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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
4 November 2024

Overview

- Robust MJO activity continues, with the enhanced convective phase rapidly crossing the central Pacific and now over the far eastern Pacific and Western Hemisphere.

- Dynamical models depict continued evolution of the MJO signal, with the enhanced phase crossing the Western Hemisphere during Week-1, and entering the Indian Ocean basin during Week-2.

- The MJO favors a pattern of enhanced low-level westerlies across the Caribbean Sea, which, coupled with well above average SSTs, may promote enhanced late season tropical cyclone activity.

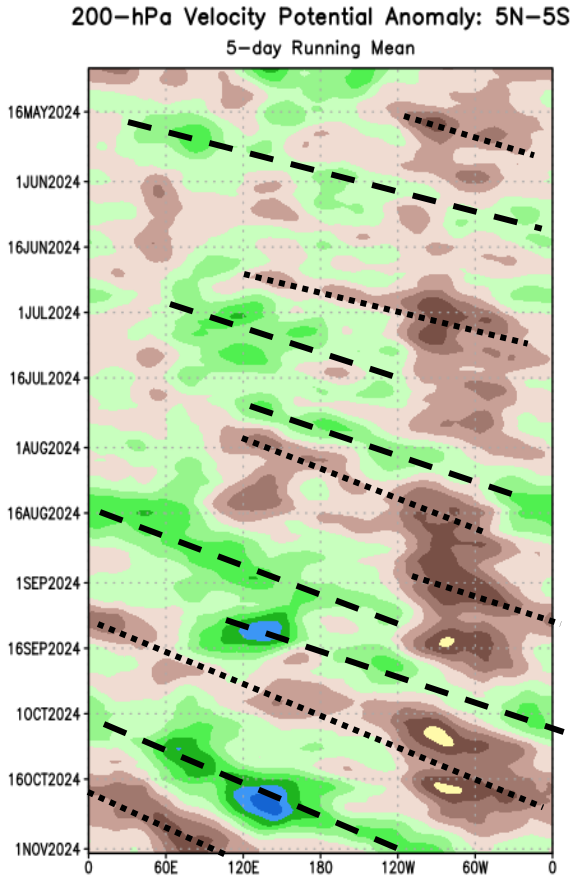
- La Niña conditions have been slow to evolve across the Pacific, and may be further disrupted by recent MJO activity. As the suppressed phase of the MJO crosses the Pacific over the next few weeks, however, a strong trade wind surge is favored, which may help further the evolution of the low frequency base state.

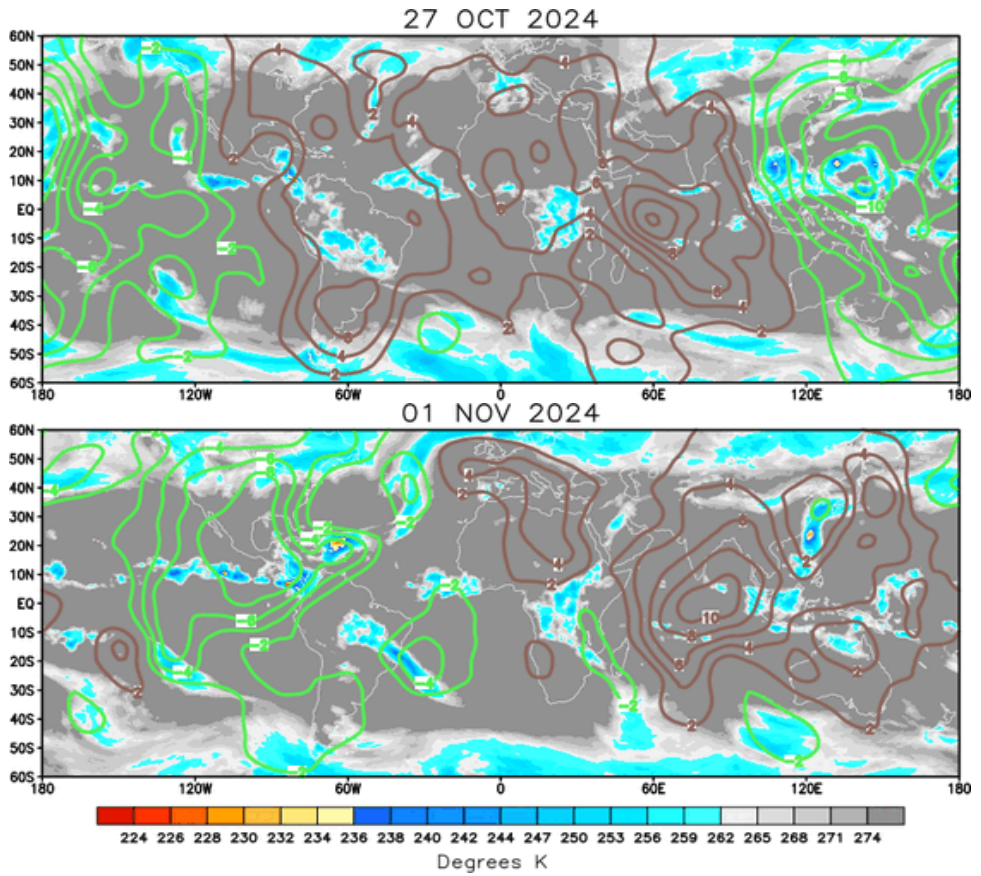
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

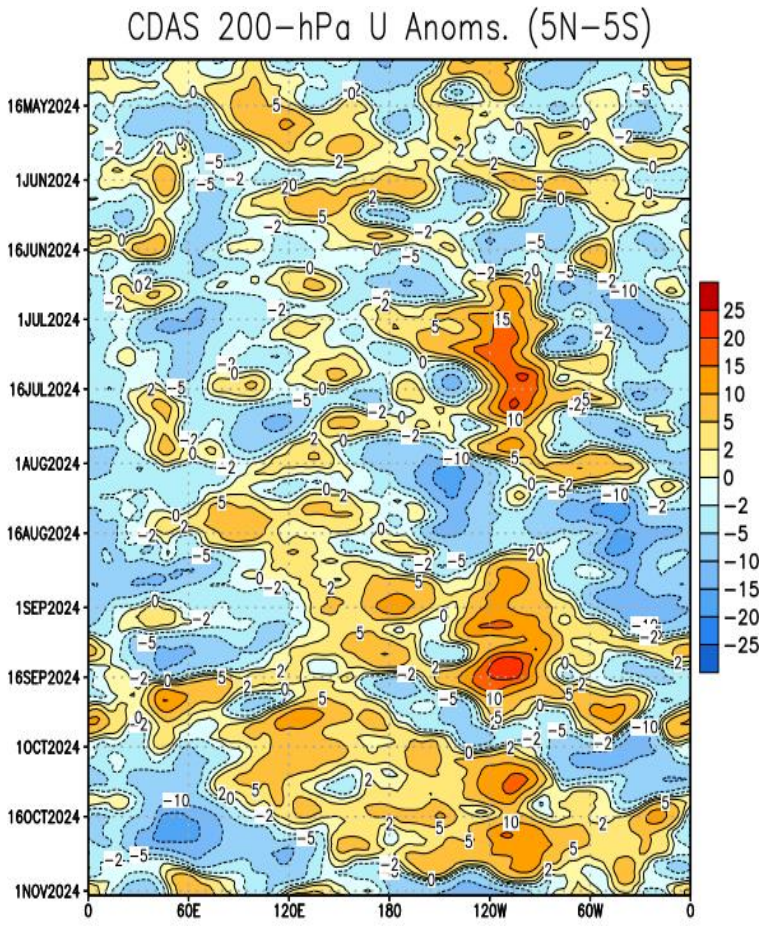


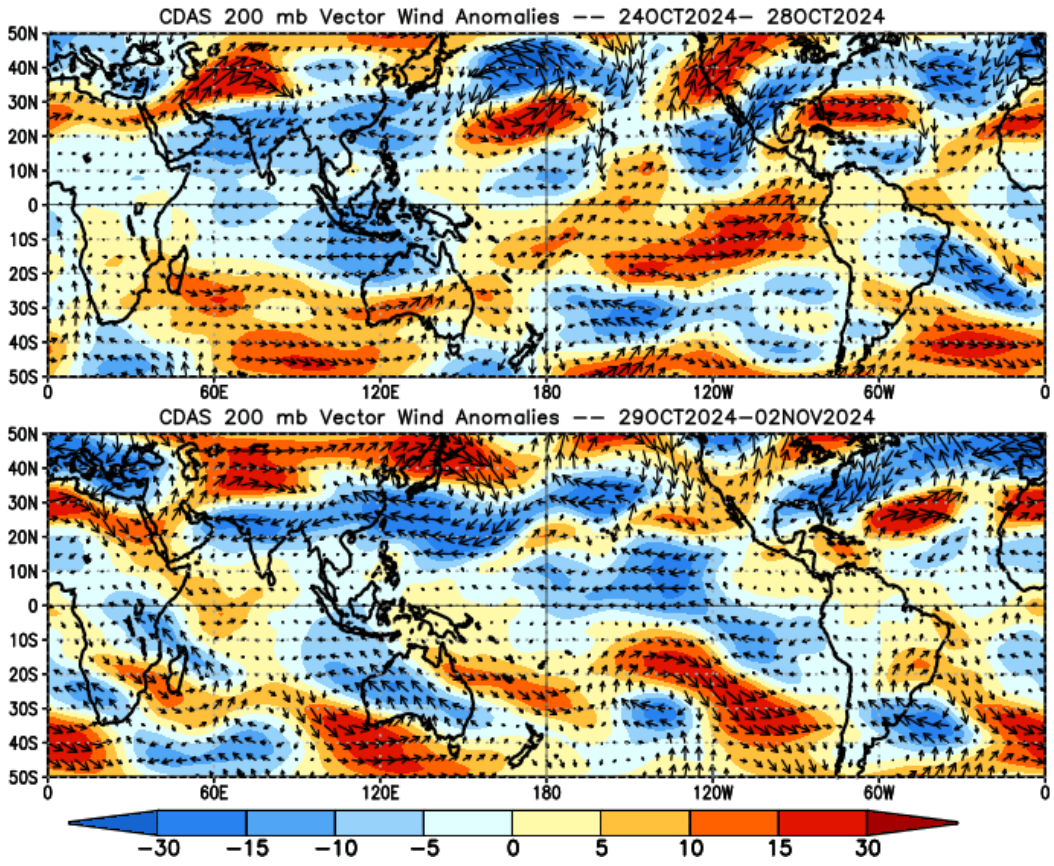


- Well organized, eastward propagating envelopes of enhanced (suppressed) large-scale ascent during October and early November indicate robust MJO activity.
- Spatially, the upper-level VP field continues to exhibit a robust Wave-1 structure, despite interference from the low frequency base state as the enhanced phase crossed the Pacific.
- The enhanced convective phase of the MJO is currently over the East Pacific and Americas.

200-hPa Wind Anomalies

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

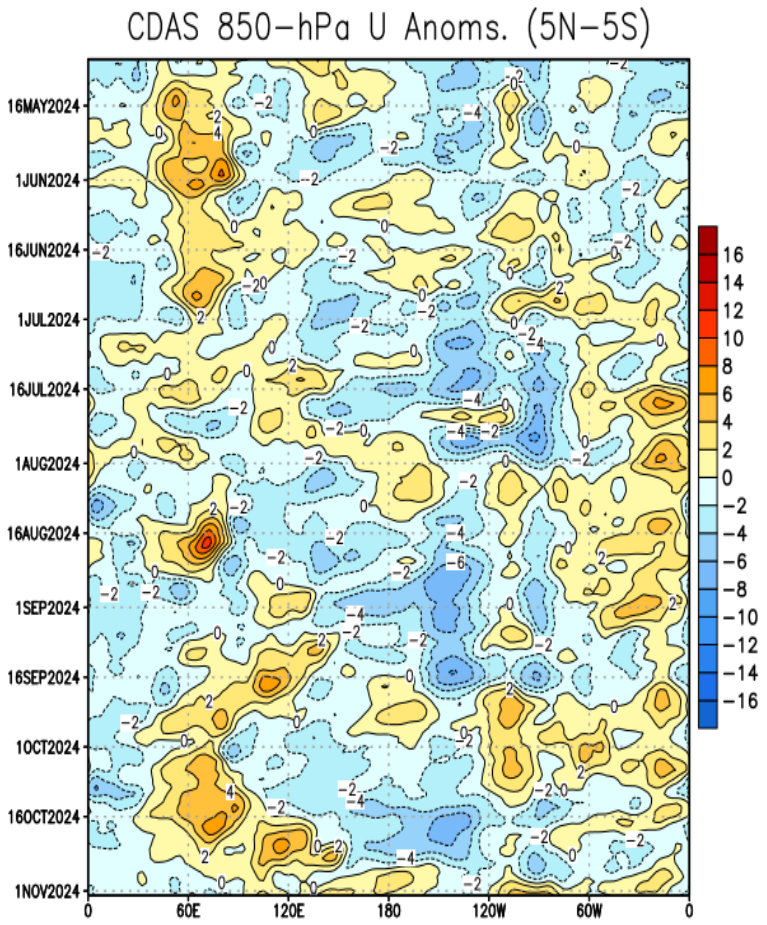


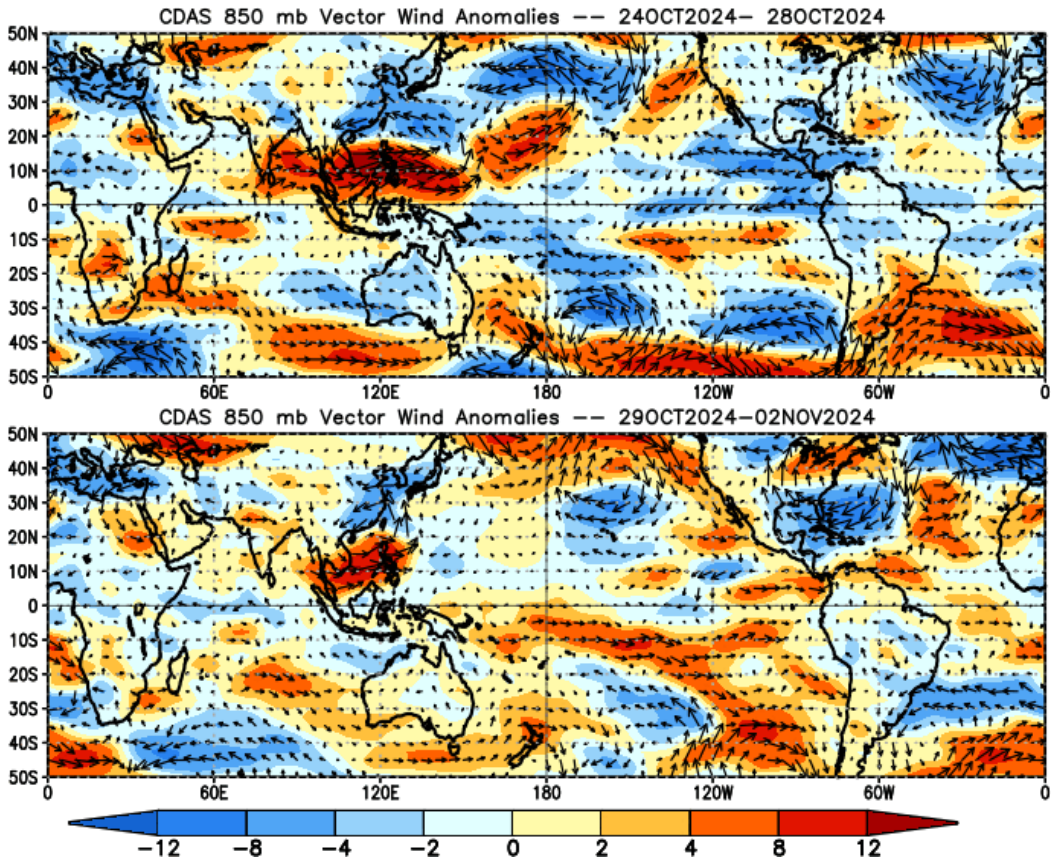


- Westerly anomalies over the central and eastern Pacific during late October were replaced by easterlies as the MJO progressed towards the Western Hemisphere.
- The envelope of westerly anomalies became more incoherent due to interference from other modes of variability.

850-hPa Wind Anomalies

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

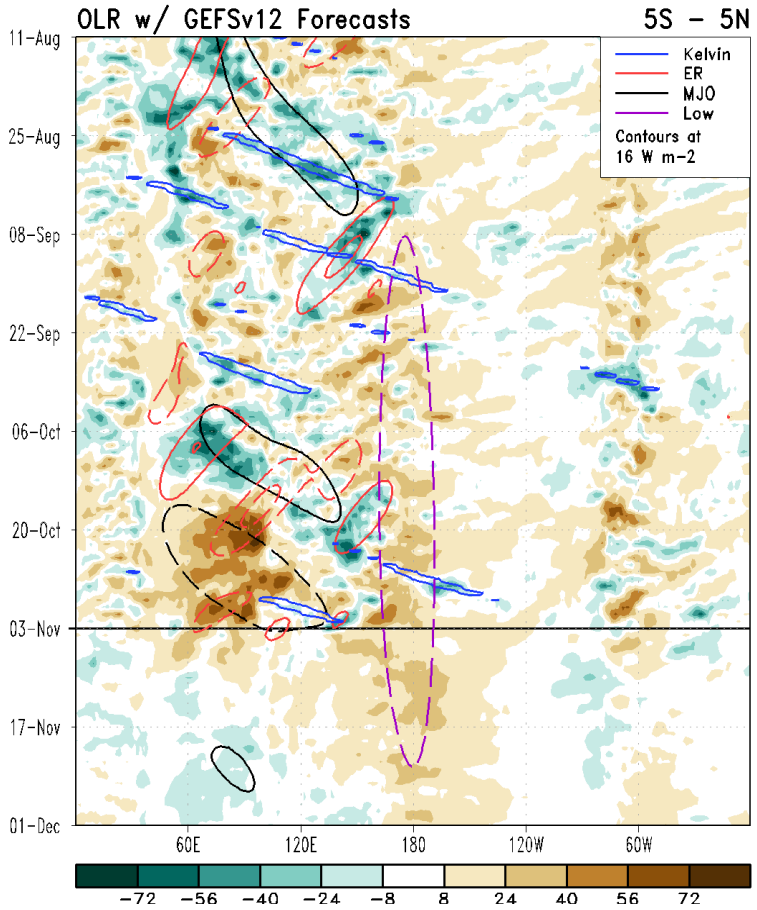


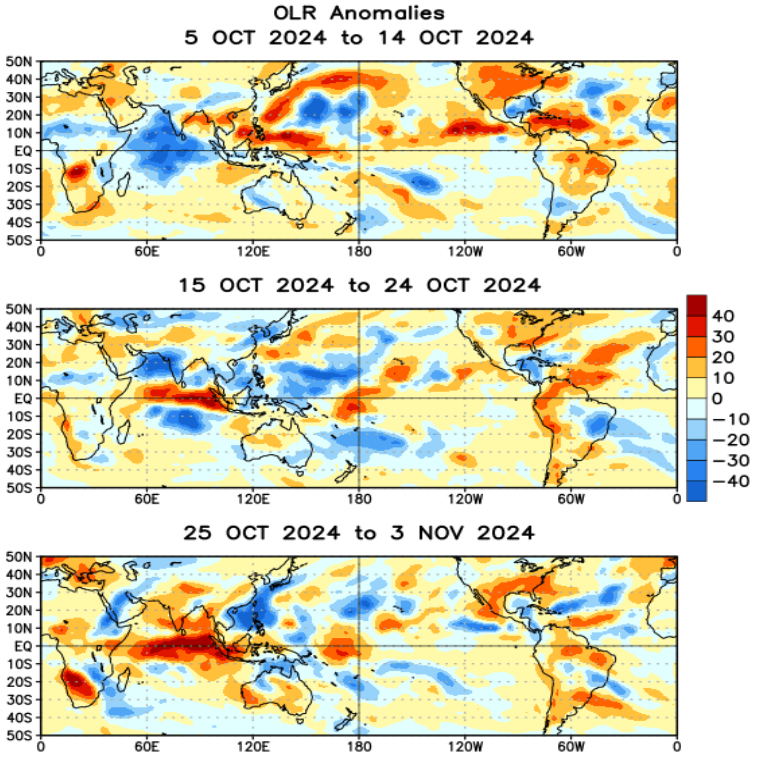


- The strongest westerly anomalies during late October materialized over the northwestern Pacific, mainly north of the Equator.
- Westerly anomalies propagated across the Pacific during the end of October and early November, destructively interfering with the evolving low frequency base state.
- Strong high pressure is evident over eastern North America.

Outgoing Longwave Radiation (OLR) Anomalies

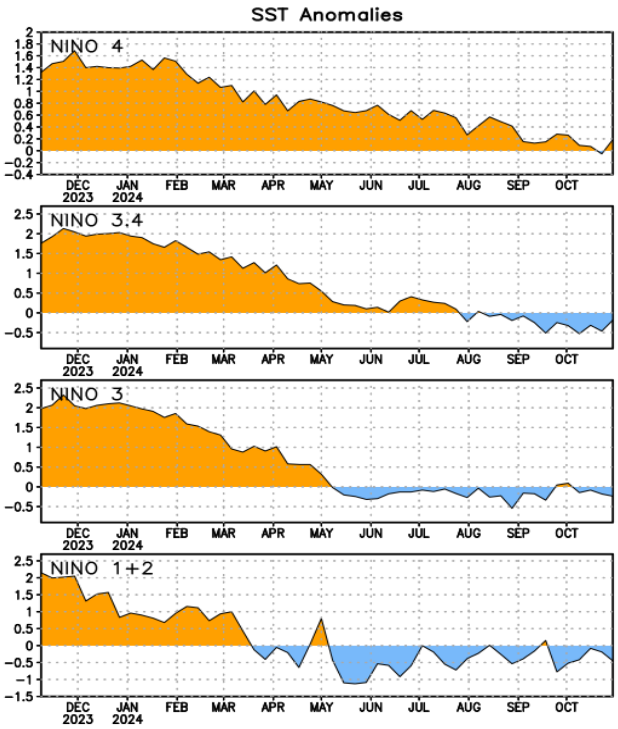
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

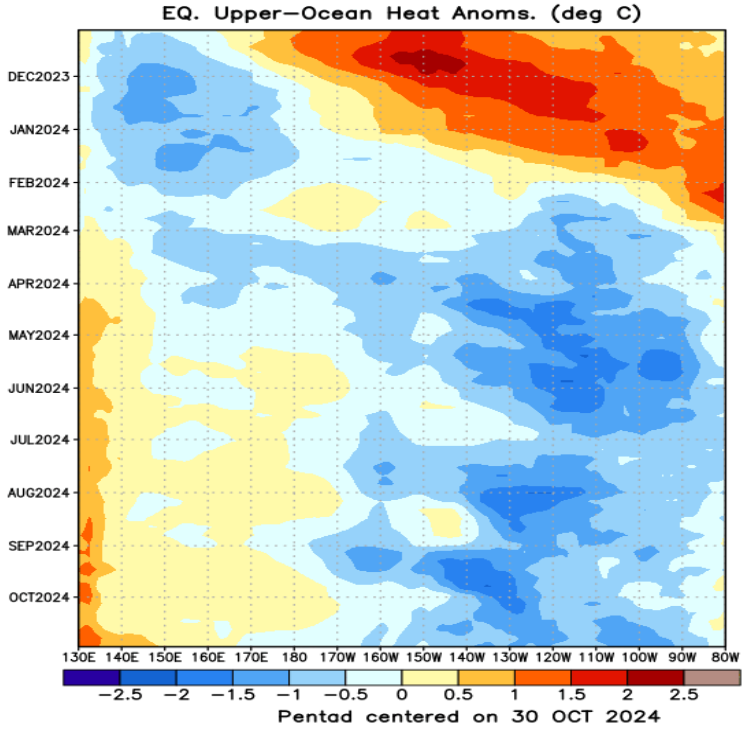




- Enhanced convection over the Indian Ocean basin during early and mid-October was replaced by suppressed conditions by the end of October and early November as the MJO propagated eastward across the Pacific.
- The enhanced convective phase became more disorganized as the intraseasonal signal destructively interfered with the low frequency suppressed signal across the central Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

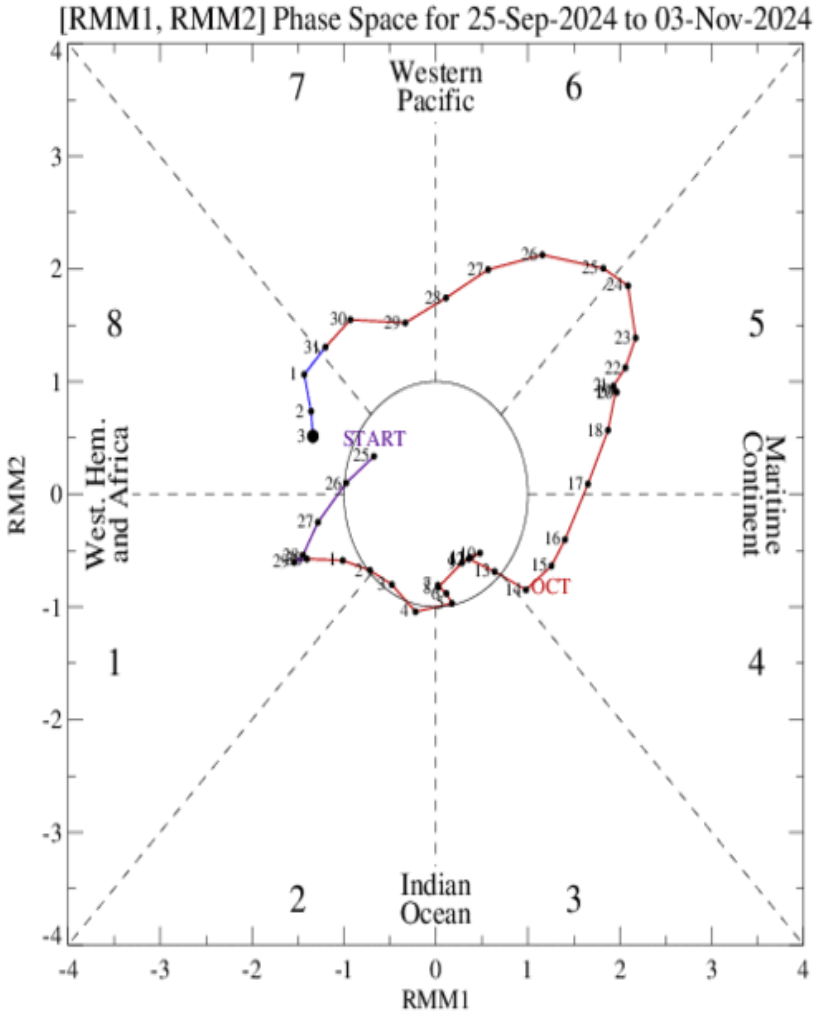




- The Nino regions east of the Date Line continue to reflect cold-neutral conditions, with more significant below-average sub-surface heat content remaining in place.
- A slight uptick in SSTs in the Nino 4 region, along with a slight eastward expansion of warm anomalies across the far western Pacific, may reflect a response to recent MJO activity.
- Given that most of the low-level westerly anomalies were north of the Equator, it is uncertain whether recent activity will result in a robust downwelling oceanic Kelvin wave.

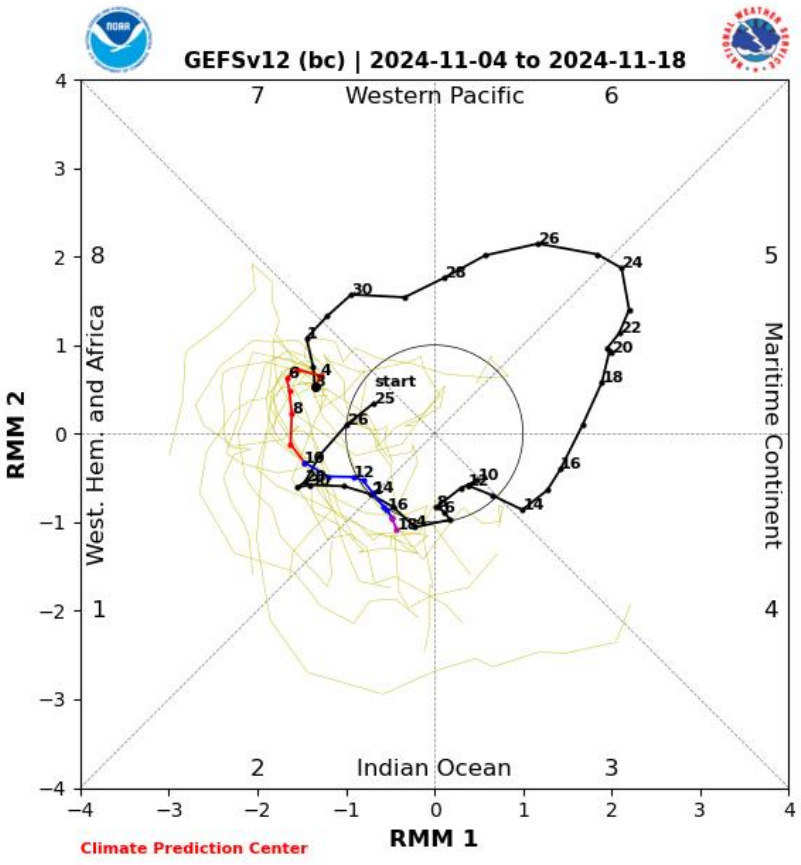
MJO Index: Recent Evolution

- RMM observations depict that the MJO circumnavigated the globe over approximately the last 40 days, consistent with canonical MJO activity.
- Rapid propagation was observed across the Pacific, with high amplitude reflecting the disruption of the evolving low frequency base state that favors suppressed activity across the Pacific.
- Most recently, the MJO was crossing the East Pacific and Western Hemisphere.

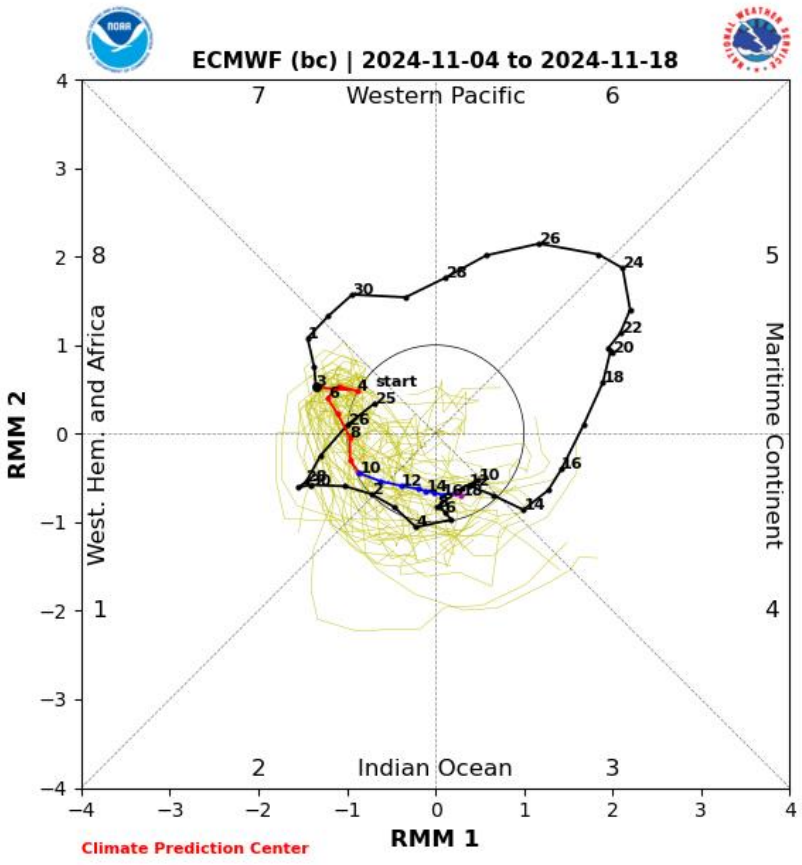


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

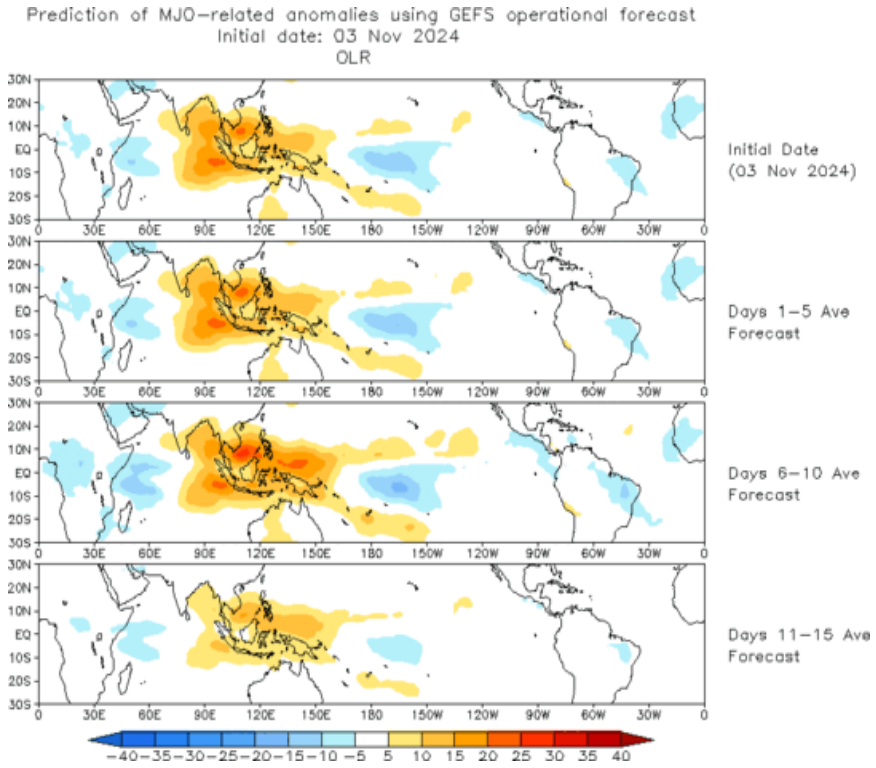


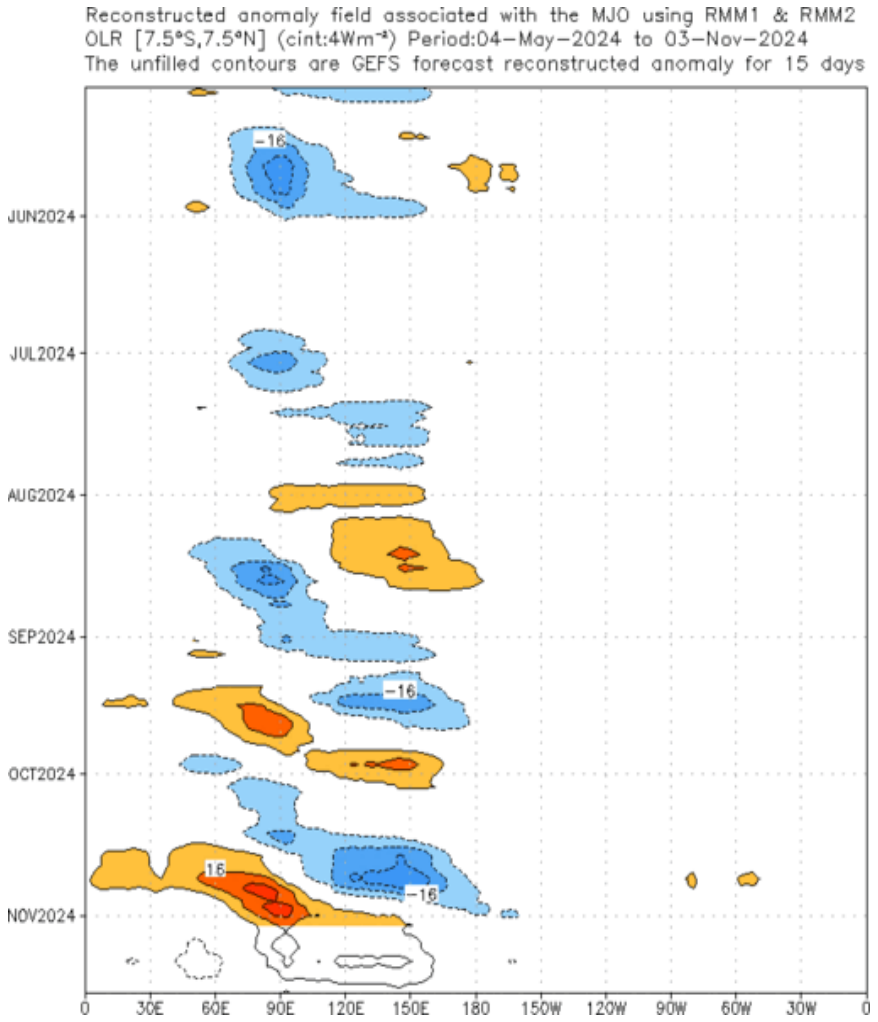
ECMWF Forecast

- Dynamical model MJO index forecasts are in broad agreement supporting continued MJO evolution from the Western Hemisphere to the Indian Ocean over the upcoming two weeks.
- While the amplitude of the RMM index is favored to decrease, the forecast event appears similar to the most recent MJO progression across the Indian Ocean observed during early October.
- The GEFS ensemble members tend to be slower and more amplified than the ECMWF ensemble members.

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.)

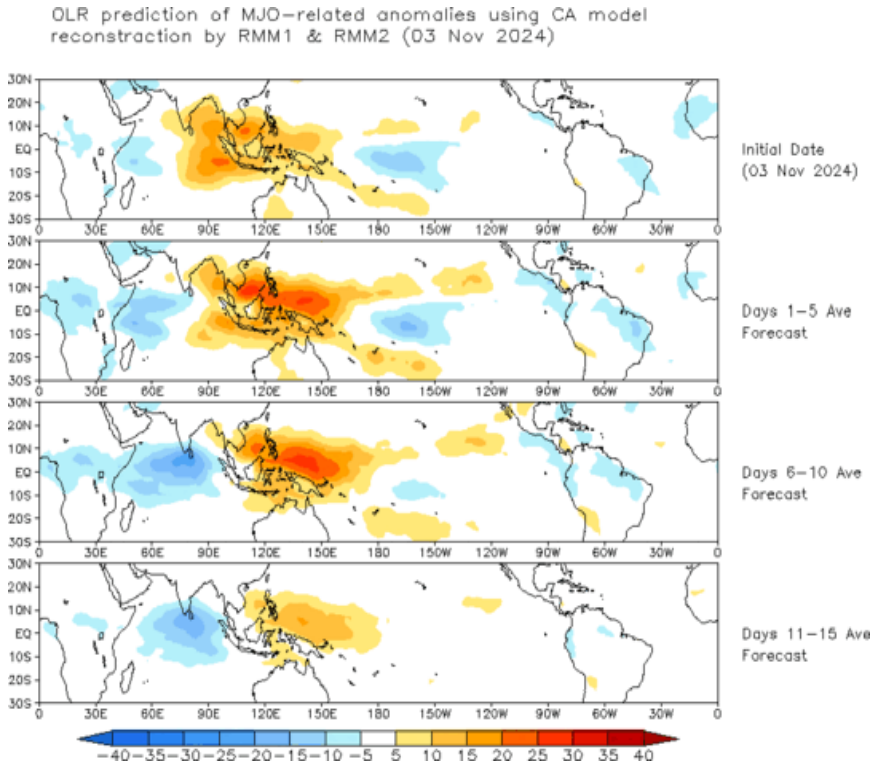


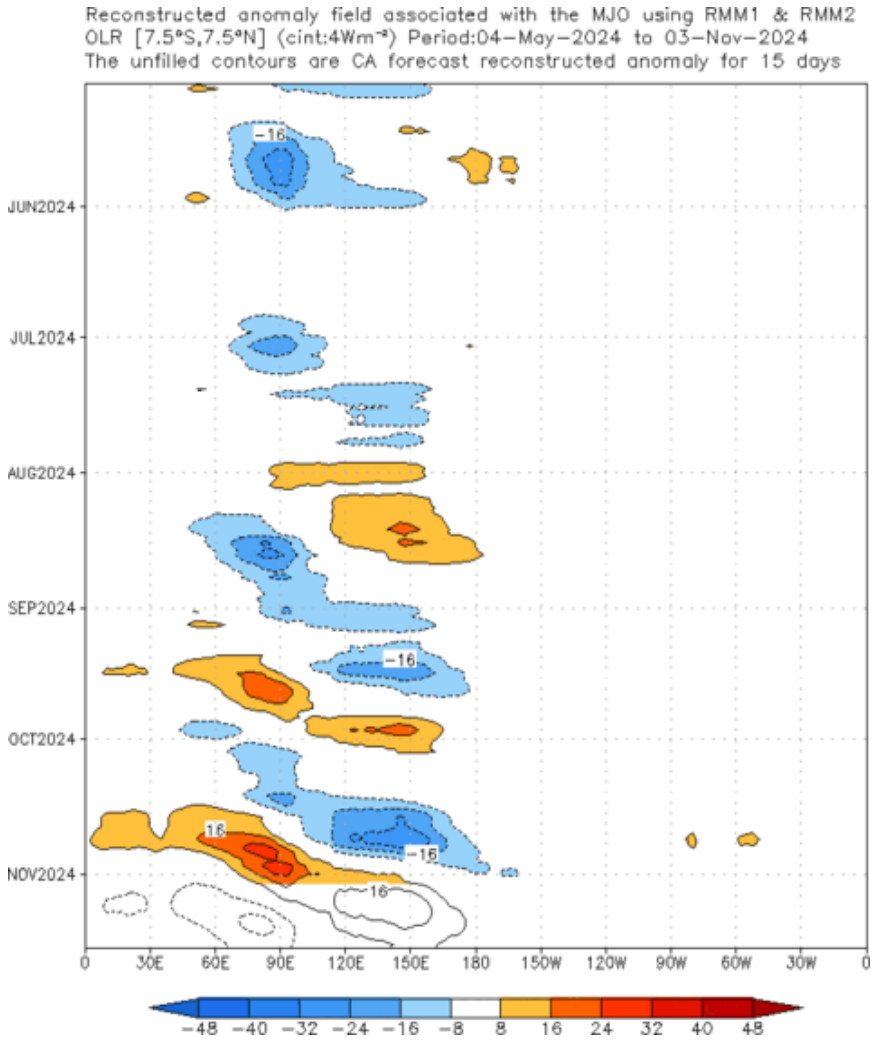


- The GEFS OLR anomaly forecast based on the projected RMM index depicts an amplified and slowly evolving signal moving from the Western Hemisphere towards the Indian Ocean.

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.)

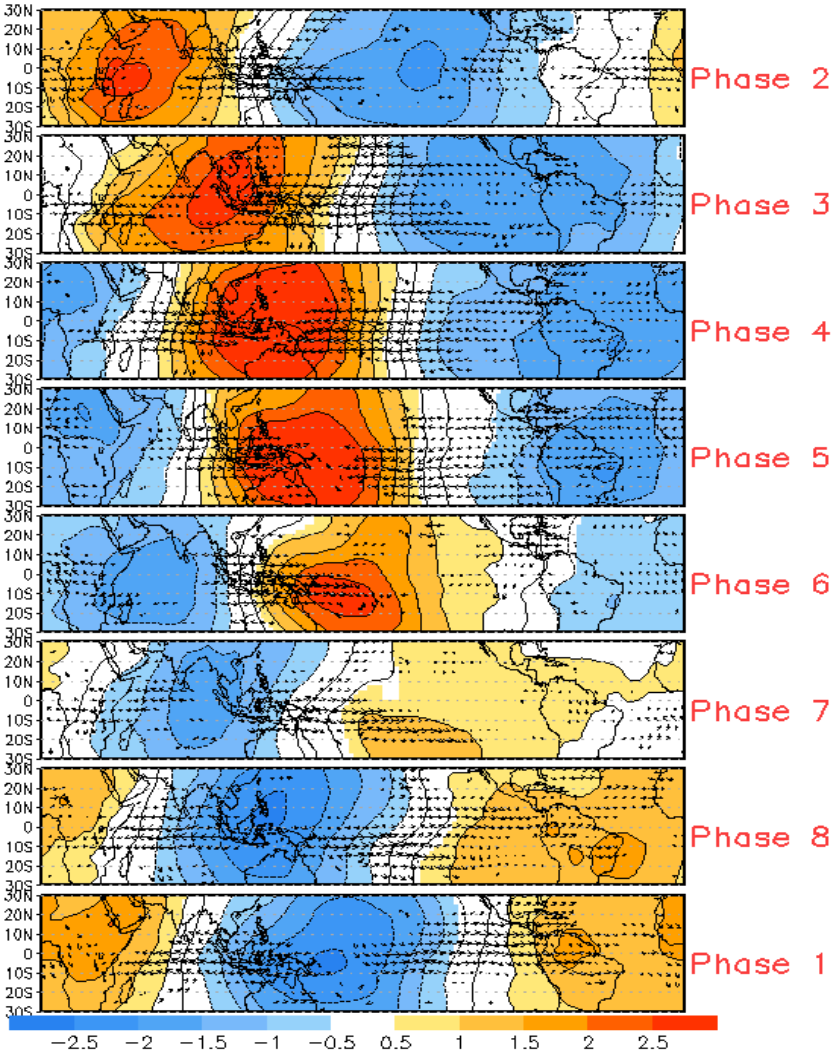




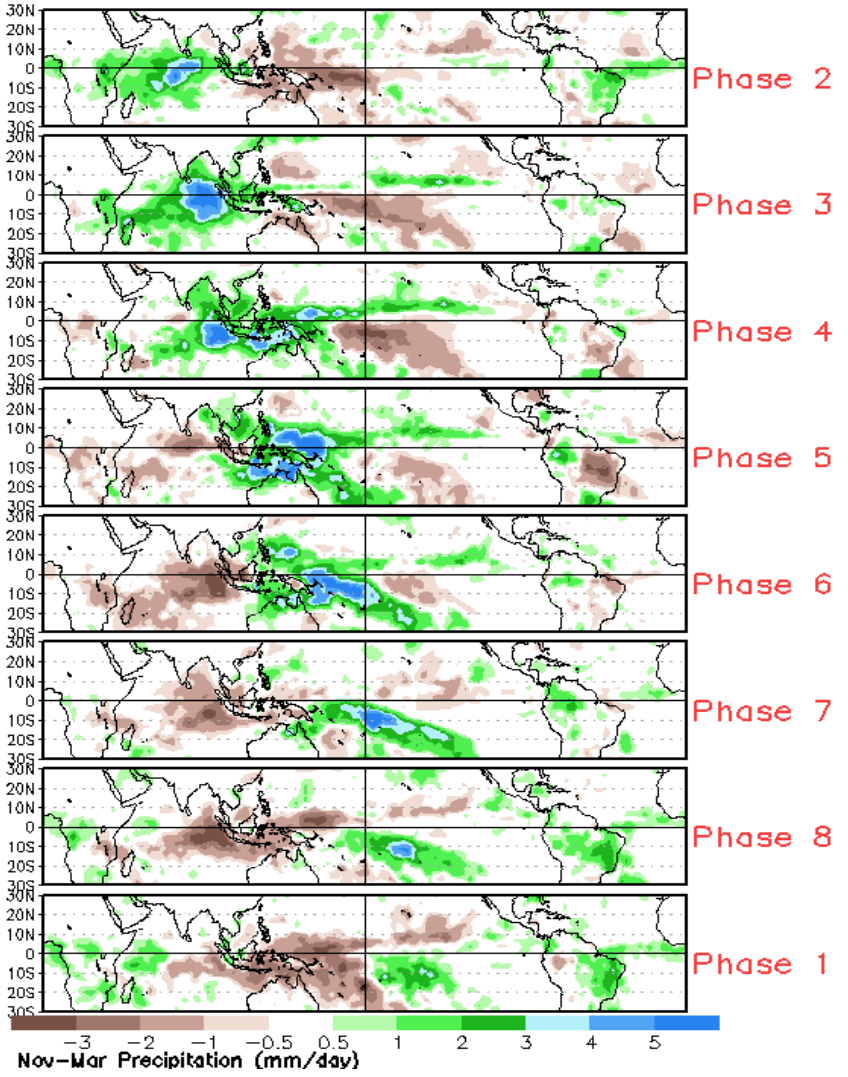
- The constructed analog forecast is also highly amplified and more progressive than the GEFS, depicting a full transition of the MJO back to the central Indian Ocean basin by the end of Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



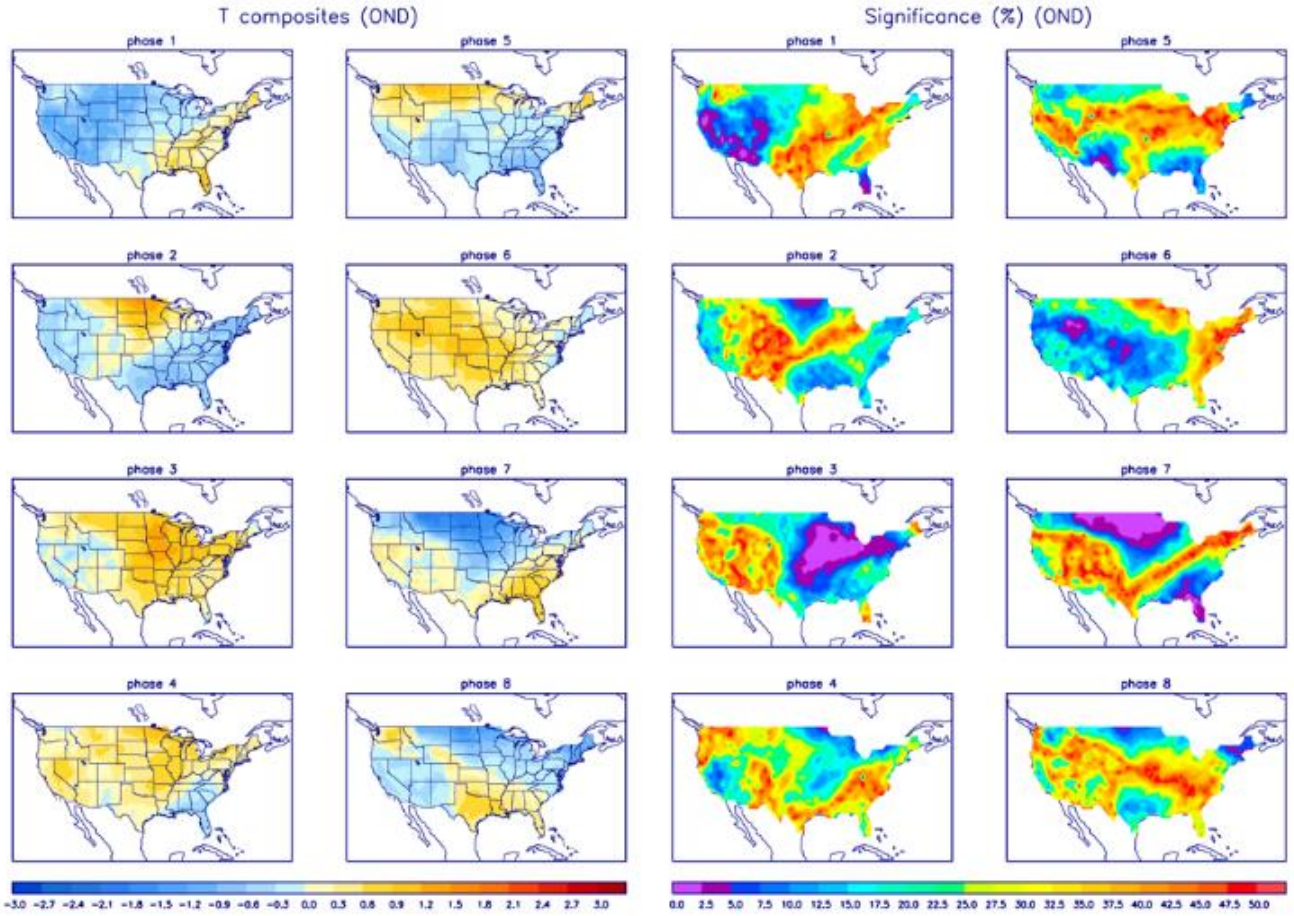
Precipitation Anomalies



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.

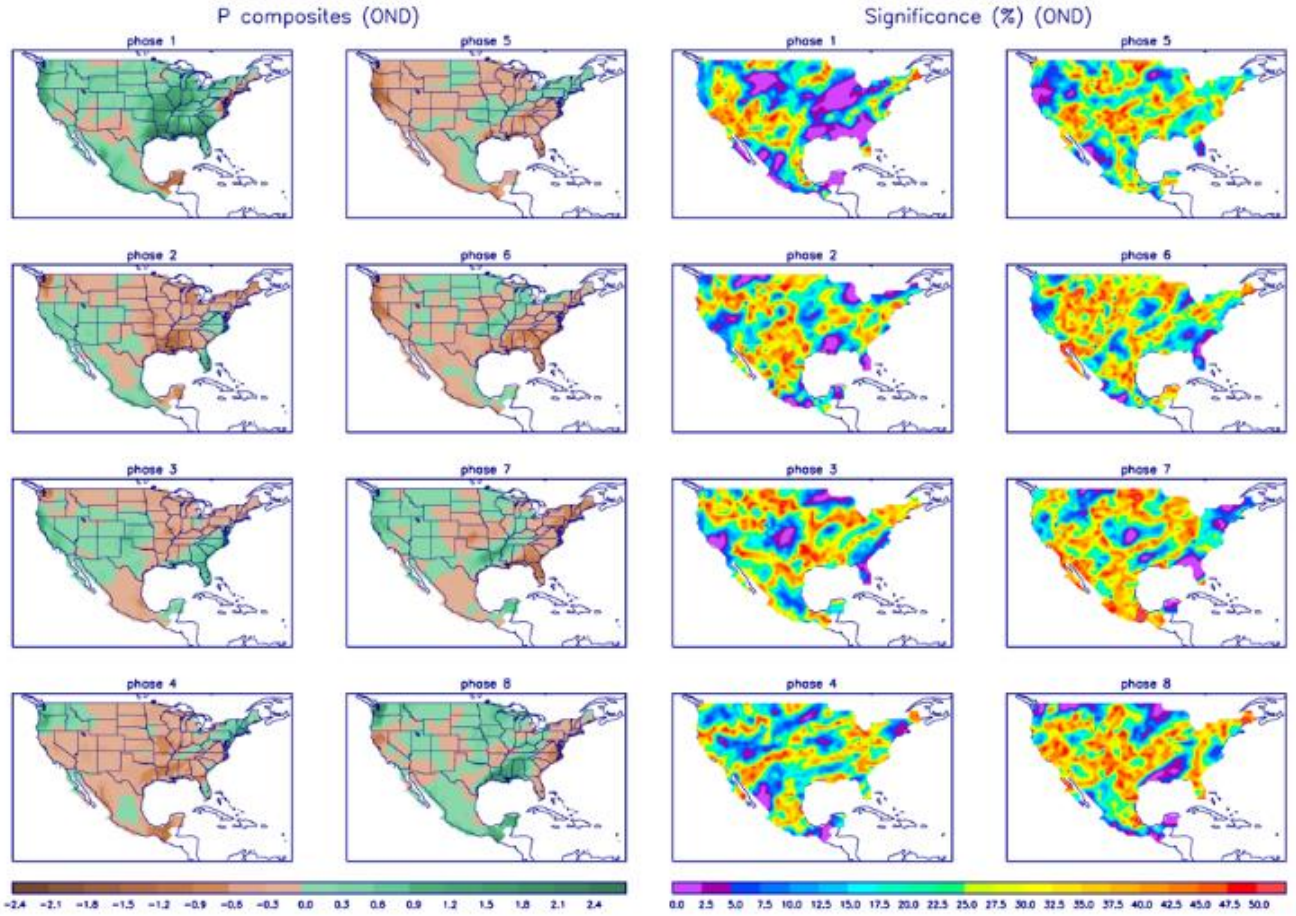


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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