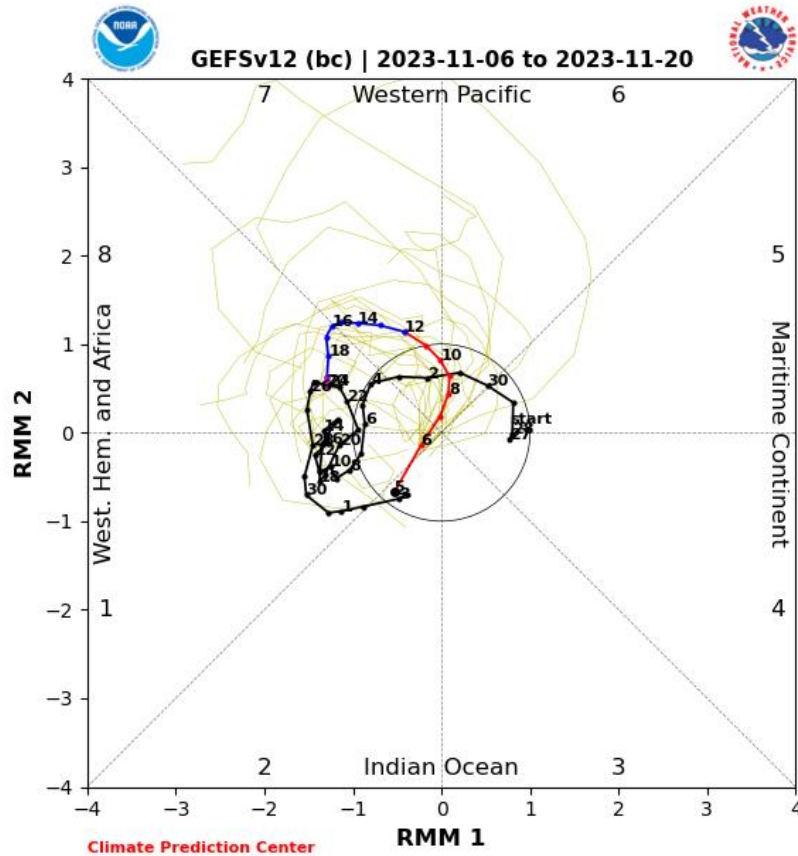
MJO Index: Recent Evolution

- The RMM-based MJO index has been meandering across the Western Hemisphere (phases 8 and 1) for much of the last month. The index is likely being overwhelmed by the ENSO and +IOD signals.
- More recently, some eastward propagation to the western Indian Ocean was observed, consistent with the upper-level velocity potential field.

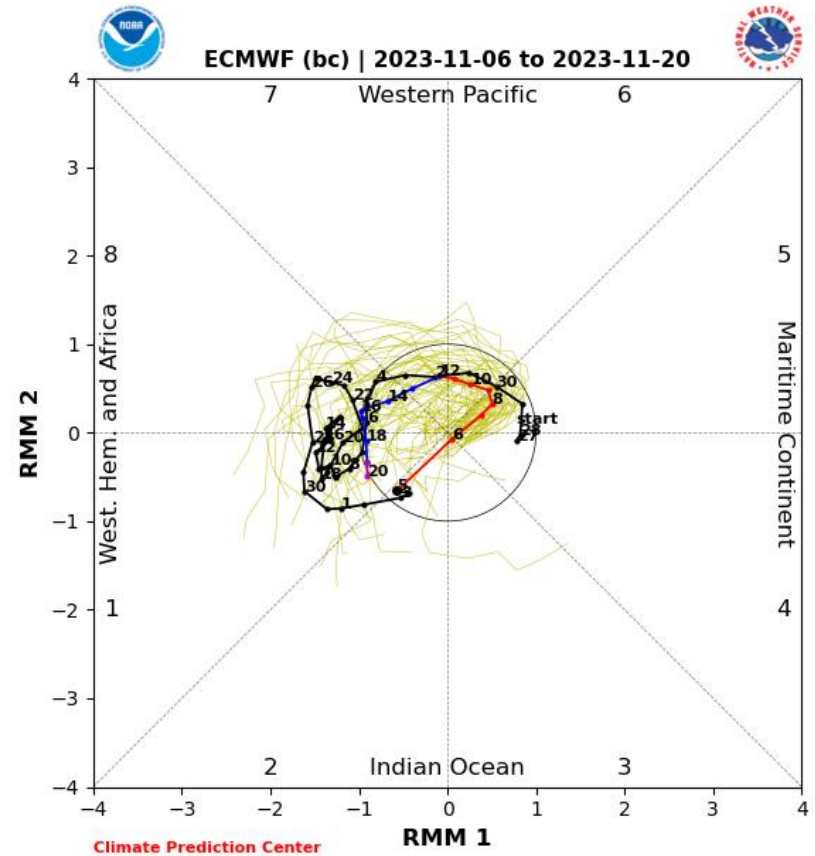


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



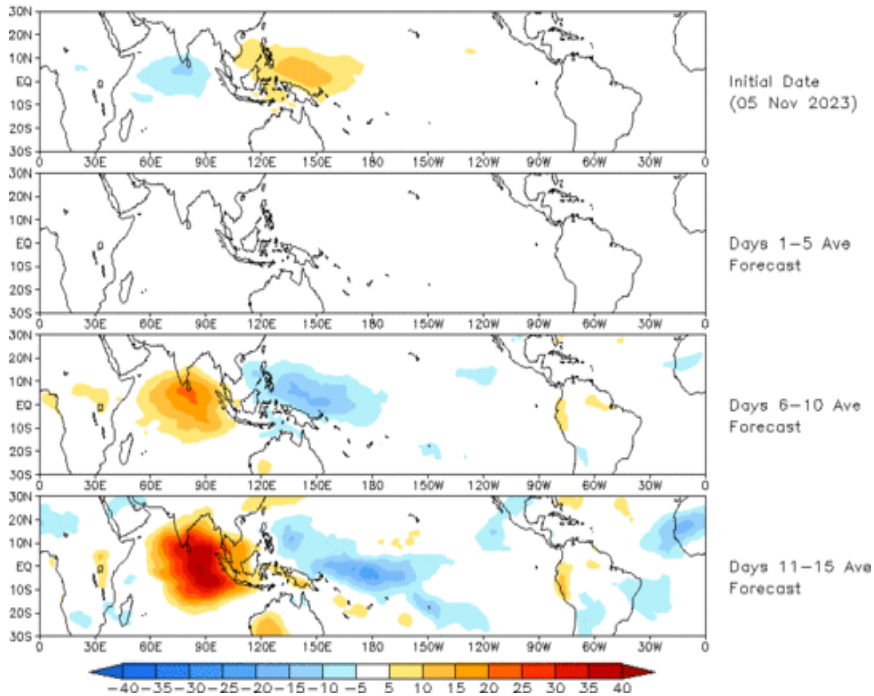
ECMWF Forecast

- Dynamical model guidance generally does not depict a continuation of the eastward propagating signal across the Indian Ocean or Maritime Continent. Most ensemble members quickly return the signal to the West Pacific or Western Hemisphere by Week-2, with some eastward propagation possible at that point.

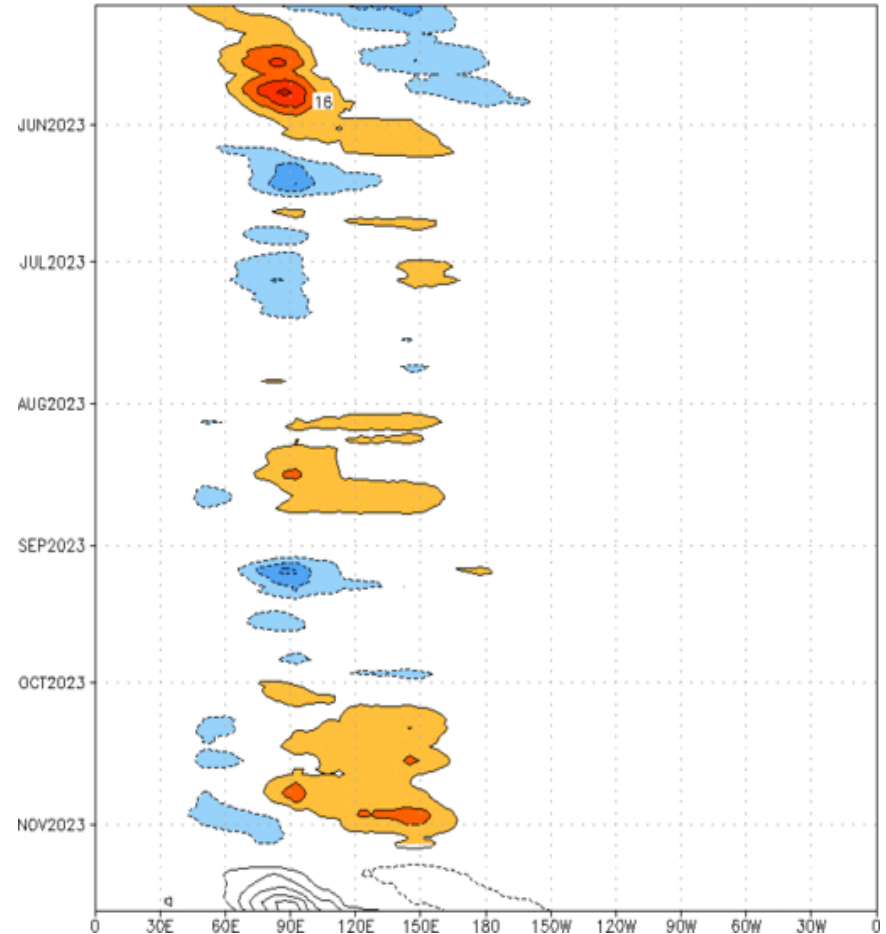
MJO: GEFS Forecast Evolution

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: 05 Nov 2023
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 06-May-2023 to 05-Nov-2023
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

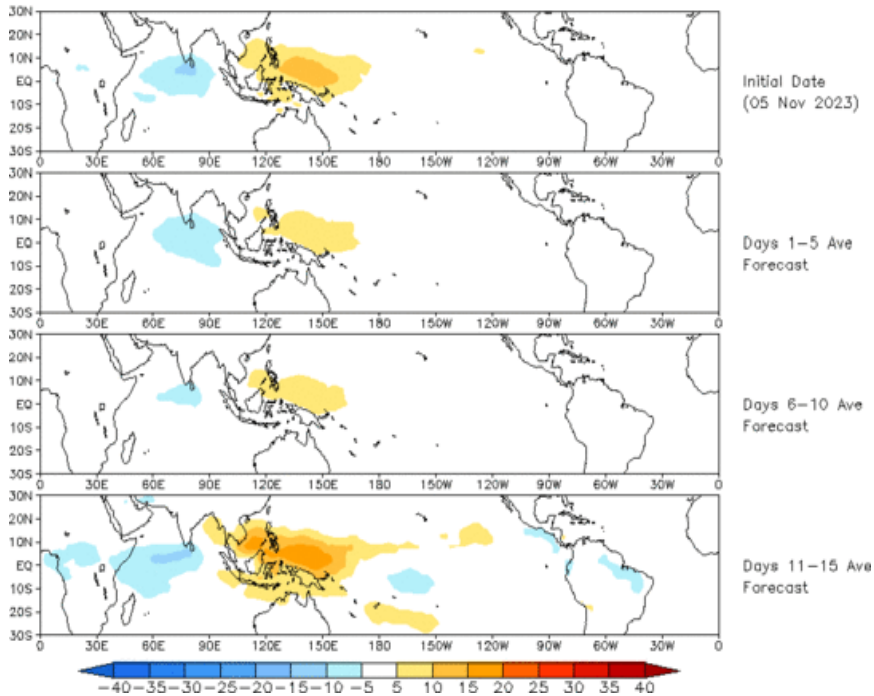


- The GEFS RMM-based OLR forecast depicts a rapidly weakening Indian Ocean signal during Week-1.
- Strong suppression (enhancement) returns to the Indian Ocean (Pacific) by Week-2; reflective of the low frequency base state.

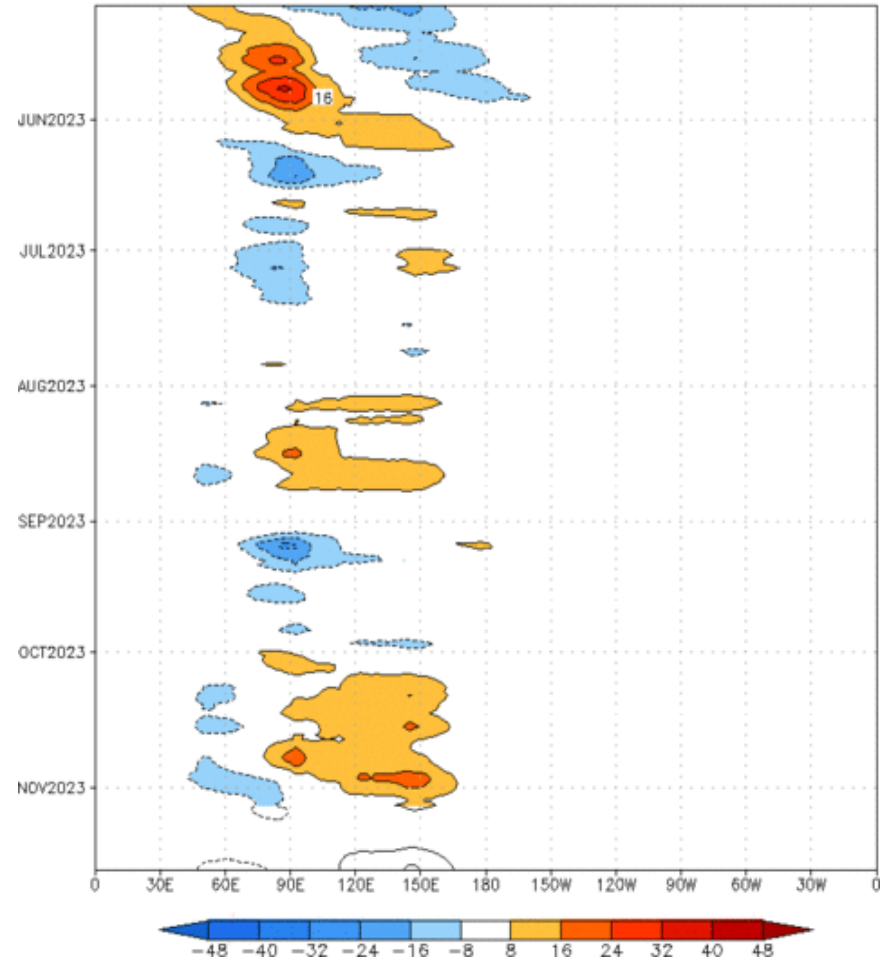
MJO: Constructed Analog Forecast Evolution

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 (05 Nov 2023)



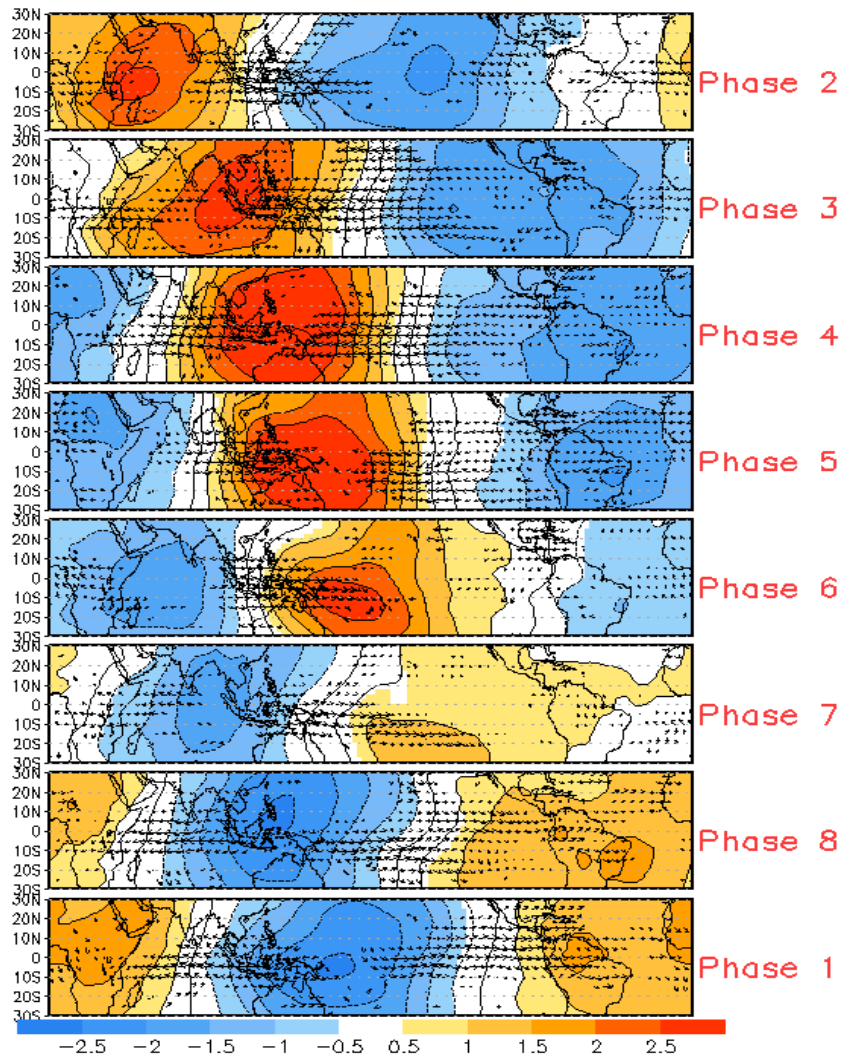
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:06–May–2023 to 05–Nov–2023
The unfilled contours are CA forecast reconstructed anomaly for 15 days



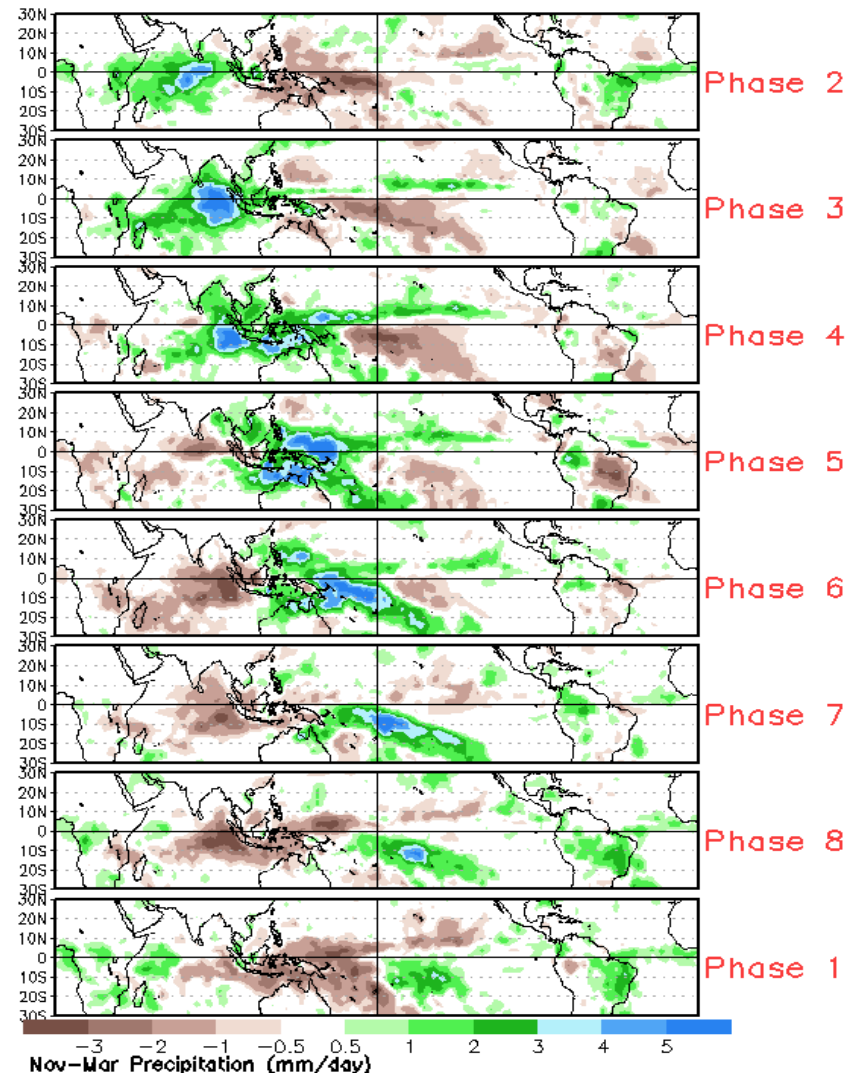
- The constructed analog RMM-based forecast reflects more potency in the higher frequency mode, though with little eastward propagation during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



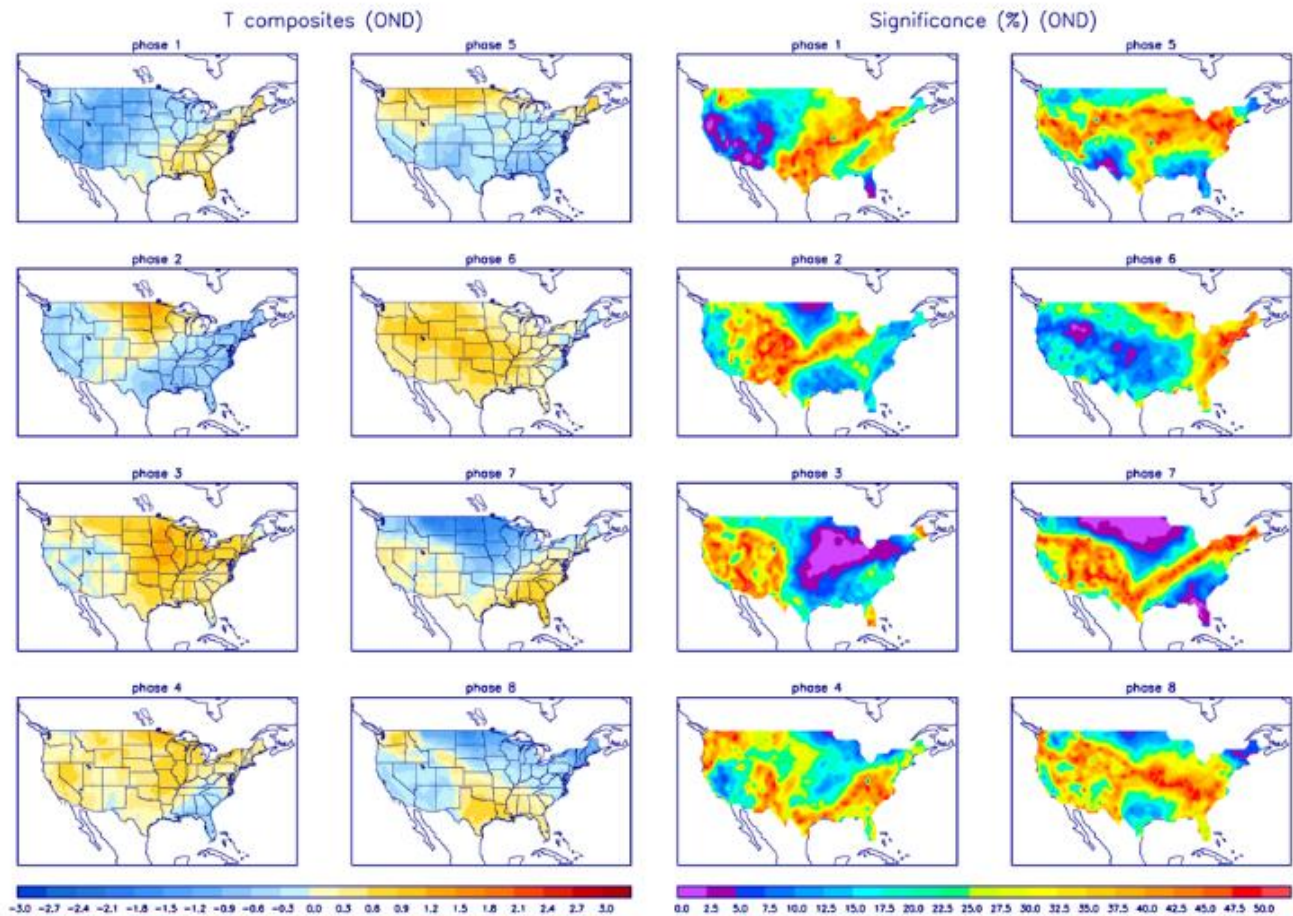
Precipitation Anomalies



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.

