

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
21 October 2024

Overview

- The MJO recently completed a circumnavigation of the global tropics and its enhanced (suppressed) phase is over the Maritime Continent (Americas and Africa).
- Dynamical models are in good agreement that the MJO continues to propagate eastward to the western Hemisphere by the beginning of November.
- This predicted MJO evolution would maintain a favorable environment for tropical cyclone (TC) development across the West Pacific through the next two weeks. By week-3 (November 6-12), chances for additional TC genesis are expected to diminish for the West Pacific. An elevated chance of TC development is forecast across the Caribbean Sea during late October and early November.
- An eastward propagating MJO over the Pacific favors above-normal precipitation along the West Coast at the end of October.

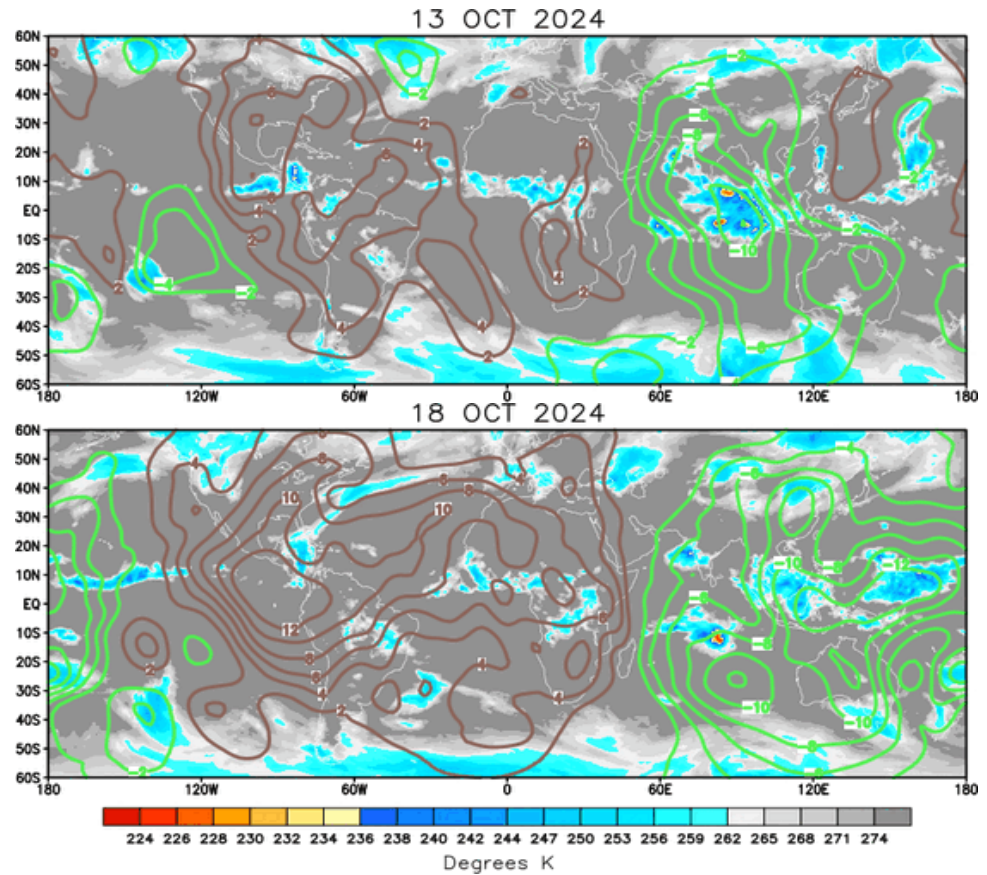
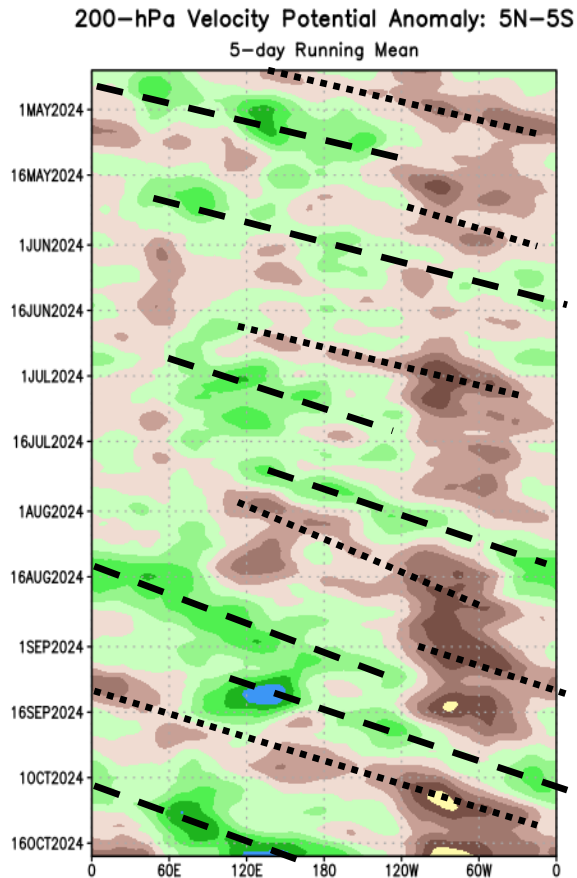
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

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

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

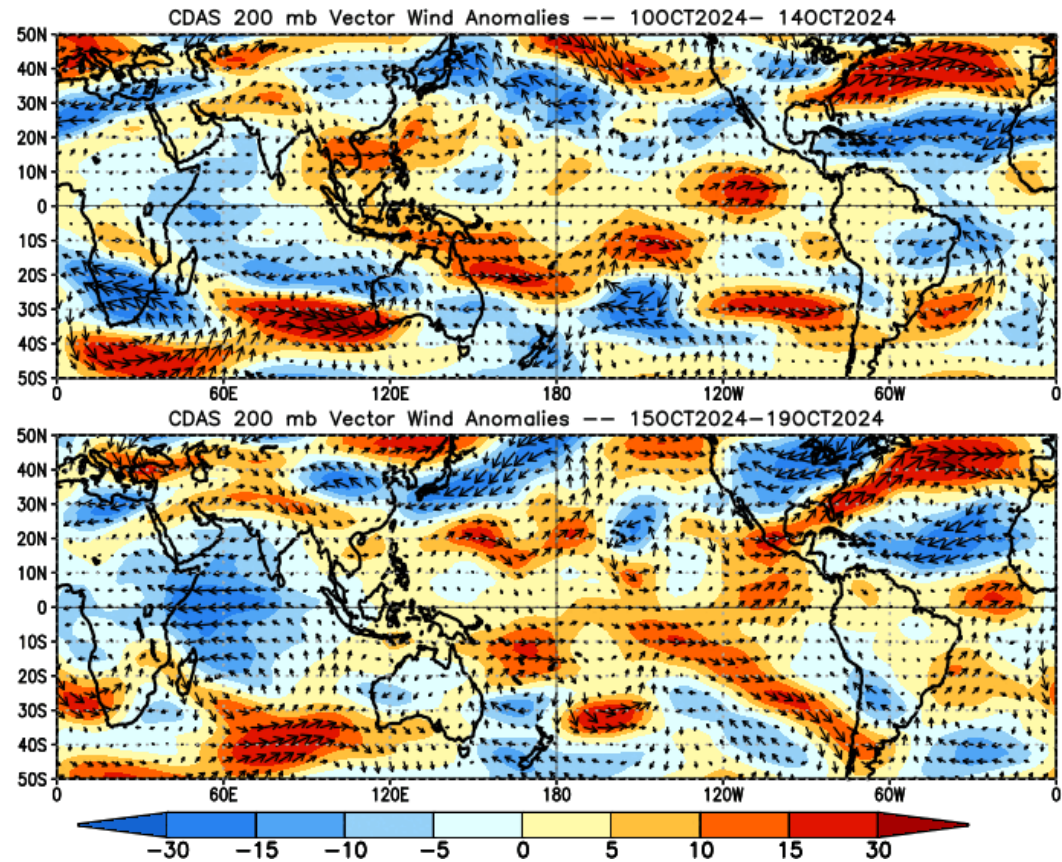
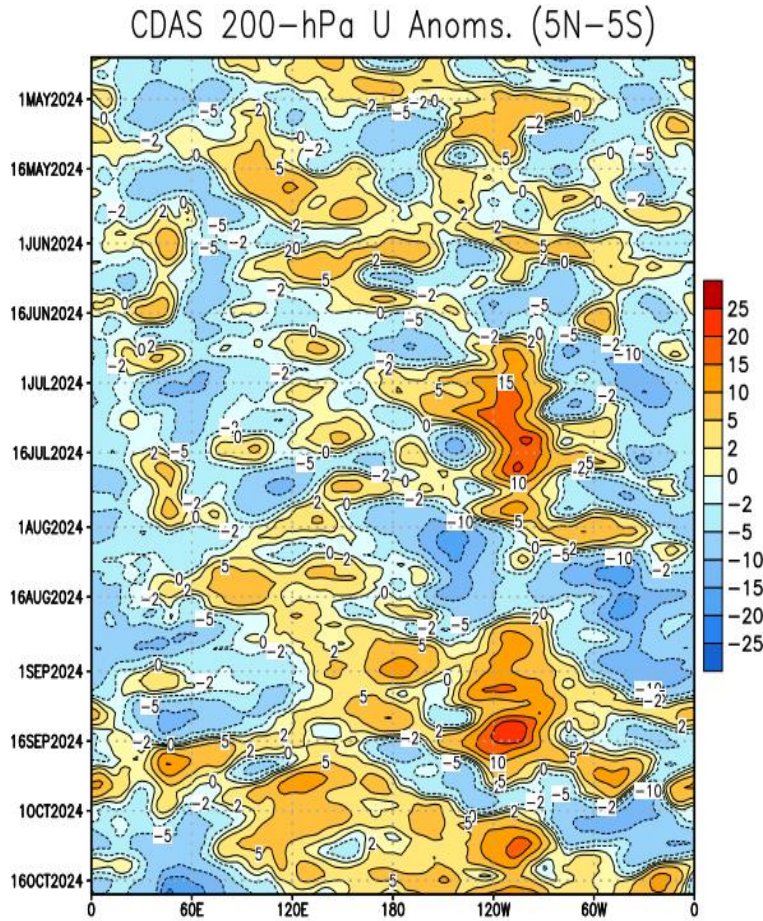
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Upper-level velocity potential anomalies depict a wave-1 pattern, where the enhanced (suppressed) divergence envelope is observed over the Indian Ocean, Maritime Continent, and West Pacific (Americas, Atlantic Ocean, and Africa).
- This wave-1 pattern is consistent with a robust MJO but its eastward propagation slowed during early to mid-October as strong upper-level convergence persists over the East Pacific.

200-hPa Wind Anomalies

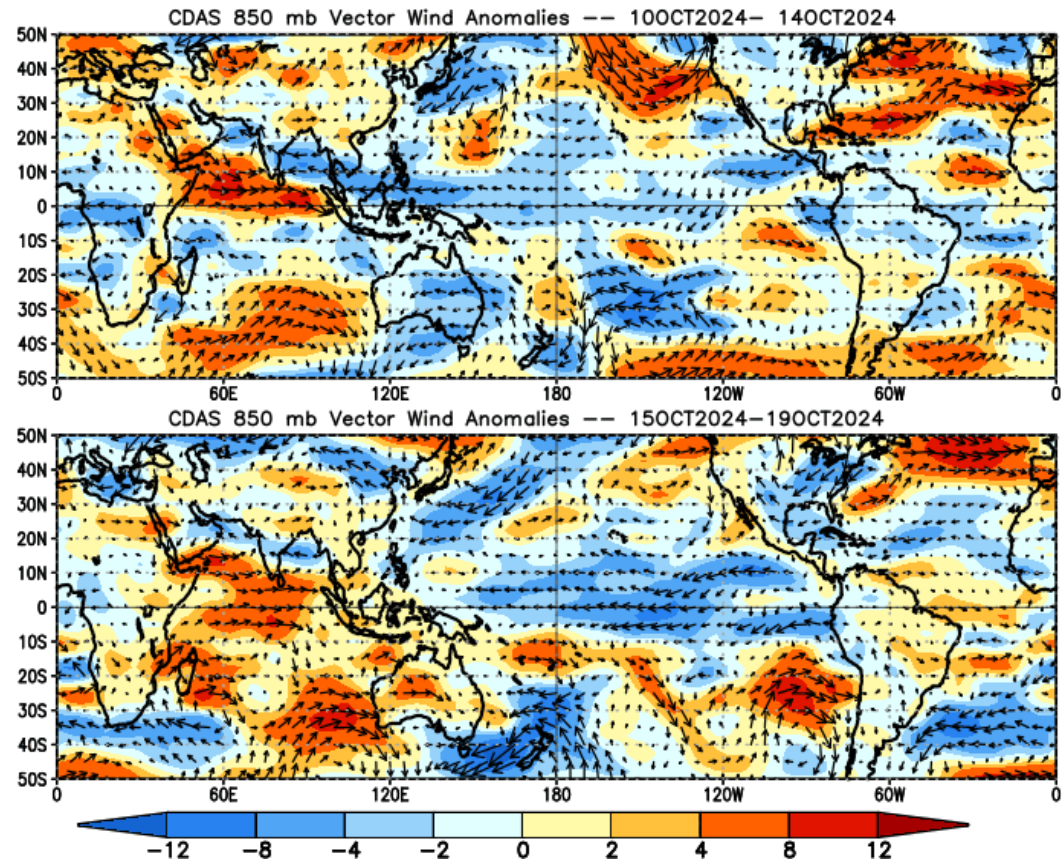
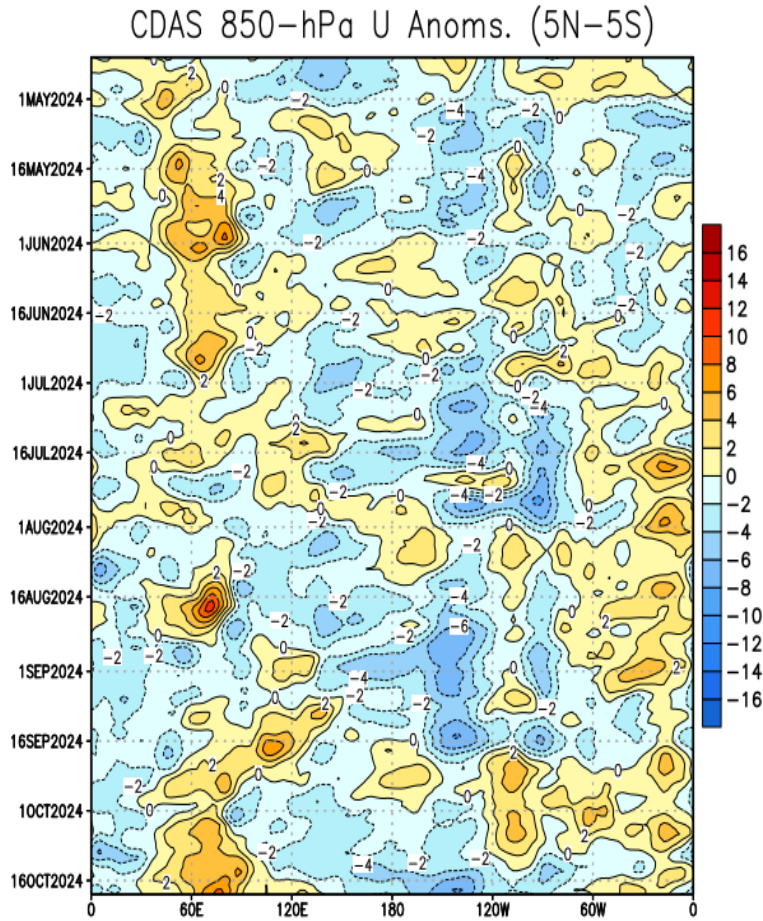
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The westerly phase of the MJO is evident in the time longitude plot, and is contributing to a strong uptick in the signal near 120W along the equator and recently overspread the tropical Atlantic.
- The easterly phase of the MJO has strengthened over the equatorial Indian Ocean, with more enhanced easterlies closer to 120E.

850-hPa Wind Anomalies

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

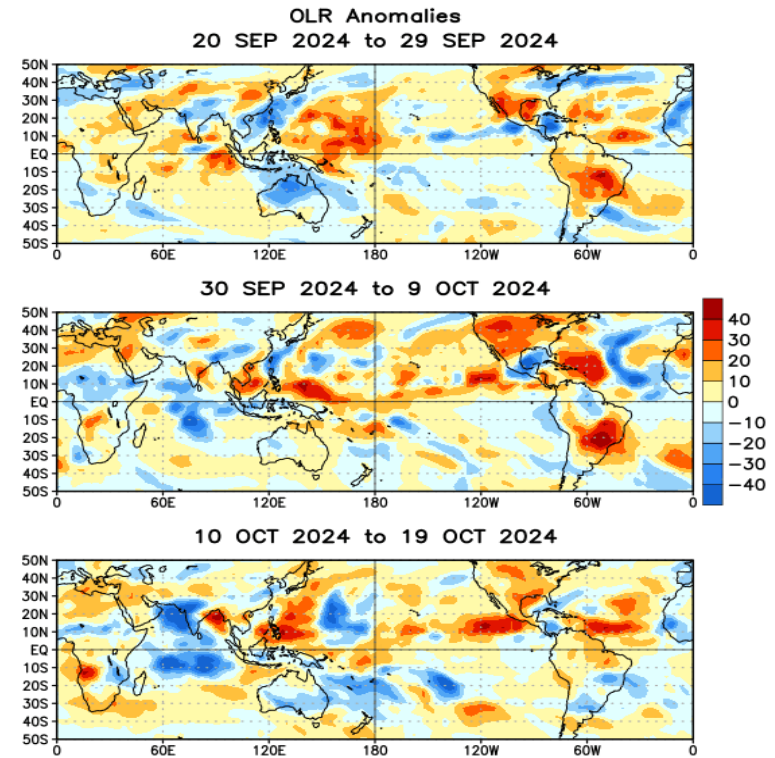
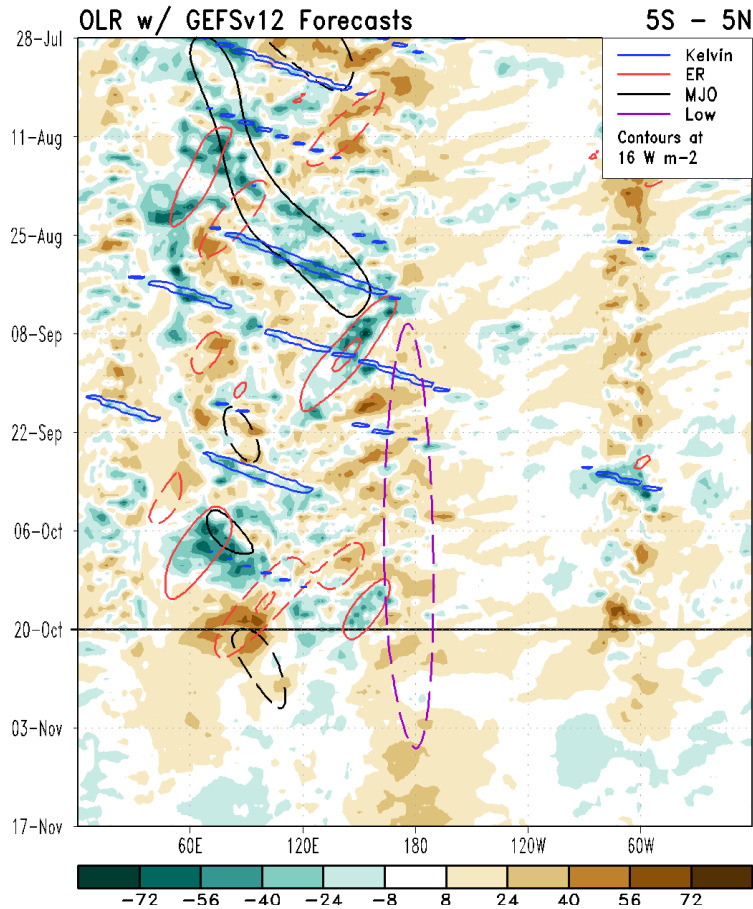


- Anomalous westerlies continue to persist over the Indian Ocean, near 60E, and could be associated with a low-frequency response.
- By mid-October, the enhanced trade winds became even stronger due to recent constructive interference between the developing La Niña and the MJO.

Outgoing Longwave Radiation (OLR) Anomalies

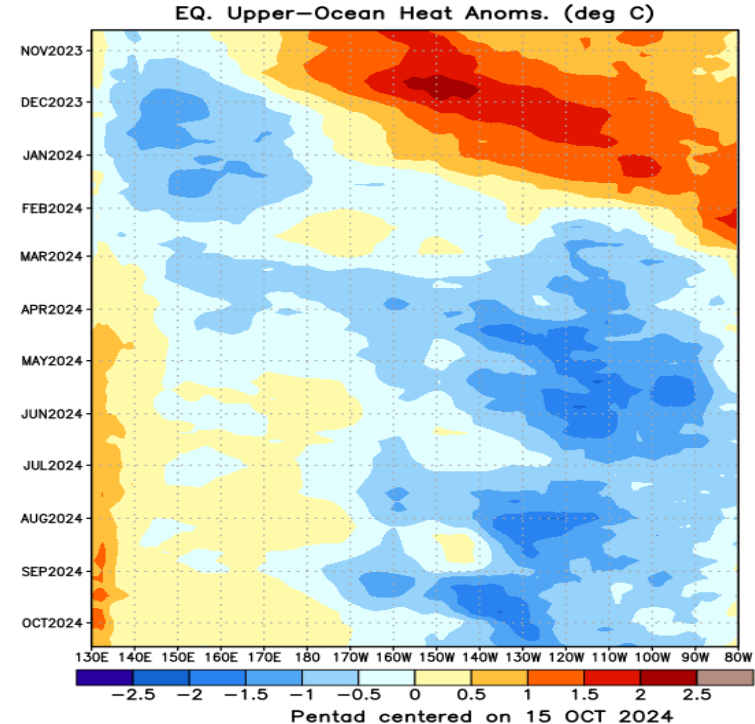
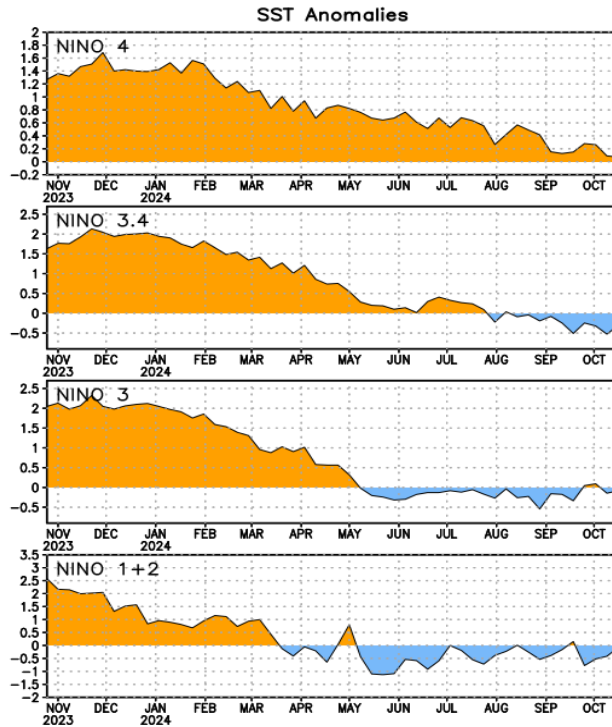
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Tied to the MJO, a broad area of enhanced convection was observed over the Indian Ocean, with suppressed convection prevailing over the western Hemisphere.
- OLR forecasts from the GEFS along the equator show the suppressed convection persisting across the equatorial central Pacific, associated with the developing La Niña.

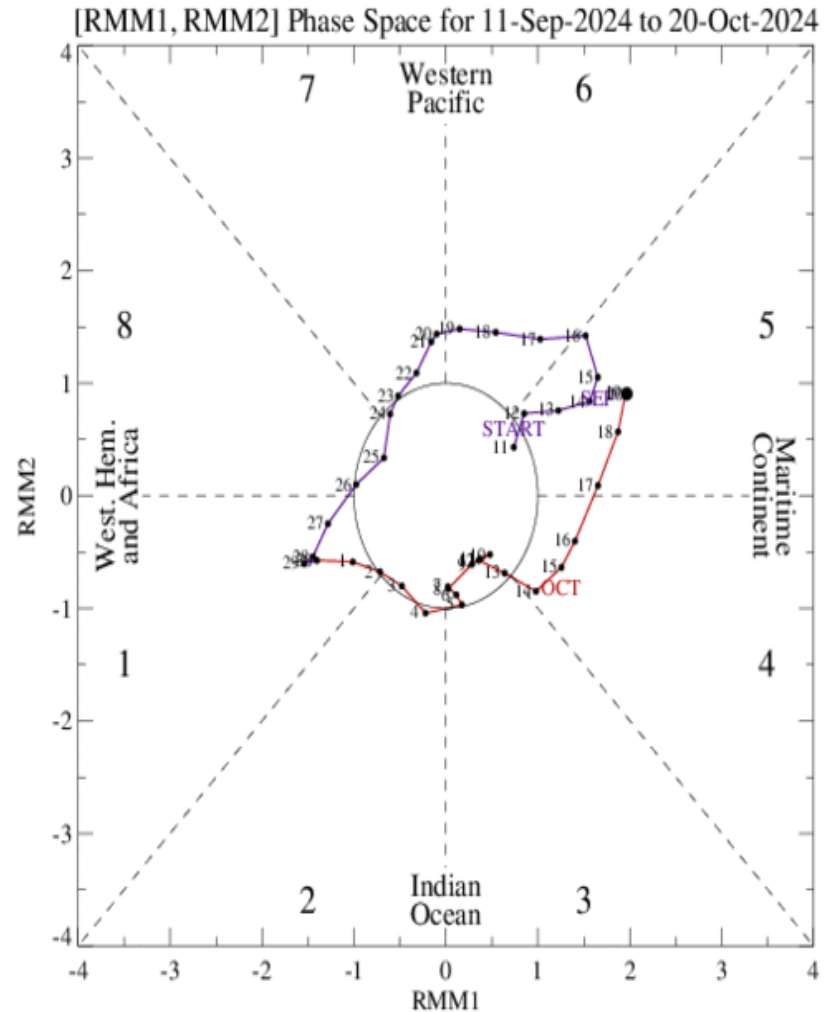
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- The eastern Niño regions remain neutral to slightly below normal, with Niño 4 registering slightly above-average.
- Except for waters between 140°W and 120°W, subsurface temperature anomalies are not markedly anomalous, akin to the surface.

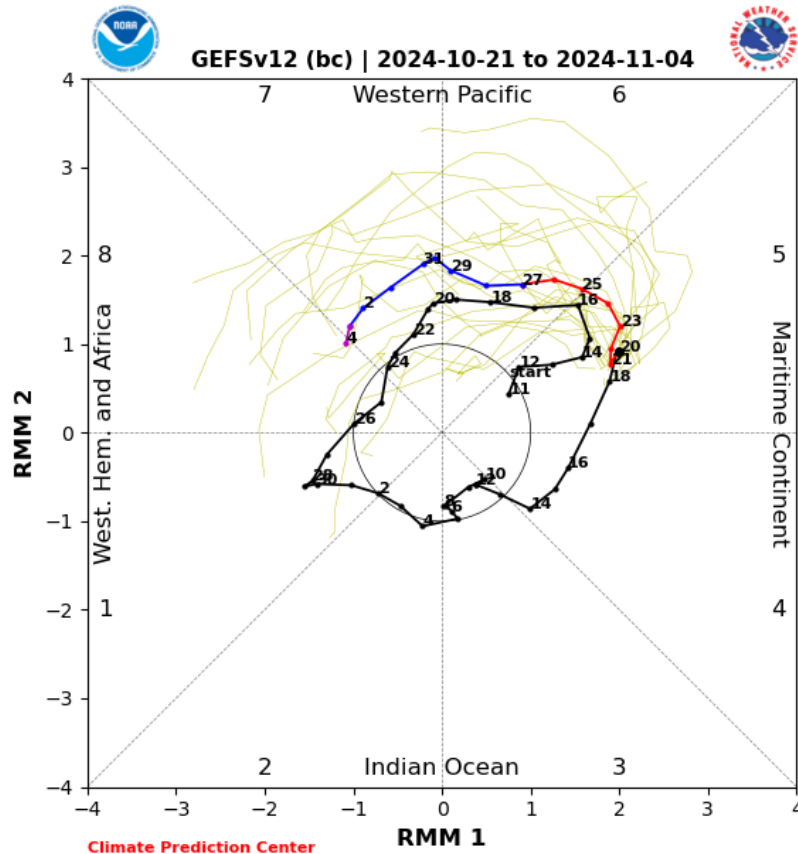
MJO Index: Recent Evolution

- RMM observations depict a circumnavigation during the past 35 days which is consistent with a well-defined MJO.
- During mid-October, the MJO gained amplitude as it propagated eastward to the Maritime Continent.

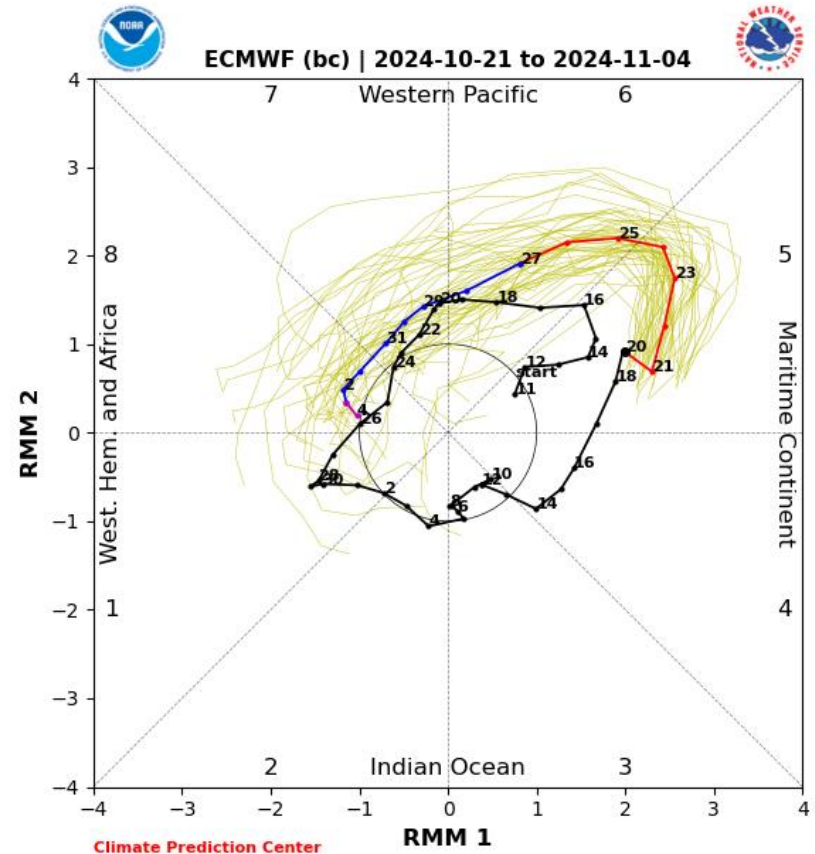


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



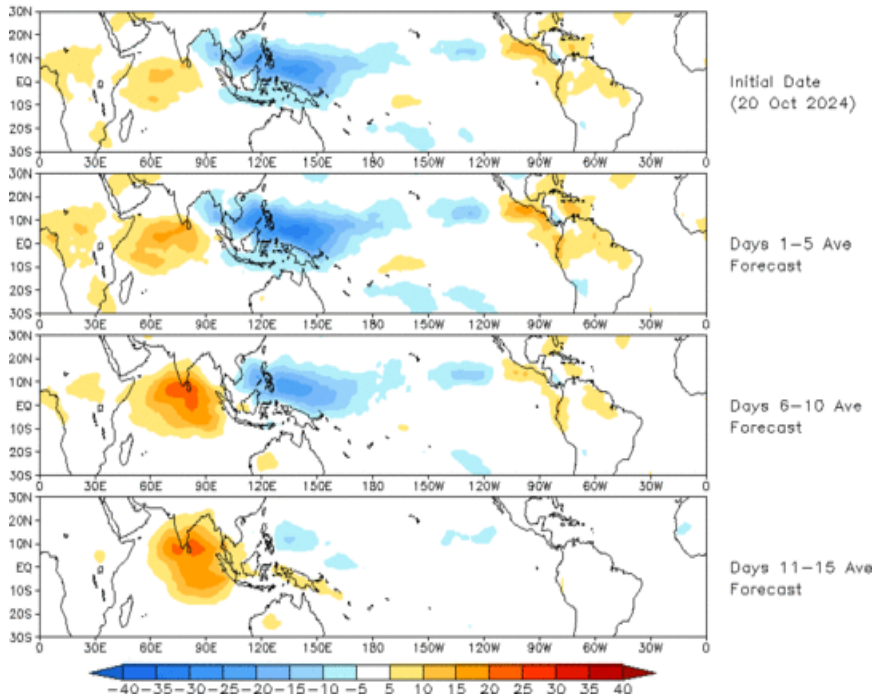
ECMWF Forecast

- Dynamical models are in good agreement and depict a continued eastward propagation of the MJO from the Maritime Continent to the western Hemisphere by the beginning of November.
- The ECMWF ensemble members generally favor a faster eastward propagation with the MJO reaching Africa (phase 1) by the end of week-2.

MJO: GEFS Forecast Evolution

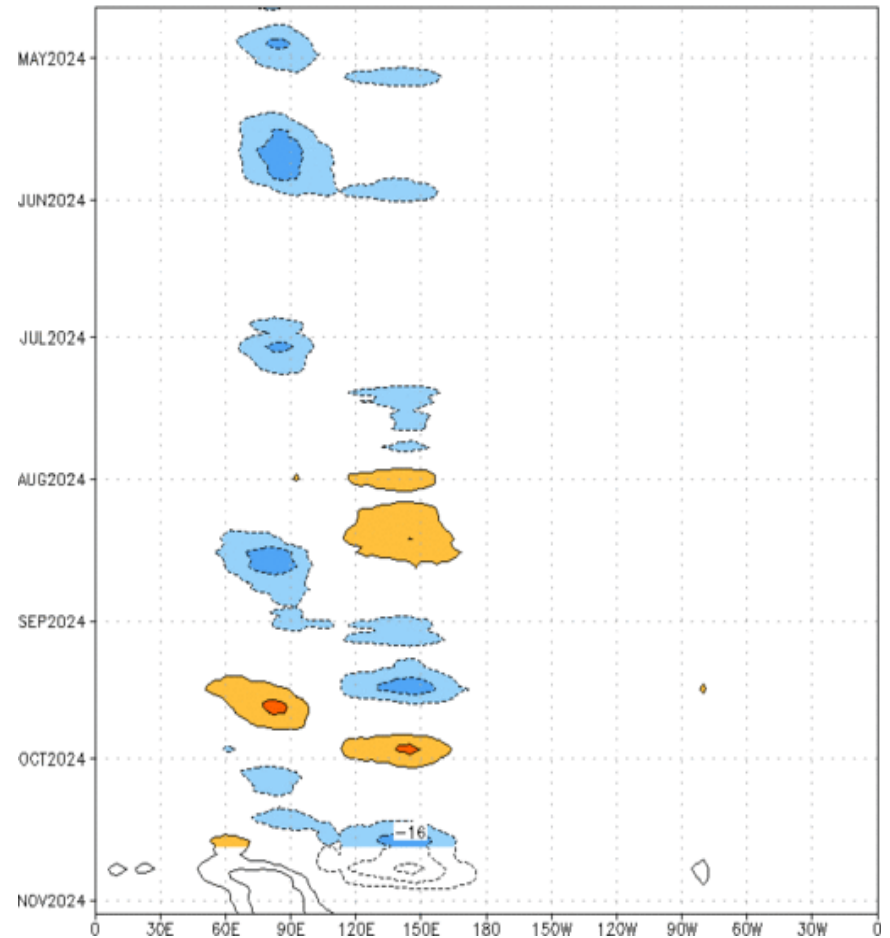
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 20 Oct 2024
OLR



- The GEFS OLR anomaly forecast depicts enhanced convection shifting eastward over the Pacific and weakening in magnitude.
- Suppressed convection is favored to strengthen over the Indian Ocean.

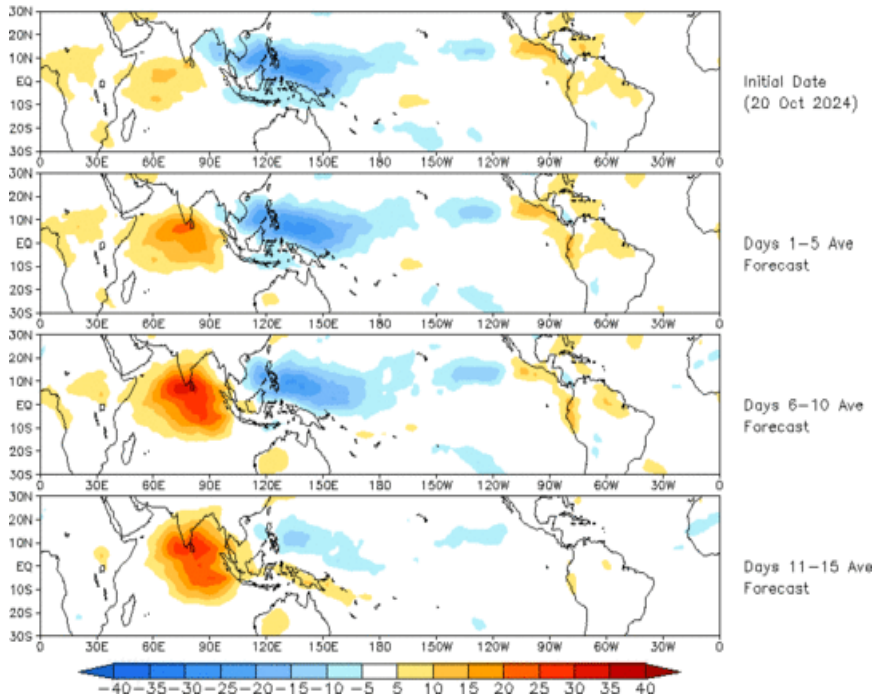
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 20-Apr-2024 to 20-Oct-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



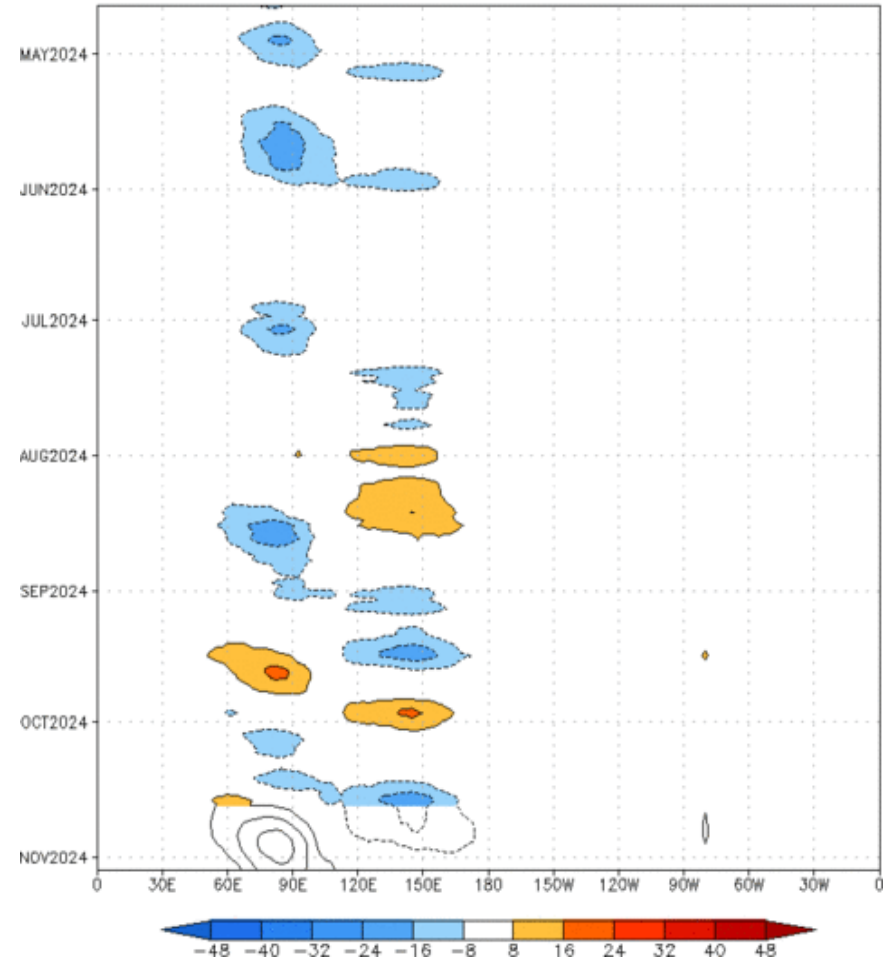
MJO: Constructed Analog Forecast Evolution

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 (20 Oct 2024)



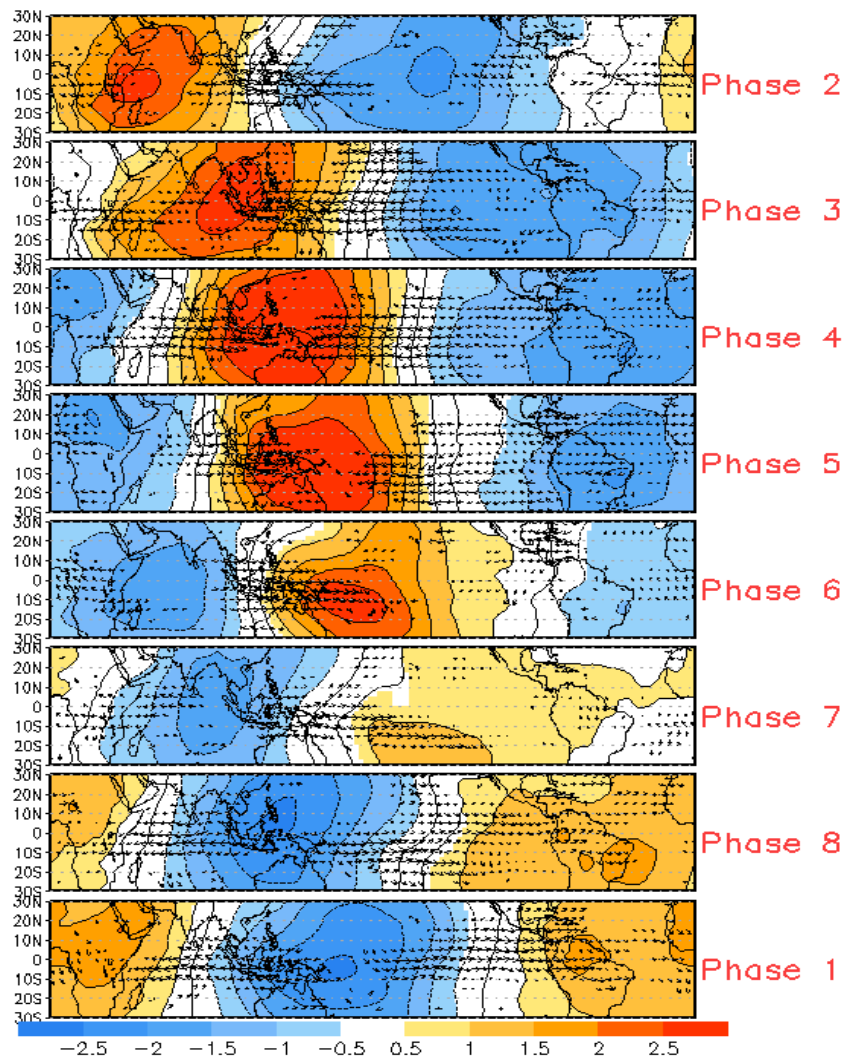
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] ($\text{cont:}4\text{Wm}^{-2}$) Period:20-Apr-2024 to 20-Oct-2024
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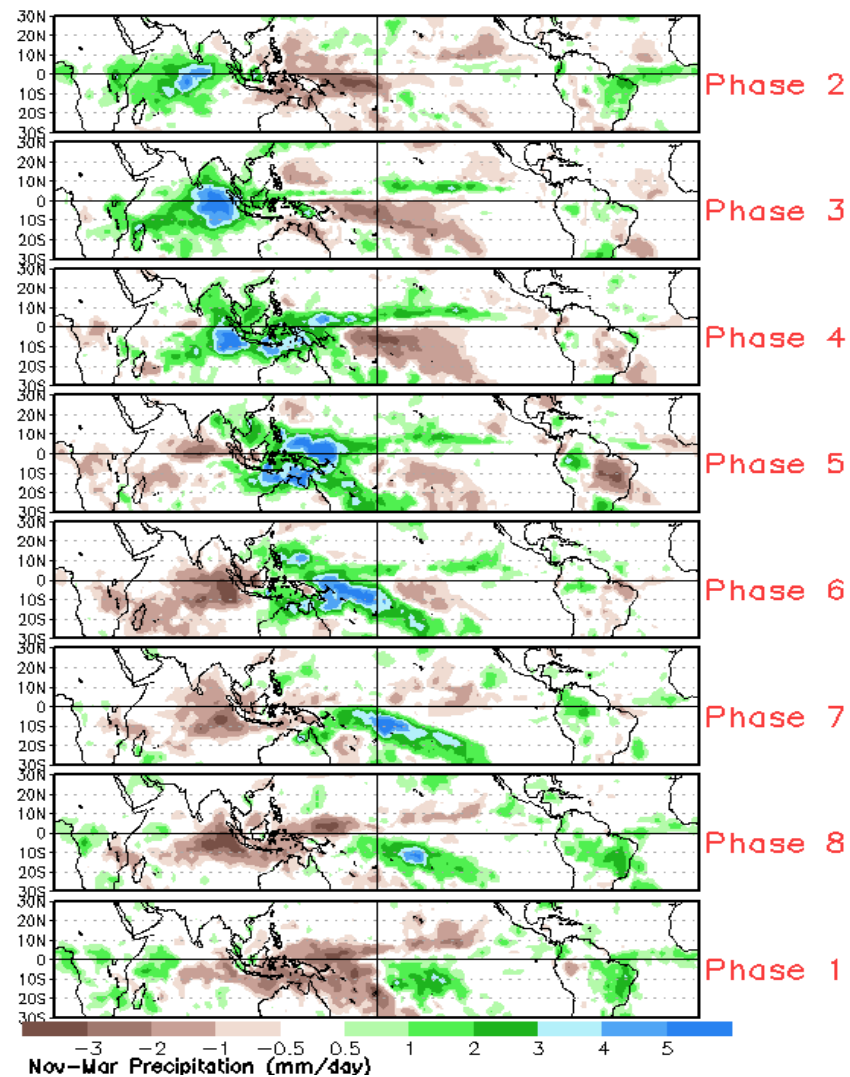
- The constructed analog forecast is very similar to the GEFS forecast.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



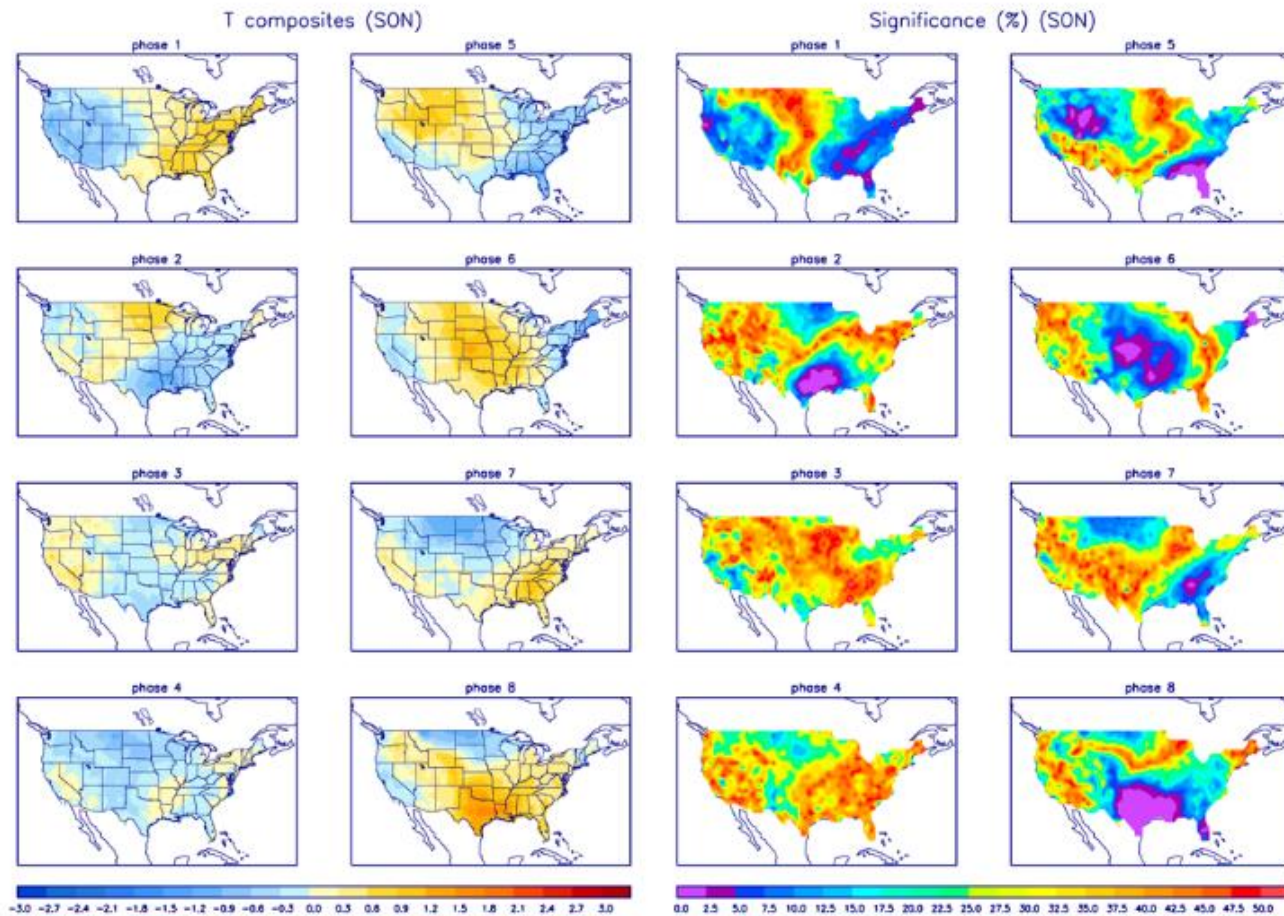
Precipitation Anomalies



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.

