

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



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

Overview

- The MJO remains active, completing a full circumnavigation of the globe during the past month.
- Dynamical models depict the MJO moving back over the Indian Ocean during the next week, but slowing down, and constructively interfering with the developing low frequency enhanced convective state over the region.
- This forecast slowing of the enhanced convective envelope is likely to promote enhanced TC activity across the Southern Indian Ocean and Bay of Bengal, and perhaps closer to northwestern Australia by the end of November. Additional TC activity also cannot be ruled out across the Western North Pacific due to ongoing high activity.
- In the wake of the MJO, suppressed convection is forecast to overspread the Americas, reducing the chances for TC development, consistent with the end of the Eastern North Pacific and North Atlantic seasons.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

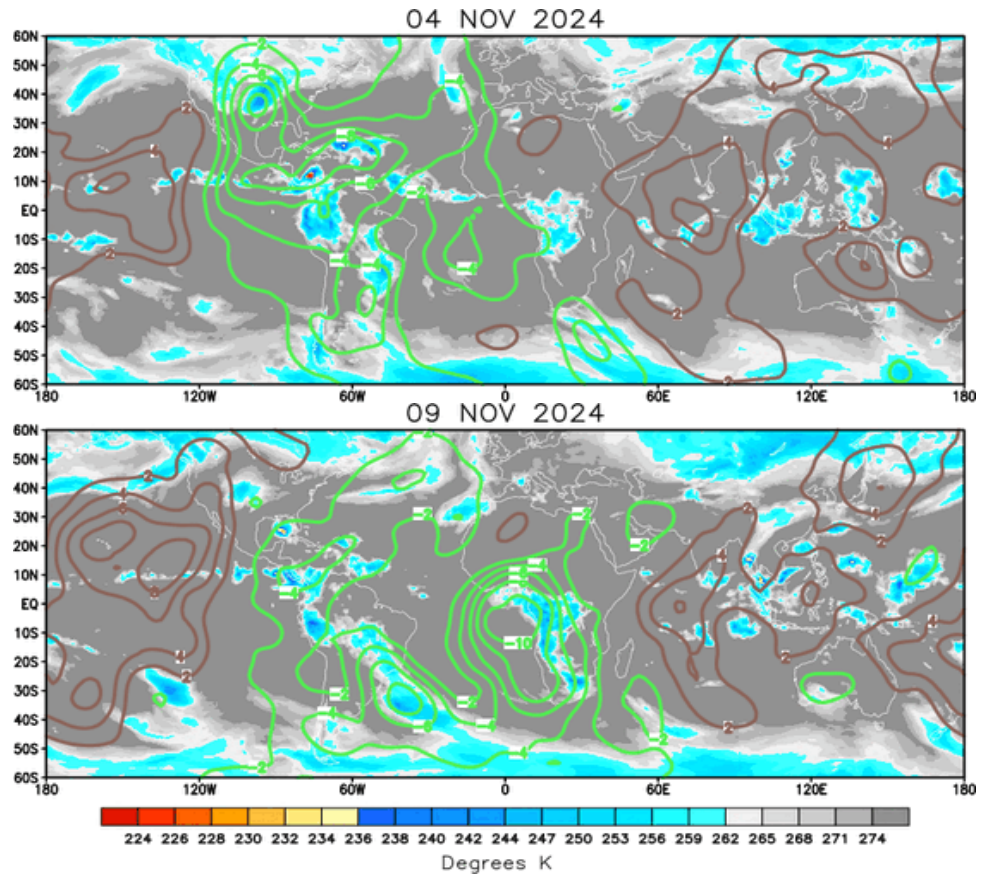
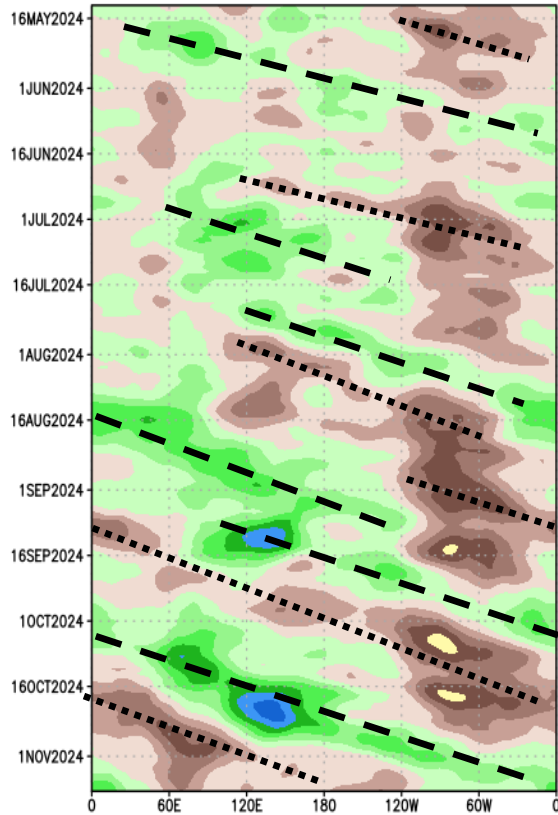
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

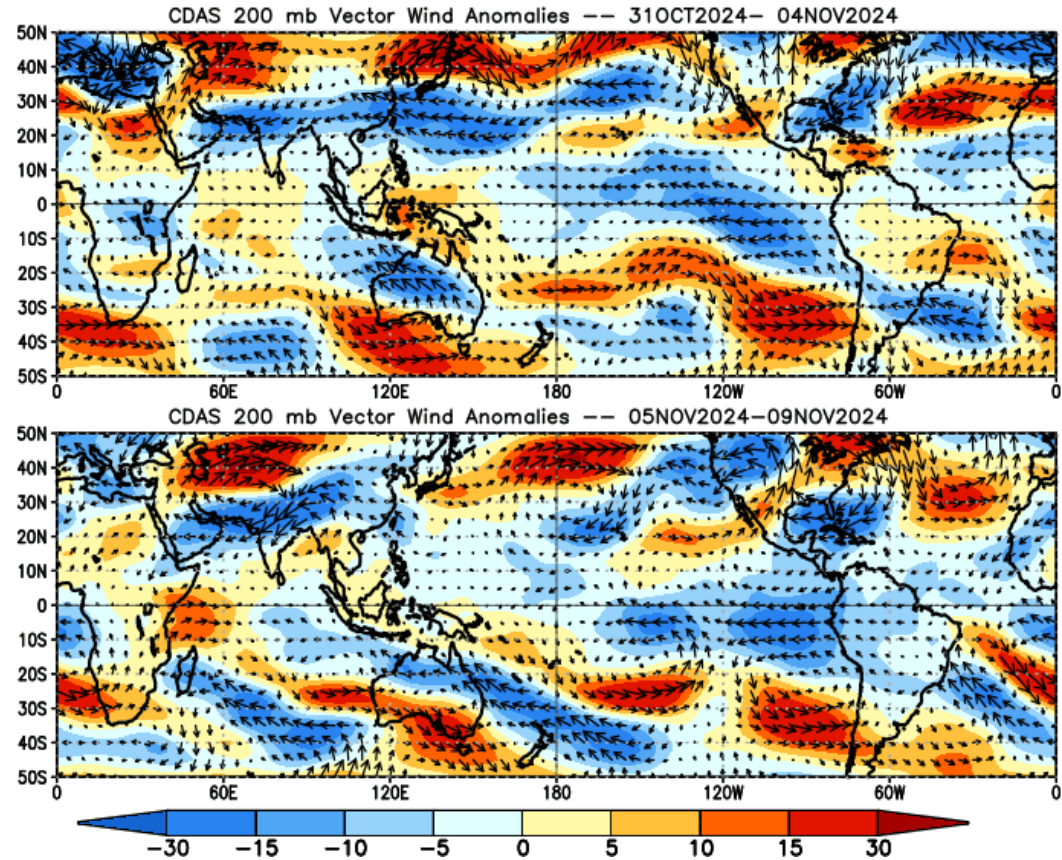
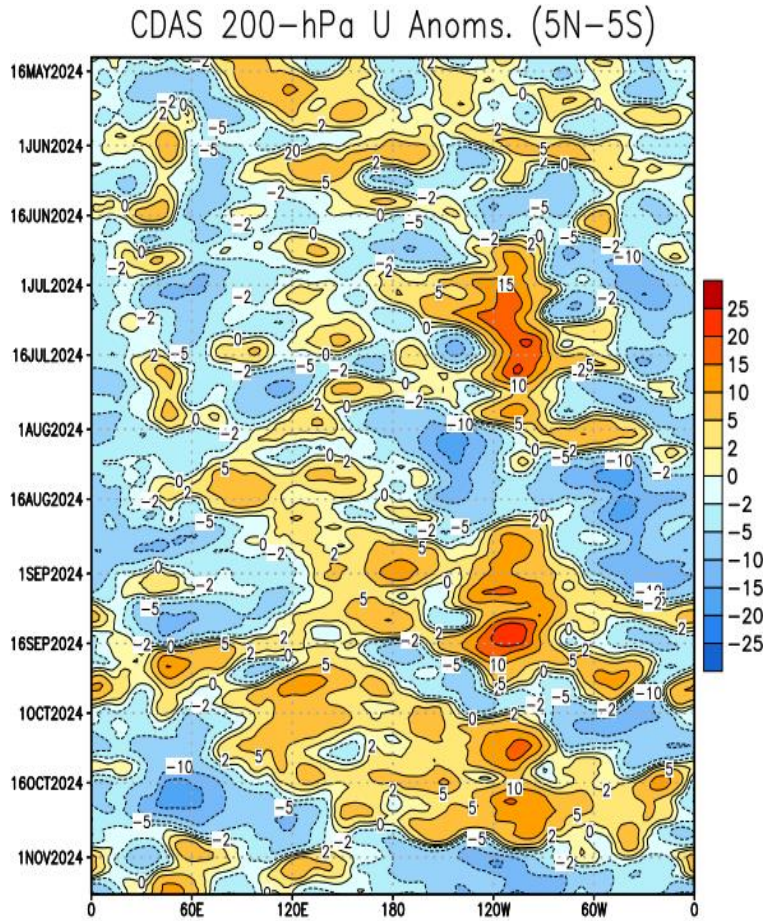
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A wave-1 asymmetry pattern continues to be evident in the spatial upper-level velocity potential field tied to robust MJO activity during the past month.
- The enhanced convective envelope is currently located over the Americas, Atlantic, and Africa, with the suppressed convective envelope beginning to move across the Western Hemisphere.

200-hPa Wind Anomalies

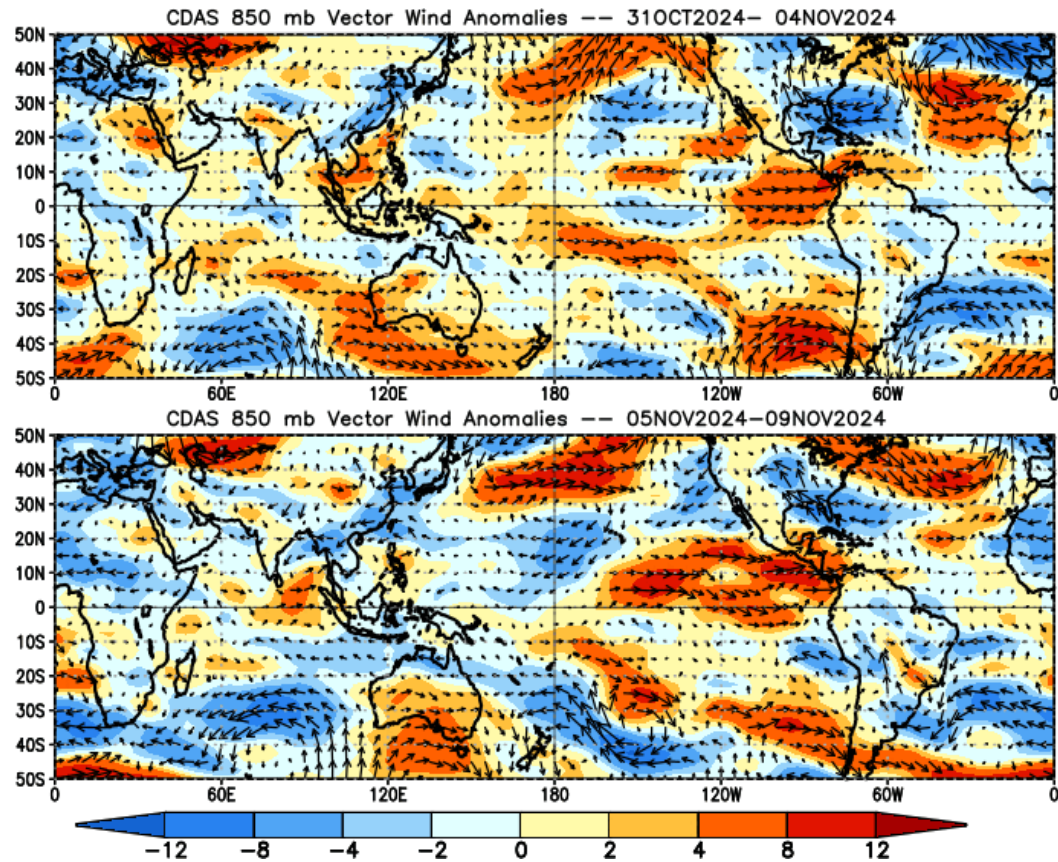
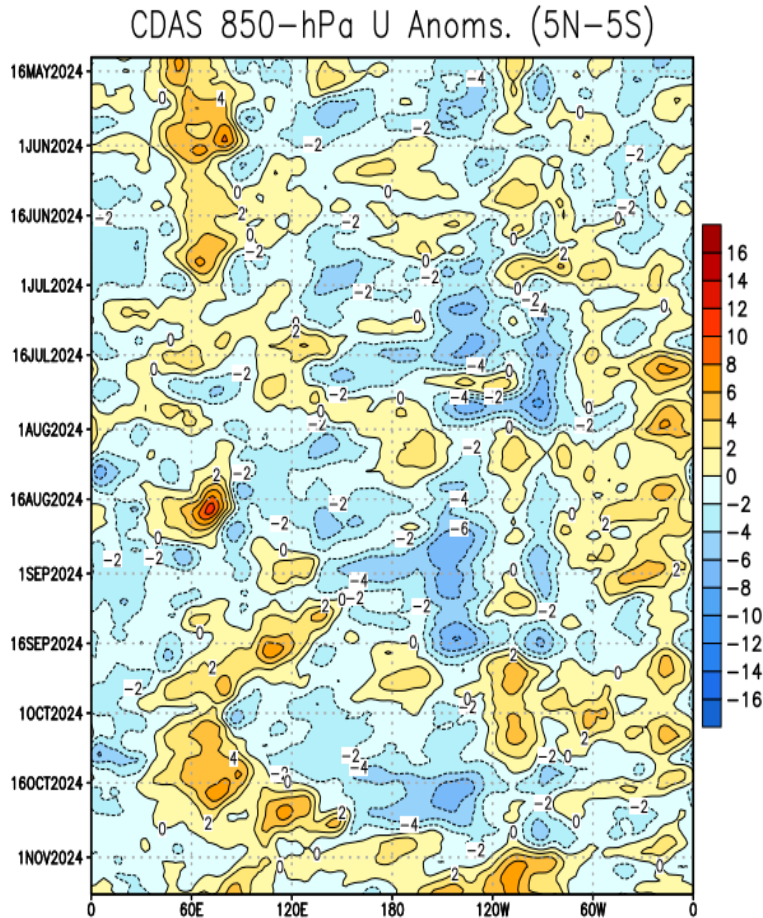
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Enhanced anti-cyclonic upper-level flow is noted over the eastern U.S.
- There is a clear progression of anomalous upper-level easterlies across the globe tied to the MJO, with some disruption of the upper-level westerlies emerging over the Indian Ocean as the MJO begins to propagate back toward the region.
- Pacific jet extension into the Great Plains resulted in an increase in precipitation during the past week.

850-hPa Wind Anomalies

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

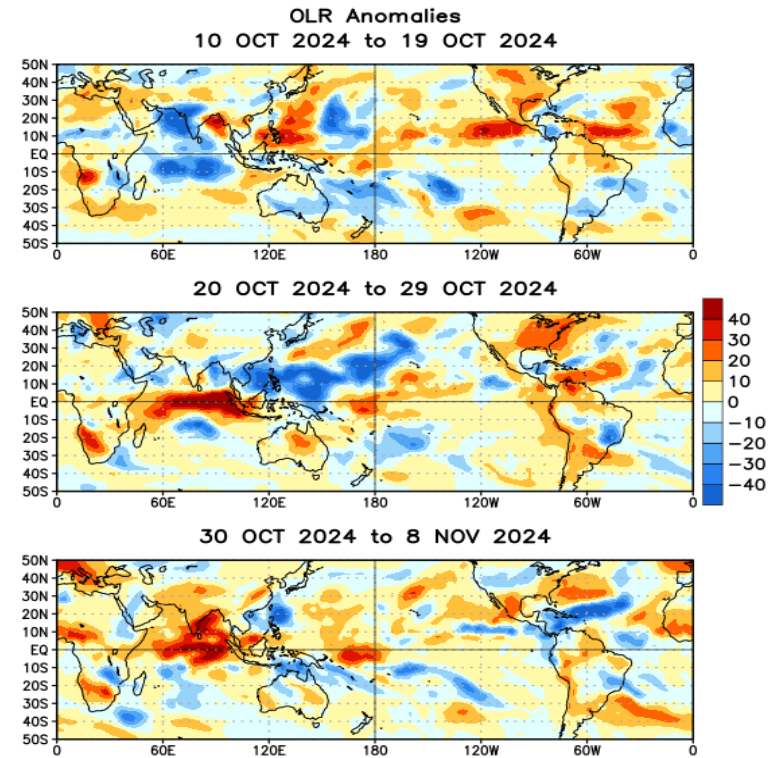
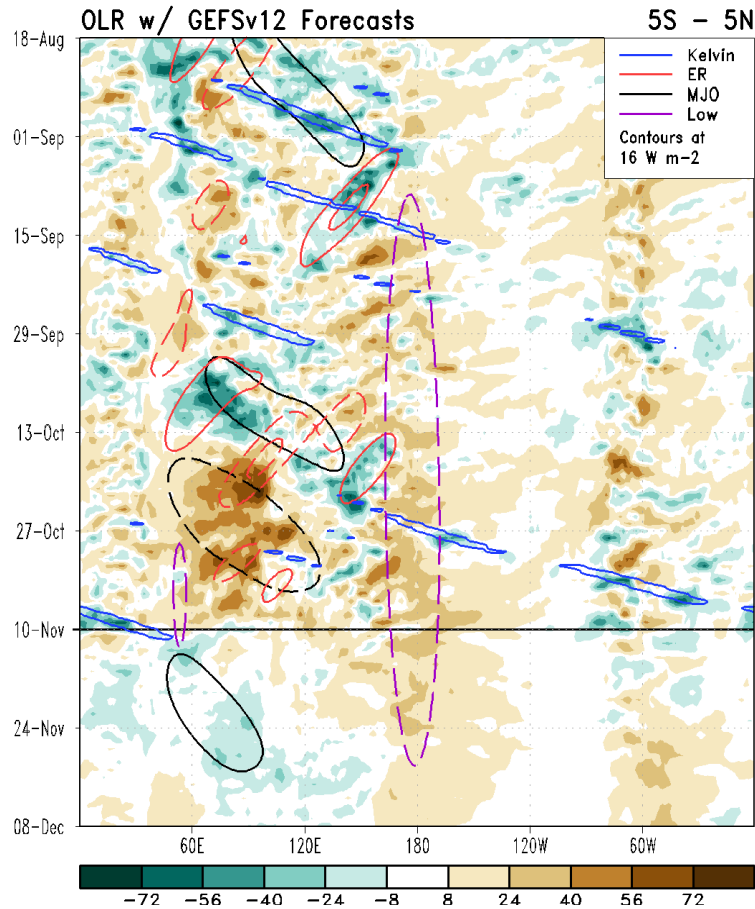


- Surface high pressure over the eastern U.S. resulted in abnormally dry conditions.
- Low-level westerlies propagated across the globe, becoming concentrated over the Eastern Pacific and Central America during the past week.
- Enhanced low-level westerlies increased across the Indian Ocean, perhaps signaling an incoming westerly wind burst, although its eastward extent is uncertain given the predicted slowing of the MJO and a potential trade wind surge across the tropical Pacific tied to the developing La Niña.

Outgoing Longwave Radiation (OLR) Anomalies

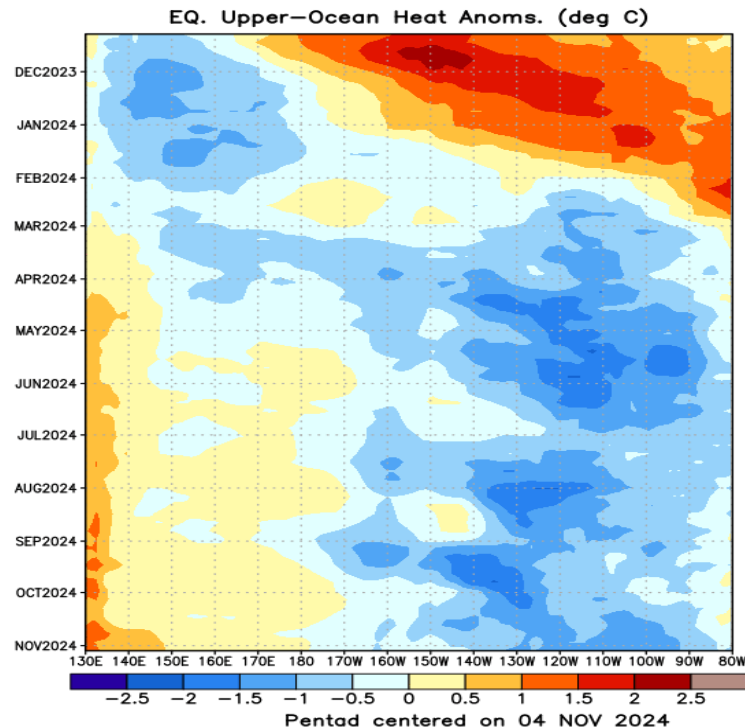
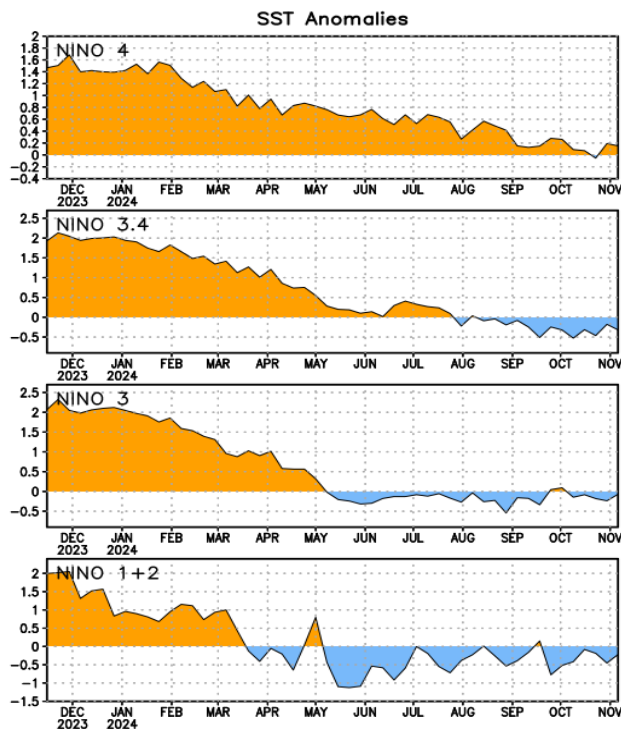
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Consistent with the MJO, negative OLR anomalies shifted from the Western Pacific to the Caribbean/Atlantic and are also tied to the development of Hurricane Rafael.
- Positive OLR anomalies currently exist over the Indian Ocean.
- The GEFS forecast depicts a slow-moving region of negative OLR anomalies over the Indian Ocean developing over the next 1-2 weeks, with the MJO coming through the objective filtering.

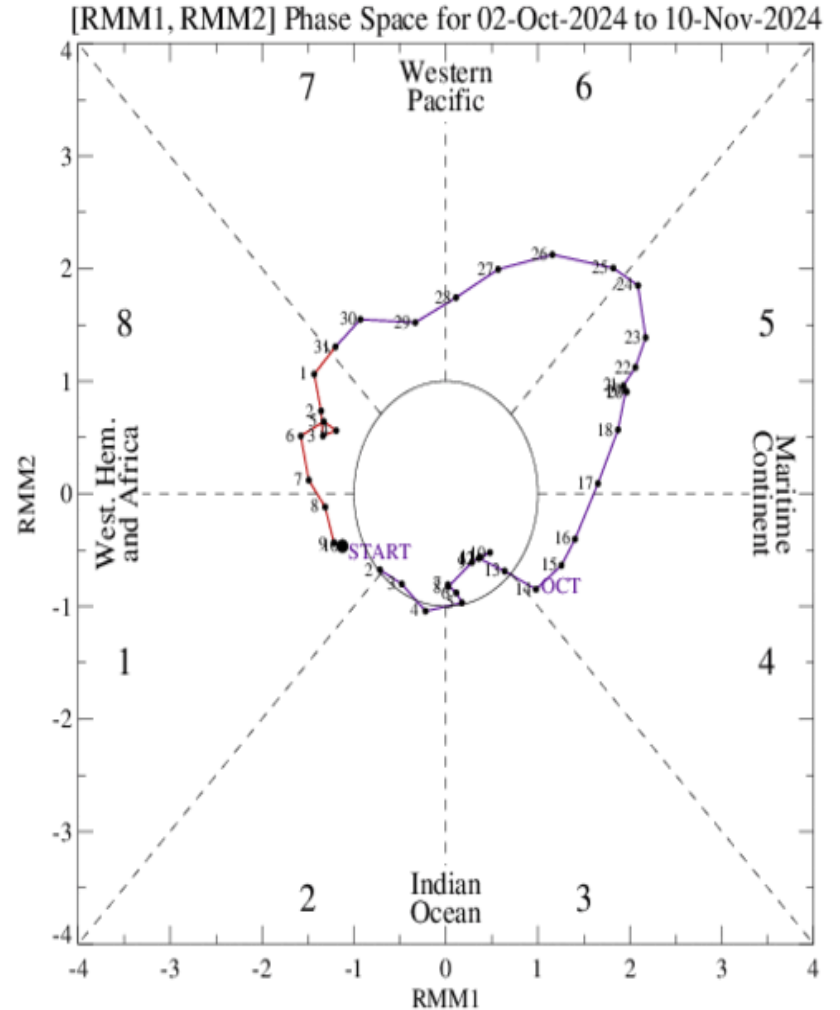
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs have steadily decreased in all of the NINO regions throughout the past year, with slightly below-normal SSTs now observed in the regions east of the Date Line.
- Increased low-level westerlies related to MJO activity likely resulted in an eastward expansion of positive upper-ocean heat content anomalies across the Western Pacific, along with a corresponding uptick in SSTs over the NINO 4 region.

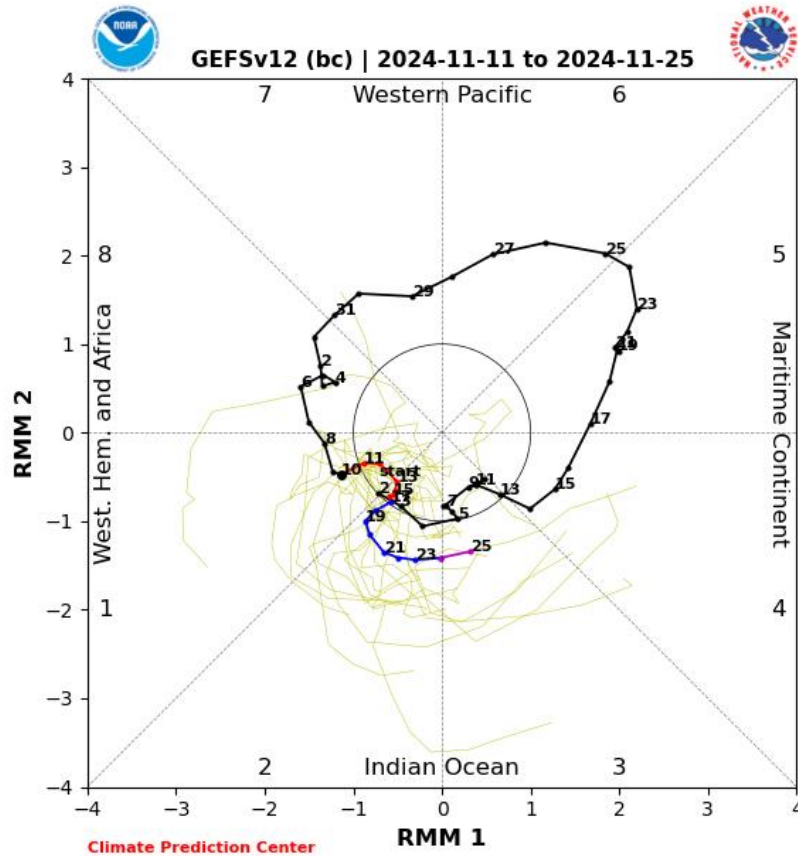
MJO Index: Recent Evolution

- The MJO has been active during the past month, completing a full circumnavigation of the globe.
- The intraseasonal signal is now back over Africa (phase 1) and is predicted to move over the Indian Ocean in the next few days.

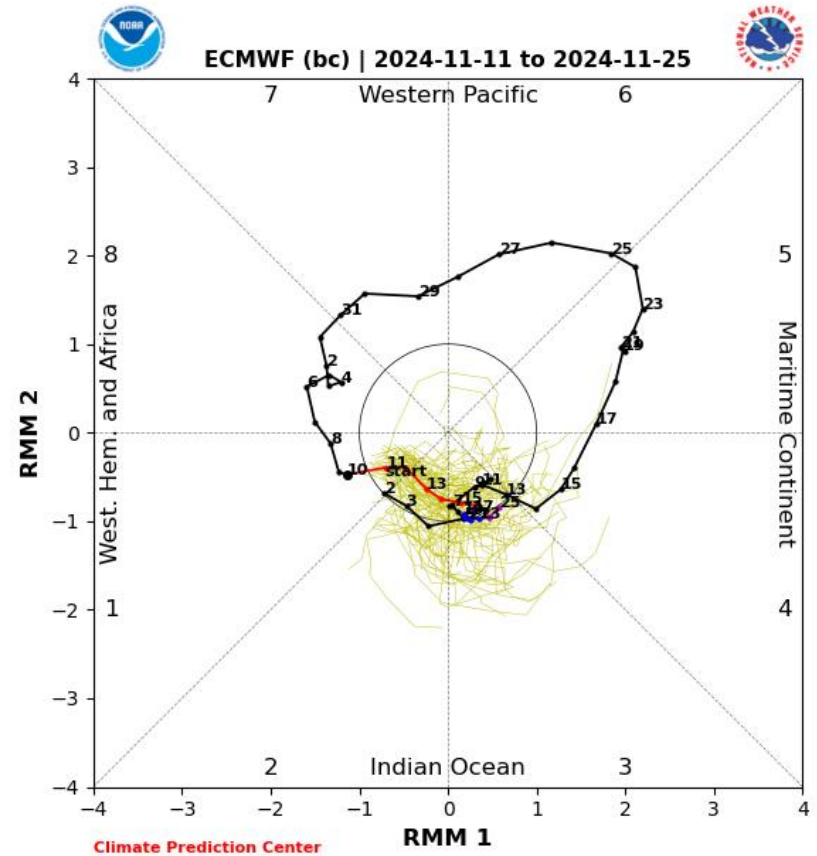


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



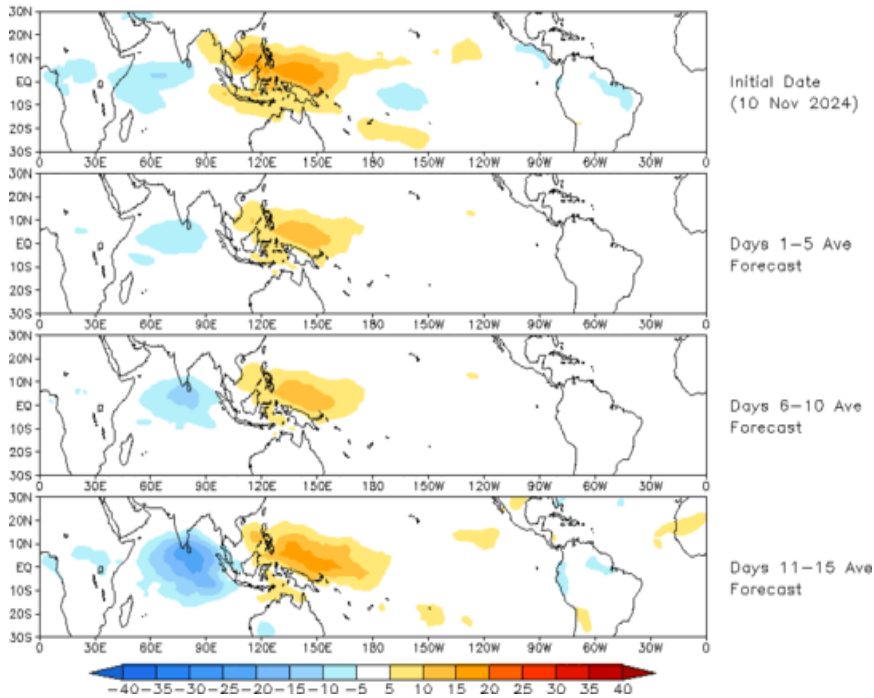
ECMWF Forecast

- The GEFS and ECMWF models both depict the RMM-based MJO index moving over the Indian Ocean, but slowing down its eastward propagation.
- Some of the more amplified ensemble members are likely attributed to constructive interference between the MJO and the low frequency enhanced convective state over the region tied to the developing La Niña.

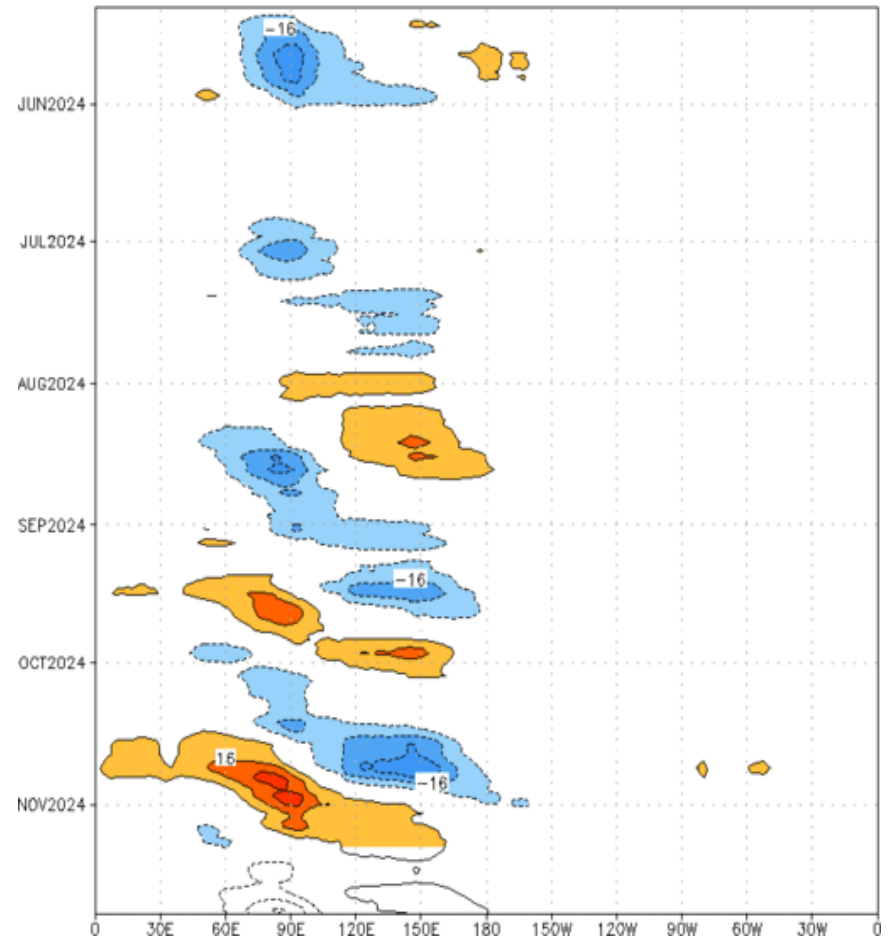
MJO: GEFS Forecast Evolution

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: 10 Nov 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: 11–May–2024 to 10–Nov–2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

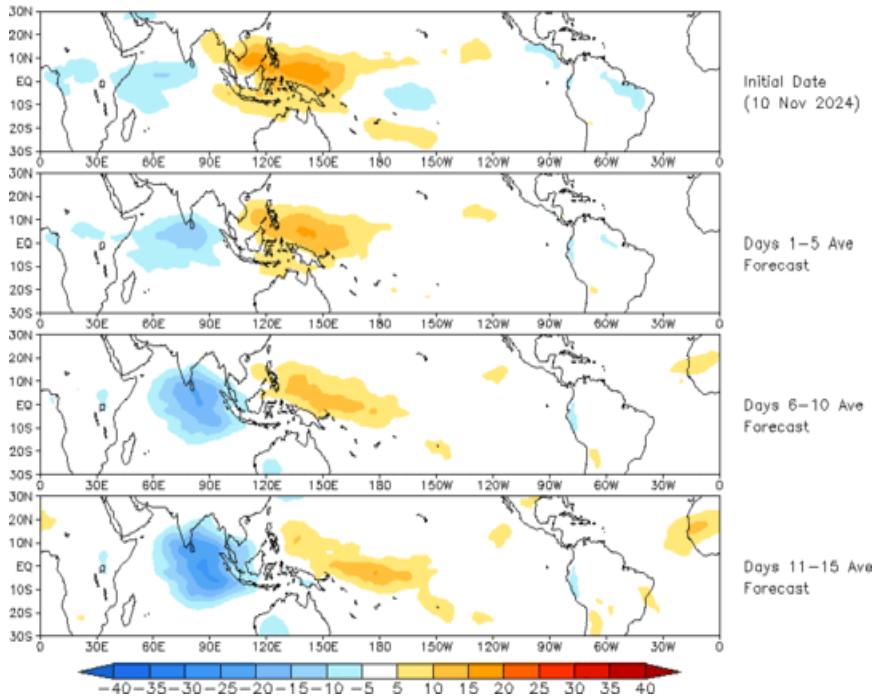


- The GEFS OLR anomaly forecast depicts nearly stationary areas of OLR anomalies over the Eastern Hemisphere during the next 2 weeks.
- Negative OLR anomalies (enhanced convection) are forecast to expand over the Indian Ocean, with positive OLR anomalies (suppressed convection) predicted over the Western Pacific.

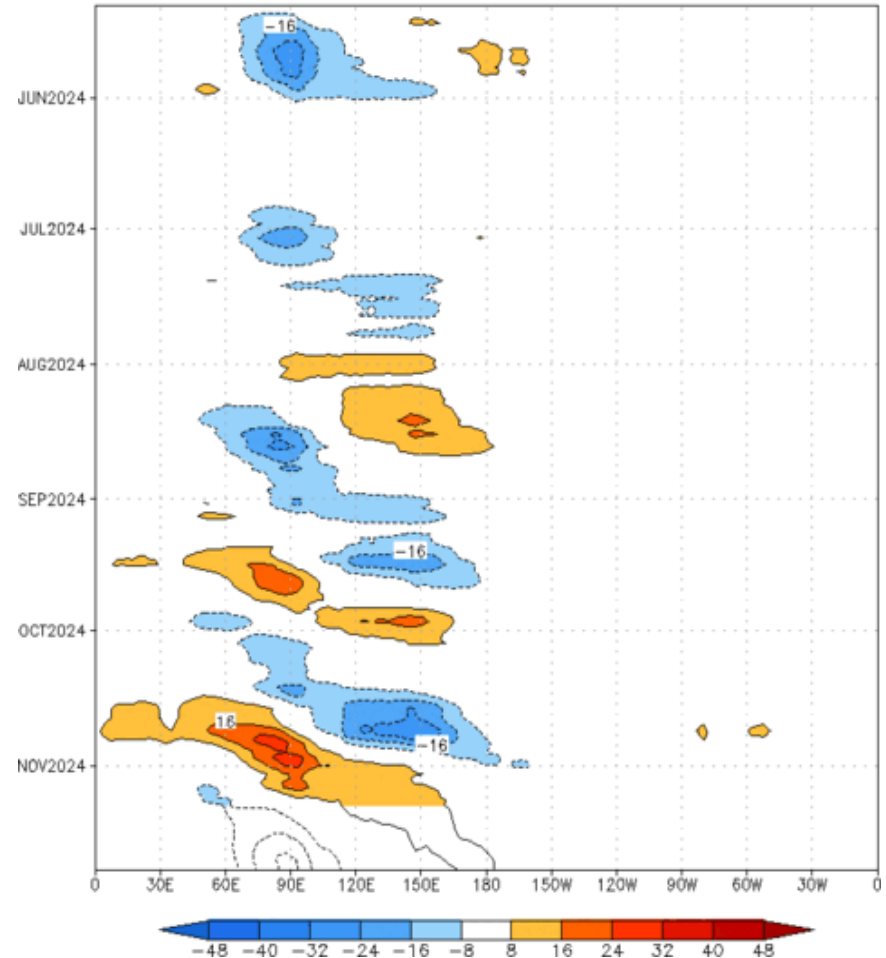
MJO: Constructed Analog Forecast Evolution

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 (10 Nov 2024)



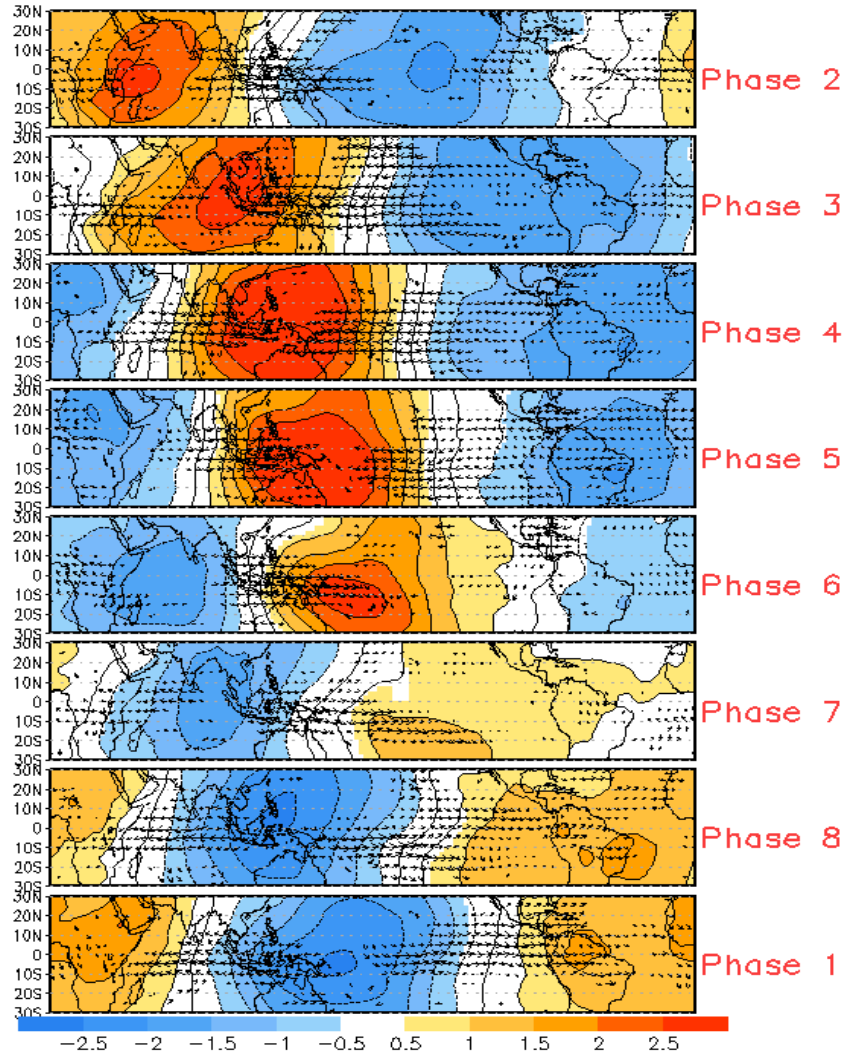
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:11-May-2024 to 10-Nov-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



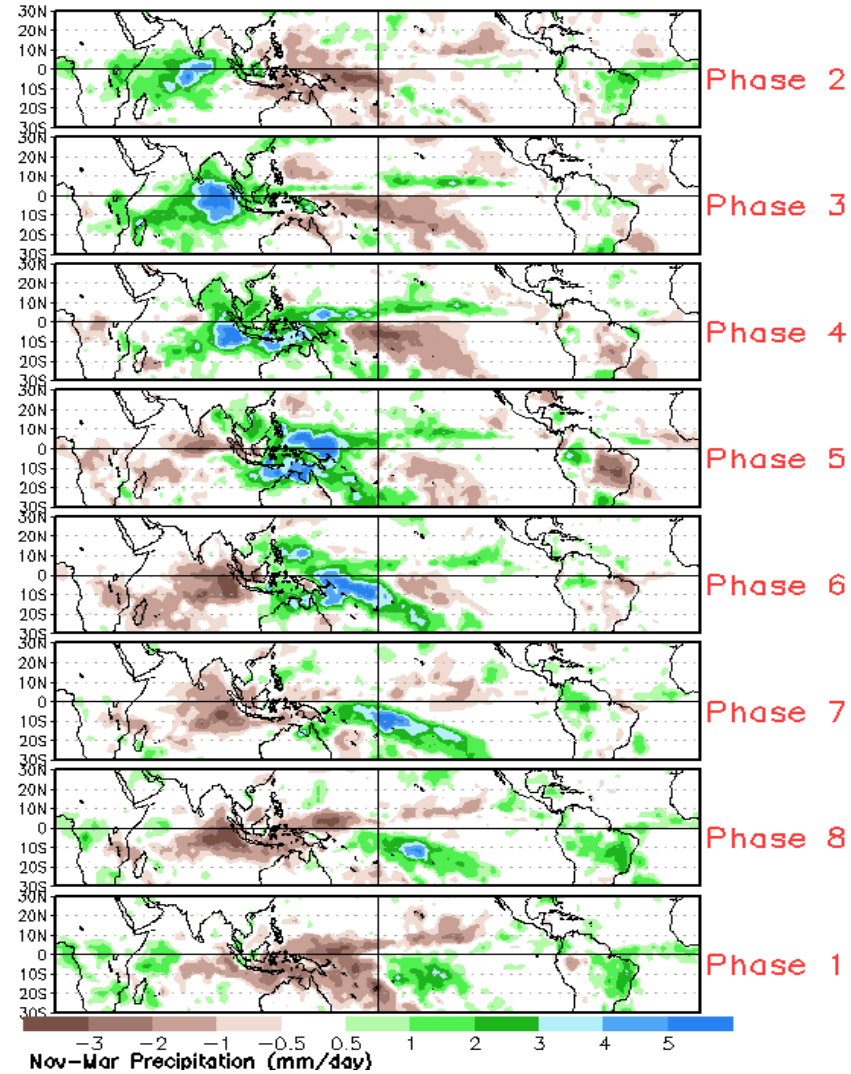
- The constructed analog forecast is in good agreement with the GEFS depicting negative (positive) OLR anomalies across the Indian Ocean (Western Pacific).

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



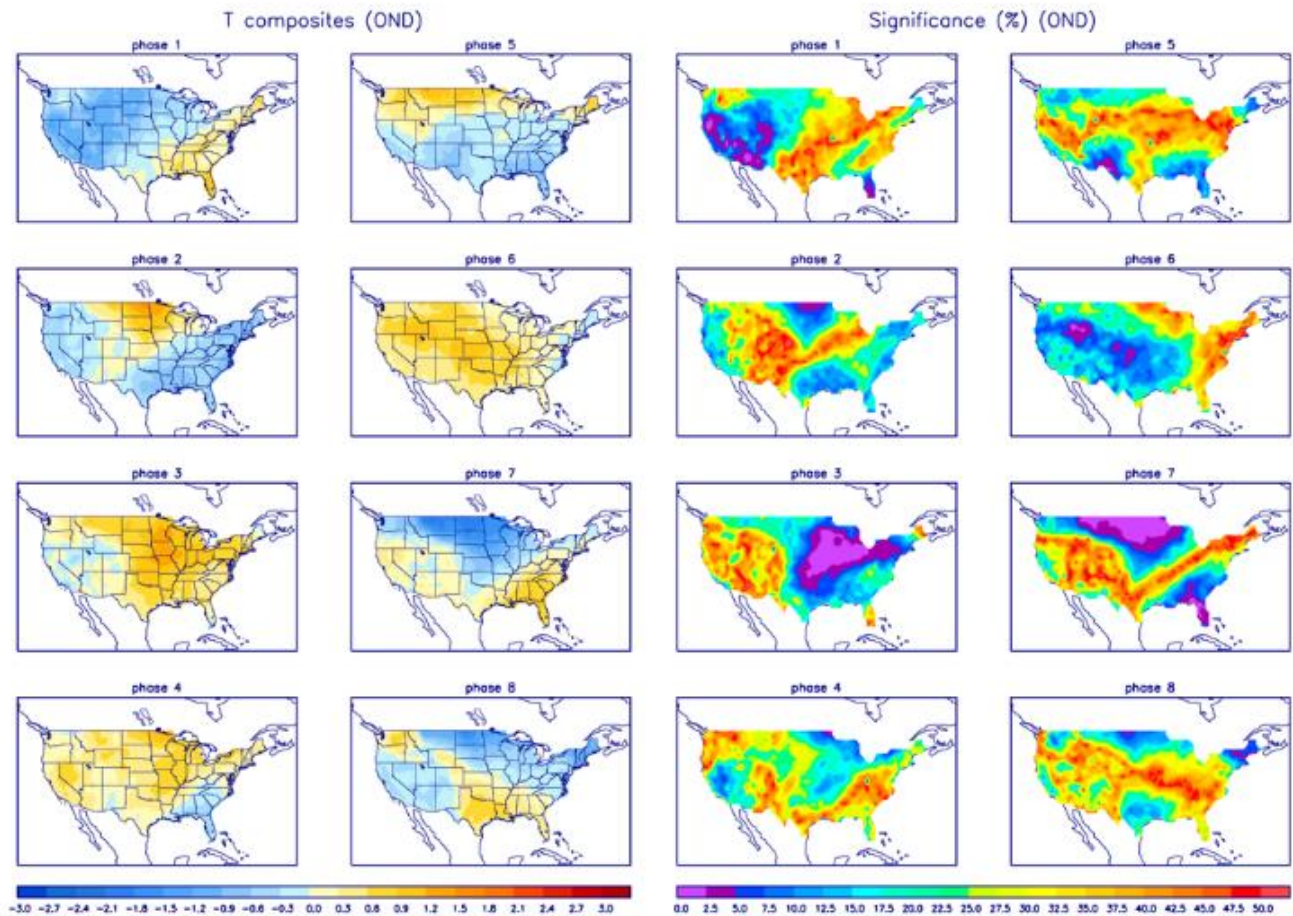
Precipitation Anomalies



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.

